Saskatchewan
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Report 262

Saskatchewan Gold: Mineralization Styles and Mining History

by

R.M. Morelli and K. MacLachlan

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Cover: Depiction of some historical landmarks in Saskatchewan's gold exploration and mining industry, which dates back to the turn of the 20th century:

Top left: Aerial view of the Jolu mill (*ca.* 2005), located in the Star Lake area of the La Ronge Domain, which originally processed ore from the Jolu mine between 1988 and 1991. Golden Band Resources Inc. subsequently acquired and refurbished the mill and, since commencing production from its 'La Ronge Gold Project' in 2011, is using the centralized mill to process the ore from multiple mines. Photo courtesy of Golden Band Resources Inc.

Top right: View of the historical Box mine (*ca.* 1952), which was located in the Beaverlodge Domain at the former Goldfields townsite, north of Lake Athabasca. The mine operated between 1939 and 1942. Photo courtesy of Saskatchewan Archives Board; record R-B5755.

Bottom right: View of the Flin Flon mine (*ca.* 1974), showing the South Main shaft (foreground, bottom right), the North Main shaft (background, top left), and the intervening open pit. As of 2012, the Flin Flon mine, located in the Flin Flon Domain, stands as Saskatchewan's largest-ever gold producer, despite having produced gold as a by-product of Cu-Zn mining. Photo source: Hudson Bay Mining and Smelting Co., Ltd. public relations brochure, 1974.

Bottom left: C. Bucholz (left) showing a mineralized sample to Consolidated Mining and Smelting Co. prospector J. Coffyne (right) at the Seabee property at Laonil Lake (*ca.* 1949). Coffyne and fellow prospector B. Corrigan originally discovered gold mineralization at Laonil Lake, located in the northern Glennie Domain, in 1947. The Seabee mine, owned by Claude Resources Inc., commenced operation in 1991 and, as of 2012, is the largest primary gold producer in Saskatchewan's history. Photo courtesy of Saskatchewan Archives Board; record R-A9295.

Centre: Sample of quartz vein–hosted high-grade gold ore from the Komis deposit, located in the Waddy Lake area of the La Ronge Domain. Komis, previously mined in 1996-97, is one of several deposits being developed within Golden Band Resources Inc.'s La Ronge Gold Project. Sample, as viewed from top, is approximately 24.5 by 11 cm. Photo courtesy of Golden Band Resources Inc.

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Foreword

In 1984, the Saskatchewan Geological Survey published *Gold in Saskatchewan*, which had been prepared under contract by W. Coombe. That report, which represented the first comprehensive compilation of available information on gold occurrences in Saskatchewan, has served as an important reference for gold explorationists. At the time of its publication, the report highlighted that more than 3.2 million oz. of gold had been produced, most of which came from base metal deposits, with only about 70,000 oz. from primary gold production.

In the 28 years since *Gold in Saskatchewan* was published, there has been significant primary gold production from several mines in the Precambrian shield of northern Saskatchewan. All of this recent mining has taken place in the La Ronge and Glennie domains of the Trans-Hudson orogen, the most notable being the Seabee operation, which will surpass 1 million oz. of gold production in the summer of 2012. Also during that period, through the work of the Saskatchewan Geological Survey, industry, and other researchers, there has developed an enhanced understanding of the nature and geological context of many of areas of gold potential in Saskatchewan.

This new report, which is a substantial update on the 1984 report, should serve as an important reference that not only profiles the province's gold potential, but also helps facilitate further exploration successes that will ultimately grow the province's gold production.

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Executive Summary

Saskatchewan has a long, albeit sporadic, history of gold exploration and mining that dates back to the turn of the 20th century. Over 500 gold showings of varying mineralization styles have been discovered to date. The province's largest gold producer was the Flin Flon massive sulphide deposit, which produced about 112 t (3.6 million oz.) of gold in Saskatchewan during Cu-Zn mining between 1930 and 1992. A particularly important period of gold exploration occurred in the 1980s, when an exploration rush driven by record gold prices led to the discovery and/or further exploration of numerous showings, some of which have since been mined. For example, the Seabee mining operation, Saskatchewan's largest ever primary gold-producer, commenced in 1991 and is slated to produce its millionth ounce in 2012. Most recently, gold mining began in 2011 at the Roy Lloyd mine, representing the first of several mines planned as part of the 'La Ronge Gold Project'.

Gold has been found in almost all geological regions of Saskatchewan, but the most significant showings are in the Precambrian shield which underlies the northern one third of the province. A variety of gold mineralization styles are known in the Precambrian rocks, though the majority of production has come from deposits proposed to be of two main types: 'volcanogenic massive sulphide' (VMS) deposits and 'orogenic gold deposits' (OGDs). The VMS deposits, only some of which contain significant accumulations of gold (*e.g.*, the Flin Flon deposit), are found in select volcanic assemblages of the Reindeer Zone and were deposited in a restricted time span between about 1900 and 1865 Ma. The OGDs are more widespread and have the potential to host large, relatively high grade gold resources (*e.g.*, the Seabee deposit). Known OGDs are found dominantly within shear zones that transect greenstone belts of the Rae Province, the Hearne Province, and the Reindeer Zone. The majority, if not all OGDs, are thought to be of Paleoproterozoic age, despite some possibly being hosted by Archean rocks. Most of the OGDs in Saskatchewan are thought to have been emplaced due to thermotectonism during the waning stages of the Trans-Hudson orogeny at *ca.* 1800 Ma. In addition to VMS deposits and OGDs, other gold mineralization styles in Precambrian rocks of Saskatchewan include disseminated sediment-hosted gold-sulphide mineralization and minor gold in vein- and unconformity-associated uranium deposits, among others. In southern Saskatchewan, minor placer and paleoplacer gold showings are hosted by rocks and unconsolidated sediment of the Phanerozoic sedimentary basin.

Despite a long history of gold exploration, Saskatchewan remains under-explored compared to many other jurisdictions. New discoveries continue to be made, and additional drilling of known showings, many of which are currently poorly defined, commonly results in expansion of known resources. A variety of innovative gold exploration techniques (*e.g.*, new geophysical and geochemical techniques, remote sensing, *etc.*) are now available that, when combined with traditional techniques (*e.g.*, glacial drift prospecting, rock and sediment sampling, *etc.*) and comprehensive knowledge of the geological relationships, will facilitate the discovery of additional gold deposits in the future.

Keywords: gold, Saskatchewan, Precambrian shield, Rae Province, Hearne Province, Reindeer Zone, Trans-Hudson orogen, Paleoproterozoic, metallogenesis, volcanogenic massive sulphide, orogenic gold, Phanerozoic, placer gold.

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Chapter 1 – Introduction

Saskatchewan is well known for its wealth of mineral resources, particularly its abundant reserves of potash and uranium. Somewhat overshadowed by this vast endowment is the fact that the province also hosts significant gold resources and boasts a long and productive history of gold exploration and mining. Indeed, gold showings are known throughout the province and are particularly concentrated in parts of the northern Precambrian shield (Figure 1). As outlined in *Gold and Other Stories as Told to Berry Richards* (Kupsch and Hanson, 1986), the earliest records of gold exploration in the province date back to the start of the 20th century, when prospecting was initiated in the Pine Channel and greater Lac La Ronge areas, and gold panning and early dredging efforts took place along the North Saskatchewan River. Shortly afterwards, in 1912, T. Creighton and several other prospectors began exploring in the northern Amisk Lake area. This work led to the discovery of several auriferous quartz veins in the area, some of which produced small amounts of gold in these early years (*e.g.*, historical mining at the Graham, Prince Albert, and Phantom Lake showings, among others). This work also resulted in the discovery of the world-class Flin Flon Cu-Zn volcanogenic massive sulphide (VMS) deposit, straddling the Saskatchewan-Manitoba provincial border. Ironically, this base metal deposit would prove to become Saskatchewan's largest gold producer, having produced about 112 t (3.6 million oz.) of gold as a by-product of Cu-Zn mining between 1930 and 1992 (Table 1).

Subsequent to the opening of the Flin Flon mine in 1930, gold exploration in the province was sporadic, with periods of more intensive exploration generally coinciding with sharp increases in the price of gold. One of the busiest and most productive periods of gold exploration and development in the province was during the 1980s, when gold prices soared to new record highs. This resulted in a widespread staking rush, discovery of multiple gold occurrences, and opening of new gold mines between the mid-1980s and mid-1990s (Table 1). The Seabee mine, located 125 km northeast of La Ronge, is one such mine and, despite reserve estimates at the start of mining being just under 11.8 t (380,000 oz.) of gold (Basnett, 1999), it remains in operation in 2012. The Seabee mining operation is set to reach the 1 million oz. production mark in 2012, making it the largest primary gold-producing mine in Saskatchewan's history. In 2011, gold production also commenced at the nearby Santoy 8 mine, ore from which is processed within the Seabee operation.

Notwithstanding the success of the Seabee operation, gold exploration and mining activity declined during the 1990s because of depressed gold prices and an unfavourable economic climate. From an exploration perspective, one of the main consequences of this cyclical pattern is that most known deposits in the province have not been fully delineated, with most drilled only to shallow (<350 m) depths. Even mined deposits, many of which were short-lived operations (Table 1), typically have poorly defined vertical extents. With renewed interest in the province's gold resources in recent years, again coinciding with a steady increase in the gold price since the mid-2000s, much of the most favourable ground has been re-staked. Exploration has been renewed at many previously known deposits and has resulted in definition of new and/or expanded mineral resources (Table 2). Another landmark in Saskatchewan's gold history was achieved in 2011 with the initiation of an additional mining operation (the 'La Ronge Gold Project'), marked by commencement of gold production at the Roy Lloyd mine, located 75 km north-northeast of La Ronge.

This 'cyclicity' in gold exploration and mining activity is also reflected in the literature on Saskatchewan's gold resources. The bulk of existing studies focussed primarily on gold were published or initiated between 1984 and 1992, reflecting a demand for improved technical information from the burgeoning gold exploration community at that time. Important publications in this regard include government maps and regional syntheses of favourable lithotectonic domains (*e.g.*, La Ronge Domain: Thomas, 1993; Glennie Domain: Delaney, 1992), detailed deposit-scale studies (*e.g.*, Roberts, 1990, 1993; Ansdell and Kyser, 1991; Ibrahim and Kyser, 1991), and topical graduate theses (*e.g.*, Armstrong, 1990; Durocher, 1997; He, 1997). Conferences focussed on, or including, both gold metallogenesis and gold exploration methods occurred at this time and resulted in the release of symposia proceedings, some of which stand as the most comprehensive existing documents on some aspects of gold mineralization in the province. Important examples include *Gold in the Western Shield* (Clark, 1986), *Economic Minerals of Saskatchewan* (Gilboy and Vigrass, 1987), and *Modern Exploration Techniques* (Beck and Harper, 1990). Perhaps the most important and widely referenced publication from this time, however, was W.L. Coombe's *Gold in Saskatchewan* (Coombe, 1984), in which the geological character and exploration history was systematically detailed for virtually all known gold showings in Saskatchewan at that time. Coombe's report has served as the authoritative source on Saskatchewan's gold resources for nearly three decades. It is clear, however, that developments since 1984 in both the industry and our understanding of these mineralizing systems have

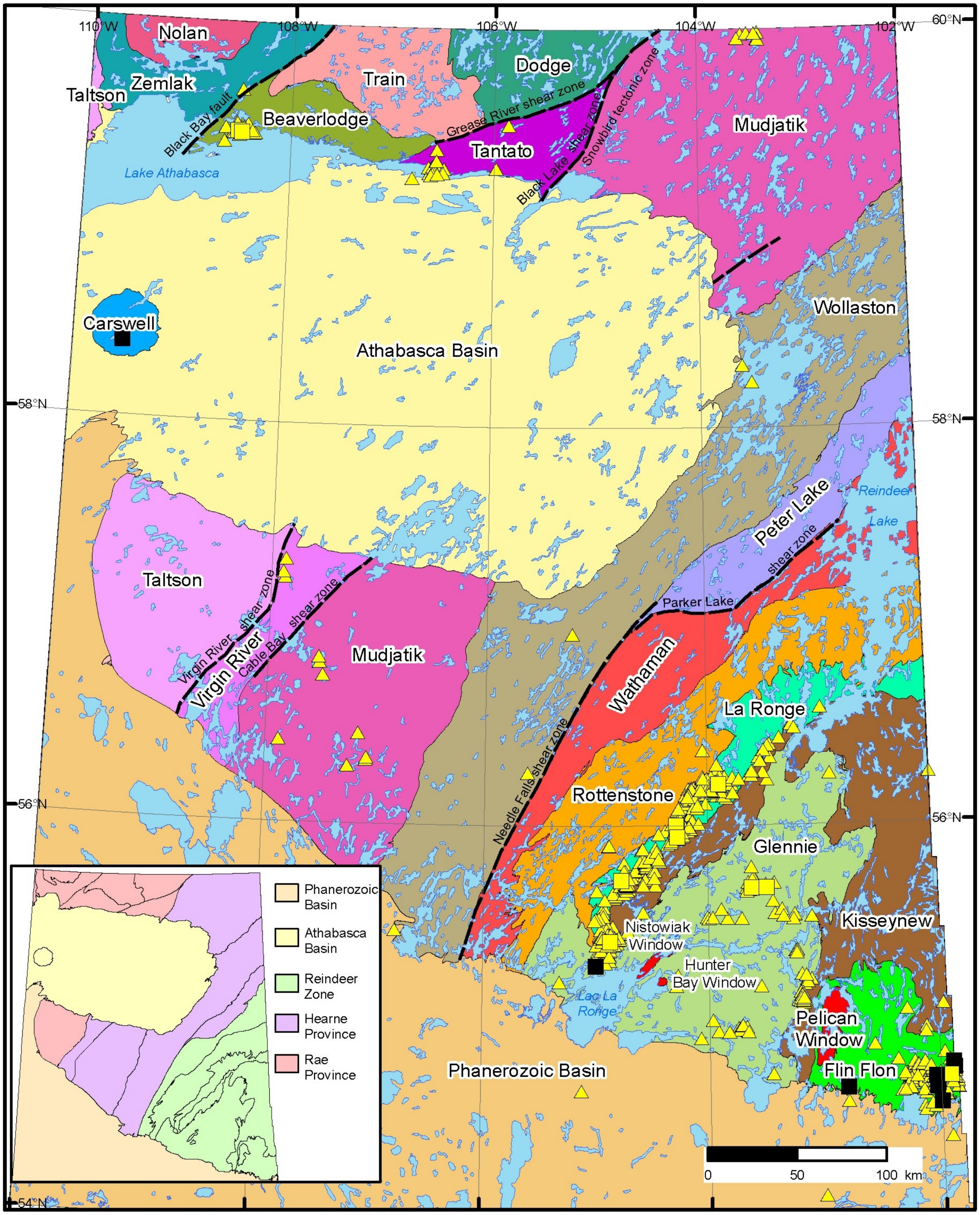

Figure 1 – Lithotectonic domains of the Precambrian shield of Saskatchewan, with locations of currently or past-producing gold mines (yellow squares), past-producing mines with by-product gold (black squares), and known gold showings (yellow triangles). Mine/showing data are from the Saskatchewan Mineral Deposits Index (SMDI), which can be found at URL <http://www.er.gov.sk.ca/SMDI>. Inset shows the extent of the informally designated gold-bearing 'regions' of Saskatchewan, used for descriptive purposes in this report.

Table 1 – Synthesis of historical gold production from Saskatchewan deposits as of January 1, 2012 (values are non NI 43-101 compliant).

Mine	Mine operator	Years operated	Ore milled in tonnes (short tons)	Average grade in g/t (oz./ton)	Gold produced in tonnes[1] (troy oz.)	Source
North Saskatchewan River	Various placer operations	~1900 to 1949	n/a	n/a	0.036 (1,160)	Saskatchewan Geological Survey (2003)
Flin Flon[2] (Saskatchewan portion only)	Hudson Bay Mining and Smelting Company Ltd.	1930 to 1992	43 243 752 (47,668,020)	2.6 (0.076)	~112[3,4] (~3,600,000)	HudBay Minerals Inc. (unpubl. data; tonnage, grade only)
Rio/Bootleg	Henning-Maloney Gold Mines Ltd. / Flin Flon Mines Ltd. / Vista Mines Inc.	1934 to 1941, 1984, 1989	n/a	n/a	0.049 (1,561)	Saskatchewan Geological Survey (2003)
Phantom Lake	Man-Sask Gold Mines, Ltd.	1934 to 1937	11.8 (13)	84.9 (2.48)	0.001 (25.8)	Coombe (1984)
Henning-Maloney	Henning-Maloney Gold Mines Ltd.	1934 to 1941	307 (338)	n/a	0.010 (331)	SMDI; unknown source
Prince Albert (Monarch)	Monarch Gold (Miners) Synd., Ltd. / Pamon Gold Mines Ltd.	1937, 1940 to 1942	5 282 (5,822)	n/a	0.152 (4,882)	Beck (1969)
Box	Consolidated Mining and Smelting Company of Canada Ltd.	1939 to 1942	1 286 680 (1,418,320)	1.6 (0.045)	1.99 (64,066)	Beck (1969)
Birch Lake[2]	Hudson Bay Mining and Smelting Company Ltd.	1957 to 1960	278 747 (307,265)	0.1 (0.003)	0.025 (813)	Coombe Geoconsultants Ltd. (1991)
Coronation[2]	Hudson Bay Mining and Smelting Company Ltd.	1960 to 1965	1 281 727 (1,412,861)	2.0 (0.059)	2.33 (~75,055)	Coombe Geoconsultants Ltd. (1991)
Anglo-Rouyn[2] (A and C zones)	Rio Algom Mines Ltd.	1966 to 1972	1 717 121 (1,892,800)	1.2 (0.036)	2.10 (67,652)	Coombe Geoconsultants Ltd. (1991)
Hanson Lake[2] (Western Nuclear)	Share Mines & Oils Ltd. / Western Nuclear Mines Inc.	1967 to 1969	n/a	n/a	0.061 (1,970)	Coombe Geoconsultants Ltd. (1991)
Flexar[2]	Hudson Bay Mining and Smelting Company Ltd.	1969 to 1972	305 854 (337,146)	1.3 (0.038)	0.314 (10,111)	Coombe Geoconsultants Ltd. (1991)
Decade (Mallard)	Decade Development Ltd. / L.J. Manning & Associates Ltd. / Jolu Mining Ltd.	1973 to 1975	5 000 (5,512)	10.3 (0.300)	0.013 (425)	Coombe (1984)
Cluff Lake (D zone)[5]	COGEMA Resources Inc.	1987 to 1988	128 000 (141,096)	n/a	0.248 (7,970)	Saskatchewan Geological Survey (2003)
Star Lake (21 and Rush zones)	Cameco Corp.	1986 to 1989	180 301 (198,747)	13.3 (0.387)	2.39 (76,900)	Thomas (1993)
Jolu (Rod and Mallard zones)	Corona Corp.	1988 to 1991	472 210 (520,522)	13.7 (0.401)	6.32 (203,301)	Thomas (1993)
Jasper (Jasper-James zone)	Cameco Corp.	1990 to 1991	140 127 (154,463)	18.9 (0.553)	2.57 (82,697)	Giancola (1992)
Seabee Mining Operation[6]	Claude Resources Inc.	1991 to November 2011[7]	4 303 728 (4,744,042)	7.52 (0.220)	30.06 (966,401)	Claude Resources Inc. (unpubl. data)
Contact Lake	Cameco Corp.	1995 to 1998	n/a	~7.0 (~0.2)	5.91 (189,920)	Giancola (1997, 1998, 1999)
Komis	Golden Rule Resources Ltd.	1996 to 1997	120 565 (132,900)	6.9 (0.201)	0.835 (26,859)	Hrdy (2010)
Callinan North[2] (Saskatchewan portion only)	Hudson Bay Mining and Smelting Company Ltd.	1997 to 2005	396 895 (437,501)	1.6 (0.046)	~0.626[3,4] (~20,125)	HudBay Minerals Inc. (unpubl. data; tonnage, grade only)
Konuto[2]	Hudson Bay Mining and Smelting Company Ltd.	1998 to 2005	2 033 111 (2,241,119)	2.0 (0.057)	~3.97[3] (~127,743)	HudBay Minerals Inc. (unpubl. data; tonnage, grade only)
Roy Lloyd (Bingo)	Golden Band Resources Inc.	2011 to January 1, 2012[7]	70 808 (78,052)	11.5 (0.336)	0.801 (25,748)	Golden Band Resources Inc. (2011a, 2011b, 2011c)

[1] Discrepancies between deposit grade/tonnage and production totals reflect <100% mill recovery.
[2] By-product gold from base metal mining.
[3] Assumes 100% mill recovery; actual gold recovery is unknown.
[4] Total gold produced from combined Saskatchewan and Manitoba portions was about 170 t (5.47 million oz.) for the Flin Flon mine and about 14 t (0.45 million oz.) for the Callinan mine.
[5] By-product gold from uranium mining.
[6] Includes ore from Porky West and Santoy 7 bulk samples, and Santoy 8 mine.
[7] Currently producing gold (as of January 1, 2012).

Table 2 – Summary of existing NI 43-101–compliant Mineral Reserve/Resource[1] estimates for Saskatchewan deposits as of January 1, 2012.

Deposit	Ownership (% if shared)	Year	Tonnes	Au grade (g/t)	Cut-off grade (g/t)	*In situ* Au (tonnes / troy oz.)
RESERVES (Proven + Probable)						
Box	Brigus Gold Corp.	2011	16 502 247	1.51	0.72	24.88 / 800,000
Athona	Brigus Gold Corp.	2011	5 830 798	1.17	0.72	6.84 /220,000
Seabee[2,3]	Claude Resources Inc.	2010	887 100	6.69	4.57	5.93 / 190,800
Santoy 8[2,3]	Claude Resources Inc.	2010	1 079 900	4.66	3.0	5.03 / 161,900
RESOURCES - Measured + Indicated						
Box[4]	Brigus Gold Corp.	2011	13 824 000	1.66	0.50	22.92 / 737,000
Athona[4]	Brigus Gold Corp.	2011	7 036 400	1.28	0.50	9.01 / 289,600
Porky Main	Claude Resources Inc.	2010	160 000	7.50	4.26	1.20 / 38,581
Porky West[3]	Claude Resources Inc.	2010	112 908	3.06	4.26	0.31 / 11,104
Roy Lloyd mine (Bingo)[2,3]	Golden Band Resources Ltd.	2011	157 116	13.14	5.0	2.07 / 66,376
Komis[5]	Golden Band Resources Ltd.	2010	191 740	7.85	4.0	1.51 / 48,398
Memorial	Golden Band Resources Ltd.	2005	288 400	2.83	1.0	0.82 / 26,220
Tower East	Golden Band Resources Ltd.	2007	5 019 080	1.86	1.0	9.33 / 299,835
Golden Heart	Golden Band Resources Ltd.	2011	362 423	7.94	4.0	2.88 / 92,520
EP (Eric Partridge)[2]	Golden Band Resources Ltd.	2008	102 000	3.81	1.0	0.39 / 12,494
Greywacke Lake (North zone)	Masuparia Gold Corp. (51) / Golden Band Resources Ltd. (49)	2008	184 000	8.40	5.0	1.55 / 49,705
Jojay (Red zone)	Wescan Goldfields Inc.	2010	420 000	3.70	2.0	1.55 / 50,000
Laurel Lake / Amisk Gold[6]	Claude Resources Inc.	2011	30 150 000	0.95	0.40	28.65 / 921,000
McIlvenna Bay (Copper Stockwork zone)	Foran Mining Corp.	2011	5 560 000	0.53	1.10%[7]	2.97 / 95,400
RESOURCES - Inferred						
Box	Brigus Gold Corp.	2011	3 158 000	1.74	0.50	5.47 / 176,000
Athona	Brigus Gold Corp.	2011	1 406 400	1.10	0.50	1.55 / 49,700
Seabee[2]	Claude Resources Inc.	2010	705 500	6.33	4.57	4.47 / 143,600
Santoy 8[2]	Claude Resources Inc.	2010	384 800	5.35	3.0	2.06 / 66,200
Porky Main	Claude Resources Inc.	2010	70 000	10.43	4.26	0.73 / 23,473
Porky West	Claude Resources Inc.	2010	138 314	6.03	4.26	0.83 / 26,792
Bingo (Roy Lloyd mine)[2]	Golden Band Resources Ltd.	2009	155 074	13.89	5.0	2.11 / 67,756
Komis[5]	Golden Band Resources Ltd.	2010	10 746	7.91	4.0	0.09 / 2,731
Memorial	Golden Band Resources Ltd.	2005	90 900	2.49	1.0	0.23 / 7,272
Tower East	Golden Band Resources Ltd.	2007	902 020	1.52	1.0	1.37 / 43,965
Golden Heart	Golden Band Resources Ltd.	2011	7 479	9.36	4.0	0.07 / 2,251
Birch Crossing	Golden Band Resources Ltd.	2007	536 300	5.11	2.0	2.74 / 88,100
Corner Lake	Golden Band Resources Ltd.	2010	184 400	8.07	5.0	1.49 / 47,900
Greywacke Lake (North zone)	Masuparia Gold Corp. (51) / Golden Band Resources Ltd. (49)	2008	58 000	7.29	5.0	0.42 / 13,600
Jojay	Wescan Goldfields Inc.	2010	630 000	4.30	2.0	2.71 / 87,000
Laurel Lake / Amisk Gold[6]	Claude Resources Inc.	2011	28 653 000	0.70	0.40	20.09 / 646,000
McIlvenna Bay (Copper Stockwork zone)	Foran Mining Corp.	2011	3 570 000	0.35	1.10%[7]	1.24 / 39,800

Notes:

Data in this table are intended to reflect NI-43-101–compliant standards but might not all necessarily conform to the current legal definition of Reserves and Resources by the Canadian Institute of Mining, Metallurgy and Petroleum.

Data are from published technical (NI 43-101) reports and/or corporate websites.

[1] Throughout this report, capitalization indicates NI 43-101 compliancy (*e.g.*, 'Mineral Reserve/Resource' estimate, 'Pre-Feasibility Study', *etc.*), whereas non-capitalization indicates historical reporting (non–NI 43-101 compliancy). Specific values are only provided for the former.

[2] Currently in production.

[3] Some or all of this Reserve/Resource might have been extracted/processed since its definition (see Table 1).

[4] Some or all of this Mineral Resource is included in the Mineral Reserve estimate for the deposit.

[5] Excludes ore extracted during previous mining.

[6] Mineral Resource includes Ag as 'Au equivalent'.

[7] Cu equivalent cut-off.

rendered an update necessary. *Saskatchewan Gold: Mineralization Styles and Mining History* is intended to capture these developments and augment the information originally described in Coombe's report.

Saskatchewan Gold follows a format broadly similar to that of Coombe, in that individual gold showings are grouped according to the geological 'region'[1] in which they occur, and descriptions of the exploration history and geological character are provided for each. In contrast, however, not all known showings in the province are covered in detail; according to the Saskatchewan Mineral Deposits Index (SMDI), there are currently more than 500 known mineral occurrences in the province with gold listed as the primary commodity (Appendix 1), a number that cannot reasonably be covered in a report of this scope. As an alternative approach, we have described only those showings or groups of showings (~45) that are of historical economic significance (*i.e.*, have been mined or extensively explored), are of distinct geological character, or are geographically isolated from other showings. We have also attempted to focus on the characteristics of the showings that allude to deposit genesis, so as to put them into more of an 'ore systems' context. For information on some of the individual gold showings not covered in this report, the reader is encouraged to consult Coombe's report, other Saskatchewan Geological Survey publications (where applicable), and/or the SMDI.

In this report, the individual showing descriptions are arranged using the following categories (notes in parentheses correspond to information provided in parentheses in the descriptions):

Name: Most commonly used name of the showing, along with other names used for, or pertaining to, the showing (and relevant SMDI file number(s))

Location: General location of the showing (along with National Topographic System information and UTM co-ordinates[2])

Metal Associations: Main elements associated with the gold mineralization (along with minor/trace constituents)

Status: Current status of the project using classification methods of Rogers and Hart, 1995; see Appendix 2

Exploration and Development History: Synopsis of the mineral exploration history at the showing

Geological Character: Key geological characteristics of the mineralization and relationship(s) with hostrocks

Inferred Deposit Type: Considering existing generic gold deposit models (see Chapter 2), this is speculated to be the most likely mineralization style of the showing based on existing information (subject to reinterpretation as new information becomes available)

Associated Showings: Other showings in Saskatchewan speculated to be of similar style or, in some cases, genetically related (with SMDI file number)

Production and Reserves/Resources: When applicable, this section briefly describes whether past production occurred at the deposit (see Table 1) or if reserve/resource information exists. Specific values are provided only for the most recent, NI 43-101–compliant Mineral Reserve/Resource[3] estimates (see Table 2).

Additionally, in the final section of each chapter, the deposit information is integrated with existing information on regional geological relationships (*e.g.*, spatial, temporal, thermotectonic constraints, *etc.*) to infer the history of 'gold metallogenesis' for each region. It must be emphasized, however, that both the inferred deposit type and the regional metallogenic history are derived ultimately from compilation of observations and interpretations of other authors, so they do not generally reflect first-hand observations by the present authors. These two sections of each description should therefore be considered as provisional interpretations, based only on existing information at hand and subject to change as new data are obtained.

Information in this report is compiled from many publicly available sources, including refereed journal publications, government maps and reports, graduate theses, and industry documents. An attempt was also made to capture

[1] For the purposes of this report, Saskatchewan has been subdivided into five geological 'regions' (see Figure 1 inset map). Sedimentary strata of the Athabasca Basin are not known to contain any significant gold mineralization, and are therefore not specifically discussed in the report.

[2] UTM co-ordinates are from Zone 13, NAD 83 and are approximate.

[3] Throughout this report, capitalization indicates NI 43-101 compliancy (*e.g.*, 'Mineral Reserve/Resource' estimate, 'Pre-Feasibility Study', *etc.*), whereas non-capitalization indicates historical reporting (non–NI 43-101 compliancy). Specific values are provided only for the former.

information from the Saskatchewan Ministry of Energy and Resources' mineral exploration assessment files, though this was achieved mainly through consultation of SMDI descriptions because the magnitude of information held in the assessment files themselves precluded a more in-depth examination. It must be noted, however, that these files represent an extremely valuable publicly available resource and, along with the original references listed in this report, should be consulted directly for further information on individual gold showings.

This report is intended to serve as a comprehensive, albeit generalized, information source on Saskatchewan's gold resources, current as of January 1, 2012. Although the Saskatchewan Ministry of Energy and Resources has exercised all reasonable care in the compilation, interpretation and production of this report, it is not possible to ensure total accuracy, and all persons who rely on the information contained herein do so at their own risk. The Ministry of Energy and Resources and the Government of Saskatchewan do not accept liability for any errors, omissions, or inaccuracies that may be included in, or derived from, this report.

Chapter 2 – Gold Deposit Models

This chapter is intended to provide a generalized overview of gold deposit models, as established by comparison with global examples, that are of most relevance to mineralization styles known in Saskatchewan. Although isolated examples of several other mineralization styles are present in the province, the majority have characteristics that are most consistent with two generalized genetic models: orogenic gold deposits (OGDs) and volcanogenic massive sulphide (VMS) deposits. An overview of the characteristics of these two deposit types is provided below. Synoptic descriptive models for examples specific to Saskatchewan are available in *Saskatchewan Descriptive Mineral Deposit Models* (Rogers, 2011).

Orogenic Gold Deposits (Saskatchewan Descriptive Mineral Deposit Model A-8)

The majority of gold mineralization in Saskatchewan can be characterized as the type referred to as 'OGDs'. This nomenclature, brought into widespread usage by Groves *et al.* (1998), includes gold deposits that are elsewhere referred to as 'mesothermal', 'shear zone–hosted', or 'gold-only' deposits. Common elements among deposits of this designation include their occurrence in metamorphosed hostrocks, their epigenetic timing with respect to their hostrocks, a strong structural control, and a broad temporal relationship with peak thermotectonism (Groves *et al.*, 2003). This style of mineralization has formed episodically throughout most of the Earth's history and is geographically widespread (Goldfarb *et al.*, 2001). Though many genetic aspects of these deposits remain contentious, their overriding characteristics are well documented in the literature. Syntheses of the salient characteristics of gold mineralization of this style include Hodgson (1993), Groves *et al.* (1998, 2003), Hagemann and Cassidy (2000), Goldfarb *et al.* (2005), and Dubé and Gosselin (2007). The following description is based on these references, unless otherwise specified.

Although variations are known, most OGDs can be characterized using some key criteria. The most common manifestations of OGDs are as native and/or sulphide-bound gold in quartz-carbonate veins or vein arrays, or in sulphidized wallrock adjacent to the veins. The deposits have a ubiquitous spatial association with major faults or shear zones that allowed transport of hydrothermal fluids from deeper crustal levels to the depositional site (Figure 2A). This style of deposit can be found in a wide range of hostrocks, including volcanic (*e.g.*, 'greenstone-hosted'), sedimentary (*e.g.*, 'turbidite-hosted'), or plutonic rocks. Contacts between rock types of contrasting competencies are common sites for ore deposition. Some rock types are apparently favourable hosts (*e.g.*, iron-rich rocks, such as banded iron formation; 'BIF-hosted'/'Homestake-style'), though this probably reflects its rheological or chemical attributes rather than any inherent genetic relationship with the gold.

The structures controlling these mineralizing systems are typically moderately to steeply dipping regional shears or deformation zones that originated in compressional regimes and, in some cases, were reactivated under different stress regimes. The deposits themselves, however, are typically situated within or proximal to subsidiary structures that splay off of these major structures. The mineralized structures host auriferous quartz-carbonate veins and vein arrays, and commonly exhibit ductile to brittle-ductile deformational fabrics, though several other variants are documented. These include brittle faults, fracture networks, zones of pressure-solution cleavage, and/or fold hinges in ductile rocks. There is a characteristic change from brittle to brittle-ductile to ductile style with increasing depth of formation and related metamorphic grade: from discrete veins, stockworks, and breccia zones in relatively shallow brittle settings, to discrete veins associated with shear zones and sulphide-filled fractures and shears in brittle-ductile settings, to sulphide-rich disseminated and replacement bodies in deeper ductile environments. The gold-bearing veins can range from centimetres to tens of metres in width and are typically steeply dipping fault-fill veins (Figure 2B) that are laminated with wallrock fragments. Vein systems can be much more complex, however, and can include extensional and oblique-extensional veins and vein arrays, vein stockworks, breccia veins, or combinations thereof (see Robert and Poulsen, 2001). Extensional veins are commonly subhorizontal (Figure 2B). Many deposits, including some of the largest globally, exhibit overprinting relationships of multiple mineralizing events. Deformed veins (*e.g.*, isoclinally folded) are sometimes present and can result from either incremental development in active shear zones or from superimposed deformation event(s) after displacement within the shear zone has ceased. Within the overall mineralized system, individual orebodies are commonly located within localized zones of extension or dilation, including dilational jogs, shear bifurcations, shear zone intersections, or fold hinges (*i.e.*, 'saddle reef' deposits), among others. The deposits are typically tabular to lenticular, are narrow relative to the large along-strike and down-dip dimensions, and are oriented parallel (to subparallel) to the strike of the host structures. Sibson *et al.* (1988) proposed that formation of OGDs is an incremental process, whereby cyclical fluctuations in fluid pressure are caused by the 'valve-like' behaviour of steep reverse or strike-slip shear zones, the periodic release of mineralizing fluids coinciding with distinct seismic (earthquake) events.

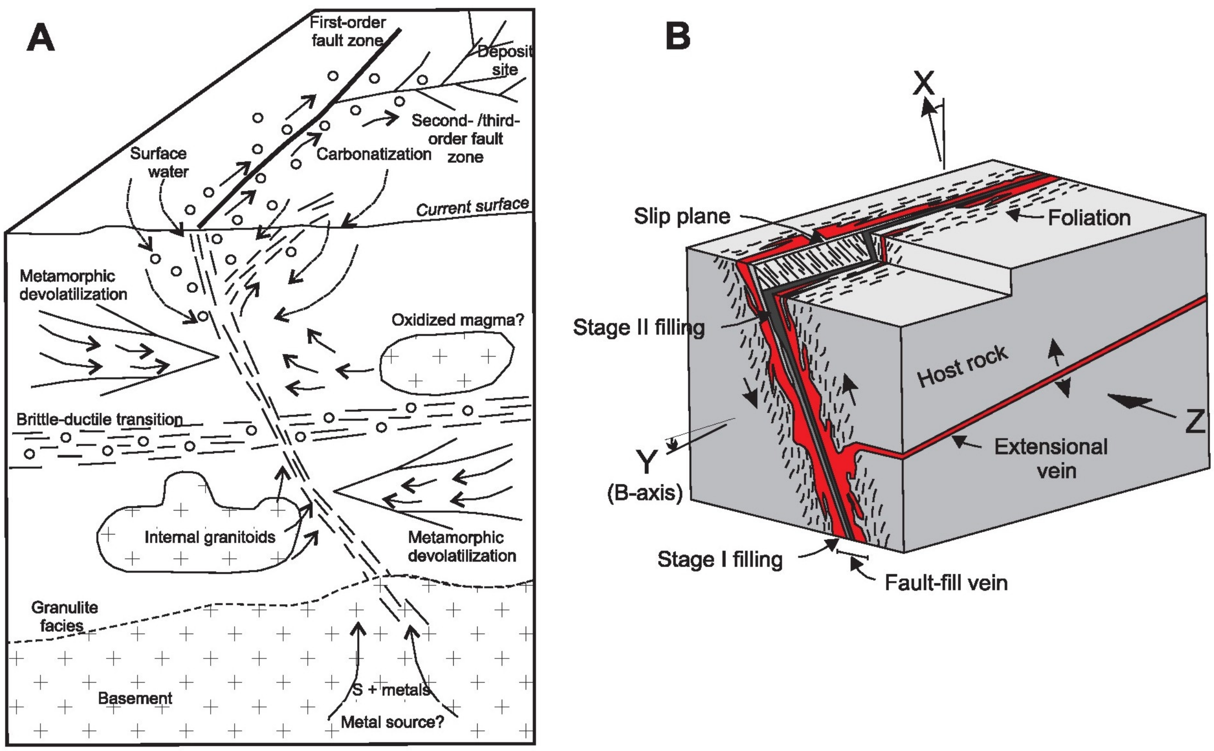

Figure 2 – Characteristics of orogenic gold deposits: A) crustal-scale model, showing the transport of ore-forming fluids along crustal-scale shear zones and precipitation in subsidiary shears (Hagemann and Cassidy, 2000); and B) schematic diagram of an orogenic gold vein system, showing the geometric relationships between shear zones and veins, and the deposit-scale strain axes (X, Y, Z) in a compressional regime (from Dubé and Gosselin, 2007 after Robert, 1990).

Mineralized vein systems hosting OGDs can have significant vertical extents of up to 2 to 3 km, over which there is typically little metal zonation. Strong lateral zonation of wallrock alteration is common, however, on a scale of centimetres to tens of metres. Alteration mineral assemblages reflect the addition of K, As, Sb, large-ion lithophile elements, CO_2, and/or S, and sometimes Na or Ca. The overall character of mineralization reflects deposition from a fluid-rich system (*i.e.*, high fluid:rock ratio) involving characteristically low-salinity, near-neutral, H_2O-CO_2±CH_4±N_2 hydrothermal fluids. In addition to gold, the deposits commonly contain silver (Au:Ag ratios typically around 10), as well as As±B±Bi±Sb±Te±W. The gold is thought to have been transported in the hydrothermal fluid mainly as a bisulphide complex (*e.g.*, Mikucki, 1998); consequently, these deposits are not generally associated with high contents of base metals (*e.g.*, Cu, Zn), which are more efficiently transported as chloride complexes in hydrothermal fluids. Gold typically occurs in native form or bound in sulphides (=3 to 5%; typically pyrite, arsenopyrite, pyrrhotite) within the quartz veins or in disseminated sulphides that replace the adjacent wallrock.

An important genetic aspect of OGDs appears to be their association with regional thermotectonism. Although examples are known in sub-greenschist to granulite facies rocks, they are most commonly hosted in rocks characterized by greenschist to lower amphibolite metamorphic facies assemblages, and exhibit characteristics consistent with deposition in the brittle-ductile transition zone. Geochronological and mineral equilibria studies generally indicate that these deposits were dominantly emplaced synchronously with, or shortly after, the peak of regional metamorphism. This is consistent with the relatively high fluid temperatures (normally 350° ±50°C) and moderate pressures (normally 1.5 ±0.5 kbar) that are commonly determined for these deposits. Deposits in some terranes of higher metamorphic grade (upper amphibolite and granulite facies) might themselves be metamorphosed (and partially melted?) due to the persistence of elevated temperature regimes at deeper levels in the crust (Phillips and Powell, 2009). Fluid-wallrock interaction (*i.e.*, wallrock sulphidization), fluid-pressure fluctuations, and fluid unmixing–phase separation are probably the dominant precipitation mechanisms for these deposits.

As reflected by the nomenclature, the cumulative characteristics of OGDs indicate their formation within a continental margin that is actively undergoing orogenesis (*i.e.*, during deformation and metamorphism; Figure 3). In detail, it is apparent that many of these deposits formed during crustal shortening in compressional or transpressional regimes in the latter stages of orogenesis, in both accretionary and collisional orogens. This setting is one in which the emplacement of metamorphic-derived granitic plutons and mantle-derived lamprophyre dykes is also common, as is the deposition of coarse clastic sedimentary rocks that unconformably overlie the volcanic rocks (*i.e.*, 'Timiskaming-like' sequence; Robert *et al.*, 2005; Dubé and Gosselin, 2007). These rock types are therefore commonly found in close spatial association with OGDs. The exact processes that contribute to formation of these deposits, along with the ultimate source of fluids and gold, are debated. One widely held model is that they originate due to dehydration of the crust during regional prograde metamorphism, particularly during devolatilization of mafic and ultramafic rocks in greenstone belts or even from a subducting slab. A model known as the 'crustal continuum' model (*e.g.*, Groves *et al.*, 1998) proposes a common, deep-seated source for synmetamorphic hydrothermal deposits of varying textures and metal associations throughout a 20 to 25 km vertical crustal profile. Other models specifically invoke contributions from deeply sourced magmatism or directly from the mantle.

Global Examples: Hollinger-McIntyre (Ontario, Canada); Red Lake (Ontario, Canada); Con/Giant (Northwest Territories, Canada); Golden Mile (Kalgoorlie, Western Australia); Ashanti (Republic of Ghana, West Africa); Homestake (South Dakota, United States); Mother Lode (California, United States); and Alaska-Juneau (Alaska, United States)

Saskatchewan Examples: Seabee mine, Roy Lloyd mine (Bingo), Contact Lake mine, Box mine, Star Lake mine, Jasper mine, Komis, and Rio/Bootleg

Volcanogenic Massive Sulphide Deposits (Saskatchewan Descriptive Mineral Deposit Model A-12)

In contrast to OGDs, which are epigenetic with respect to the hostrocks, volcanogenic massive sulphide (VMS; also referred to as 'volcanic-associated', 'volcanic-hosted', and 'volcano-sedimentary–hosted' massive sulphide) deposits are syngenetic with their hosts. As implied by the name, VMS mineralization comprises polymetallic, stratabound to slightly discordant, massive sulphide lenses that originally precipitated at or below the seafloor due to hydrothermal convection in spatial, temporal, and genetic association with subaqueous volcanism (Figure 4). These deposits, often clustered within deposit districts, commonly include a feeder zone of silicate-sulphide stockwork veinlets that was originally situated beneath the massive sulphide lens. VMS deposits are major sources of Cu, Zn, and Pb, and can also contain significant resources of Au and Ag. As with OGDs, these deposits are known to have formed episodically throughout much of geological time and are geographically widespread (Galley *et al.*, 2007a). The characteristics of VMS mineralization in general were summarized by Franklin *et al.* (2005) and Galley *et al.* (2007a), whereas the specific characteristics of gold-bearing VMS deposits were presented by Hannington *et al.*

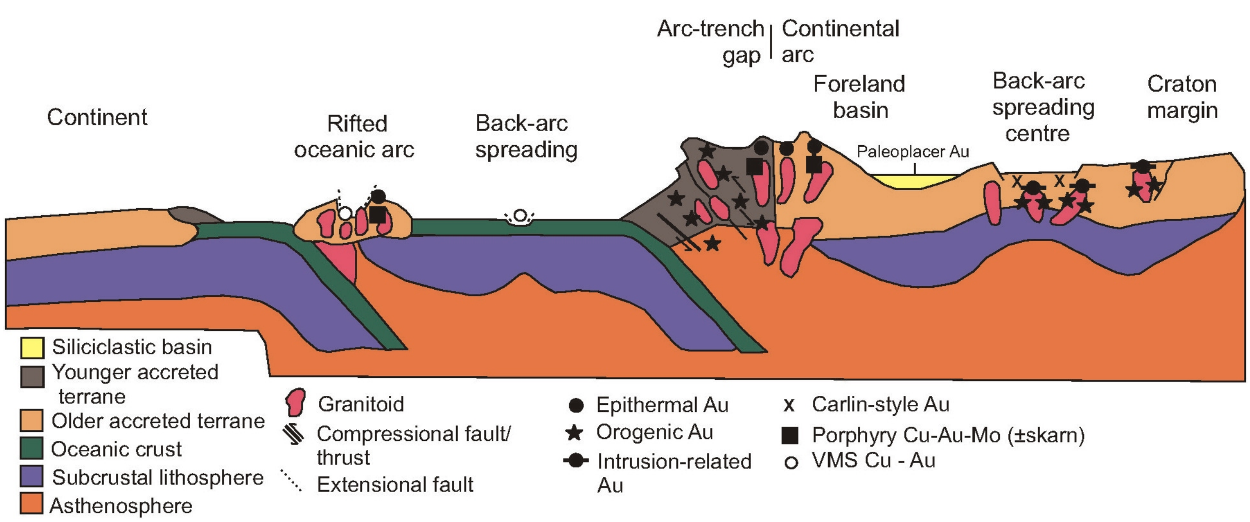

Figure 3 – Inferred tectonic settings for generation of different styles of auriferous mineral deposits (modified from Groves* et al.*, 1998).

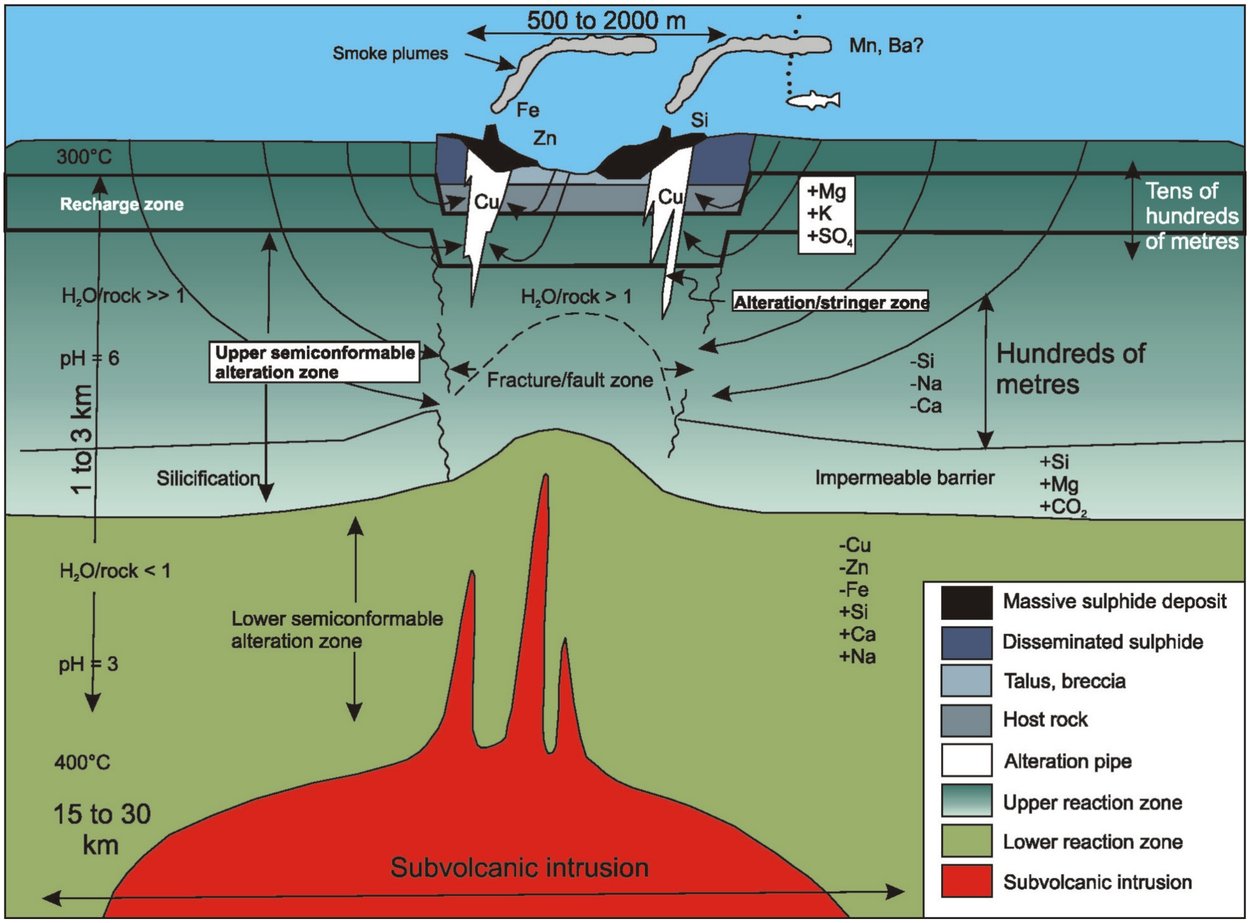

Figure 4 – Generalized model for the formation of volcanogenic massive sulphide deposits (modified from Franklin* et al.*, 2005 and references therein). Positive and negative symbols (*e.g.*, +Si, -Na) represent relative additions and subtractions, respectively, of elemental components in alteration zones.

(1999), Huston (2000), Dubé *et al.* (2007), and Mercier-Langevin *et al.* (2011). The following description is based on these collective references, which the reader should consult for more detailed information.

Several different classifications of VMS deposits have been proposed, based on such criteria as metal constitution, tectonic setting, and hostrock composition. Most recently, a district-scale classification has been proposed that is based on the principal volcanic and/or sedimentary lithostratigraphy of the hostrock sequence (for details, see Franklin *et al.*, 2005). The specific lithostratigraphic types originally defined in this scheme were: 1) bimodal-mafic ('Noranda'-type), 2) mafic ('Cyprus'-type), 3) pelitic-mafic ('Besshi'-type), 4) bimodal-felsic ('Kuroko'-type), and 5) siliciclastic-felsic. Subsequently, Galley *et al.* (2007a) proposed the addition of a subtype to the bimodal-felsic class, termed 'hybrid bimodal-felsic', to reflect a distinct class of deposit that has characteristics of both VMS and shallow-water epithermal mineralization (*e.g.*, the Laurel Lake / Amisk Gold deposit, Saskatchewan). These lithostratigraphic types generally reflect deposition in distinct extension-related, submarine tectonic settings, including mid-ocean ridge/back-arc spreading centres (*i.e.*, ophiolitic settings), rifted oceanic arcs, rifted evolved arcs, continental back-arcs, and sedimented back-arcs (*e.g.*, Figure 3).

The massive sulphide lenses are generally 20 to 500 m in length and up to tens of metres thick. A single hydrothermal system can generate multiple 'stacked' lenses over time. A distinct metal zonation is commonly evident, within both individual sulphide lenses and deposit clusters, with a relatively Cu-rich core and Zn- and Pb-rich exterior. The lenses contain >60% sulphide minerals, dominated by pyrite, pyrrhotite, sphalerite, chalcopyrite, and/or galena, although they can also contain arsenopyrite, bornite, magnetite, cobaltite, and/or barite. The stockwork feeder zones can extend for up to 500 m beneath the deposit and contain veinlets and disseminations of chalcopyrite, pyrite, pyrrhotite, and/or magnetite. Fine-grained Fe-, Mn-, and/or base metal–enriched chert, carbonate, argillite, tuff, and other exhalite deposits, partially or completely deposited from hydrothermal fluids during periods of quiescence, commonly overlie or develop laterally away from the massive sulphides. These thin horizons are often laterally extensive and can be used as guides for exploration.

Due to their genesis within extensional tectonic regimes, VMS deposits are commonly associated with steep faults and fissure zones that originated as synvolcanic, basin-bounding normal faults. In some cases, these structures served to focus fluid circulation and discharge of mineralized fluids. The hydrothermal fluids are of high temperature (up to 300° to 400°C) and leach metals from the volcanic pile that are eventually deposited at the seafloor. These fluids interact with circulating seawater and the rocks beneath the deposit (the 'footwall' sequence), thereby causing extensive alteration around the stockwork feeder system, identification of which can be an important exploration vector towards ore. On a regional scale, alteration comprises semiconformable zones, characterized by distinct mineral assemblages (diagenetic-zeolitic, patchy carbonatization, spilitization, silicification and epidote-quartz alteration) that are controlled to some degree by the footwall lithofacies and indicate broadly increasing depths from the deposit. Alteration proximal to the stockwork zone (the 'alteration pipe') is more intense, though it is compositionally and morphologically variable between deposits depending on the dominant lithofacies assemblages of the footwall sequence, including the presence or absence of a unit acting as an 'impermeable barrier' (Figure 4). This alteration typically comprises either: 1) a strongly Fe-chloritic and variably silicified core with a sericitic and Mg-chloritic exterior, or 2) a pervasively silicified core with variable carbonate and Mg-chlorite contents and less significant Fe-chlorite contents. Due to continuation of fluid circulation after massive sulphide deposition, proximal alteration zones and minor sulphide mineralization can extend into the rocks overlying the deposit (the 'hangingwall' sequence).

An integral part of the VMS ore system is the presence of a subvolcanic intrusion (Figure 4). These intrusions are thought to have provided the primary heat source to drive the convective hydrothermal system at many VMS deposits and, in some cases, possibly also contributed metals to the system. They are typically up to 2 km wide and 15 to 25 km in total strike length, and commonly consist of numerous sills, stocks, and dyke swarms. Most commonly, they comprise gabbro-diorite-tonalite-trondhjemite complexes, although granodioritic, monzonitic, and granitic examples are known in some cases, particularly in epicontinental environments. In tectonic settings involving extension of relatively thin lithosphere, these intrusive complexes can be emplaced within the upper 2 to 3 km of the seafloor and intrude the comagmatic volcanic assemblages that host the VMS deposits. In settings involving extension of thicker crust (*e.g.*, continental back-arc), the intrusions can instead form mid-crustal intrusions at depths >5 km. Due to the close genetic association of these intrusions with the overall ore-forming system, they commonly show alteration effects and/or textures arising from the introduction of externally sourced fluids during cooling, particularly in the intrusion margin.

In extensively deformed and metamorphosed rocks, such as those characterizing much of northern Saskatchewan, VMS deposits and related alteration zones can take on significantly different characteristics than in undeformed equivalents. This can lead to both negative and positive consequences for exploration and mining of VMS deposits. Deformation can result in severe reorientation and/or structural disruption of the deposits, alteration zones, and the host volcanic complex, thereby obscuring original stratigraphic relationships and inhibiting vectoring towards mineralization. Later shears and faults often overprint synvolcanic faults, making recognition of these original ore-associated structures challenging. The rheological character of most sulphide minerals and related alteration zones makes them relatively susceptible to ductile deformation, so massive sulphide bodies themselves are often strongly sheared or elongated parallel to regional lineations. On the other hand, increased temperatures and pressures arising from metamorphism can result in recrystallization of original alteration minerals into more readily recognizable assemblages, including phlogopite, cordierite, anthophyllite, muscovite, staurolite, garnet, and aluminosilicate (Al_2SiO_5) minerals. Regional thermotectonism can also cause remobilization, recrystallization, and concentration of metals, including gold, within the deposit and can even result in remobilization and concentration of gold into veins/veinlets within or peripheral to the deposit.

Although it is not uncommon for VMS deposits to contain some gold, far fewer deposits can be considered to have elevated gold contents. Several classification schemes have been developed to facilitate recognition of these deposits, the most recent by Mercier-Langevin *et al.* (2011), who used gold grade and deposit tonnage as the defining criteria. According to this scheme, VMS deposits can be classified as 'ordinary' (gold grade <3.46 g/t; deposit <31 t Au), 'anomalous' (gold grade <3.46 g/t; deposit 31 t Au), 'auriferous' (gold grade 3.46 g/t; deposit <31 t Au), or 'gold-rich' (gold grade 3.46 g/t; deposit 31 t Au). VMS deposits that are richly mineralized with gold typically coexist with 'ordinary' deposits within individual VMS districts but often exhibit some distinct geological characteristics. These deposits form in a variety of lithotectonic settings, though the most elevated average gold grades seem to be in VMS deposits formed in mafic and bimodal-felsic volcanic sequences. They are commonly associated with transitional to calc-alkaline, intermediate to felsic volcanic complexes, possibly reflecting a more favourable geodynamic setting and/or timing for formation of this particular style of deposit. Intense acid leaching and silicification, akin to that accompanying formation of high-sulphidization epithermal gold deposits, is reflected in the alteration expression of many such deposits. This results in the formation of semiconformable to discordant zones of advanced argillic (aluminous) alteration characterized by the relative enrichment of SiO_2, Al_2O_3, and TiO_2. The gold can occur in either the stockwork zone or the massive sulphide lens (or both), or even in barite or exhalative horizons adjacent to the massive sulphide. Gold-bearing VMS deposits are commonly mineralogically complex, with bornite, tennantite, sulphosalts, arsenian pyrite, arsenopyrite, and/or mawsonite accompanying the major sulphide phases (*e.g.*, pyrite, chalcopyrite, sphalerite, pyrrhotite, and/or galena), and gold is present in native form, as electrum, or as tellurides. Important processes in the genesis of these deposits might include deposition in a shallow-water to subaerial volcanic setting (similar to high-sulphidization epithermal conditions) in which boiling could influence fluid chemistry and possible fluid and/or metal input from the subvolcanic intrusion(s).

Global Examples: Horne (Quebec, Canada); La Ronde Penna (Quebec, Canada); Boliden (Sweden); Lalor (Manitoba, Canada); Mount Lyell (Tasmania, Australia); Caribou (New Brunswick, Canada); Mount Morgan (Queensland, Australia); and Eskay Creek (British Columbia, Canada)

Saskatchewan Examples: Flin Flon, Laurel Lake (Amisk Gold), McIlvenna Bay, Konuto Lake, and Anglo-Rouyn

A small number of gold occurrences in Saskatchewan exhibit mineralization styles outside those described in the two preceding models. These other mineralization styles are listed below, along with the most relevant Saskatchewan Descriptive Mineral Deposit (SDMD) model; Rogers, 2011) and some possible examples of relevant gold showings in Saskatchewan:

- Epithermal gold (SDMD Model A-10; the Laurel Lake (Amisk Gold) deposit has affinities with this mineralization style)
- Disseminated sediment-hosted gold-sulphide (included in SDMD Model A-9; see also 'atypical' greenstone-hosted deposits of Robert *et al.*, 2007; *e.g.*, Greywacke deposit)
- Gold in calc-alkaline porphyry intrusions (SDMD Model A-11; *e.g.*, Phantom Lake historical mine)
- Beaverlodge ('complex')-type uranium ± polymetallic gold (SDMD Model A-2; *e.g.*, ?Nicholson Bay uranium mine)
- Unconformity-associated uranium ± polymetallic gold (SDMD Model A-1; *e.g.*, Cluff Lake D zone)
- Placer and paleoplacer gold (SDMD Model A-7; *e.g.*, North Saskatchewan River, Simmie, and Ennis Lake anomaly)

Chapter 3 – Phanerozoic Sedimentary Basin, Southern Saskatchewan

Geology of the Phanerozoic Basin

Southern Saskatchewan is underlain by a sequence of Cambrian through Tertiary sedimentary strata and overlying Quaternary glacial deposits. These sedimentary deposits rest unconformably upon Precambrian crystalline basement at depth and form a wedge, with several internal unconformities, that tapers towards the north. Apart from the Quaternary glacial deposits, these strata form part of the Western Canada Sedimentary Basin, which extends eastward from the Rocky Mountains to southwestern Manitoba. The Saskatchewan portion of the basin (Figure 5) constitutes two distinct depositional-tectonic sequences: 1) a Cambrian to Middle Jurassic passive continental margin phase, comprising basal clastic sedimentary rocks and a thick overlying sequence of platform carbonates and evaporates; and 2) a Middle Jurassic to Eocene convergent margin phase, which resulted in establishment of a foreland basin involving the deposition of a thick sequence of clastic sediments sourced predominantly from the evolving Cordilleran mountain belt to the west. A more detailed description of individual units of the basin and a stratigraphic correlation chart for southern Saskatchewan are provided by the Saskatchewan Geological Survey (2003) and Saskatchewan Ministry of Energy and Resources (2011), respectively.

Most of the constituent units of the Western Canada Sedimentary Basin in Saskatchewan are not exposed at surface due to coverage by laterally extensive Quaternary glacial and postglacial landforms (Saskatchewan Geological Survey, 2003). Glacial deposits in southern Saskatchewan, deposited primarily as a result of the Late Wisconsinan event, commonly have a cumulative thickness of 100 to 200 m, though they can locally can range from zero (exposed bedrock) to 300 m in thickness (Millard *et al.*, 1989). In southern Saskatchewan, only the Cypress Hills and Wood Mountain areas (Figure 5) were not covered by ice during this glaciation. The Quaternary stratigraphy in southern Saskatchewan has been defined to consist of several different subunits (see Christiansen, 1992), comprising either till or stratified glaciofluvial and/or glaciolacustrine sediment. Postglacial features include eolian landforms (*e.g.*, sand dunes), bogs and fens, and sediment reworked by modern rivers (*e.g.*, the Saskatchewan River).

Showing Descriptions

Simmie (SMDI # not available)

Location: ~4 km west of Simmie (NTS 72F/16; approx. UTM[1] 5537980 m N, 273450 m E)

Metal Associations: Au

Status: occurrence

Exploration and Development History:
The discovery of the Simmie gold showing was a result of a regional (64 000 km^2) geochemical survey undertaken in 1990 in southwestern Saskatchewan by the Saskatchewan Research Council (SRC) and Cameco Corp. Heavy mineral concentrates were obtained from the sub–5 mm fraction of 25 kg samples of bedrock and glacial/fluvioglacial sand and gravel, which were collected at a density of about one sample per 300 km^2. Although the survey was designed for the recovery of kimberlite indicator minerals, gold grains were also separated during sample processing. Results from the program (Simpson, 1991) included an anomalously high gold value (468 grains of gold) from a bedrock sample taken in a small quarry located ~4 km west of the village of Simmie. Neither SRC nor Cameco performed follow-up work on the anomaly.

After optioning the property from Lemar Resources Ltd. in 1997, Consolidated Pine Channel Gold Corp. took four bulk samples of 22 kg each at the Simmie quarry, which again indicated favourable gold grain counts (686 to 1554 grains/sample; Beck, 2004). During 1996 and 1997, geological mapping, measuring of geological sections, gold panning, and channel sampling were performed at the quarry. Further prospecting, geological mapping, and sampling were also carried out in the surrounding area, including within tributary valleys connected to the Swift Current Creek valley. Several additional anomalous gold values were detected as a result of this work. It was

[1] UTM co-ordinates are from Zone 13, NAD 83 and are approximate.

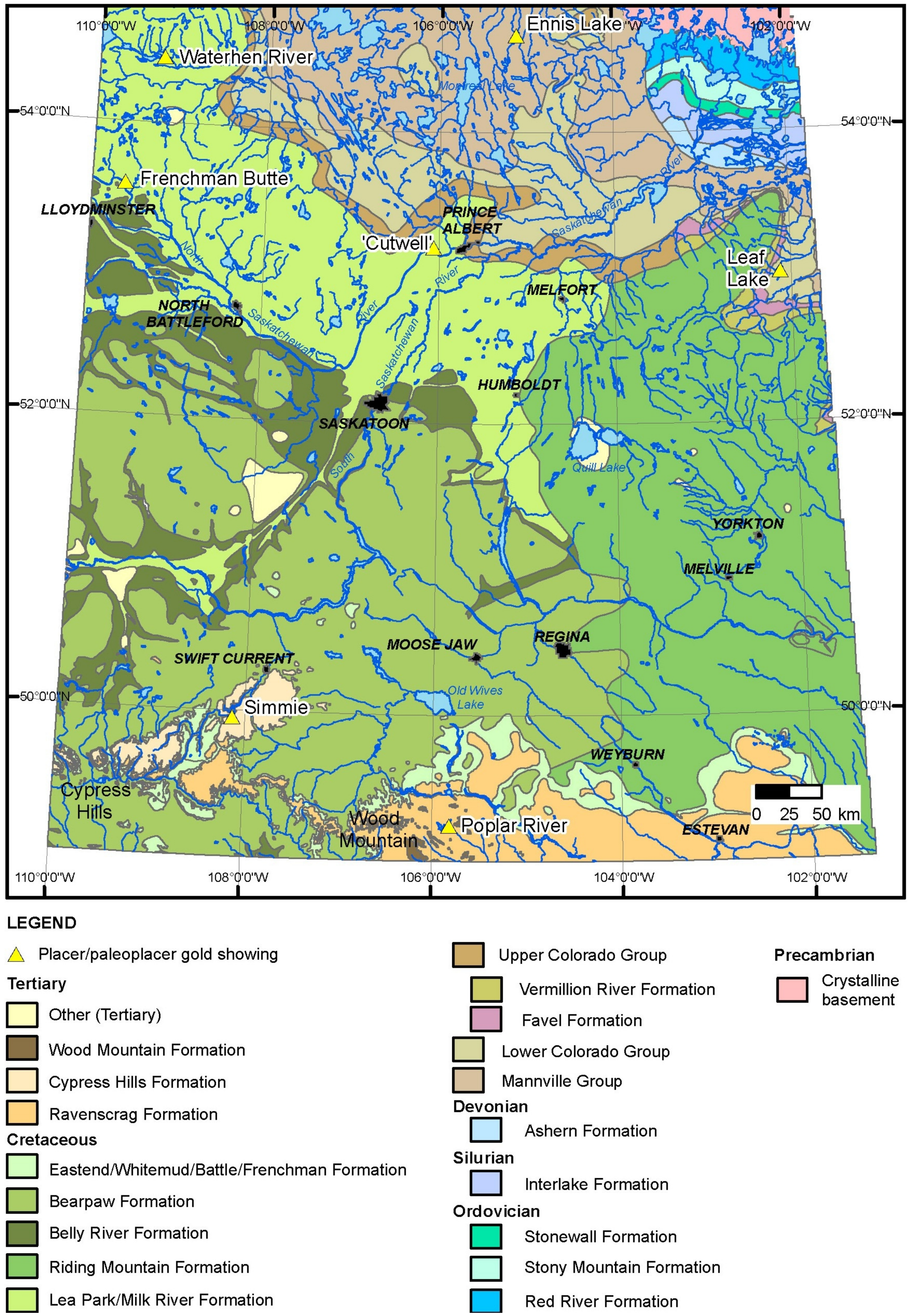

Figure 5 – Bedrock (preglacial) geological map of southern Saskatchewan, showing locations of known placer/paleoplacer gold showings.

concluded that, although the gold was widely distributed throughout the geological section, it was focussed in the 'lower conglomerate' bed (132 to 258 ppb Au over 8 m vertical thickness, 150 m lateral distance; Saskatchewan Ministry of Energy and Resources (SMER) Assessment File 72F16-0001). Although additional claims were staked over the anomalous zones, no additional work was done and, in 1999, Consolidated Pine Channel allowed the claims to lapse and dropped their option on the property.

The Simmie showing and surrounding area were restaked in January 2001 and November 2003 by Claude Resources Inc. In 2004, Claude performed a reconnaissance prospecting program at and around the Simmie property, which included both surface sampling and pit excavation and sampling. Gold contents of the samples were determined by fire assaying or gravimetric screening of the samples directly, gold grain counting, and fire assay on heavy mineral concentrates. Anomalous gold values (*i.e.*, >10 ppb Au regional background) were detected in most samples, with the highest value (184 ppb) coming from a 4 to 6 m thick conglomerate bed. Claude subsequently allowed the dispositions in the Simmie area to lapse.

The remaining disposition on the property, held by Lemar, was also subsequently allowed to lapse. In 2008, a group of five small mineral dispositions covering the Simmie showing and the immediate surrounding area was staked by L.S. Beck.

Geological Character:

The Simmie showing is hosted by Upper Miocene to Eocene, largely unconsolidated fluviatile deposits of the Cypress Hills Formation (Beck, 2004). The formation lies on a gently eastward-dipping erosional surface and has a maximum thickness of 76 m and an average thickness of 38 m (Vonhof, 1969). In southwestern Saskatchewan, the Cypress Hills Formation can be generally grouped into two large, plateau-like outcroppings: the eastern and western 'blocks' (Beck, 2004; Figure 6). The western block consists mainly of coarse-grained deposits, including imbricate and cross-stratified, well-rounded pebble to boulder gravels and planar-tabular, cross-stratified coarse sands that were deposited in a major channel system (Leckie and Cheel, 1989). There is a general eastward decrease in dominant grain size, with the eastern block characterized by finer grained sedimentary rocks deposited in small channels and interchannel areas that contained intermittent lakes and mudflats (Beck, 2004). To date, anomalous gold values have been detected only in the eastern block. Beck (2004) speculated that the eastward overall decrease in sediment grain size in the Cypress Hills Formation, which reflects a decrease in the energy level of the rivers, can explain the observed distribution of detrital gold. According to this interpretation, the decreased capacity for the rivers to hold gold in suspension resulted in the settling of gold in the more easterly portion of the fluvial system.

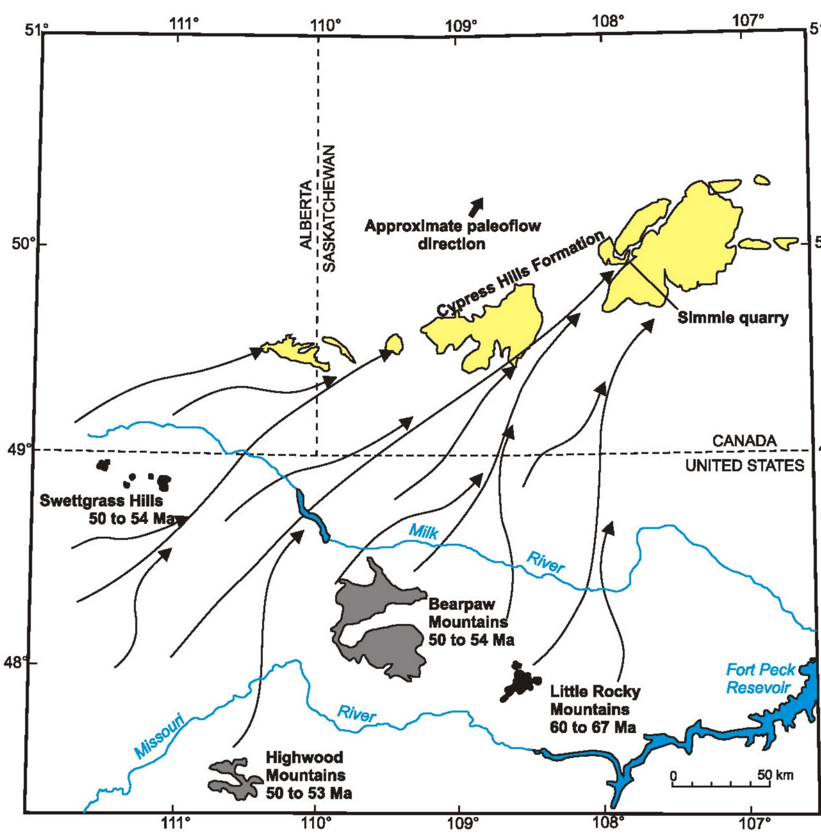

Figure 6 – Paleogeography of the Cypress Hills Formation (modified from Beck, 2004).

The type section at the Simmie quarry comprises a 25 to 35 m thick sequence of poorly consolidated Cypress Hills Formation that includes: 1) a 3 to 4 m thick exposure of basal conglomerate ('lower conglomerate') that might extend another 15 to 20 m below surface; 2) a 1 m bed of fine crossbedded sand; and 3) a 1 to 1.5 m conglomerate layer ('upper conglomerate'; SMER Assessment File 72F16-0001). An additional thin layer of fine crossbedded sand and an overlying, 0.5 m thick conglomerate layer are identified at the southern extent of the quarry. The conglomerates consist of well-rounded chert and quartzite cobbles and boulders in a sandy to pebbly matrix. Sampling to date has shown that the best gold grain yields come from the sandy matrix of the lower conglomerate, but that anomalous gold contents are generally evenly distributed throughout the section. Morphologically, detrital gold grains in the Simmie showing exhibit roughly equal proportions of irregular (local source) and abraded (distant source) grains, with an average grain size of 100 to 200 m (Beck, 2004). The largest identified gold grain was 200 by 580 m. Craw *et al.* (2005) reported that the majority of samples of the host sediment yield gold values that are near or below detection limits.

Sedimentological and paleocurrent analysis suggests that the Cypress Hills Formation was deposited by a north- to northeast-flowing braided-river system on a braidplain (Leckie and Cheel, 1989). The sediment is believed to derive from unroofing of one or more isolated mountainous regions in northern Montana, including the Bearpaw Mountains, Highwood Mountains, Little Rocky Mountains, and/or Sweetgrass Hills (Figure 6; Beck, 2004). Low-grade hydrothermal gold deposits associated with alkalic intrusions, which caused the uplift of the mountains in the Eocene, are localized throughout this potential source region (Craw *et al.*, 2005).

Inferred Deposit Type: paleoplacer gold

Associated Showings: Ennis Lake (paleoplacer gold in Cambrian Deadwood Formation; SMDI #1148)

Production and Reserves/Resources/Historical Data: none

North Saskatchewan River (SMDI # not available)

Location: south-central Saskatchewan, extending from the Alberta border north of Lloydminster to Prince Albert

Metal Associations: Au

Status: not applicable

Exploration and Development History:

Interest in placer gold from the North Saskatchewan River dates back to as early as 1862 and was originally centred on an area near Edmonton, Alberta. By the early 1900s, fine placer gold had been discovered and was being panned near the Battlefords and as far east as Prince Albert. Since its discovery, minor quantities of gold have been recovered from river gravels by panning and sluicing, though focussed gold recovery efforts using large dredges have also been attempted. Between 1905 and 1909, small-scale placer mining of river gravel was being undertaken by the International Gold Dredging Company Ltd. This operation, located near the village of 'Cutwell'[2], about 32 km east of Prince Albert (Figure 5), utilized a refurbished steam dredge (Figure 7) but met with little success (Kupsch and Hanson, 1986). Other short-lived placer mining operations that yielded minor gold were established along the river near Frenchman Butte in 1939, and at an undisclosed location in the late 1940s (Saskatchewan Geological Survey, 2003; Table 1).

Figure 7 – Steam dredge used by the International Gold Dredging Company Ltd. for extraction of placer gold from the North Saskatchewan River near 'Cutwell' (photo courtesy of the Saskatchewan Archives Board, record R-A5761(1)).

Geological Character:

The North Saskatchewan River originates in the Rocky Mountains, near Rocky Mountain House, Alberta, from alpine glacial meltwater. From here it flows eastwards and eventually connects with the South Saskatchewan River about 30 km east of Prince Albert, eventually emptying into Lake Winnipeg in Manitoba. Placer gold

[2] Any unofficial or informal name, whether geographical or geological, will appear in single quotation marks when first mentioned. The quotation marks will be subsequently dropped.

has been recovered from the North Saskatchewan River along an area extending from its western source to as far east as Prince Albert.

Placer gold in the river occurs primarily in well-sorted gravels. The gold grain size diminishes eastwards owing to increased transport distances and an associated decrease in stream energy, and is typically of 'flour-like' consistency in the Prince Albert area. Not surprisingly, this very fine grain size has greatly inhibited historical gold recovery efforts from this part of the river system (Kupsch and Hanson, 1986). The ultimate source of placer gold in the North Saskatchewan River is unknown, though it is likely derived from a bedrock-hosted gold deposit(s) in the Rocky Mountains that has been eroded by the river.

Inferred Deposit Type: placer gold

Associated Showings: Although geographically separate from the North Saskatchewan River, the Poplar River, Leaf Lake, and the Waterhen River are also known to contain placer gold (no SMDI #; see Coombe (1984) and Figure 5).

Production and Reserves/Resources: Though not considered to hold a significant gold resource, there was minor placer gold production from the North Saskatchewan River in Saskatchewan in the early- to mid-1900s (Table 1).

Gold Metallogenesis

Gold showings associated with Phanerozoic rocks and/or sediments are scattered throughout southern Saskatchewan and reflect distinct processes that were widely spaced in time. Detrital gold in Paleozoic through Early Cenozoic strata reflects paleoplacer accumulations deposited by ancient river systems. Known showings of this type indicate that such accumulations could have been formed by: 1) localized erosion and resedimentation (and possible subsequent hydrothermal remobilization?) of Precambrian basement rocks in basal Cambrian conglomerates (*i.e.*, Deadwood Formation) on the western margin of the North American proto-continent (*e.g.*, Ennis Lake showing; SMDI #1148), or 2) erosion of distal mountain belts in response to Mesozoic to Cenozoic orogenesis (*e.g.*, Laramide) to the west/southwest, and subsequent deposition in the eastern foreland basin. The Cenozoic Simmie showing, for example, was probably sourced from minor hydrothermal gold-bearing vein deposits associated with *ca.* 50 Ma alkaline intrusions in northern Montana (Beck, 2004), which locally caused doming of overlying Paleozoic rocks. In the view of Craw *et al.* (2005), occurrences of this type are unlikely to yield economic concentrations of gold due to the paucity of significant gold sources and the inefficiency of sediment recycling processes during filling of the foreland basin. Such occurrences are, however, conducive to gold panning and/or small-scale sluicing operations when the gold grains are sufficiently coarse.

Another form of fluvial placer gold mineralization occurs in modern-day (postglacial) river systems, the most notable example in southern Saskatchewan being placer gold in the North Saskatchewan River. Gold in the modern rivers is probably sourced in the Rocky Mountains to the west, from where it is transported downstream (eastwards) through Alberta and into central Saskatchewan. Beyond Prince Albert, the detrital gold becomes of exceedingly fine grain size, thereby making recovery difficult.

Chapter 4 – Rae Province

Geology of the Rae Province

The Rae Province of northern Saskatchewan constitutes that part of the Precambrian shield located west of the Virgin River and Black Lake shear zones (‘Snowbird tectonic zone’; Figure 1) and, although largely obscured by unconformably overlying, unmetamorphosed sedimentary rocks of the Athabasca Basin, it is exposed in two general areas. South of the basin, the Rae Province comprises dominantly *ca.* 2.0 to 1.9 Ga plutonic[1] rocks of the Taltson magmatic zone, along with remnants of the 3.2 to 2.1 Ga Taltson basement gneissic complex (McNicoll *et al.*, 2000) and vestiges of mixed sedimentary rocks of unknown age (‘Careen Lake group’; Scott 1985). Rocks of the Rae Province south of the Athabasca Basin are not known to contain gold showings. The northern extension of the Taltson rocks is also exposed north of the basin on the northern shore of Lake Athabasca. To the east, rocks of the Rae Province that are north of the Athabasca Basin consist dominantly of felsic orthogneiss basement, granitoid intrusions, and subordinate supracrustal belts, and have been subdivided into the Zemlak, Nolan, Beaverlodge, Train, Dodge, and Tantato domains (Figure 8 inset map). Although a single quartz vein–associated gold showing is known in the easternmost Zemlak Domain (Neeley Lake showing, SMDI #1281), significant gold mineralization is known only in the Beaverlodge and Tantato domains. Additionally, gold accompanying unconformity-associated uranium mineralization is known to underlie the Carswell structure (Figure 1) in an inlier of Rae Province basement within the Athabasca Basin.

Known gold showings in the Beaverlodge Domain are clustered near its southwestern margin, less than 20 km southeast of Uranium City. Here, the domain is underlain by basement rocks consisting of *ca.* 3.0 Ga granite-tonalite and derived gneiss, as well as unconformably overlying supracrustal rocks of the Murmac Bay group, and intrusive rocks of varying ages (Figure 9). Deposition of the Murmac Bay group probably began at about 2.32 Ga and lasted until sometime between 2.17 and 1.93 Ga (Ashton *et al.*, 2009a). It consists of basal polymictic conglomerate and overlying quartzite, psammite, psammopelite, and pelite, as well as mafic volcanic rocks and co-magmatic gabbro (Hartlaub, 1999). Subordinate marble, ultramafic intrusive rocks, and oxide-facies banded iron formation are also present within the sequence. Distinctive felsic plutonic suites intruded the basement granitoid rocks and/or the Murmac Bay group at *ca.* 2.6 Ga (*e.g.*, Dead Man granite; Hartlaub *et al.*, 2004) and at *ca.* 2.3 Ga (*e.g.*, Gunnar and Mackintosh Bay monzogranites (Hartlaub *et al.*, 2007), Athona leucogranite (O’Hanley *et al.*, 1994)), as well as a suite of low-temperature anatectic leucogranite melts at *ca.* 1.97 to 1.93 Ga (Hartlaub *et al.*, 2005). Collectively, these rocks are unconformably overlain by the *ca.* 1.82 Ga Martin group, comprising areally restricted exposures of interbedded continental redbed siliciclastic and mafic volcanic rocks. Just to the south, flat-lying, *ca.* 1750 to 1500 Ma, undeformed, clastic sedimentary rocks of the Athabasca Basin unconformably overlie all other Precambrian rocks (Figure 1).

Rocks in the Beaverlodge Domain have been subjected to a complex thermotectonic history that includes multiple phases of deformation and metamorphism. A model for the history and timing of this thermotectonism was presented by Ashton *et al.* (2009a). Although an early thermal event related to the ‘Arrowsmith orogen’ is inferred at *ca.* 2.3 Ga, no distinct fabrics have been attributed to this event. The earliest recognized deformational event that resulted in foliation development (S_1) is of unknown timing. This early fabric was reoriented and transposed during subsequent (D_2) deformation, resulting in tight to isoclinal folding, widespread mylonitization, and generation of the east-southeast–trending, composite (S_1/S_2) regional foliation. This deformation affects the *ca.* 1.97 to 1.93 Ga leucogranites, providing a maximum age for fabric development. Both leucogranite emplacement (from anatectic melts) and the D_2 deformational event are thought to be related to 1.94 to 1.92 Ga metamorphism in the Taltson magmatic zone to the west (*op. cit.*).

According to the structural model of Ashton *et al.* (2009a), the D_1/D_2 structures were overprinted during a later deformational event (D_3) that resulted in a prominent and widespread, northeast-trending structural fabric. This event caused tight to isoclinal folding and development of mylonite zones (*e.g.*, Black Bay and Grease River straight belts) that parallel the Snowbird tectonic zone to the east (Figure 8). An alternative interpretation views the D_3 structures as resulting from dextral transpression (Kraus and Ashton, 2000). The D_3 event is thought to coincide temporally with development of peak metamorphic conditions in the western Beaverlodge Domain. Known gold showings cluster in an isolated parcel of greenschist to lower amphibolite facies rocks that yielded a *ca.* 1.91 Ga U-Pb titanite age, which is interpreted as the age of this deformational/metamorphic event (Ashton *et al.*, 2009a).

[1] Apart from the Athabasca Group and minor late- to post-tectonic intrusions, all rocks of the Precambrian shield in Saskatchewan have been metamorphosed; the prefix ‘meta’ is therefore omitted from unit descriptions throughout this report.

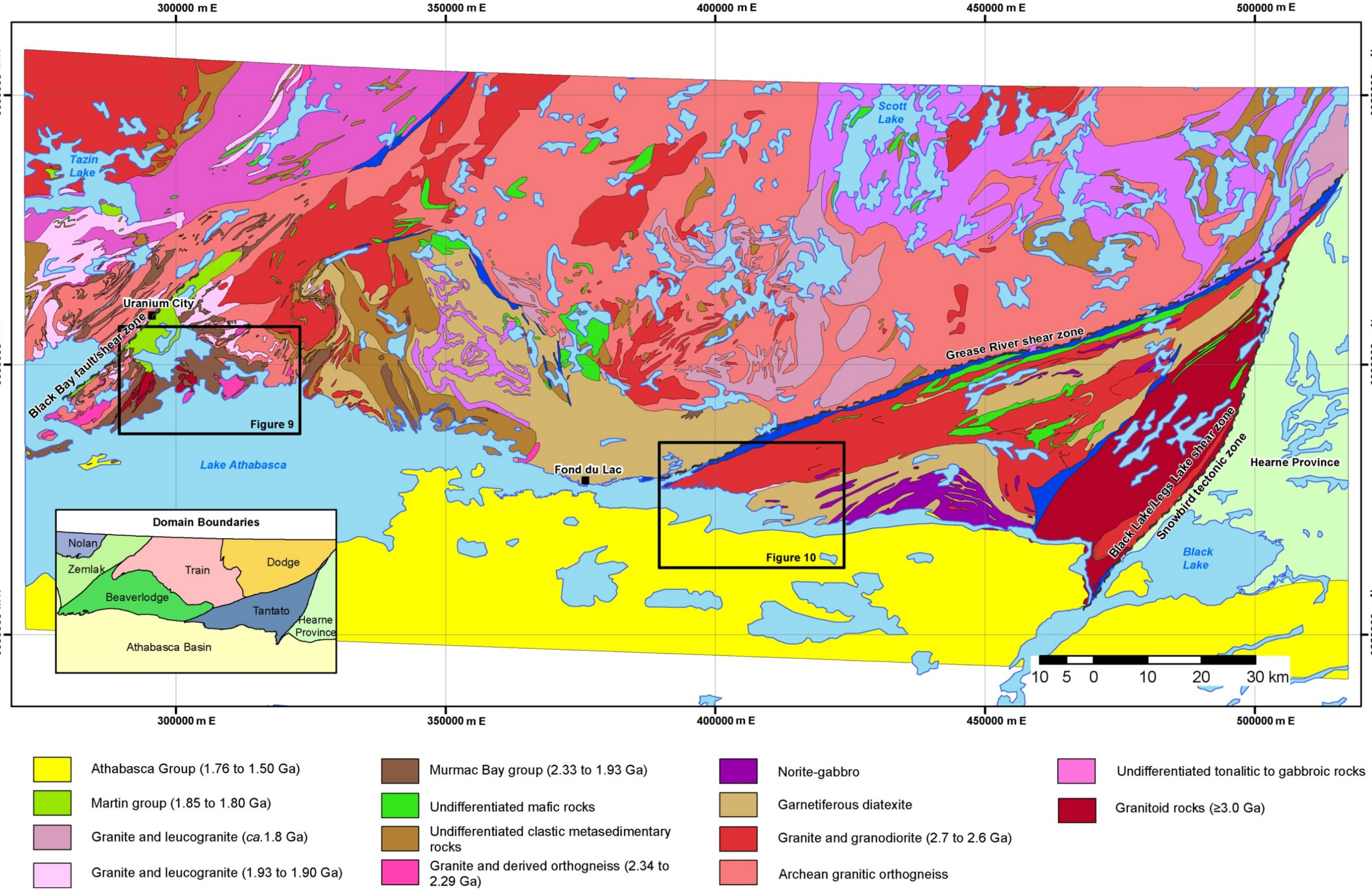

Figure 8 – Generalized geology of the northern Rae Province in Saskatchewan (modified from Slimmon, 2011).

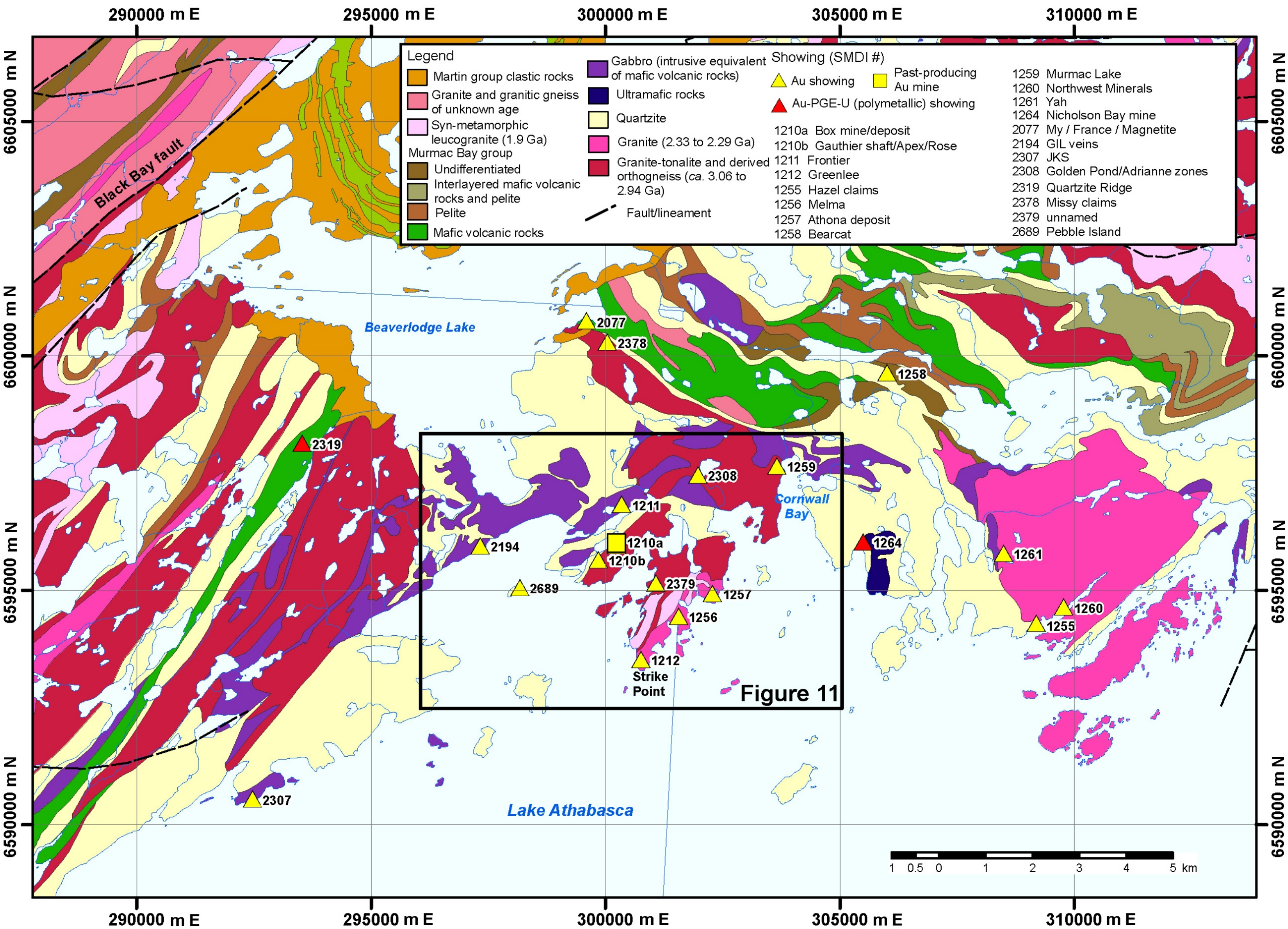

Figure 9 – Geological character of the western Beaverlodge Domain and locations of known orogenic gold and polymetallic U-Au-PGE (platinum group element) showings (refer to Appendix 1 for individual showing names; figure modified from Ashton, 2009).

Subsequent deformation is attributed to a protracted D_4 event. This deformation was ongoing prior to and throughout deposition of the *ca.* 1820 Ma Martin group, subsequently producing gentle north-trending regional folds, one of which deforms the Martin group itself. This close temporal relationship with the Martin group indicates a *ca.* 1820 Ma timing for the D_4 event, contemporaneous with the Trans-Hudson orogeny to the east. Subsequent brittle, normal displacement along the Black Bay fault might have facilitated preservation of higher-crustal-level rocks to the east, including the unmetamorphosed Martin group and the anomalously low-grade parcel that hosts the known gold showings (Ashton *et al.*, 2001).

To the east, the Tantato Domain is underlain mainly by Meso- to Neoarchean orthogneiss and granitoid rocks, along with garnetiferous diatexite and mafic rocks of unknown age. Almost all rocks of the domain have been subjected to multiple episodes of high-pressure granulite facies metamorphism, as well as widespread mylonitization. The northwestern boundary of the domain, shared with the Beaverlodge, Train, and Dodge domains, is defined by the Grease River shear zone (Figure 8). The Black Lake (or Legs Lake) shear zone, part of the Snowbird tectonic zone, defines the eastern domain boundary, along which are juxtaposed rocks of the westernmost Hearne Province.

Known gold showings are concentrated mainly in the Pine Channel area in the westernmost part of the Tantato Domain (Figure 10), ~35 km east of the community of Fond-du-Lac. This area is underlain mainly by: 1) variably mylonitic garnet quartzofeldspathic gneiss, and 2) variably mylonitic interlayers of garnet-clinopyroxene mafic gneiss that is locally associated with Fe-rich rocks and quartz-rich rocks of uncertain derivation. This sequence, referred to as the Pine Channel assemblage, has been interpreted by some to represent a clastic sedimentary basin with associated mafic volcanic rocks and synvolcanic intrusions (Slimmon and Macdonald, 1987).

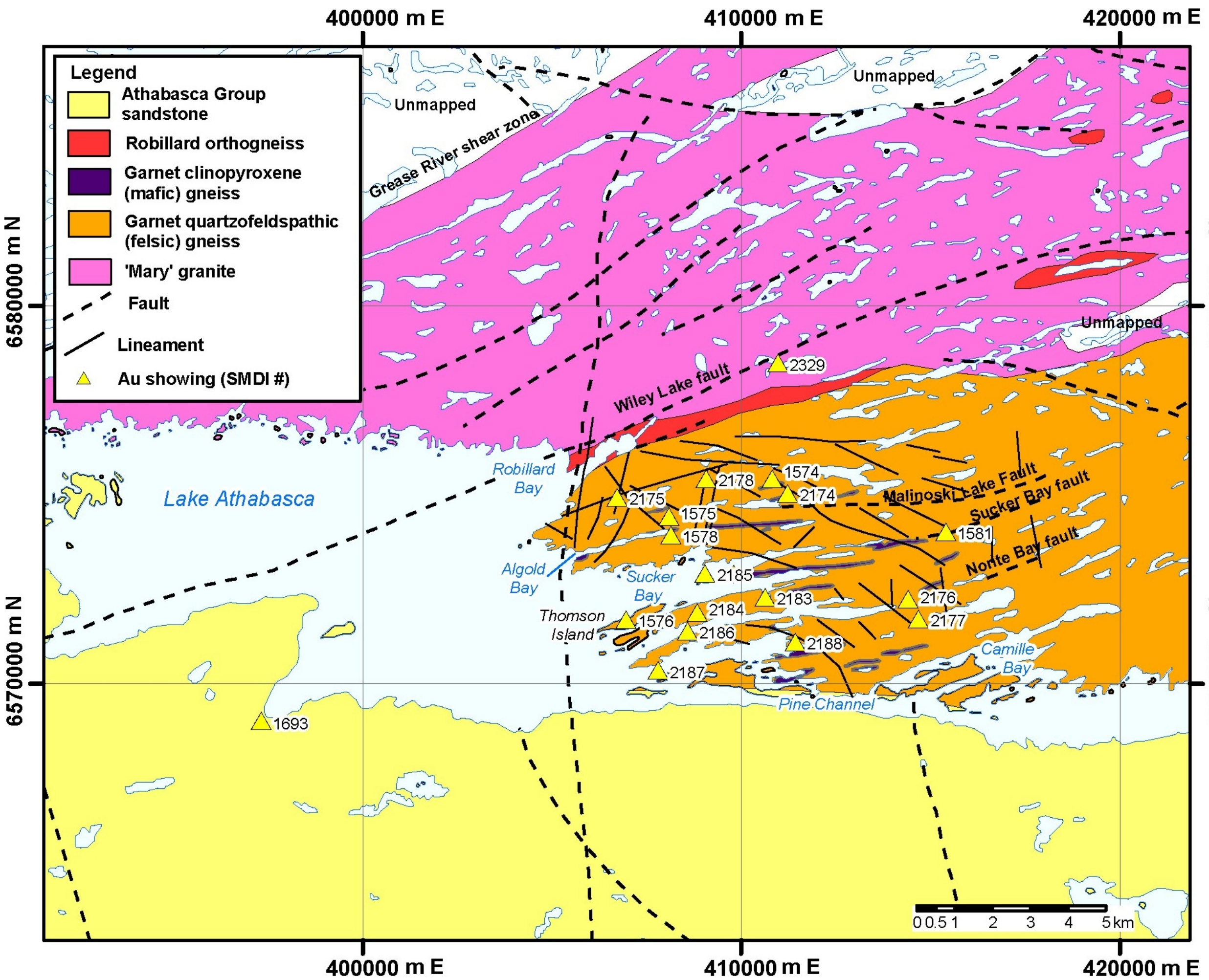

Figure 10 – Locations and generalized geological context of the Pine Channel gold showings, Tantato Domain (after Slimmon and MacDonald, 1987).

The main regional fabric in the Tantato Domain consists of a composite S_1/S_2 foliation/gneissosity, possibly of Paleoproterozoic age (Ashton *et al.*, 2007). In the Pine Channel area, it is dominantly east to east-northeast trending, steeply south dipping, and associated with a shallowly southwest-plunging stretching lineation. Granulite facies peak metamorphism, evidenced by hypersthene in both the felsic and mafic gneisses (Slimmon and Macdonald, 1987), prevailed during this early deformation (Baldwin *et al.*, 2003). Subsequent deformation caused reorientation of this fabric into outcrop-scale isoclinal folds and, regionally, into a major, open, shallowly southwest-plunging synform, the western limb of which extends into the Pine Channel area (Slimmon and Macdonald, 1987). The Grease River shear zone, at the western domain boundary, is a wide, northeast-striking, steeply northwest-dipping mylonite zone. The ductile shear fabric overprints the earlier composite fabric, exhibits dextral kinematic indicators, and is associated with greenschist to amphibolite facies retrograde metamorphism (Lafrance and Sibbald, 1997). Although previously interpreted to represent a major Neoarchean structure (Hanmer *et al.*, 1994), recent re-evaluations (Lafrance and Sibbald, 1997; Williams and Jercinovic, 2002) have indicated that the Grease River shear zone was active mainly during the Paleoproterozoic (*ca.* 1920 to 1800 Ma; Dumond *et al.*, 2008).

A series of gneissosity-parallel, commonly graphitic faults transects the Pine Channel area (*e.g.*, Sucker Bay, Malinoski Lake, and Norite Bay faults; Figure 10) and commonly manifests only as topographic lineaments. Lafrance (1997) interpreted these as minor, relatively late faults that were superimposed on pre-existing graphitic zones during a period of north- to northwest-directed shortening, sometime after movement along the Grease River shear zone. Northwest- and north-trending faults/fractures in the area, which have a close spatial association with the gold showings, were interpreted as conjugate structures that underwent minor transcurrent movement during this event.

Showing Descriptions

Beaverlodge Domain

Box Mine/Deposit (SMDI #1210a)

Location: on Box Point on the north shore of Lake Athabasca, ~15 km southeast of Uranium City (NTS 74N/07; UTM 6595762 m N, 300285 m E)

Metal Associations: Au (Ag, Zn, Pb, Cu, Mo)

Status: past-producing mine with Reserves

Exploration and Development History:
Gold mineralization in the vicinity of the Box deposit was originally discovered by prospectors T. Box and G. Nyman in 1934. The Box property (‘VIC’) group of claims was staked for the Consolidated Mining and Smelting Company of Canada Ltd. (later Cominco Ltd.) later that year. At about the same time, the Athona deposit was discovered by Athona Mines Ltd. approximately 2 km southeast of the Box deposit (see ‘Athona’ showing). By the end of 1935, two inclined shafts had been completed on the Box property. The No. 1 shaft was developed for exploration in the footwall toward the west end of the orebody and the No. 2 shaft was sunk for production at the east end of the orebody. Underground development included 4892 m of drifting and crosscutting on the 30, 91, and 152 m levels (Bikerman Engineering & Technology Associates Inc., 2009). Further diamond drilling and underground work extended the deposit to the 300 m level. Following initial stope development in mid-1938, the grade of the mined ore proved significantly lower than reserve grade estimates; as a result, additional underground drilling was undertaken. The revised reserve grade provided sufficient encouragement to uphold the production decision and a 1400 tons/day mill began operation in June 1939. The first gold brick was poured on August 15th of that year. After nearly three years of mining (Table 1), operations ceased in May of 1942 due to lower-than-expected grades, mounting costs, and a labour shortage resulting from World War II (Kupsch and Hanson, 1986). Operations never resumed and, in 1976, both the headframes and the mill were dismantled.

Exploration activity was renewed in the area in 1987-89, when a consortium of Kasner Group companies (Greater Lenora Resources Corp.) acquired and re-evaluated the Box mine and adjacent Athona properties. An extensive drilling and surface bulk sampling program ensued and, in 1990, new geological reserves were announced for a potential 265 m deep open pit on the site of the Box mine. A revised reserve estimate was subsequently reported in 1995 as part of a feasibility study. Yet another assessment of ore reserves was provided in 1997 by Behre Dolbear and Co. Ltd. The Goldfields Operating Co. Ltd. was formed in 1999 as an equal-share joint-venture partnership between Greater Lenora, Cantera Mining Ltd., and Tormin Resources Ltd., and it was announced that small-scale development would proceed, with the goal of eventual production. An agreement was reached with Can Am Construction Inc. of La Ronge in July 2000 to construct and operate the Box mine. Metallurgical tests in 2001 indicated that suitable gold recoveries could be achieved solely through gravity separation. In July 2001, GLR Resources Inc. acquired all assets of Greater Lenora Resources Corp. and, in May 2002, GLR Resources Inc. tabled conditional approval for production at the Box mine, given a gold price of greater than $300 and annual production of 1200 kg (40,000 oz.) of gold averaged over a minimum 10-year mine life. The proposed mining did not, however, take place at this time.

A drill program was undertaken in 2004-05 to verify the results of historical Cominco drilling, the core from which was no longer available for inspection or sampling. In 2007-08, GLR undertook another drilling program to further define reserves/resources at the Box deposit, bringing the cumulative total to more than 435 holes drilled on the property. In May 2008, GLR released a revised Technical Report outlining a mining plan for the deposit. Mining was to be undertaken using open-pit methods and was to yield an average of 1.8 million tonnes (Mt) of ore per year for a proposed mine life of six years. The plan also noted that the addition of ore from the Athona deposit could extend the life of the Goldfields mining operation by three years. GLR announced in May 2009, however, that it had signed an agreement to sell the Goldfields property, including the Box and Athona deposits, to Linear Gold Corp. Linear revised the existing scoping study and undertook an exploration program that included drilling (3000 m) and deep-penetrating geophysical (IP and resistivity) surveys to test known regional targets, identify new mineralized zones, and test for mineralization beneath the proposed Box open pit. In 2010, Linear merged with Apollo Gold Corp. to form a new company, Brigus Gold Corp., which assumed ownership of the Goldfields property. Brigus received provincial approval of an Environmental Impact Statement for the project and continued with drilling of the Box deposit in 2010 (12 holes, 1333 m). These drill results were incorporated into a new Resource model for the deposit (Table 2), released as part of a new Pre-Feasibility Study on the Goldfields project in 2011. The report concluded viability for the project, which includes mining of both the Box and Athona deposits over a 13-year mine life with average annual production of about 100,000 oz. Brigus continued with exploration and definition drilling, confirmatory metallurgical sampling, and geotechnical investigations at the Goldfields property in 2011. An updated Ore Reserve estimate was reported as part of a Pre-Feasibility Study in 2011 (Table 2), and a decision on the development of the Goldfields project was pending as of January 1, 2012.

Geological Character:

The Box deposit is hosted by an elongate, northeast-striking leucogranitic lens known as the Box leucogranite (Figure 11). This leucogranite yielded a poorly defined U-Pb zircon crystallization age of 1994 ±37 Ma (Persons, 1983) and probably belongs to the suite of low-temperature, anatexis-derived leucogranites that were emplaced throughout the Beaverlodge Domain at *ca.* 1974 to 1933 Ma (Hartlaub *et al.*, 2005). This leucogranite is rusty weathering, pink to red on fresh surface, medium grained, and equigranular (Sibbald, 1984). It was intruded into sericite-rich schist, which was previously interpreted as having a sedimentary protolith (*e.g.*, Appleyard, 1989), possibly having undergone metasomatic 'granitization' (Sibbald, 1984). This schist has, however, recently been reinterpreted as sheared granitic basement (*ca.* 3.0 Ga; Ashton, 2009) and/or as saprolite at the unconformity between granitic basement and the unconformably overlying Murmac Bay group (K. Ashton, pers. comm., 2010). An implication of the latter scenario, if accurate, is that the Box leucogranite and the Box deposit are situated along this unconformity. The leucogranite is thought to have been derived from partial melting of underlying supracrustal rocks of the Murmac Bay group (Appleyard, 1990) and/or the older granite host (Ashton *et al.*, 2000). Hostrocks to the deposit were metamorphosed under lower amphibolite facies conditions (Ashton, 2009).

The Box property lies on the western limb of a major open synclinal structure, the 'Athona syncline' (Figure 11), which folds the host Box leucogranite (Roberts, 1990). This fold is a north-northeast–trending, upright, shallowly south-plunging synform and is accompanied by parasitic folds and a subvertical axial-planar foliation (*op.cit.*), as well as a mineral 'rodding' lineation (Sibbald, 1984). Gold mineralization at the Box deposit is hosted by a stockwork of mutually crosscutting, undeformed quartz veins within the host Box leucogranite (Figure 12). The veins range in width from 8 to 25 cm and are generally restricted to the host leucogranite, though they increase in abundance adjacent to the contact with the basement rock. In a detailed structural study of the deposit, Roberts (1990) defined three distinct vein 'groups' at the deposit. Group 1 veins and associated shears, having an average orientation of 042°/34°E, parallel lithological contacts and the regional foliation, and are present in both the Box leucogranite and the rocks it intrudes. The relationship between group 1 veins/shears and gold mineralization is unknown. Group 2 veins transect group 1 veins, though veins from both groups are observed to pass into each other in some instances. The group 2 veins are gold bearing and are of several mutually crosscutting orientations at the Box deposit (034°/68°W, 076°/62°N, 169°/78°W, 099°/76°N); those with an average orientation of 169°/78°W are

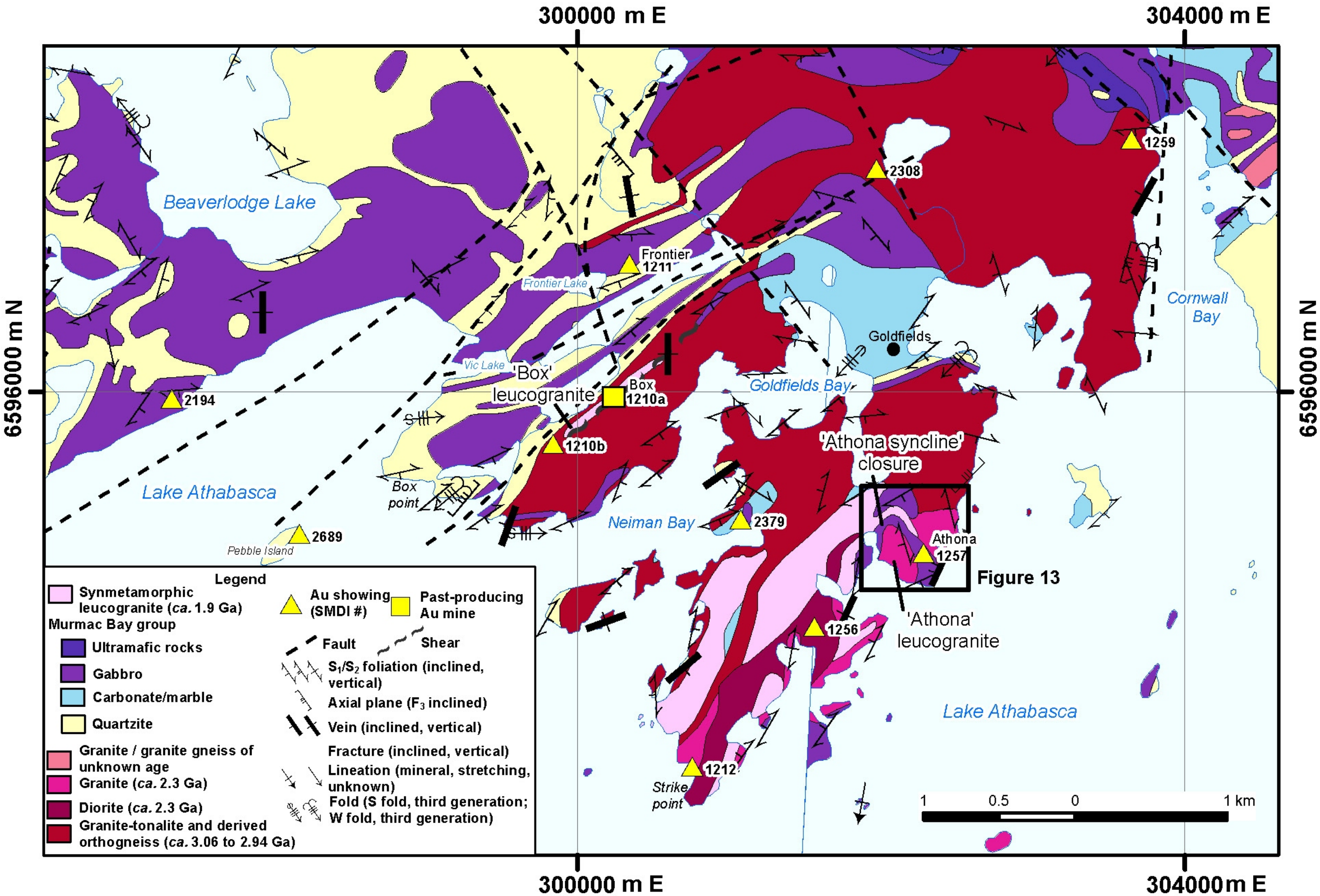

Figure 11 – Generalized geology of the Goldfields area (after Ashton et al.*, 2000), showing locations of known gold showings.*

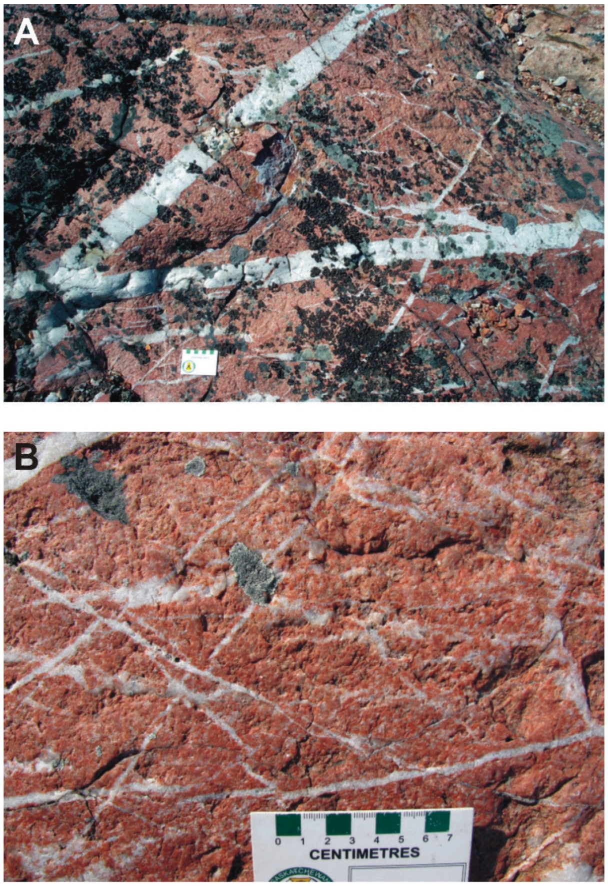

Figure 12 – Mineralization in the Box leucogranite, north shore of Lake Athabasca, ~15 km southeast of Uranium City: A) mineralized quartz veins emplaced within conjugate fracture sets; and B) close-up of mutually crosscutting quartz veins (photos courtesy of K. Ashton).

the most common. Although vein-parallel fractures are noted, no obvious shear zones are associated with individual group 2 veins. Shear zones at the nearby Athona deposit (see below), however, have similar orientations to some of the group 2 veins at the Box deposit, suggesting a correlative relationship. Group 3 veins are south-southeast striking and subvertical, crosscut group 1 and group 2 veins, and consist of brecciated fragments of wallrock in a quartz-calcite matrix. According to Rees (1992), the group 3 veins contain pitchblende but not gold.

The Box deposit, as currently defined, is a large-tonnage, relatively low-grade deposit, though distinct high-grade zones are locally present. The extent of the mineralized zone conforms roughly to that of the host leucogranite, having a 700 m strike length and 40 m width, and dipping ~43° to the southeast. Gold at the Box deposit is unevenly distributed, occurring primarily in quartz veins and, to a lesser extent, with sulphides in the host Box leucogranite. Quartz is the main vein component, but minor to trace amounts of chlorite, albite, microcline, tourmaline, and/or muscovite are also reported as gangue constituents. Vein-hosted sulphides include pyrite, sphalerite, galena, chalcopyrite, arsenopyrite, pyrrhotite, and molybdenite. Most pyrite crystallized early in the vein paragenesis as groups of subhedral to euhedral crystals, with gold introduced later as coatings on, or fracture fillings in, the pyrite (Rees, 1992). Free gold is relatively rare at Box, though it is present within small fractures in the quartz veins. The host leucogranite has also been subjected to an episode of albitization, perhaps equivalent to a widespread hydrothermal albitization event in the region that is believed to be related to the formation of pitchblende-bearing veins (Sibbald, 1984). Radioactive fractures containing chlorite and rare pitchblende have been observed cutting the gold-bearing quartz veins (Christie, 1952).

In his structural analysis of the deposit, Roberts (1990) demonstrated that the mineralized vein system was emplaced during deformation that affected (postdated) emplacement of the host leucogranite, thereby invalidating models that link genesis of the mineralizing system to granite emplacement (*e.g.*, Beavan, 1938; Christie, 1952; Sibbald, 1984). Roberts (1990) considered the localization of veins within the leucogranite to be the result of rheological contrasts, such that the deformation that produced the brittle faults and fractures in the rigid leucogranite body, which were later mineralized, was accommodated in a more ductile manner in its less competent, sericite-rich host. Gold-mineralized veins are considered to have been emplaced slightly after formation of the Athona syncline. Through correlation of vein orientations at the Box deposit with observed shear orientations at the Athona deposit (see below), Roberts (1990) inferred that the mineralized vein sets formed simultaneously in response to northwest-directed shortening, with the vein set oriented at 099°/76°N interpreted as tension fracture fills.

Inferred Deposit Type: orogenic gold

Associated Showings: Athona (SMDI #1257); Gauthier/Apex/Rose (SMDI #1210b); Frontier (SMDI #1211); My/France/Magnetite (SMDI #2077); Pebble Island (SMDI #2689)

Production and Reserves/Resources: Between 1939 and 1942, gold was produced at the Box mine (Table 1). An updated Reserve/Resource estimate for the Box deposit was reported in 2011 (Table 2).

Athona
(Main and East zones; SMDI #1257)

Location: near Goldfields Bay on the north shore of Lake Athabasca, ~2 km southeast of the Box deposit, and ~17 km southeast of Uranium City (NTS 74N/08; UTM 6594944 m N, 302278 m E)

Metal Associations: Au (Zn, Pb, Cu, As, Ag)

Status: developed prospect with Reserves

Exploration and Development History:

In 1935, trenching and drilling (7345 m) in the Goldfields area by Athona Mines Ltd. (previously Great Bear Lake Mines Ltd.) led to discovery of several mineralized zones that constitute the Athona deposit. Two shafts were sunk on the 'Main' zone (Figure 13) later that year to vertical depths of 85 and 34 m, respectively, and drifts were developed off the shafts. A 15 tons/day pilot mill was installed to facilitate bulk sampling of the mineralized zones, allowing for initial estimates of ore reserves. Operations ceased in 1939, prior to the start of gold production, due to an inability to reach an agreement with Cominco Ltd. (owners of the nearby Box mine) to treat the ore and because of the lack of a suitable power source for the operation.

No focussed work was done on the property until 1987, when Greater Lenora Resources Corp. (an amalgamation of Mary Ellen Resources Ltd., Lenora Explorations Ltd., and AXR Resources Ltd.) optioned the Athona property from New Athona Mines Ltd. Prospecting, reconnaissance geological mapping, and sampling were undertaken. The following year, Greater Lenora conducted drilling (52 holes, 6381 m) and a 8165 t (9,000 ton) bulk sample was taken from the Athona trenches. A pre-feasibility study with a reserve estimate, completed later that year, included both data acquired during this recent work and historical data acquired between 1934 and 1938. Further drilling (47 reverse-circulation drill holes, 3169 m) was undertaken on the Box-Athona properties in 1989, in addition to on-site metallurgical testing and bulk sampling. A further 1037 m of reverse-circulation drilling was done on the Athona property later in 1989. Updated reserve estimates for the Box-Athona deposits were reported in 1990 and again in 1994. In 1994, another significant drill program was undertaken on the Goldfields properties (52 holes, 6704 m) and an environmental study was completed. An additional 17 holes were drilled on the properties in 1995, and Greater Lenora released a revised resource estimate for the combined Box-Athona deposits in 1996. An airborne geophysical (EM, resistivity, magnetic, and spectrometer) survey was conducted in the area in 1997.

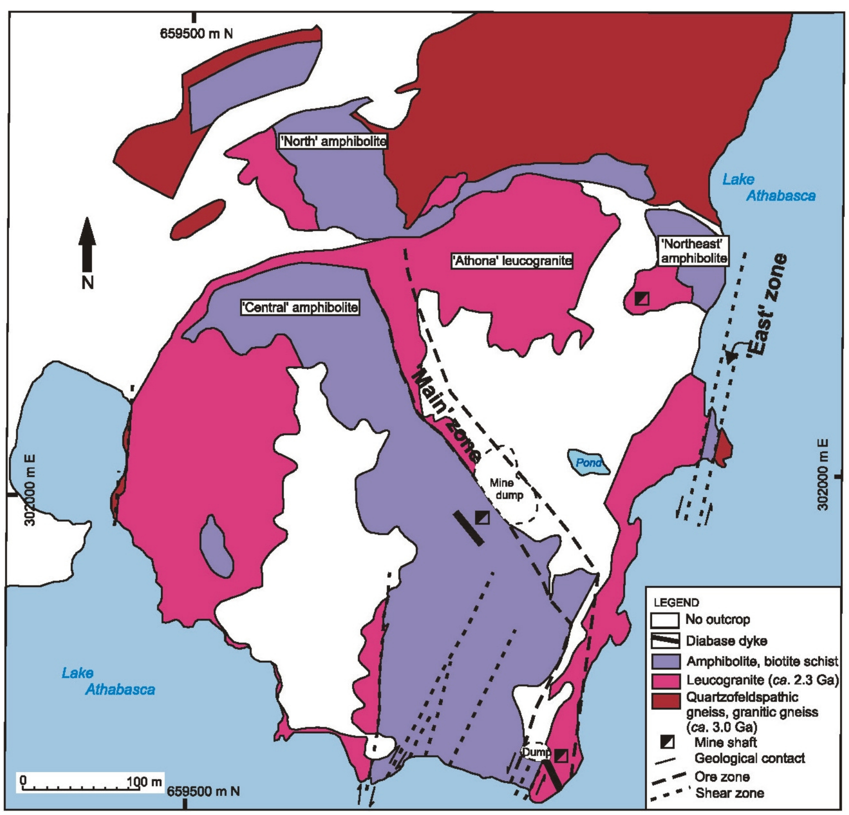

Figure 13 – Geology of the Athona mine area, with location of ore zones and historical mine shafts (modified from Roberts and Tyedmers, 1988).

The Goldfields Operating Co. was formed in 1999 by an equal-share joint-venture partnership between Greater Lenora Resources Corp., Cantera Mining Ltd., and Tormin Resources Ltd., and an announcement was made that small-scale development of the Box and Athona deposits would proceed. In July of 2001, GLR Resources Inc. acquired all assets of Greater Lenora. As of the beginning of 2006, a total of

263 holes totalling just under 24 000 m had been drilled on the Athona property (Maunula, 2007). Additional drilling (16 NQ core-size holes, 1592 m) was performed in 2006 in order to establish an NI 43-101–compliant Ore Reserve estimate for the deposit, which was released in 2007. The deposit was slated to move to production in conjunction with mining of the nearby Box deposit.

In May of 2009, GLR Resources announced that it had signed an agreement to sell the Goldfields property, including the Athona deposit, to Halifax-based Linear Gold Corp. Linear commenced an exploration program in the Goldfields area, including an 840 ha, high-resolution ground geophysical (IP and resistivity) survey and drilling to test for down-dip and along-strike mineralization outside the limits of the proposed Athona open-pit. In March 2010, Linear merged with Apollo Gold Corp. to form a new company, Brigus Gold Corp., which assumed ownership of the property. A revised Mineral Reserve estimate was released for the deposit in a new Pre-Feasibility Study on the Goldfields project in 2011 (Table 2). The report concluded viability for the project, which includes mining of both the Athona and Box deposits, based on a 13-year mine life with average annual production of about 100,000 oz. Brigus continued with exploration and definition drilling, confirmatory metallurgical sampling, and geotechnical investigations at the Goldfields property in 2011. A decision on the development of the Goldfields project was pending as of January 1, 2012.

Geological Character:

The Athona deposit shares many of the characteristics of the nearby Box deposit (see above), suggesting a close genetic association. The mineralized zones that make up the deposit are hosted by the 'Athona' leucogranite (Figure 13), a white to pink, equigranular to weakly feldspar-porphyroblastic to megacrystic, biotite (chlorite) leucogranite (Sibbald, 1984). Uranium-lead dating of zircon from this leucogranite yielded an age of 2327 ±27 Ma (Van Schmus *et al.*, 1986), significantly older than the inferred 1974 to 1933 Ma age of the leucogranite that hosts the Box deposit (Hartlaub *et al.*, 2005; see above). Like the Box leucogranite, the Athona leucogranite is hosted by quartz-sericite schist, likely derived from sheared basement (*ca.* 3.0 Ga) granite and/or metamorphosed saprolite at the unconformity between this basement and the overlying supracrustal rocks of the Murmac Bay group (K. Ashton, pers. comm., 2011). The leucogranite exposures subdivide three gabbroic (amphibolitic) units ('central, north, and northeast amphibolites'; Roberts, 1990; Figure 13); amphibolitic xenoliths in the granite and apophyses of the granite into the gabbroic units indicate that the granite intruded the gabbro (Appleyard, 1990). Both of these rocks are crosscut by a northwest-trending diabase dyke (Christie, 1952). The relative timing relationship(s) between these dykes and the mineralized zones is not clear from existing descriptions.

The Athona leucogranite is a shallowly (25°) south-dipping 'sheet' situated in the hinge of, and folded by, the Athona syncline (Roberts, 1990). This fold is an open, upright, north-northeast–trending, shallowly plunging synform, the closure of which is defined by changes in orientation of the main regional foliation. Minor (centimetre-scale) upright folding of this foliation, associated with shallowly south-plunging axes and subvertical north-northeast–trending (030°) axial planes, is observed near the western contact between the central amphibolite and the leucogranite, and is interpreted to be parasitic to the Athona syncline (*op cit.*). As at the Box deposit, three generations of quartz veins are observed at Athona, the second of which is thought to mark the gold emplacement event (*op cit.*). At Athona, these 'group 2' veins are of three main orientations: 027°/72°W, 073°/70°N, and 138°/85°E, the first being the most common set and the last probably representing tension fractures (*op cit.*). In contrast to the fracture-hosted vein network at the Box deposit, mineralized veins at Athona are in tabular zones with continuous strike lengths (metres) that are controlled by north- to north-northeast–trending, brittle-ductile shears. Roberts (1990) observed three main orientations of vein-associated shears at Athona (024°/74°W, 073°/73°N, 177°/82°W), which deflect the regional foliation. Of these, the east-northeast–oriented shears are the least abundant and are deflected into the (sinistral) northerly and (dextral) north-northeasterly trending, strike-slip shears. These shears are associated with retrograde metamorphic mineral assemblages.

The two main auriferous vein zones at Athona are roughly north trending and confined almost entirely to the leucogranite (the 'Main' and 'East' zones; Figure 13), though two additional zones are known ('West Mine Granite' and 'Pond' zones; see Maunula (2007) for detailed zone descriptions). The Athona Main zone, about 24 m wide, is situated within sheared Athona leucogranite near the contact with the central amphibolite, whereas the East zone is situated within sheared leucogranite at the contact with the northeast amphibolite (Figure 13). Gold is reported to be enriched along the leucogranite-amphibolite contact (Beavan, 1938), and it has been suggested that these amphibolite units might have provided impermeable barriers that facilitated 'ponding' of ore fluids in the adjacent sheared/fractured rocks (Saskatchewan Ministry of Energy and Resources (SMER) Assessment File 74N07-0315). Gold is mainly associated with minor sulphide mineralization in both the quartz veins and the wallrock at the ore zones. Pyrite in the form of disseminated cubes is the sole sulphide present in the wallrock. Sphalerite, galena, and subordinate pyrite, chalcopyrite, and pyrrhotite are the main sulphides present in the veins; coarse gold is present as isolated grains or in association with sulphides. Beavan (1938) suggested that sphalerite and galena are associated with localized zones of high gold-grain counts.

Roberts (1990) pointed out that some of the shear orientations at Athona correspond to quartz vein/fracture orientations within the vein stockwork of the Box deposit, indicating contemporaneous formation of the deposits within a common stress regime. In his model for vein development, Roberts (1990) emphasized that the sinistral north-trending and dextral northeast-trending strike-slip shears observed at Athona enclose the axial surfaces of the Athona syncline and related minor folds, suggesting shortening along a vertical plane trending ~140°. This model thus relates development of the Athona syncline, the Athona shear zones, and the mineralized veins at both the Athona and Box deposits to a common deformational event.

Inferred Deposit Type: orogenic gold

Associated Showings: Box (SMDI #1210a); Frontier (SMDI #1211); My/France/Magnetite (SMDI #2077); Pebble Island (SMDI #2689)

Production and Reserves/Resources: Although two shafts were developed to access the Athona Main zone in 1935, operations stopped shortly thereafter and there are no records of gold production from that time. Several reserve/resource estimates have been released since 1987. The most recent Mineral Reserve/Resource estimate was reported in 2011 (Table 2).

Frontier
Frontier Adit; Frontier Trust Adit; Earl (SMDI #1211)

Location: immediately northwest of Frontier Lake, ~1 km northwest of the Box deposit, and ~14 km southeast of Uranium City (NTS 74N/07; UTM 6596845 m N, 300343 m E)

Metal Associations: Au (Ag, Cu)

Status: developed prospect without Resources

Exploration and Development History:
The Frontier showing was discovered between 1930 and 1934, and staked as the APEX-MIKE-LYDIA claims. In 1935, Coniagas Mines Ltd. optioned the claims and completed 80 surface pits and trenches, and 10 diamond-drill holes. The property was optioned by Consolidated Mining and Smelting Co. of Canada Ltd. in 1937. After further trenching and drilling (11 holes), a 100 m adit was driven to the northwest, as well as 185.6 m of drifts and 104 m of crosscuts (Bikerman Engineering & Technology Associates Inc., 2009). In 1939, the option was cancelled and the claims lapsed. The property was restaked in 1957 as the EARL group of claims and was also allowed to lapse.

In 1977, the Saskatchewan Mining Development Corporation (SMDC) staked the showing area. From 1977 to 1982, the company conducted reconnaissance prospecting, geological mapping, lake-sediment sampling, and sampling of existing showings. This work resulted in the rediscovery of the Frontier showing and the discovery of the nearby Anderson and JKS showings (SMER Assessment Files 74N07-0292 and -0314). Between 1983 and 1988, SMDC completed drilling (26 holes) on the 'West' and 'East' zones, as well as geological mapping, sampling, and geophysical (EM-16, VLF-EM, IP, and magnetic) surveying over the showing.

In 1995, a partnership involving Greater Lenora Resources Corp. and R. Dubnick conducted a reconnaissance program of prospecting and rock sampling, locating a new showing, the 'Golden Pond' (SMDI #2308), on the southeast side of Frontier Lake. Grab samples returned maximum values of 4.9 g/t Au, 1.0 ppm Ag, and 49 ppm Cu. One sample from the area of the Frontier showing returned values of 53.25 g/t (1.56 oz./ton) Au, 2.2 ppm Ag, and <1 ppm Cu. In 1997, an airborne geophysical (EM, magnetic, and spectrometer) survey was flown over the property.

In May 2009, GLR Resources announced that it had signed an agreement to sell the Goldfields property, which included the Frontier showing, to Linear Gold Corp. In March 2010, Linear merged with Apollo Gold Corp. to form a new company, Brigus Gold Corp., which assumed ownership of the property.

Geological Character:

The Frontier prospect is hosted by rocks of controversial origin that are situated within an interlayered, southeast-dipping (30°) sequence of quartzite, feldspathic quartzite, and gabbroic sills of the Murmac Bay group (Figure 11). The protolith of the hostrock is granitic in composition ('Frontier granite'), although it has been alternatively interpreted to derive from either metasomatism ('granitization') of the supracrustal rocks (Sibbald and Jiricka, 1986; Quirt, 1990) or by igneous processes (*i.e.*, melting of proximal sedimentary rocks; Appleyard, 1990); for descriptive purposes, the latter interpretation is used herein. On outcrop scale, this granite forms thin, semiconcordant sills and veins that commonly exhibit gradational contacts with adjacent rocks. Appleyard (1990) separated the granite into two distinct types, including a red, quartz-rich, locally K-feldspar–megacrystic leucocratic phase and a fine-grained, massive aplitic phase. Gold mineralization is localized mainly within quartz veins in a sill-like body of fine-grained pink granite. This granitic sill is 6 to 18 m thick and was emplaced into quartzite below an amphibolite sill (Coombe, 1984).

The granite sill contains sporadic crystals of pyrite that are partially or completely altered to hematite (Beavan, 1938; Christie, 1952). Minute stringers of quartz cut the pyrite cubes and gold is described to be present both with the pyrite and as flakes coating fracture surfaces in the granite. The majority of gold mineralization occurs, however, in quartz vein stockworks within the granite. The main auriferous quartz veining zone is exposed by surface trenching near the amphibolite contact. Assessment file information on the showing suggests the presence of five distinct vein sets, two of which carry anomalous gold values in both the 'East' and 'West' mineralized zones; these auriferous vein sets are of high grade and relatively narrow, and oriented 155° to 170°/65 to 90°W, and 010° to 020°/75 to 90°E (SMER Assessment File 74N07-0315). Vein-associated mineralization consists of native gold with pyrite, hematite, and trace chalcopyrite, though the precise mineral paragenesis has not been defined. Dark green chlorite is commonly associated with mineralized veins and, in addition to the distinct quartz veins, hydrothermal activity in the host sequence variably manifests as pervasive silicification, feldspathization, hematitization, chloritization, and pyritization. The main auriferous zone and its hostrock are thought to be bounded to the west by the north- to northwest-trending Triangle Lake fault and to the east by a fault trending N315°E at the northeast end of Frontier Lake, and the lake itself might occupy a unit-parallel fault zone (Bikerman Engineering & Technology Associates Inc., 2009).

Inferred Deposit Type: orogenic gold

Associated Showings: Box (SMDI #1210a); Athona (SMDI #1257)

Production and Reserves/Resources: none known

Nicholson Bay
Nos. 1 to 6 zones (SMDI #1264)

Location: north shore of Lake Athabasca at Nicholson Bay, approximately 16 km southeast of Uranium City (NTS 74N/08; UTM 6596047 m N, 305491 m E)

Metal Associations: Au, with U, PGE (±Co±Cu±Zn±Rb±Sr±Y±Ag±Cd±Sb±Se±REE)

Status: past-producing (uranium) mine without Resources

Exploration and Development History:

Minor gold mineralization, along with pitchblende, was discovered in several zones at Nicholson Bay by the Mineral Belt Locators Syndicate in 1935 (Kupsch and Hanson, 1986). According to Beck (1969), the No. 4 zone was explored for gold by two adits at this time, with a total of ~107 m (350 feet) of underground workings. This exploration led to the discovery of additional pitchblende mineralization on the property. Work was suspended until 1949, when vertical shafts and lateral drifts were completed by Consolidated Nicholson Mines Ltd. on the Nos. 1, 2, and 4 zones to extract pitchblende. Operations were suspended shortly thereafter, but resumed briefly in 1955 and again in 1958-59 under different ownership (KLK Mining Company). No gold production was reported from any of this exploration/development activity.

A portion of the property was re-staked by J. McDonald in 1965 and optioned to Enex Mines Ltd. in 1967, which undertook minor exploration. Minor exploration was also done in 1970 by Consolidated Nicholson on an adjacent claim covering the Nos. 1 and 6 zones. Enex completed a small drilling program (eight holes, ~617 m) on the No. 4 zone but failed to intersect any significant mineralization.

The property was acquired by a joint-venture partnership between Eldor Resources Ltd. (60%) and Mary Ellen Resources Ltd. (40%) in 1987, and additional exploration, including geological mapping, sampling, and drilling (nine holes), was undertaken in 1987 and 1988. Shortly thereafter, further exploration was carried out by Chancellor Energy Resources Ltd. (50%) and SMDC (50%) under an option from Mary Ellen. This work included trenching, sampling and drilling (26 holes), primarily on the Nos. 1, 2, and 6 zones, and a ground geophysical survey (magnetic) on the No. 2 zone. Apart from an airborne geophysical (EM and magnetic) survey over the property in 1997 by Greater Lenora Resources Corp., no further work has been done. A disposition on the property is currently held by an unnamed company.

Geological Character:

The geological relationships at the Nicholson Bay showing were described in detail by Beck (1969), Sibbald (1988), and Rees (1992). Mineralization constituting the showing is hosted primarily by white quartzite of the *ca.* 2.3 Ga Murmac Bay group (Ashton *et al.*, 2009a), which grades locally into diopsidic and/or fuchsitic quartzite and dolomitic marble. A large gabbroic to ultramafic intrusion ('Nicholson ultramafic complex'; Sibbald *et al.*, 1983), which cuts the supracrustal sequence, is exposed ~100 m east of the showing. The hostrocks to the deposit are polydeformed, now exhibiting a dominant north to northeasterly structural trend on the limb of a south-plunging regional syncline (Hartlaub *et al.*, 1998), and were metamorphosed under lower to middle amphibolite facies conditions (Sibbald, 1988). Several small outliers of unconformable, unmetamorphosed Athabasca Group sandstone reportedly overlie the crystalline basement to the southwest, north, and west of the showing, typically in association with extreme hematitization at the unconformity (*op. cit.*).

The showing includes six separate mineralized zones (Nos. 1 to 6), commonly comprising steeply dipping veins within northwest- to north-trending fractures. Pitchblende mineralization occurs preferentially within these fractures. Sibbald (1988) emphasized, however, that the fractures are discordant to the overall alteration zone, which appears to transition laterally into unfractured basement rocks, and that they probably did not control the overall mineralizing system. Moreover, he considered the sub–Athabasca Group unconformity (and overprinting structures) to provide the only unambiguous control. In contrast, Hulbert (1990) suggested that mineralized fractures have an association with a steep, easterly dipping, northeast-trending fault zone. Mineralization is of two main types, including: 1) pitchblende veins with complex mineralogy, including coffinite, Ni-Co arsenides, native Au and Ag, and carbonaceous matter (*e.g.*, No. 4 zone); and 2) irregular 'pods' of Au-PGE-U mineralization (*e.g.*, No. 2 zone). Both mineralization types have a strong spatial association with hematitic alteration, although elevated chlorine contents, steatitization of diopside, development of vugs (±quartz infill), and carbonate veining have also been suggested as alteration features.

Several models have been proposed for the paragenesis of ore at Nicholson Bay. Sibbald (1988) suggested a cogenetic relation between both styles of mineralization (*i.e.*, complex-style pitchblende veins and Au-PGE-U pods) and the regionally known sub-Athabasca 'unconformity-associated' uranium deposits of simple mineralogy. Hulbert (1990) outlined an intricate, four-stage paragenetic sequence for the mineralization, in which gold and PGE (stage 2) were introduced after deposition of most of the uranium (stage 1). Rees (1992) used stable isotope and fluid inclusion data to suggest that the emplacement of Au-PGE-U mineralization occurred during an earlier fluid event than the complex-style pitchblende veins, and that both mineralization styles postdated unconformity-associated uranium deposits of simple mineralogy.

Inferred Deposit Type: ?vein-type Au-PGE-U (Beaverlodge-type U±polymetallic; 'complex-type'); ?Athabasca Basin unconformity-associated U±polymetallic ('complex-type')

Associated Showings: Fish Hook Bay (45-SH-10 showing; SMDI #1272); Quartzite Ridge (SMDI #2319); ?Cluff Lake D Zone (SMDI #1150a); ?McIntosh Bay zone, Poplar project (CanAlaska Uranium Ltd.)

Production and Reserves/Resources: Minor uranium production from the property occurred between 1935 and 1959 (see SMDI #1264), but no gold production was reported.

Cluff Lake Mine, D Zone (SMDI #1150a)

Location: ~140 km southeast of Uranium City (NTS 74K/05; UTM 6477941 m N, 235850 m E)

Metal Associations: U (Au, Pb, Ni, Co, As, Cu, Mo)

Status: past-producing (U) mine without Resources

Exploration and Development History:

Exploration in the Cluff Lake area first took place in 1958, when airborne geophysical (magnetic and radiometric) surveys were completed for W.S. Kennedy. An airborne radiometric survey completed in 1968 by Mokta (Canada) Ltd. (subsequently Amok Ltd.) outlined several weak anomalies. Follow-up exploration led to the discovery of four ore zones, referred to as 'D', 'N', 'OP', and 'Claude', between 1969 and 1971. The 'Dominique-Peter', 'Dominique-Janine', and 'West Dominique-Janine' zones were discovered between 1981 and 1996. These ore zones, some of which were originally owned by Amok Ltd. (80%) and Cameco Corp. (20%), were later acquired by COGEMA Resources Inc. (80%) and Corona Grande Exploration Corp. (20%; a wholly owned subsidiary of COGEMA Resources Inc.), and, as of 2012, are owned outright by COGEMA Resources Inc.

The Cluff Lake deposits were originally estimated to contain in excess of 20 000 t of uranium, the grade of the ore varying substantially between different deposits. The D zone, for example, had an average uranium ore grade of around 3.5%, whereas the others graded about 0.5%. Open pit mining at the D zone (phase I) occurred in 1979 and 1980, though ore milling was performed later, between 1980 and 1984. Gold, residually concentrated in the leach tailings derived from phase I processing of the gravimetric concentrate from D zone ore, was extracted in 1987 and 1988. Total gold production from this process was reported to be 0.248 t (7,970 oz.; Table 1).

Phase II operations were initiated in 1983 with development of the Claude deposit open pit and the OP underground mine. Production from these deposits began in August 1984. Depletion of the OP orebody in 1985 was followed by production from the Dominique-Peter underground mine, which lasted until 2000. Closure of the Claude open pit in June 1989 was followed immediately by production from the Dominique-Janine North open pit, which was mined out by December 1991. Subsequently, mining of the Dominique-Janine South extension open pit and underground mine lasted from 1994 to 1997 and from 1996 to 2000, respectively. Production from the West Dominique-Janine deposit, where underground mining started in 1999, ended in May 2002, though ore was processed through 2003. Of all mining that occurred, only the D zone produced gold.

Geological Character[2]:

The past-producing Cluff Lake mine is located in the western part of the Athabasca Basin, near the southern margin of the basement core of the Carswell structure (Figure 1). This fault-bounded circular structure, 35 km in diameter, is considered to be of meteorite-impact origin (Harper, 1978). The core is surrounded by successive, 4 to 5 km wide, concentric zones of deformed and fragmented Athabasca Group sandstone, mudstone, and stromatolitic dolomite. The uplifted basement rocks in the core comprise mainly granitoid gneiss (Earl River Complex) and pelitic and minor mafic gneiss (Peter River gneiss), invaded by sheets of pink, leucocratic, garnetiferous granite–granite pegmatite.

The D zone is located in an overthrust block at the inverted sub-Athabasca unconformity, which dips moderately northward. At the deposit, graphitic Peter River paragneiss overlies interbedded siltstone, conglomerate, and sandstone of the Athabasca Group. Massive uranium ore occurs mainly in the siltstone and in the superjacent basement close to a zone of mylonitization. The orebody is ellipsoidal, measuring about 140 m long, up to 25 m wide, and 7 m thick, with mineralization forming discontinuous lenses. The D orebody is considered to comprise 'complex' ('D-type') polymetallic mineralization (Harper, 1978) and is distributed along faults/fractures at the intersection of three major fracture systems (Ruzicka, 1975). Pitchblende, uraninite, and coffinite ore minerals are associated with accessory native gold and gold tellurides, native selenium, galena, chalcopyrite, jordisite, pyrite, pararammelsbergite, and various selenides, among other minor constituents (Harper, 1978). Hydrocarbon buttons and other carbonaceous material also occur in the ore. Ore emplacement was accompanied by pervasive hydrothermal alteration, including hematitization, illitization, and superimposed chlorite-sericite, which affected both the basement and the Athabasca Group.

Little information exists on the paragenesis of gold with respect to other ore minerals in the D zone. Reported observations in this regard (*e.g.*, Ruzicka, 1975 and references therein) indicate that uranium minerals were the first precipitated, in the order of uraninite, pitchblende, and thucholite, with pitchblende being most abundant. Sulphides, selenides, and other minerals and metals, including gold, tellurides, bismuth, cobalt, pararammelsbergite, galena, and chalcopyrite, were precipitated relatively later and commonly exhibit intricate intergrowth textures. Gold, in particular, is observed to be intergrown with altaite.

Inferred Deposit Type: Athabasca Basin unconformity-associated U±polymetallic ('complex-type')

[2] Although the ore has been mined out, the description is in the present tense for consistency.

Associated Showings: ?Nicholson Bay (SMDI #1264)

Production and Reserves/Resources: Unconfirmed reports indicate that 0.248 t (7,970 oz.) of gold was recovered in 1987-88 by processing of the gravimetric concentrate from previously mined D zone uranium ore (Table 1).

Tantato Domain

Pine Channel Gold Showings
(see Table 3 for SMDI numbers)

Location: multiple showings north of Pine Channel between Robillard Bay and Camille Bay, eastern Lake Athabasca (NTS 74O/07; see Figure 10)

Metal Associations: Au, As (Pb Cu Zn B)

Status: occurrences, except North Norite Bay 'prospect' (SMDI #2183)

Exploration and Development History:
Although prospectors had visited the area as early as 1910, it wasn't until 1935-36 that gold showings were identified in the Pine Channel area, on the north shore of Lake Athabasca. At this time, work by individual prospectors and by exploration companies (Cominco Ltd., Athona Mines Ltd., Sterling Collieries Co. Ltd., Prospectors Airways Co. Ltd., Ceres Explorations Ltd.) led to the discovery of several showings on Thomson Island and on the mainland near Sucker and Algold bays (Kupsch and Hanson, 1986). Intermittent work in the area over the next 60 years resulted in the identification of more than 30 gold showings in the area between Camille and Robillard bays (Figure 10; Table 3). Although minor exploration was carried out in 1946, no significant work was done until the late 1970s and early 1980s, when several companies (Golden Rule Resources Ltd., Kintla Explorations Ltd., Saskatchewan Mining Development Corporation (SMDC)) undertook extensive geological mapping, geophysical (EM and magnetic) surveys, biogeochemical sampling, and trenching throughout the area. Along with SMDC, other companies, including Cominco Ltd. and Colchis Resources Ltd., undertook exploration in the area between 1986 and 1988. A small number of drill holes were completed on some of the showings (*e.g.*, Mel-Cec, SMDI #1575) as part of this work. No other appreciable work was done until 1996, when Devex Exploration Inc. discovered and subsequently drilled several new gold showings on the mainland between Camille Bay and Robillard Bay (Lafrance, 1997).

Geological Character:
With the exception of one minor showing in the southeastern Tantato Domain (pyritic iron formation–hosted Pine Channel JJ Anomaly showing, SMDI #2612), all known showings are situated near the Grease River shear zone at the eastern domain boundary (Figure 10). Gold showings in the Pine Channel area are localized in a relatively small (90 km^2) region between Robillard and Camille bays (Figure 10). According to Lafrance (1997), this area is underlain by two main rock types, garnet quartzofeldspathic felsic gneiss and garnet-clinopyroxene mafic gneiss, both of which are variably mylonitic. The garnet quartzofeldspathic gneiss is strongly layered and generally diatexitic, with leucosome strongly stretched parallel to the mylonitic foliation. Concordant zones of pyrrhotite-pyrite mineralization, distinct from the structurally controlled, quartz vein–associated mineralization that comprises the bulk of gold mineralization, occur within the garnet-clinopyroxene mafic gneiss and are commonly associated with graphitic schist.

Although there is little detailed information available on the geological setting of the Pine Channel gold showings, an overview of some of the mineralized veins and structures was provided by Lafrance (1997) and is summarized below. Details of the showings are also given in Table 3 and locations of the showings are shown on Figure 10. Mineralized quartz veins occupy narrow fractures and fault zones (Figure 14). Although a few mineralized veins strike parallel, and dip either subparallel (zones 1 and 2 on Thomson Island, SMDI #1576) or at a high angle (Occurrence 26, SMDI #2188) to the regional foliation, most trend either northwest or north and cut across the regional foliation. The host fracture and fault zones are brittle structures that are typically steeply dipping and can be followed along strike for hundreds of metres. They range in width from <0.1 to 2 m, with an average fracture-plane spacing within the fault zone of 3 to 5 cm. The mineralized veins consist of white quartz, which varies from massive to vuggy, with euhedral elongate quartz crystals rimming the interior surfaces of vugs and the walls of open fractures. The gold-bearing veins almost invariably contain arsenopyrite, which forms massive, 1 to 10 cm wide sulphide lenses parallel to the vein walls. Other common minerals in the quartz veins include pyrite, sphalerite,

Table 3 – Synthesis of characteristics of selected Pine Channel gold showings, western Tantato Domain (information from Lafrance (1997) and the SMDI).

Showing (SMDI #)	Location	Orientation	Host Rock	Vein/Sulphide Mineralogy	Alteration Mineralogy	Description
Mel-Cec (1575)	East end of Algold Bay	Northwest / subvertical	Mafic and felsic gneiss	Quartz, arsenopyrite, pyrite	Pyrite, arsenopyrite	Veins and lenses in 300 m long fracture zone up to 1 m wide
Thomson Island, zones 1 to 9 (1576)	Thomson Island	174°/68°E	Mafic and felsic gneiss	Quartz, pyrite, arsenopyrite, trace chalcopyrite	Chloritization and sericitization	At zone 7: sheared and boudinaged, 0.3 to 1.3 m wide quartz vein within a 0.4 to 1.3 m wide sinistral fault zone; small conjugate dextral faults (151°/79° E) occur adjacent to the main fault
Occurrence 10 (2176)	South of Fisher Creek and east of Norite Bay	134°/68°N	Felsic gneiss	Quartz, arsenopyrite, pyrite, galena	—	10 to 30 cm wide quartz vein over 30 to 40 m in strike length, emplaced in a 1.5 m wide fracture zone; holes drilled by Pine Channel Explorer Ltd. intersected graphitic schist with specks and veinlets of pyrite and fragments of country rock cut by graphite-filled fractures, at the approximate location of the inferred Norite Bay fault
Old Cabin quartz vein (2176)	East end of Norite Bay	120° to 130°/ 75° to 85°N	Mafic and felsic gneisses	Massive white quartz, vuggy; chloritic margins; 1% combined arsenopyrite, pyrite; disseminated arsenopyrite and pyrite up to 5 cm from veins	Feldspars are sericitized and carbonatized; wallrock cut by veinlets of chlorite, carbonate, and quartz	Several quartz veins 2 to 25 cm wide within a 1.2 to 1.4 m wide fault zone; dextral displacement up to 25 m
Ridge zone (2176)	350 m south of Norite Bay	111°/78°N	Felsic gneiss	Quartz and 5% combined arsenopyrite+pyrite and trace chalcopyrite and galena	—	15 to 55 cm wide fault zone containing 11 cm wide quartz vein; intersects a foliation-parallel gossan zone at north end of showing
North Pond zone (2176)	Southern extension of Ridge zone	136°/70°E	Contact between mafic and felsic gneiss	Quartz vein with massive arsenopyrite lenses and blebs of pyrite	Chloritization, carbonatization	Two quartz veins from 15 to 40 cm wide in an 80 cm wide fault zone, traceable over strike length of 25 m; dextral offset of 9 m
South Cole Lake quartz vein - trench 1 (2177)	Southwest of Cole Lake	140°/73°E	Felsic gneiss	Quartz vein with average 5 to 10% combined arsenopyrite+ sphalerite, minor galena and pyrite	—	Three white, vuggy quartz veins from 4 to 12 cm in a 50 cm wide fault zone
South Cole Lake quartz vein - trenches 2 and 3 (2177)	Southwest of Cole Lake	Northwest-trending vein cutting east-northeast–trending, foliation-parallel semimassive sulphide zone	Felsic gneiss and graphitic schist	'Blue' quartz vein cutting semi-massive mineralized zone with 10 to 15% combined pyrrhotite+pyrite, and trace chalcopyrite as massive sulphide 'pockets', veins, and disseminations	Feldspars are sericitized and carbonatized; wallrock cut by veinlets of chlorite	Concordant mineralized zone associated with graphitic schist along a lithological contact (mineralized veins in trench 2 are dextrally offset about 1 m along this zone)

Table 3 (continued)

Showing (SMDI #)	Location	Orientation	Host Rock	Vein/Sulphide Mineralogy	Alteration Mineralogy	Description
Cole Lake quartz vein (2177)	200 m north of South Cole Lake quartz vein	139°/70°E	Felsic gneiss	Quartz vein with <1% combined arsenopyrite+pyrite	Chloritization, sericitization, carbonatization	20 cm wide vein in a 70 cm wide fracture zone, no displacement observed
King South vein (2177)	700 m southwest of Cole Lake	140°/84°E	Mafic gneiss	1% combined pyrrhotite+arsenopyrite	Silicification	40 cm wide fracture zone, silicified over a width of 18 cm with 1% combined pyrrhotite+ arsenopyrite
North Norite Bay showing (2183)	Southeast of Stoll Point, on peninsula between Sucker and Norite	118°/80°N	Mafic and felsic gneiss	Quartz and up to 10% combined pyrite and arsenopyrite; disseminated sulphides in wallrock	—	Quartz vein, up to 60 cm wide, in a shear zone; south end of vein is dextrally offset by a crosscutting fault
RN-15-13 showing (2184)	North shore of Norite Bay	156°/80°W	Felsic gneiss	Quartz and up to 10% combined pyrite+arsenopyrite	—	Quartz vein, up to 40 cm wide, in shear zone
RN-15-4 showing (2184)	North shore of Norite Bay (350 m southeast of RN-15-13)	145°/83°W	Felsic gneiss and pyritized norite (mafic gneiss)	Quartz and massive and disseminated pyrite, arsenopyrite	—	Quartz vein in shear zone
RN-15-22 showing (2185)	Island west-southwest of Stoll point	145°	Felsic gneiss	Massive and disseminated pyrite and arsenopyrite	—	30 cm wide quartz vein in shear zone
Stoll Point showing (2186)	Stoll Point in Sucker Bay	157°/80°E	Mafic and felsic gneiss	Quartz, arsenopyrite, pyrite, galena; also disseminated sulphides in wallrock	—	20 cm wide quartz vein in shear zone
Dardier Island showing (2187)	Island in Dardier Bay	Northwest/78°E	Felsic gneiss	Quartz with pyrite	—	Four parallel, vuggy, grey quartz veins in a shear zone
Occurrence 26 (2188)	South shore of an unnamed peninsula on Dardier Bay	072°/53°N	Felsic gneiss	White quartz with 2% combined arsenopyrite+pyrite, trace chalcopyrite; also disseminated sulphides in wallrock	—	Two white quartz veins, from 5 to 22 cm wide, emplaced in a zone of tension fractures; smaller secondary veins cut and merge with the two main ones; cut by minor steeply dipping, northwest-trending, sinistral and dextral fractures

Figure 14 – Steeply dipping auriferous quartz vein in shear zone at the ELA showing, eastern Tantato Domain (photo courtesy of W.L. Slimmon).

galena, chalcopyrite, native gold, and tourmaline. The wallrocks surrounding mineralized veins are sericitized, chloritized, and carbonatized over widths comparable to that of the veins themselves.

Inferred Deposit Type: orogenic gold

Associated Showings: see Table 3

Production and Reserves/Resources: none

Gold Metallogenesis

Gold in both the Rae Province is concentrated in the western Beaverlodge Domain and in the Pine Channel area of the western Tantato Domain. Two styles of gold mineralization are known to occur in the Beaverlodge Domain: minor gold associated with 'complex', polymetallic U-PGE-Au mineralization (*e.g.*, Nicholson Bay, SMDI #1264; Quartzite Ridge, SMDI #2319; Fish Hook Bay showing 45-SH-10, SMDI #1272; ?Cluff Lake D zone, SMDI #1150a) and orogenic-style deposits (*e.g.*, Box, Athona, Frontier). Structural relationships, vein textures, and fluid compositions indicate that the polymetallic veins significantly postdate and are genetically unrelated to the orogenic-style deposits (Rees, 1992). Of the two styles, the orogenic clearly represents the higher potential for economic concentrations of gold.

Documented relationships from known orogenic-style showings in the western Beaverlodge Domain, combined with existing knowledge of the geological history of the hostrocks, place constraints on the timing of the mineralization and the tectonic controls on mineralization in the Beaverlodge district. Granitoid plutons are a seemingly preferred host for gold mineralization, whether quartz vein or wallrock hosted. The presence of gold showings in other rock types (*e.g.*, the mafic volcanic/banded iron formation–hosted 'My/France/Magnetite' showings (SMDI #2077) and the arkose/argillite–hosted Pebble Island showing (SMDI #2689); Figure 9) shows, however, that the structural and rheological character, as opposed to the hostrock association, are the salient controls on mineralization. This is further exemplified by existing geochronological results that demonstrate that host plutons to some deposits are not contemporaneous (*e.g.*, *ca.* 1.97 to 1.93 Ga Box leucogranite *vs. ca.* 2.3 Ga Athona leucogranite), a determination consistent with observed textural and mineralogical variation between these granite bodies (Ashton, pers. comm., 2010). These observations also argue against models that relate deposit genesis to the granite-forming process, and constrain the maximum age of mineralization to about 1.97 to 1.93 Ga.

Known orogenic-style gold deposits/showings in the Beaverlodge district (Figure 9) are restricted to a relatively confined area, covering ~40 km^2, that extends from the southeastern shore of Beaverlodge Lake southeast towards Cornwall Bay and Strike Point on the northern shore of Lake Athabasca. The reason for this spatial restriction is currently unclear and could, in fact, result from a combination of factors. Recent geological mapping (Ashton, 2009) has shown that this area generally coincides with the location of the unconformity between *ca.* 3.0 Ga granitoid basement and overlying supracrustal rocks of the Paleoproterozoic Murmac Bay group. It is possible, therefore, that this planar discontinuity acted as a fluid pathway (zone of dilation?) during the mineralizing event. Another distinguishing feature of the rocks in this particular area is that, having undergone greenschist or lower amphibolite facies peak metamorphism, they are of anomalously low grade compared to surrounding rocks, which were subjected to upper amphibolite to granulite facies peak metamorphism (Ashton *et al.*, 2000). This apparent association with the lower grade rocks suggests that the gold mineralization was originally emplaced at relatively shallow depths (<10 to 15 km?) and has since been exhumed and eroded from the areas of higher metamorphic grade in the domain. It is possible, however, that this spatial distribution partly reflects a bias of historical gold exploration preferentially within the lower grade rocks.

Roberts (1990) interpreted structural relationships between auriferous veins, shear zones, and foliations/minor fold orientations at both Box and Athona to suggest that the gold mineralizing event occurred immediately following northeast-southwest shortening, which was responsible for development of the Athona syncline (Figure 11). Judging from its orientation and relationship to other fabrics, this north-northeast–trending, upright, shallowly plunging synform probably formed during either the D_3 or D_4 deformational event (F_3 or F_4 folding) of Ashton *et al.* (2009a), although currently available information does not permit a conclusive designation.

The Beaverlodge gold deposits are interpreted to have formed from a high-density, low-salinity, aqueous-carbonic fluid of metamorphic origin, with a minimum temperature of ~300°C (Rees, 1992). This fluid character, along with other characteristics of the deposits (*e.g.*, gold rich and base-metal deficient, structural control, associated with higher order shear zones, hosted by quartz vein stockworks, *etc.*), are hallmarks of the orogenic model (*e.g.*, Groves *et al.*, 2003; Goldfarb *et al.*, 2005). This association might help constrain the relative timing of mineralization, specifically whether it was contemporaneous with D_3 or D_4 deformation. The D_4 deformational event is interpreted to have occurred in response to terrane accretion to the west and terminal collision in the Trans-Hudson orogen to the east at *ca.* 1.83 to 1.82 Ga (Ashton *et al.*, 2009a). At this time, rocks of the Beaverlodge area were situated in the hinterland of the Trans-Hudson orogen, with the nearest subduction zone located more than 400 km away on the southeastern margin of the Hearne craton. This scenario is at odds with prevailing models for the genesis of OGDs, which emphasize their formation proximal to convergent margins at or near the time of the peak metamorphic event (*e.g.*, Groves *et al.*, 1998, 2003; Kerrich *et al.*, 2000; Figure 3). The significant gap in timing with respect to peak metamorphism of the hostrocks (*ca.* 1.91 to 1.90 Ga; Ashton *et al.*, 2009a) and D_4 deformation (1.83 to 1.82 Ga) is therefore also problematic for the orogenic model. Together, these 'model-driven' inconsistencies could indicate that: 1) the Beaverlodge deposits exemplify a unique example of orogenic-style gold; 2) they are actually not OGDs and represent a similar but distinct style of gold mineralization; or 3) their formation is instead related to D_3 deformation/thermotectonism at *ca.* 1.9 Ga, broadly contemporaneous with peak metamorphism in this area and possibly related to collision between the Rae and Hearne cratons (and ocean closure) along the Snowbird tectonic zone to the east (Berman *et al.*, 2007), or to the Taltson orogeny to the west. Further work is required to resolve the timing and cause of main-stage orogenic gold mineralization in the Beaverlodge Domain.

Regardless of the timing of gold deposition, some empirical observations can be made regarding deposit characteristics that provide useful exploration tools for gold in the Beaverlodge Domain. These observations include:

- rigid granitoid plutons as preferred deposit hosts due to their rheological character (though mineralization is known in other rock types);
- possibly, a preferential association with relatively low metamorphic grade (greenschist to lower amphibolite facies) hostrocks;
- an association with brittle-ductile shears of variable orientation and conjugate fracture systems;
- an association with mildly sulphidic quartz veins and quartz vein stockworks, although gold is commonly concentrated in the wallrock adjacent to these veins;
- chloritic alteration adjacent to and/or within shears and veins; and
- possibly, a spatial association with the unconformity between *ca.* 3.0 Ga basement granitoid and overlying Paleoproterozoic rocks of the Murmac Bay group.

In the Tantato Domain, gold showings are consistently associated with quartz veins in narrow, steeply dipping, north- and northwest-trending brittle faults and fracture systems (and corresponding topographic lineaments) that exhibit sinistral and dextral offsets, respectively (Lafrance, 1997). The mineralization is clearly epigenetic, and host structures crosscut the regional gneissosity and are associated with greenschist facies retrograde mineral assemblages (*e.g.*, chlorite, sericite, carbonate) that overprint earlier granulite facies assemblages. Higher gold concentrations are commonly localized along contacts between mafic gneiss and graphitic schist (*op cit.*).

On a regional scale, the mineralized faults have a spatial association with east-northeast–trending, foliation-parallel, sulphidic and graphitic shear zones and fault lineaments (*e.g.*, the Wiley Lake and Malinoski Lake faults, and the Sucker Bay and Norite Bay faults; Figure 10). Coombe (1984) and Slimmon and MacDonald (1987) considered the mineralized fault and fracture systems to be subsidiary structures to (and thus cogenetic with) these more extensive graphitic shears, which they proposed to have a component of dextral offset. This model is attractive in that it attempts to link the mineralizing system to regional shearing, perhaps even allowing linkages to late fluid flow and greenschist facies mineral assemblages along the crustal-scale Grease River shear zone.

Subsequent study by Lafrance (1997) yielded an alternative interpretation for the structural origin of these deposits, however, contending that the stress regime implied by the orientation of the relevant structures excludes a genetic relationship between the mineralized faults and the graphitic regional shears. Based on this observation, a model was proposed in which the north- and northwest-trending mineralized faults were a conjugate fault/fracture set produced by relatively late north-northwest shortening, and were unrelated to regional dextral shearing. Evidence put forth in support of this model includes an inappropriate (inferred) stress regime at the time of gold mineralization to produce dextral offset, the apparent lack of evidence for transcurrent displacements along these shear zones at the time of gold mineralization, and the continuity of mineralized structures across these shear zones.

Regardless of the exact mode of formation, it is clear that the mineralizing event must be associated with an episode of late (Hudsonian) rehydration of high-grade rocks in the Tantato Domain (Coombe, 1984). Specifically, Lafrance (1997) proposed, based on structural relationships, that gold mineralization postdated the *ca.* 1910 Ma Robillard orthogneiss (Hanmer *et al.*, 1994) and predated Athabasca Group sedimentation that started at *ca.* 1750 Ma. Moreover, monazite growth linked to growth of greenschist facies retrograde metamorphic assemblages along the Grease River shear zone has been identified at both *ca.* 1850 and *ca.* 1800 Ma, possibly placing further constraints on the timing of gold mineralization. Considering that high-grade rocks of the Tantato Domain were completely dehydrated during prior (?*ca.* 1900 Ma) granulite facies metamorphism, an intriguing problem concerns the source of the mineralizing fluids (and gold) during rehydration. Further work is required to address this specific problem, to clarify the regional stress regime and tectonic setting at the time of mineralization, and to determine whether genetic links exist between orogenic-style gold showings in the Tantato and Beaverlodge domains, all of which appear to have been emplaced during Paleoproterozoic reworking of the Rae Province.

Chapter 5 – Hearne Province

Geology of the Hearne Province

The Hearne Province of the Precambrian shield is separated from the Rae Province to the west by the Snowbird tectonic zone and is bounded on its eastern margin by the Wathaman Batholith, along the Needle Falls and Parker Lake shear zones (Figure 1). Four northeast-trending lithostructural domains make up the Hearne Province in Saskatchewan; these are, from east to west, the Virgin River, Mudjatik, Wollaston, and Peter Lake domains. Rocks of all these domains, except the Peter Lake, are unconformably overlain by, and thus partly obscured by, unmetamorphosed clastic sedimentary rocks of the Athabasca Basin. The majority of known gold showings in the Hearne Province are in the Mudjatik Domain, although a small number of minor showings are known in the Virgin River and Wollaston domains. At present, no gold showings of significance are known in the Peter Lake Domain.

The Virgin River Domain is separated from rocks of the Taltson magmatic zone to the west by the northwest-dipping Virgin River shear zone, an extension of the Snowbird tectonic zone (*e.g.*, Card *et al.*, 2007). On its eastern margin, the domain is separated from the Mudjatik Domain by the surface trace of the Cable Bay shear zone. The Virgin River Domain is underlain dominantly by Archean felsic orthogneiss (Lewry and Sibbald, 1977), along with remnants of unconformably overlying supracrustal belts that comprise mainly quartzite and amphibolite (Figure 15). All of these rocks have undergone upper amphibolite to granulite facies metamorphism and commonly bear a composite (S_1/S_2) foliation (Card, 2009). A supracrustal rock assemblage coring the Virgin River shear zone, the Virgin schist group, comprises middle amphibolite facies psammopelite, quartzite, pelite, and amphibolite. In terms of age and affinity, rocks of the Virgin schist group are possibly distinct from supracrustal vestiges elsewhere in the domain (*op. cit.*).

Known gold showings in the domain are focussed along the Virgin River shear zone (Figure 15), a zone of ductile shear up to 10 km wide that has been overprinted by brittle faulting. The shear zone is spatially coincident with an increase in the intensity of folding of S_1/S_2 and of a foliation attributed to D_3 deformation, and probably initiated as a thrust fault (Card, 2009). It has a protracted movement history, however, starting with ductile (D_3) thrusting after 1940 to 1930 Ma (Card *et al.*, 2008), subsequent episodic oblique-dextral shearing with variable amounts of dip-slip movement until *ca.* 1830 Ma, and further (1830 to 1780 Ma?) reactivation as a sinistral-oblique, brittle-ductile fault (Card *et al.*, 2007). Later movement along the zone was apparently accompanied by retrograde greenschist facies metamorphism (Card, 2009), suggesting a rehydration event.

A regional geological description of the Mudjatik Domain is provided here using an informal subdivision into 'southwestern' and 'northeastern' components. This subdivision, though somewhat arbitrary, partly reflects differences in the character and age of contained supracrustal rocks (as described below), thus making lithological correlations between the two components tenuous. The southwestern Mudjatik Domain (Figure 15) is underlain primarily by felsic orthogneiss and migmatite, probably of Archean age, with narrow supracrustal septa containing pelite, psammite, quartzite, and amphibolite, as well as rare calc-silicate units and iron formation. These supracrustal sequences are of unknown and possibly variable age, though their deposition is broadly constrained between 2655 Ma and 1840 Ma (Orrell *et al.*, 1999).

In contrast to the strong northeast structural grain in the Virgin River Domain, the southwestern Mudjatik Domain is characterized by arcuate dome-and-basin–style fold-interference patterns (Lewry and Sibbald, 1977). Several periods of deformation have been documented in this part of the domain, most recently in the Black Birch Lake area ('Mudjatik dome-and-basin domain'; Card *et al.*, 2008). The earliest recognized deformational event (D_1) is represented by a composite foliation or gneissosity, in places containing transposed primary layering, that locally defines rare intrafolial F_2 folds. These features are overprinted by close to tight, upright, northeast-trending folds (F_3), some of which developed contemporaneous high-strain zones on their limbs. Hook-style fold interference, thought to be a result of refolding of F_2 by F_3 folds, has also been noted locally (*op. cit.*). The northeast-trending F_3 folds are, in turn, refolded by gentle northwest-trending folds, thereby producing the dominant dome-and-basin fold-interference pattern of the domain. The opposite relationship is noted in the Cree Lake area to the northeast, however, such that northwest-striking F_3 folds were refolded by orthogonal F_4 folds to produce fold-interference patterns not limited to domes and basins (Lewry and Sibbald, 1977; Card and Bosman, 2007).

Peak metamorphism in the southwestern Mudjatik Domain produced mineral assemblages near the upper amphibolite to granulite facies transition (Orrell *et al.*, 1999), though occurrences of granulite facies assemblages have been reported south of Ithingo Lake (Harper, 1988). Card *et al.* (2008) postulated that original granulite facies

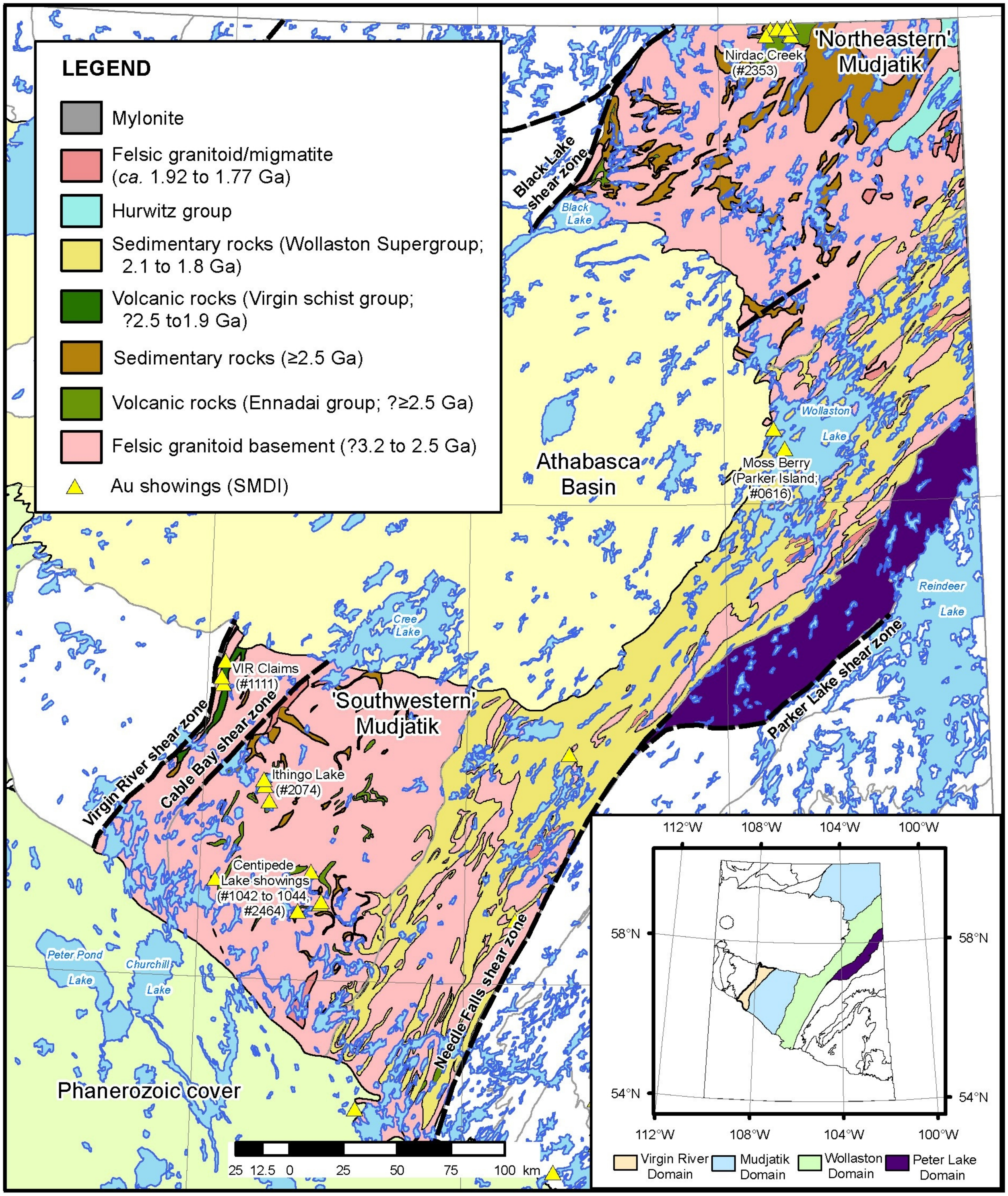

Figure 15 – Generalized geology of the Hearne Province in Saskatchewan (modified from Slimmon, 2011).

assemblages might have been overprinted during a later, upper amphibolite facies retrograde event. The absolute timing of these metamorphic events and their relative position within the deformational history of the southwestern Mudjatik Domain is not well constrained, though Card *et al.* (2007) proposed a distinct Archean (?>2550 Ma) event and one or more Paleoproterozoic (?1820 to 1800 Ma) events, the latter coincident with deformation related to the Trans-Hudson orogeny to the east.

Similar to the southwestern Mudjatik Domain, the northeastern part of the domain (Figure 15) is dominated by felsic orthogneiss and derived migmatite, dominantly of Archean age. The northernmost part of the domain is, however, also underlain by felsic orthogneiss of unknown age and origin, and by distinctive Archean to Paleoproterozoic supracrustal assemblages (van Breeman *et al.*, 2007) that have no definitive analogues to the southwest (Figure 15). Along the Northwest Territories border, the domain is underlain by the *ca.* 2.7 Ga Ennadai-Rankin greenstone belt, the only sequence in this part of the domain known to contain gold mineralization. The Paleoproterozoic Hurwitz group, exposed in the far northeast along the Manitoba border (Figure 15), consists mainly of siliciclastic sedimentary rocks with minor calc-silicate, dolomitic marble, and volcanic rocks. Hudsonian-age intrusions are prevalent throughout the domain and postdate all other rock types.

The Ennadai-Rankin belt is dominated by mafic (and lesser intermediate to felsic) volcanic rocks, locally interlayered with psammopelitic to pelitic schist and iron formation, as well as mafic to ultramafic intrusions (Harper *et al.*, 2001). Although occurrences of strongly deformed, upper amphibolite to granulite facies amphibolite gneiss represent possible remnants of the sequence towards the southwest, the main part of the belt is only weakly deformed and contains upper greenschist to lower amphibolite facies peak metamorphic assemblages. Harper *et al.* (2002) proposed a geological history for the area that includes multiple deformational and coincident metamorphic events. An early (Archean to ?Paleoproterozoic) composite fabric is probably the result of multiple deformational events, at least some of which can be related to outcrop-scale folds, and was locally the focus of dextral shear. Convergence during the Paleoproterozoic, likely resulting from Trans-Hudson orogenesis, caused northwesterly(?) thrusting of Ennadai-Rankin belt rocks over younger Hurwitz group rocks. Subsequent Paleoproterozoic deformation produced sets of west-northwest–trending and north-trending folds that cause outcrop-scale dome-and-basin fold-interference patterns. This folding pattern is more prevalent away from the lower grade rocks of the Ennadai-Rankin belt, which define a broad northeast-trending straight belt. Late centimetre- to metre-scale, asymmetric crenulation folds have been noted and speculated to coincide with dextral Hudsonian shears known regionally. Van Breeman *et al.* (2007) proposed four metamorphic events, including at least two Archean (M_1, 3300 to 2800 Ma; M_2, 2690 to 2680 Ma) and two Paleoproterozoic (M_3 and M_4; 1850 to 1810 Ma) events.

The Wollaston Domain is defined along its western boundary by a transition from the open fold-interference morphologies characterizing the northeastern Mudjatik Domain to a linear, northeast-trending, and tightly folded structural style to the east. Similar to elsewhere in the Hearne Province, rocks of the Wollaston Domain consist partly of Neoarchean felsic orthogneiss and derived migmatite. These rocks are, however, unconformably overlain by and interfolded with a distinctive Paleoproterozoic supracrustal succession, the Wollaston Supergroup (Yeo and Delaney, 2007), that is not identified in other domains of the Hearne Province. The Wollaston Supergroup consists dominantly of siliciclastic metasedimentary rocks, along with subordinate chemical sedimentary and volcanic units, that were deposited between *ca.* 2075 and 1860 Ma. Over the past 45 years, rocks of this sequence have been subdivided by different workers into varying classification schemes (see summary in Saskatchewan Geological Survey, 2003). Recently, Yeo and Delaney (2007) subdivided the Wollaston Supergroup into four unconformity-bounded groups, the Courtenay Lake, Souter Lake, Daly Lake, and Geikie River groups, each consisting of multiple subunits. Collectively, rocks of the Wollaston Supergroup were interpreted by Yeo and Delaney (2007) to record a progressive transition in depositional environment that corresponds to one entire Wilson cycle, reflecting opening and closure of an ocean basin. The basal Courtenay Lake group, dominated by intercalated arkose, conglomerate, and quartzite, with subordinate pelite and bimodal volcanic rocks, is interpreted to record rifting and consequent opening of an ocean basin *ca.* 2075 Ma. The overlying Souter Lake group, comprising quartzite, arkose, and argillite, was interpreted to be deposited on a passive margin, whereas siliciclastic and chemical sedimentary rocks of the uppermost Daly Lake and Geikie River groups are thought to record deposition in a foreland basin between *ca.* 1880 and 1860 Ma. Wollaston Supergroup rocks host numerous small plutonic bodies, ranging from syntectonic diorite and granodiorite complexes to late-tectonic gabbroic bodies to late- to post-tectonic granitoid suites.

Rocks of the Wollaston Domain record a complex structural and metamorphic history. Early structures, related either to Archean deformation or to faulting coincident with deposition of early components of the Wollaston Supergroup, are largely obliterated by later deformation related to the Trans-Hudson orogeny. Four ductile deformational events (D_1 to D_4) have been identified to postdate deposition of the Wollaston Supergroup (Tran *et al.*, 1999; Yeo and Delaney, 2007). The D_1 event, associated with flattening, isoclinal folding, boudinage, and rotation of primary layering, generated a prominent regional foliation and caused shearing focussed near the basement-cover contact. Transposition and refolding of earlier structures into west-northwest–trending upright folds resulted from the D_2 deformational event, particularly in the western part of the domain. The D_3 event produced a pervasive, steeply northwest-dipping foliation that is axial planar to widespread, northeast-trending and doubly plunging, tight to isoclinal folds. These folds are largely responsible for the regional structural patterns of the domain. Subsequent D_4 deformation produced local northwest-trending upright folds, a localized steep axial-planar foliation, and dextral shears that are localized mainly beneath the eastern part of the Athabasca Basin, where they commonly have an association with unconformity-associated uranium mineralization (Yeo and Delaney, 2007). A set of late north-northwest–trending, dominantly brittle faults (D_5), likely related to the regional Tabbernor fault system, offsets all earlier structures in a sinistral sense. Regional metamorphism of Wollaston Domain rocks occurred during two distinct events contemporaneous with D_1 to D_3 deformation. Peak metamorphic assemblages correspond mainly to the upper amphibolite to granulite transition (Tran *et al.*, 1999), although upper greenschist to lower amphibolite facies assemblages predominate in rocks along the eastern margin of the domain.

Showing Descriptions

Southwestern Mudjatik Domain

Ithingo Lake

Main Zone (Including Money, Muskeg, Hilltop, and McMatt Pits/Trenches) and Riverside Zone (SMDI #2074)

Location: southern Ithingo Lake (NTS 74B/13; UTM 6298936 m N, 345557 m E)

Metal Associations: Au (As, Cu, Te, Bi)

Status: developed prospect without Resources

Exploration and Development History:

Gold was first reported in the Ithingo Lake area in 1938 by J.C. Sproule of the Geological Survey of Canada (Sproule, 1938), who noted traces of gold associated with sulphides in quartz veins. Gold mineralization was specifically noted on the south shore of Vermilion Lake, farther west along the same volcanic belt, and along the central peninsula of, and south of, Ithingo Lake.

Although some minor work was done to assess the potential for uranium and iron ore in the area in the 1950s and 1960s, no focussed gold exploration was done until 1985, when Claude Resources Inc. staked areas that had been sampled during the Geological Survey of Canada investigations and yielded anomalous gold values. The Ithingo 'Main' zone was discovered by prospecting in 1987 and the stratigraphic units hosting the mineralized zone were subsequently traced laterally for more than 7 km. Two mineralized trenches ('Money' and 'Hilltop' pits) within the Main zone were subsequently mapped, trenched, and sampled in 1987-88. Geophysical (magnetic?) surveys in the showing area were completed at that time.

In December 1987, Newmont Mines Ltd. entered into an option agreement with Claude on the property. The partnership had airborne geophysical (VLF-EM and magnetic) surveys flown over the area and undertook subsequent ground geophysical ('MaxMin' EM and magnetic) surveys. Exploration in the summer of 1988 resulted in the discovery of several new gold showings along a single 'favourable' lithological horizon, including the 'Riverside', 'Krupski Lake', 'Teardrop Lake', 'Sterny', and 'North Sterny' zones. An extensive diamond-drill program (25 holes, 1236.6 m) was undertaken on the Main zone. The best reported intersection (from the 'Buller' zone) was 7.0 g/t (0.205 oz./ton) Au over a true width of 4.9 m.

In 1989, Pine Channel Gold Corp. entered into an option agreement with Newmont to earn a 60% interest in the Ithingo project. This partnership undertook additional drilling (~2438 m) early that year at the Main and Sterny zones, as well as some of the other newly discovered zones. This drilling outlined five separate mineralized (sub)zones within the Main zone (*i.e.*, the Nos. 1 to 5 zones), as well as several (sub)zones above and below those constituting the Main zone. A third phase of drilling (~3050 m) was undertaken on the property in the summer of 1989 and focussed on and around the Main and Riverside zones.

No additional work was done until 1998, when Claude completed detailed geological mapping, prospecting, and rock sampling on the Main zone (Hilltop Pit, Money Pit, Pit 106, and Muskeg Pit zones) and the Riverside and McMatt Pit zones. The claims were allowed to lapse, but the deposit area was restaked in 2008, after which New Moon Minerals Corp. acquired a 100% interest in the property.

Geological Character:

The mineralized zones that form the Ithingo Lake prospect are hosted by a belt of supracrustal rocks of uncertain age, which includes psammite, quartzite, psammopelite, and mafic volcanic rocks and sills, with subordinate carbonate and calc-silicate units and iron formation (Gilboy, 1985; Harper, 1988; Card *et al.*, 2008). The supracrustal sequence overlies gneissic felsic intrusive rocks of probable Archean age (Orrell *et al.*, 1999), and is intruded by K-feldspar megacrystic to porphyritic granite (*e.g.*, the 'Newmont' granite; Harper, 1988). These rocks have experienced multiple episodes of deformation, as evidenced by pronounced dome-and-basin (type 1) fold-interference patterns (Lewry and Sibbald, 1977; Card *et al.*, 2008) that control the map pattern of the supracrustal rocks around Ithingo Lake (Figure 16). Rocks in the immediate Ithingo Lake area have been metamorphosed either under transitional upper amphibolite to granulite facies conditions (Harper, 1988) or under upper amphibolite facies conditions that possibly overprinted an earlier granulite facies assemblage (Card *et al.*, 2008).

Gold mineralization at Ithingo is associated mainly with shear zone–hosted quartz veins that are stratabound within amphibolitic units (mafic volcanic rocks) and, to a lesser degree, banded iron formation. Three main gold-mineralized zones are known (Main, Riverside, and McMatt Pit), some comprising multiple subzones, and are aligned in a broadly east-west orientation along the strike of the hostrocks (Figure 17). At the Main zone, the shear and auriferous veins are easterly trending and northerly dipping (Figure 18), parallel the main regional foliation, and can be traced for about 430 m along strike and to a vertical depth of 85 m. Harper (1988) reported that the veins are isoclinally folded, boudinaged, and metamorphosed, and suggested that the mineralizing event predated major deformation and peak metamorphism. Card *et al.* (2008) emphasized the lenticular shape and lateral discontinuity of the vein system, suggesting that a postmineralization, down-dip extension event, now manifested as a prominent down-dip stretching lineation in the Main zone, dismembered a once-continuous vein system. They further suggest that, if this interpretation is correct, orebodies should be linear in form and plunging down the dip of the shear zone. A series of late, north-northwest–trending faults is interpreted to overprint and offset the vein system (Saskatchewan Ministry of Energy and Resources (SMER) Assessment File 74B14-0006).

The mineralized veins at the Main zone are up to 1.5 m wide and contain up to 30% disseminated, fine- to coarse-grained pyrite and pyrrhotite, with subordinate arsenopyrite and chalcopyrite as interstitial 'blebs'. Free gold is locally observed. Gold content does not seem to correlate with increased base metal content (SMER Assessment File 74B14-0006). Harper (1988) reported the presence of sparsely disseminated sulphides and iron staining in the structural hangingwall of the vein system. Silicification is the most common evidence of hydrothermal fluid flow, although the presence of albite, chlorite, prehnite, actinolite, and epidote has also been reported proximal to auriferous veins. Units of K-metasomatized (biotite-bearing) and Mg-metasomatized (anthophyllite- and/or cordierite-bearing) amphibolite have been mapped near the showing area (Card *et al.*, 2008), though their relationship with gold mineralization, if any, has not been resolved. A gold grade of ~33.5 g/t (0.98 oz./ton) has, however, been reported from biotitic amphibolite apparently devoid of any apparent quartz-veining/silicification or sulphides (SMER Assessment File 74B13-0012), potentially expanding the prospective zone for gold mineralization (*e.g.*, Turner, 2009).

Inferred Deposit Type: orogenic gold

Associated Showings: Sterny and North Sterny zones (SMDI #2479)

Production, Reserves/Resources: none known

Centipede Lake Showings

Including Centipede Lake Trenches (SMDI #1042) and Rex Silver Mines Grid A to C Trenches / Sunlite Trenches (SMDI #1043, #1044, and #2464)

Location: within 1 to 10 km east of Porter Lake, ~40 km east of the east end of Frobisher Lake (NTS 74B/06; UTM 6240662 m N, 360740 m E)

Metal Associations: Au (Cu, As)

Status: occurrences

Exploration and Development History:

Gold exploration in the Centipede Lake area was initiated in 1969 by Sunlite Oil Company Ltd., which completed prospecting, geological mapping, and an airborne geophysical (INPUT-EM) survey. Trace gold values were

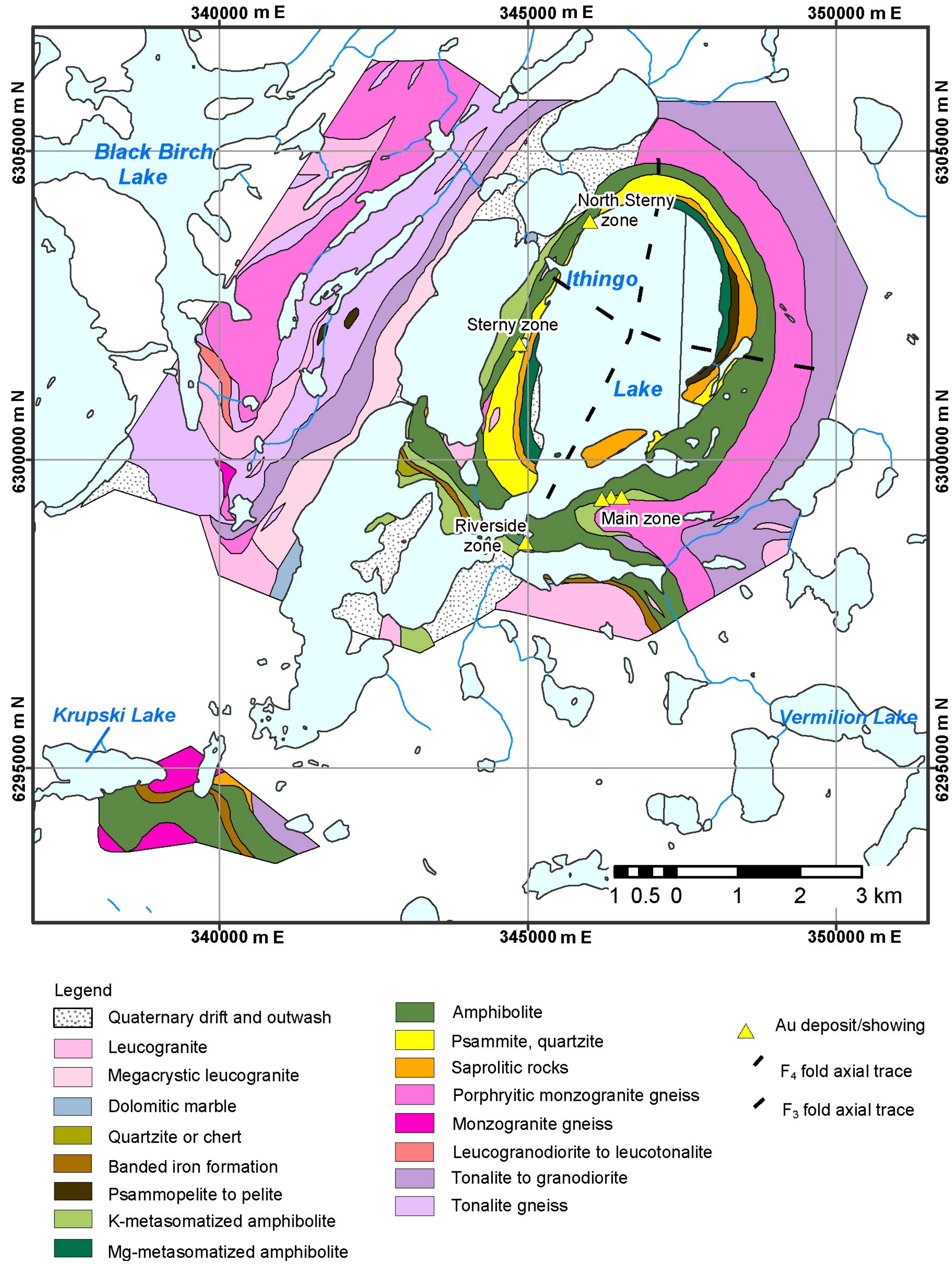

Figure 16 – Geological character of the Ithingo Lake area (modified from Card et al.*, 2008), with locations of gold-mineralized zones.*

returned from sampling of a gossanous outcrop. Sunlite completed additional prospecting, geological mapping, geochemical sampling, and geophysical (EM) surveying in the Centipede-Segment lakes area in 1973, and subsequently completed a series of trenches that led to the discovery of several slightly anomalous gold, silver and base metal showings.

No appreciable work was done in the area until 1978-79, when Saskatchewan Mining Development Corp. (SMDC) acquired claims in the area and completed airborne geophysical (EM, magnetic, and radiometric) surveys. After these claims lapsed, Rex Silver Mines Ltd. acquired claims in the area in 1984 and completed geological mapping, rock and soil sampling, and trenching. Assays from 'C Grid' trench samples (SMDI #1044) generally yielded minor gold mineralization, although assaying of grab samples from the 'A Grid' trench (SMDI #1043) graded between 8 and 11 g/t Au. Claims covering the area were allowed to lapse, but were under disposition as of January 1, 2012.

Figure 17 – Quartz veins at the Ithingo Lake Main zone, showing stratabound character within steeply dipping amphibolitic unit (photo courtesy C. Card).

Geological Character:

The Centipede-Segment lakes area is underlain by thin vestiges of supracrustal rocks within vast expanses of massive to gneissic granite that characterize much of the Mudjatik Domain. The supracrustal rocks in the showing area, of unknown age, comprise mainly amphibolite, psammitic to pelitic gneiss, quartzite, and oxide-silicate facies iron formation. The supracrustal belts form arcuate to subcircular outcrop patterns, the result of type 1 (dome-and-basin style) fold interference (Lewry and Sibbald, 1977).

Minor gold mineralization at the showing is associated mainly with sulphides in oxide facies banded iron formation, magnetite-bearing quartzite, and graphitic pelitic gneiss. Sulphide phases include pyrrhotite (up to 20%), pyrite (up to 5 to 10%), and trace chalcopyrite, arsenopyrite, sphalerite, and/or molybdenite; gold mineralization, associated with graphite, magnetite, and minor native copper, has also been noted. One unique gold showing (A Grid trench; SMDI #1043) is described as a "15.2 cm wide vein of white sulphide-arsenide" hosted in possible silicate facies iron formation. Little is known of the structural setting or

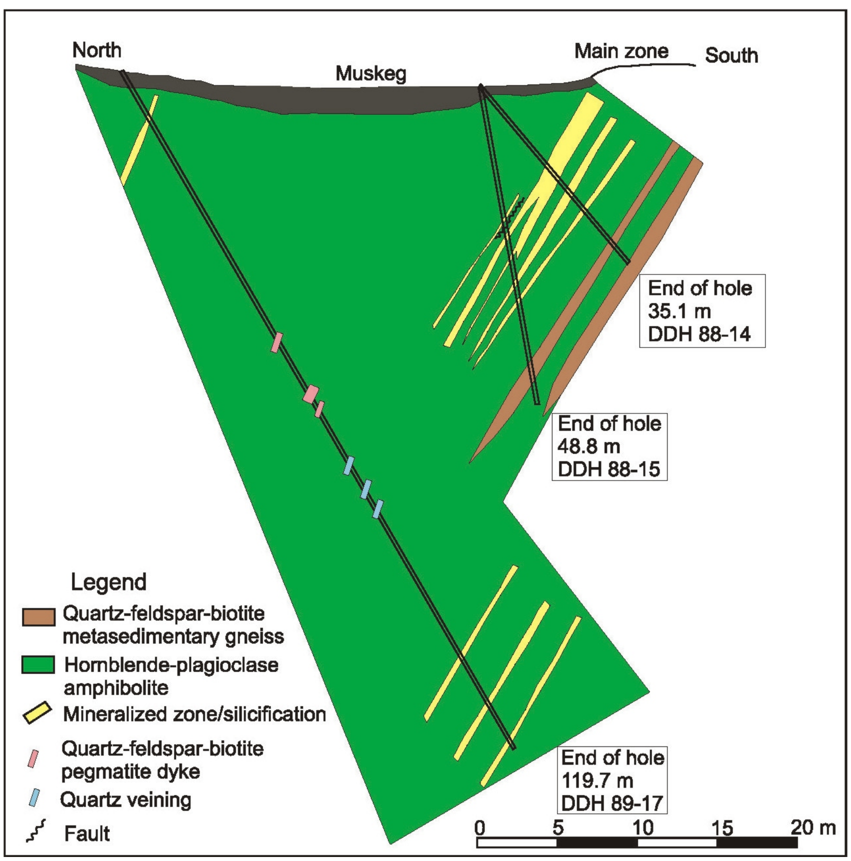

Figure 18 – North-south cross-section through three drill holes in the Ithingo Lake Main zone (from SMER Assessment File 74B13-0012, Pine Channel Gold Corp.). Abbreviation: DDH, diamond-drill hole.

petrogenesis of the mineralization in the Centipede-Segment lakes area.

Inferred Deposit Type: unknown

Associated Showings: ?Nigel's Au, New gold showings (SMDI #2525)

Production and Reserve/Resources: none

Northeastern Mudjatik Domain

Nirdac Creek (SMDI #2353)

Location: ~5 km west of Hatle Lake (NTS 64M/13; UTM 6649717 m N, 580325 m E)

Metal Associations: Au, (Ag, As, Cu, Te)

Status: occurrence

Exploration and Development History:

Regional geological mapping and airborne and ground geophysical (magnetic and radiometric) surveying were undertaken sporadically in the showing area between the mid-1950s and 1976, primarily for uranium exploration.

The first concerted effort directed at gold exploration was made by Saskatchewan Mining Development Corporation (SMDC) in 1984, with the completion of an airborne geophysical (INPUT EM and magnetic) survey over the property. This was followed by regional bedrock and surficial mapping, prospecting, and till and lake-sediment geochemistry, the latter leading to the first indication of anomalous gold in the area: a boulder sampled just north of the Nirdac Creek showing yielded 8.7 g/t (0.253 oz./ton) Au. In 1985, SMDC followed up on targets defined the previous year through detailed, grid-based geological and surficial mapping, ground geophysical (HLEM, VLF-EM, and magnetic) surveys, prospecting, and till and lake-sediment sampling. A drill program (19 holes) was initiated to test previously defined targets and to locate the source of a boulder train of auriferous iron formation. Three of these holes intersected significant gold mineralization in the source area. The highest value intersected was 21.5 g/t (0.637 oz./ton) Au over 0.5 m, although the typical range was 0.7 to 4.5 g/t (0.020 to 0.131 oz./ton) Au over 0.5 to 1 m.

SMDC entered into a joint venture with East West Resource Corp. in 1987 to further explore the property. The partnership conducted additional fieldwork and undertook further drilling (17 holes), but no significant results were reported. Athabasca Gold Resources Ltd. joined the joint-venture partnership in 1987 and additional regional exploration programs were carried out in the area between 1987 and 1989.

No further exploration was carried out in the area until 1996, when R. Spooner staked a claim on the showing area. The claim was optioned to Golden Band Resources Inc. in 1997, which collected 68 bulk till samples in the Nirdac Creek project area. No anomalous gold grain counts or gold contents were discovered during this work. The Nirdac Creek showing area was covered by active mineral dispositions as of January 1, 2012.

Geological Character:

The Nirdac showing is hosted by interbedded iron formation and sericitic psammitic schist of the *ca.* 2.7 Ga Ennadai group (Reilly, 1993a). The iron formation is predominantly of garnet-grunerite silicate facies with minor interbeds of chert and sulphide facies iron formation, the latter containing up to 20% combined pyrite+pyrrhotite±chalcopyrite ±bornite±arsenopyrite (MacDougall, 2001). The hostrocks have been metamorphosed under lower to middle amphibolite facies conditions.

At this location, the iron formation is northeast trending, parallel to the main regional schistosity, and moderately northwest dipping. A foliation-parallel (D_4), brittle-ductile shear zone has been mapped at the showing location and the rocks have been folded into shallowly northeast-plunging, typically Z-shaped folds that were interpreted as asymmetric shear folds (Reilly, 1993a). The shearing manifests as an intense penetrative foliation; abundant sericite-rich layers and lenses; and folded, boudinaged, and rotated quartz veins (*op. cit.*).

From limited observations and assay values of drill core, SMDC geologists proposed that gold mineralization at Nirdac Creek has two main associations: 1) as stratiform concentrations within a sequence of finely interbanded sulphide (pyrrhotite) layers, chert bands, and subordinate amphibole-garnet-sulphide beds; and 2) within pyrrhotite and visible gold–bearing quartz veins that crosscut a tectonically contorted equivalent rock sequence similar to the first type (Figure 19). Rare arsenopyrite porphyroblasts are associated with both types, whereas pyrite was observed only in the latter. Veins at the showing also contain apatite and an unidentified black mineral that is possibly a telluride (MacDougall, 2001).

Inferred Deposit Type: orogenic gold (iron formation–hosted); ?exhalative/stratiform ±remobilized gold

Associated Showings: Nirdac A Grid ('Roujed' Lake; SMDI #2354), Lac? (SMDI #2356), Roumap Lake? (SMDI #2358)

Production and Reserves/Resources: none

Virgin River Domain

VIR Claims (SMDI #1111)

Location: ~5 km south of Dicks Lake, 1 km east of the Virgin River (NTS 74G/04; UTM 6346344 m N, 326412 m E)

Metal Associations: Au (As, Ag±Cu±Pb±Zn±Ni)

Status: occurrence

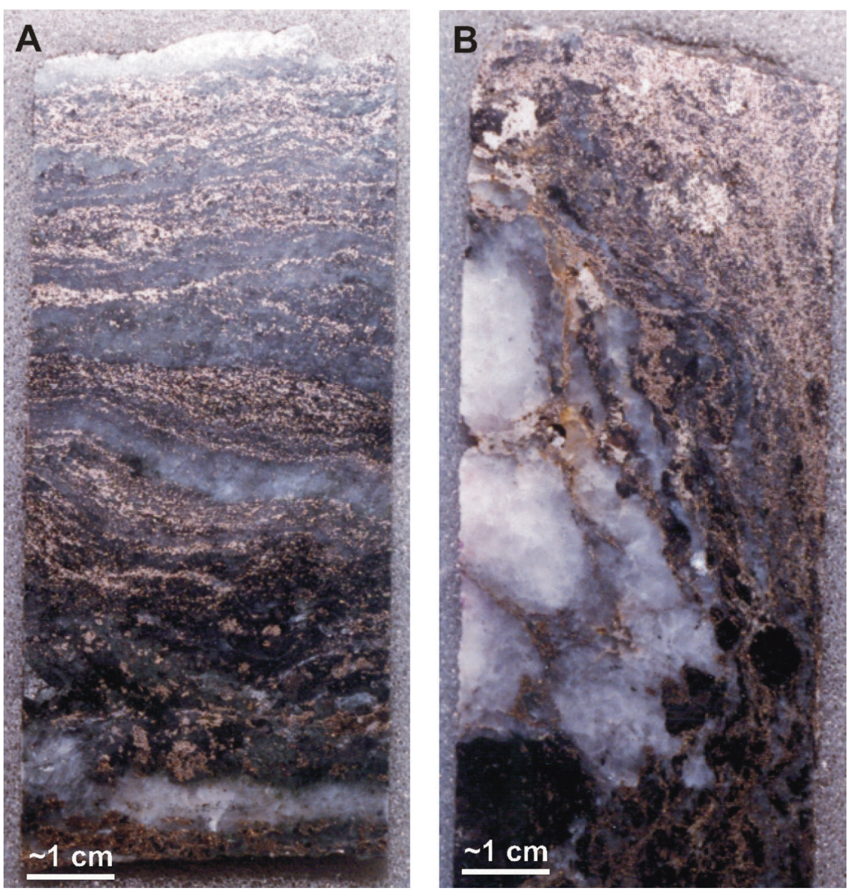

Figure 19 – Drill-core photo showing two styles of gold mineralization identified at the Nirdac Creek showing (drill hole EN51, 15.9 to 16.9 m), including: A) stratiform auriferous sulphide facies iron formation, grading 4.8 g/t (0.139 oz./ton) Au; and B) recrystallized and quartz-veined equivalent, grading 15.6 g/t (0.456 oz./ton) Au (SMER Assessment File 64M14-006, SMDC).

Exploration and Development History:

The VIR claims (1 to 11) were originally staked in 1962 by B.R. Richards and J. Slater. Shortly thereafter, an exploration program consisting of prospecting, geological mapping, and ground geophysical (EM and magnetic) surveys was completed over the claims. VIR claims 1 and 2 were subsequently allowed to lapse.

Scurry-Rainbow Oil Ltd. acquired the area covered by VIR claims 3 to 11 in 1965 and completed geological mapping, geochemical sampling, and ground geophysical (EM and magnetic) surveys, as well as limited diamond drilling (three holes) to the north of the claims. This drilling did not intersect any substantial gold mineralization. In 1966, the property covered by the VIR claims was transferred to C.A. Hogg, and then to Rapid River Resources Ltd., which performed geological mapping, geochemical sampling, and ground geophysical (EM and magnetic) surveys. Rapid River completed a small exploration pit, grab sampling, and trenching on VIR claim 11, which yielded some slightly elevated gold and silver values. A mineralized boulder sampled just south of Dicks Lake, ~3 km north of the VIR showing area, reportedly yielded 7.5 g/t (0.22 oz./ton) Au and 1.04% Cu (Coombe, 1984). A diamond-drill program (29 holes) was completed on the VIR claims in 1967 to test geophysical targets; only two of these yielded slightly anomalous gold values, although intersections in several other holes yielded slightly anomalous Ag, Pb, Zn, Ni, and Cu concentrations.

The claims lapsed in 1968 but were restaked shortly thereafter by Vespar Mines Ltd. After performing geological mapping and airborne geophysical (EM, magnetic, and gamma ray) surveying, Vespar allowed the claims to lapse in 1970. After claiming the showing area in 1978, Bonn Energy Corp. optioned the property to Getty Minerals Ltd. the following year, which undertook a reconnaissance uranium exploration project in the region. Additional exploration work was done in the general area in 1986 by Claude Resources Inc. (prospecting and rock sampling) and in 2005 by Dejour Enterprises Ltd. (airborne magnetic and gamma-ray spectrometer survey). As of the end of 2011, the VIR Claims showing area was not covered by an active mineral disposition.

Geological Character:
The area of the VIR claims showing is underlain by the Virgin schist group (Figure 15), a supracrustal sequence near the northwestern margin of the Virgin River Domain that cores the Virgin River shear zone and comprises interlayered mafic to intermediate volcanic rocks, graphitic pelitic schist, and subordinate greywacke (Card and Bosman, 2007). The main mineralized outcrop of the VIR claims showing is situated within north-trending, steeply west-dipping units of sheared graphitic slate and greywacke. These hostrocks have attained peak metamorphic conditions corresponding to the middle to upper amphibolite facies transition, although they have experienced a lower amphibolite facies retrograde overprint (Card *et al.*, 2008).

Mineralization is associated with quartz stringers and secondary carbonate (up to 20%). Several sulphide species have been noted, including disseminated to semimassive pyrite, pyrrhotite, and arsenopyrite, as well as minor chalcopyrite, disseminations and stringers of molybdenite, and traces of bornite and pentlandite. The sulphides are concentrated in silicified and graphitic ‘bands’ that are 0.3 to 2.5 m thick and locally make up 5 to 30% of the rock. Some sulphides have been remobilized. The detailed structural setting of the mineralization is unknown.

Inferred Deposit Type: unknown

Associated Showings: ?Grab samples (SMDI #2686 and #2687)

Production and Reserve/Resources: none

Wollaston Domain

Moss Berry (Parker) Island (SMDI #0616)

Location: southwest side of ‘Little Moss Berry’ (Parker) Island, in west-central Wollaston Lake (NTS 64L/04; UTM 6455150 m N, 587033 m E)

Metal Associations: Au, Ag (Cu, Zn, Pb)

Status: occurrence

Exploration and Development History:
Mineralization was first discovered on Moss Berry Island on Wollaston Lake by prospector E.F. Partridge in 1966. The nearby Moss Berry Island showing was discovered in 1968 during a prospecting and mapping program on the south end of adjacent Little Moss Berry Island by New Continental Oil Company of Canada Ltd. The area was staked, and chip samples collected from the showing indicated slightly elevated gold values. Airborne geophysical (EM and radiometric) surveys were completed over the area in 1969. Claims covering the area lapsed in 1972. A claim was restaked over the showing area in 2006 by Northern Canadian Minerals Inc. and remained active as of January 1, 2012.

Geological Character:
The Moss Berry Island showing is hosted by a northeast-trending quartzite unit of the Hidden Bay assemblage, Wollaston Supergroup. Gold and sulphide mineralization, including up to 2% pyrite, arsenopyrite, and/or chalcopyrite, is situated in irregular quartz veins and stringers within an extensive northeast-trending shear zone.

Oxidation of sulphide minerals results in a gossanous surface exposure of the mineralization. Quartz veins are variably oriented, occurring both subparallel and oblique to the dominant schistosity in the hostrocks.

Inferred Deposit Type: ?orogenic gold

Associated Showings: none known

Production and Reserves/Resources: none

Gold Metallogenesis

Currently available information indicates that, in the Hearne Province, the Mudjatik Domain has the highest potential for economic concentrations of gold, though minor gold showings are also known in the Virgin River and Wollaston domains. Throughout the Hearne Province, gold mineralization is dominantly epigenetic (associated with shear zones ± quartz veins) in character; syngenetic mineralization has not been conclusively identified to date, though it has been speculated that iron formation was the original source of gold at the Nirdac Creek (Reilly, 1993a) and Ithingo Lake (Card *et al.*, 2008) showings. Metamorphosed hydrothermal alteration zones, possibly of volcanogenic massive sulphide style, have also been identified (*e.g.*, 'K- and Mg-metasomatized amphibolite'; Card *et al.*, 2008).

Gold showings throughout the Hearne Province are invariably hosted by supracrustal rocks, specifically including mafic volcanic rocks / amphibolite (Ithingo Lake), banded iron formation (Nirdac Creek and Ithingo Lake), and clastic sedimentary rocks (Moss Berry Island). Relative to the surrounding rocks, these hostrocks likely provided a rheologically (and/or chemically?) favourable environment for promotion of ore deposition. No showings are currently known to be hosted by the basement felsic gneiss that is prevalent throughout the Hearne Province. Although this negative association could simply represent an exploration bias, it is consistent with relationships noted in most Archean gold districts around the world, which tend to be focussed within greenstone belts (*e.g.*, Goldfarb *et al.*, 2001).

Despite recognition of a strong structural control on gold mineralization throughout the Hearne Province, a comprehensive understanding of both the critical structural relationships and the timing of mineralization is lacking. Available information from the few known deposits/showings suggest, however, that these gold mineralizing events were unrelated and spanned much of the deformational and metamorphic history of the craton.

At the Ithingo Lake showing, gold appears to be intimately linked to a shear zone(s) that parallels the main regional fabric. Preliminary investigations by Harper (1988) and Card *et al.* (2008) indicated that the host shear zone and the mineralized veins were subjected to later deformation (folding, boudinage) and metamorphism, implying a relatively early (possibly Archean?) timing for gold deposition. This interpretation needs to be substantiated by detailed geochronology and mineral texture and mineral equilibria studies at the deposit. If valid, however, this interpretation could require a slight modification to exploration approaches at this locale and other high-grade supracrustal belts in the Hearne Province. Specifically, it might be worthwhile focussing exploration on shear zones that conform to later deformational features (*e.g.*, that wrap around dome-and-basin fold-interference structures) and on recognition of cryptic metamorphosed ore and alteration features (*e.g.*, partial melting features; K-rich metamorphosed alteration zones in mafic rocks; gold inclusions in metamorphic minerals; Phillips and Powell, 2009).

At the Nirdac Creek showing, a major question is whether all gold mineralization resulted from epigenetic hydrothermal-fluid flow, or whether the stratiform, iron formation–hosted style of ore (Figure 19A) was syngenetic in origin (*e.g.*, Reilly 1993a). This style of ore at Nirdac Creek has been compared by exploration geologists (SMER Assessment File 64M14-006) to that present at other well-known, iron formation–hosted deposits in North America, including the Lupin deposit, Northwest Territories, and the Homestake deposit, South Dakota. As at Nirdac Creek, a syngenetic origin has been proposed for stratiform ore at these deposits (*e.g.*, Rye and Rye, 1974), although subsequent work has pointed instead towards an epigenetic control (*e.g.*, Lhotka and Nesbitt, 1989; Frei *et al.*, 2009; Morelli *et al.*, 2010). Although further work is required to resolve this issue at Nirdac Creek, and at iron formation–hosted gold deposits in general, the clear spatial association between gold mineralization and iron formation is nevertheless important for exploration purposes. As opposed to the stratiform ore style, the quartz vein–associated variety of gold mineralization at Nirdac Creek (Figure 19B) is clearly epigenetic and was interpreted by Reilly (1993a) to be of relatively late (D_4) timing, probably synchronous with thermotectonism associated with terminal collision between the Hearne, Sask, and Superior cratons (*i.e.*, Trans-Hudson orogen) to the east.

Regardless of ore style and genesis, Saskatchewan Mining Development Corporation geologists proposed four key criteria for exploration for gold occurrences similar to Nirdac Creek in the Ennadai-Rankin greenstone belt (SMER Assessment File 64M14-006). These include: 1) the presence of sulphide/silicate facies iron formation within clastic sedimentary rocks; 2) the presence of gossanous boulders of auriferous and arsenic-bearing iron formation; 3) weak- to moderate-strength, coincident magnetic and EM anomalies in suitable rocks, with positive induced polarization being the highest priority; and 4) bulk till samples with significant gold values (>100 ppb) taken proximal to, or down-ice from, suitable rocks.

The timing and origin of gold mineralization in the Virgin River Domain are unknown. Available information indicates that mineralization in the domain is likely focussed within supracrustal rocks of the Virgin schist group and that causative hydrothermal fluids might have been transported along the Virgin River shear zone. Additional work is required to assess the relative timing and tectonic setting of gold mineralization in the domain.

Chapter 6 – Reindeer Zone, Trans-Hudson Orogen

Geology of the Reindeer Zone

The Reindeer Zone in Saskatchewan underlies the southeastern third of the exposed Precambrian shield (Figure 1) and has historically been the area of most focussed gold exploration in the province. It has been subdivided into several lithotectonic domains, including (from west to east; Figure 20 inset map) the Wathaman, Rottenstone, La Ronge, Kisseynew, Glennie, and Flin Flon domains. As defined by Stauffer (1984), the Reindeer Zone includes rocks that form the internides of the *ca.* 1.8 Ga Trans-Hudson orogen, many of which were originally deposited between *ca.* 1900 and 1840 Ma within an ocean that separated at least three Archean (to Paleoproterozoic) cratons: the Rae-Hearne, Sask, and Superior cratons.

Lewry *et al.* (1990) proposed that rocks of the Reindeer Zone comprise several major allochthonous thrust sheets (*i.e.*, the Wapassini, Cartier, Kyaska, and Attitti sheets) that are soled by extensive high-strain zones and that were emplaced in response to extreme crustal shortening and fold/thrust stacking. During orogenesis, one or more of these allochthons were thrust over the Sask craton and, along with flat-lying Phanerozoic sedimentary deposits south of the shield, now completely obscure it, except for a few small tectonic inliers (*e.g.*, Lewry *et al.*, 1994; Figure 20). On its western margin, the Reindeer Zone is in contact with the Hearne craton margin along the Needle Falls and Parker Lake shear zones. To the east, it continues into Manitoba, where it is eventually bounded by the Superior craton along the sheared Superior boundary zone. With the exception of a suite of late, postcollisional granites (*i.e.*, the 'Jan Lake' suite), all rocks of the Reindeer Zone are polydeformed and metamorphosed.

Known gold showings are scattered throughout much of the Reindeer Zone, although they are concentrated mainly in the southern La Ronge, central Glennie, and eastern Flin Flon domains (Figure 1). Descriptions of the geological character and tectonic history of the Reindeer Zone and its constituent domains have been provided by the Saskatchewan Geological Survey (2003 and references therein), but are summarized briefly here in the context of gold mineralization. The Wathaman Domain, on the Reindeer Zone's western margin (Figure 20), is underlain dominantly by 1865 to 1850 Ma continental-arc–derived, K-feldspar–phyric monzonite, and monzogranite to quartz diorite intrusions ('Wathaman Batholith'; Fumerton *et al.*, 1984); the domain contains no known gold showings. Rocks of the adjacent Rottenstone Domain to the east (Figure 20) consist mainly of pre–1860 Ma, partially migmatized clastic sedimentary rock sequences along with several compositionally diverse intrusive suites, ranging from pretectonic (*ca.* 1890 Ma) arc-derived plutons to late (*ca.* 1835 to 1815 Ma) metamorphic-derived leucocratic melts (*e.g.*, MacLachlan, 2005). Localized exposures of 1905 Ma volcanic rocks (Clements Island belt; *e.g.*, Corrigan *et al.*, 2001) have also been identified. Metamorphic mineral assemblages of these rocks range from lower to upper amphibolite facies, with the lowest grade rocks occurring on the eastern margin of the domain. Historically, the Rottenstone Domain has not been regarded as a region of high gold potential, though a few minor occurrences are known in the southwestern portion of the belt (Figure 1).

Rocks of the La Ronge Domain (Figure 20), host to the largest proportion of gold showings known in the Reindeer Zone, comprise a northwest-dipping crustal stack that structurally underlies rocks of the Rottenstone Domain. The domain is dominated by *ca.* 1880 to 1875 Ma volcanic rocks of ultramafic through felsic compositions, along with minor intercalated clastic and chemical sedimentary layers. These collectively form a northeast-trending belt between Lac La Ronge and Reindeer Lake (previously the 'Central metavolcanic belt') that is continuous with the Lynn Lake belt in Manitoba. The volcanic rocks in the northeastern portion of the domain have most recently been subdivided (Maxeiner *et al.*, 2005) into: the Lawrence Point assemblage, interpreted as a mafic to ultramafic suprasubduction zone ophiolite; and the structurally overlying Reed Lake assemblage, a calc-alkaline felsic- to intermediate-dominated volcanic island arc succession that also includes minor pelitic sedimentary rocks. The southwestern portion of the domain, which contains most of the known gold showings, comprises tholeiitic to calc-alkaline volcanic rocks deposited dominantly in an island arc environment (Watters and Pearce, 1987; Thomas, 1993). The volcanic belts were intruded by a widespread suite of calc-alkaline, arc-derived plutons between about 1865 and 1835 Ma, which have been subdivided into three distinct groups based on their physical and compositional attributes (*op. cit.*). These include composite or multiphase, gabbroic and dioritic to granitic, 'Group 1' plutons; relatively homogeneous, granodioritic to granitic, 'Group 2' plutons; and small, homogeneous, quartz-rich leucogranitic and leucogranodioritic, 'Group 3' intrusions.

Several generations of structural features have been defined in the La Ronge Domain (Figure 21). The earliest known fabric (D_1) is a foliation formed before about 1860 Ma that has been identified on southern Reindeer Lake (Corrigan *et al.*, 2001) and southwest of Waddy Lake (Lafrance and Heaman, 2004). Throughout much of the La

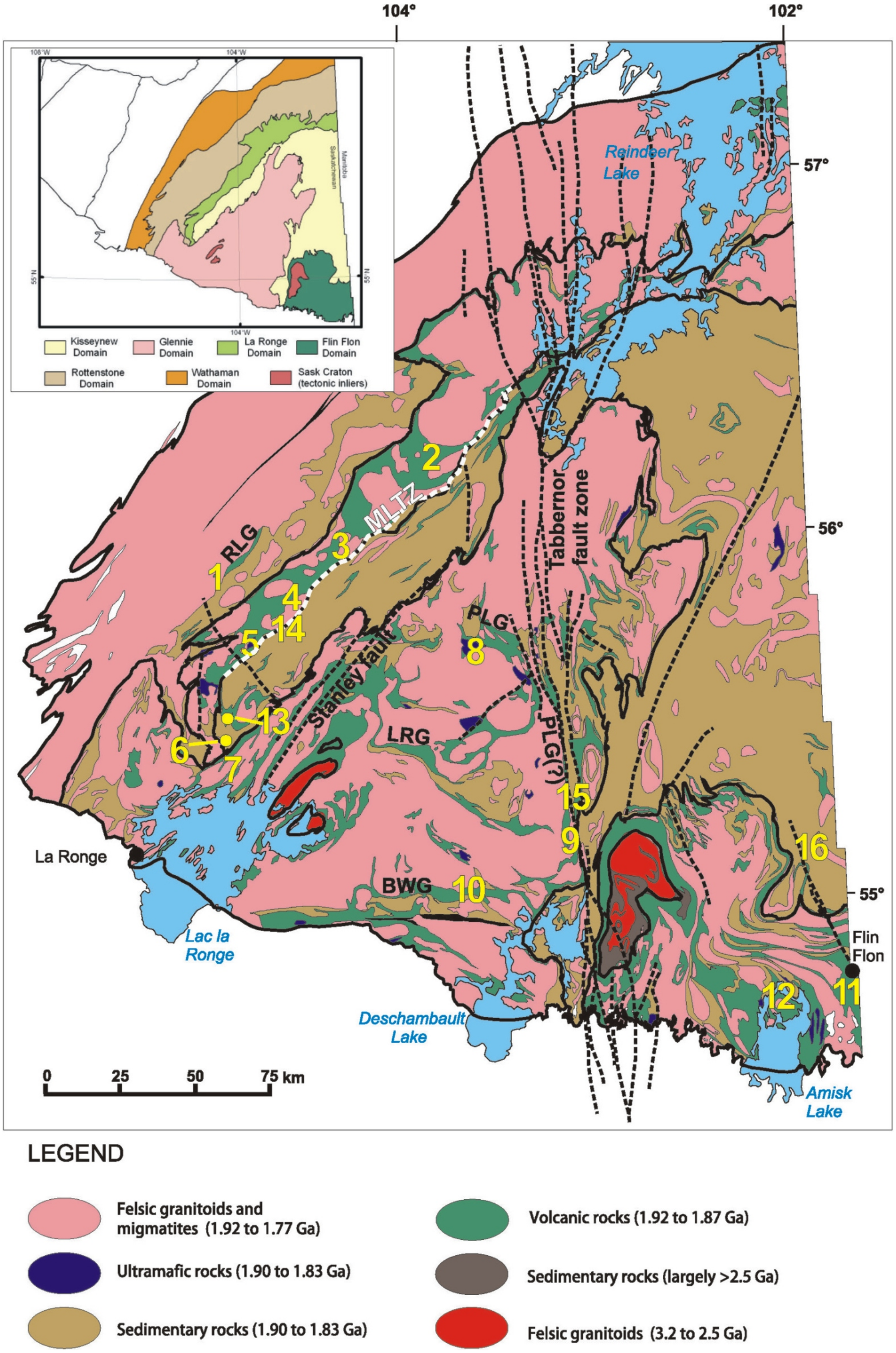

Figure 20 – Simplified geological setting of the Reindeer Zone in Saskatchewan (from Saskatchewan Geological Survey, 2003). Yellow numbers correspond to individual areas of gold mineralization in the Reindeer Zone as they appear in the text. Numbers are strictly based on geographic location and not their relative potential for gold mineralization: 1, Dunnet–Hepburn lakes; 2, Waddy Lake; 3, Star Lake; 4, Berven–Roundish lakes; 5, Dickens Lake; 6, Contact Lake (La Ronge Domain); 7, North Lac La Ronge (Glennie Domain); 8, Laonil Lake; 9, Prongua–Lariviere lakes; 10, Brownell Lake; 11, Phantom Lake–Flin Flon; 12, Amisk Lake; 13, MacKay Lake; 14, Stewart River; 15, Wood Lake; and 16, Mari Lake. Abbreviations: BWG, Brownell-Wapawekka greenstone belt; LRG, Leland–Robinson lakes greenstone belt; MLTZ, McLennan Lake tectonic zone; PLG, Pine Lake greenstone belt; and RLG, Rennick Lake greenstone belt.

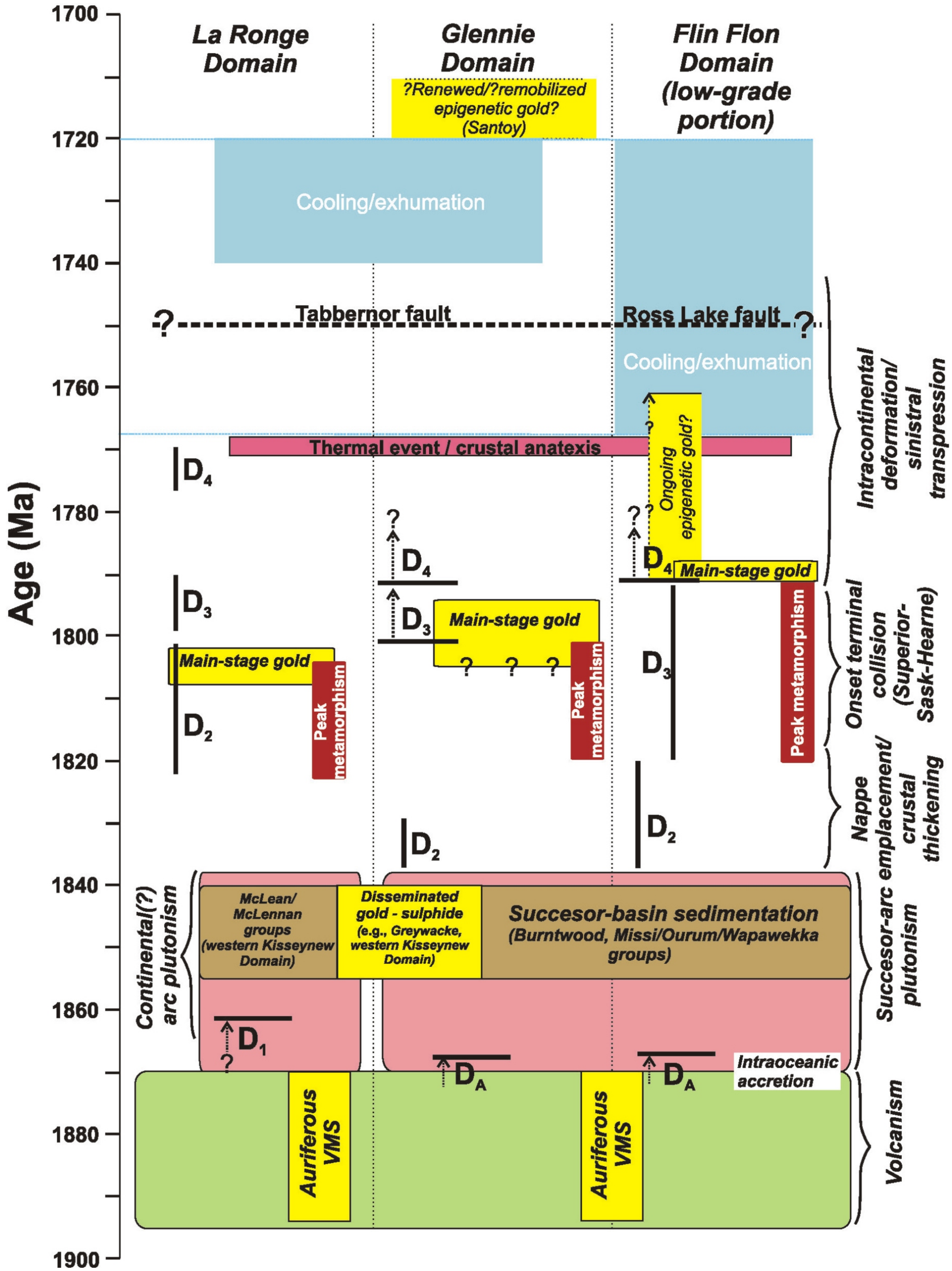

Figure 21 – Generalized interpretation of the deformational/thermotectonic history of rocks of the La Ronge, Glennie, and southwestern Flin Flon domains, compared with the relative timing of gold mineralizing events. Interpretation is based on compilation of published geochronological data from Fedorowich* et al. *(1991), Durocher (1997), Durocher* et al. *(2001), Saskatchewan Geological Survey (2003), Ansdell* et al. *(2005), and Schneider* et al. *(2007). Symbols labelled 'D' show inferred timing of distinct deformational events. Note that the size of boxes/bars generally reflects the duration of an event, but can also indicate uncertainty in the timing or duration of events. Abbreviation: VMS, volcanogenic massive sulphide.

Ronge Domain, this early foliation was transposed during subsequent (D_2) deformation, resulting in the formation of a composite (S_1/S_2), northwest-dipping foliation that is axial planar to common northeast-trending, tight to isoclinal F_2 folds and is commonly associated with a coeval down-dip stretching lineation. This D_2 deformation also resulted in displacement along major northeast-trending shear zones throughout the domain and along its margins (*e.g.,* McLennan Lake and Looney Lake tectonic zones), which, along with related subsidiary structures (*e.g.,* Byers Lake tectonic zone), have a spatial association with gold showings (Harper, 1985; Coombe *et al.*, 1986; Thomas, 1993). The McLennan Lake tectonic zone (Figure 20), for example, is an extensive, gently to moderately northwest-dipping zone of high strain that originated as a northeast-vergent thrust fault (Lewry, 1983) or transpressional zone (Thomas, 1993) and was possibly later reactivated as a dextral transcurrent fault (Poulsen *et al.*, 1987; Thomas, 1993). Collectively, these D_1/D_2 structures form the dominant northeast-trending structural grain throughout the La Ronge Domain. These earlier fabrics were overprinted by open to close, north-trending and steeply east-dipping D_3 folds and upright, northeast-trending D_4 folds. Both the D_3 and D_4 structures are known throughout the Reindeer Zone (see below) and likely formed as late- to postcollisional structures during intracontinental deformation between about 1800 and 1770 Ma (*e.g.,* Ashton *et al.*, 2005).

The lithological framework of the Flin Flon and Glennie domains is similar to that of the La Ronge Domain, consisting primarily of *ca.* 1895 to 1870 Ma volcanic belts, widespread synvolcanic to post-tectonic plutonic rocks, and minor sedimentary rocks (Figure 20). Volcanic sequences in the Flin Flon Domain have been subdivided into several distinct 'assemblages' based on the inferred geodynamic setting of deposition (Syme *et al.*, 1998), including evolved arc (Mystic Lake), juvenile arc (*e.g.*, Flin Flon, West Amisk, Hanson Lake, and Northern Lights), oceanic plateau (Sandy Bay), and mid-ocean ridge/back-arc basin (Elbow-Athapapuskow, Manitoba) assemblages. Greenstone belts of the Glennie Domain (*e.g.,* Brownell Lake, Gee Lake, and Pine Lake) comprise arc- and/or MORB/back-arc–derived constituents (Slimmon, 1994; Maxeiner and Normand, 2009). Intraoceanic accretion processes between about 1880 and 1865 Ma (D_A; Figure 21) are implicated in the formation of a tectonic 'collage', whereby the various volcanic assemblages of the Flin Flon Domain (Lucas *et al.*, 1996), along with those of the Glennie Domain, were accreted into a single tectonic entity (Ashton, 1999). Renewed subduction beneath this collage resulted in widespread arc magmatism between about 1870 and 1835 Ma ('successor arc'; Syme *et al.*, 1998), presently manifested as a suite of calc-alkaline to alkaline plutons that are prevalent throughout the Reindeer Zone. The accreted volcanic terranes and overprinting successor-arc magmas cumulatively resulted in the development of a Paleoproterozoic protocontinent (the 'Flin Flon–Glennie Complex'; Lucas *et al.*, 1997; Ashton, 1999) within the contracting ocean.

Between about 1855 and 1840 Ma, siliciclastic sedimentation occurred within and marginal to the Flin Flon–Glennie Complex during development of a 'successor basin(s)' (*e.g.,* Syme *et al.*, 1998). The main part of the basin probably developed either in a back-arc environment (Ansdell *et al.*, 1995) or along an active continental margin (Zwanzig, 1997), the remnants of which are now preserved largely within the Kisseynew Domain (Figure 20). The Kisseynew Domain is underlain primarily by: 1) a core of psammopelitic to pelitic flysch deposits of the Burntwood Group; 2) partly coeval conglomerate–feldspathic psammite successions (*e.g.,* Missi group), interpreted as fluvial-alluvial to shallow-marine facies equivalents that were deposited on and along the margins of volcano-plutonic terranes; and 3) late successor-arc plutons and anatectic granitoid rocks (Syme *et al.*, 1998). Other temporally equivalent sedimentary assemblages are preserved along isolated structural discontinuities within both the Glennie (*e.g.,* Ourom and Pine Lake groups) and Flin Flon domains. A narrow part of the Kisseynew Domain also extends towards the southwest (Figure 20), where it is flanked to the northwest by the La Ronge Domain and to the south and southeast by the Glennie Domain. This extension consists of a mixed succession of sedimentary gneiss and minor amphibolite ('MacLean Lake gneisses') and unconformably overlying K-feldspar–rich psammitic and conglomeratic rocks ('McLennan group'). These sedimentary units, likely equivalents of those in the main part of the Kisseynew Domain, are in both unconformable and tectonic contact with each other and with volcano-plutonic rocks of the La Ronge Domain, the latter mainly along the McLennan Lake tectonic zone (Figure 20). Though gold showings are not prevalent throughout the main part of the Kisseynew Domain, several are known in this southwestern extension. Several are also known to be associated with the outliers of successor-basin rocks in the Glennie and Flin Flon domains.

The first widespread deformational event recorded by rocks of the Flin Flon–Glennie Complex (regional D_2; Figure 21) produced tight to isoclinal folds and a series of layer-parallel high-strain zones, some of which sole major allochthonous thrust sheets (Lewry *et al.*, 1990). This deformation likely originated during underthrusting of the Sask craton beneath Paleoproterozoic rocks of the Flin Flon–Glennie Complex, starting at *ca.* 1835 Ma (Ashton *et al.*, 2005), and was ongoing during continued convergence between the Hearne, Sask, and Superior cratons leading up to terminal collision. Late- to postcollisional deformation was prevalent between about 1800 and 1770 Ma, resulting in the development of close to tight, north-trending and east-dipping D_3 folds and upright, open, northeast-trending D_4 folds. A prominent set of subvertical, oblique- to strike-slip faults (*e.g.,* Tabbernor and Stanley faults; Figure 20) was also produced during this episode of postcollisional, intracontinental deformation and served to accommodate the lateral extrusion of large crustal blocks (Hajnal *et al.*, 1996).

Deformation during terminal continental collision was accompanied by peak metamorphism throughout much of the Reindeer Zone, with peak conditions having been attained between 1818 and 1794 Ma (Syme *et al.*, 1998; Ashton *et al.*, 2005). Rocks of the La Ronge Domain are dominated by upper greenschist to middle amphibolite facies peak metamorphic mineral assemblages, though upper amphibolite facies assemblages are locally present, particularly near the domain margins. Due to large variation in structural relief, the exposed rocks of the Flin Flon and Glennie domains range widely in metamorphic grade, thereby complicating correlation of structural events. Whereas sub- to upper greenschist and lower amphibolite facies metamorphic mineral assemblages prevail in the Flin Flon–Amisk Lake area and on southern Hanson Lake, rocks in the northern Flin Flon Domain have attained middle to upper amphibolite facies peak metamorphic conditions. Similarly, the southern two-thirds of the Glennie Domain is dominated by assemblages consistent with lower amphibolite facies metamorphism, whereas most of the northern part of the domain is underlain by higher grade, upper amphibolite to granulite facies rocks (Ashton *et al.*, 2009b). Rocks of the Kisseynew Domain contain mainly upper amphibolite facies mineral assemblages.

Showing Descriptions

Rottenstone Domain

Location 1 – Dunnet–Hepburn Lakes Area

Cook (SMDI #2300)**, PA** (SMDI #2301)

Location: ~4 km east of Hepburn Lake, ~94 km north-northeast of La Ronge (NTS 73P/15; UTM 6194894 m N, 507122 m E)

Metal Associations: Au (Pb, Zn, Mo, Cu)

Status: occurrence

Exploration and Development History:
The first indication of auriferous mineralization in the Hepburn Lake area was an elevated gold value from a regional lake-sediment survey (Geological Survey of Canada, 1984). The area was staked the following year by M.C. Lederhouse and was optioned to Gamsan Resources Ltd. in 1987. Gasman completed reconnaissance prospecting, geological mapping, and rock chip sampling that year; samples yielding gold grades in excess of 150 g/t (4.35 oz./ton) were collected at one location ('Cook' showing). A follow-up prospecting and trench/grab sampling program in 1988 yielded several samples containing elevated gold values, including a single grab sample from the Cook showing that assayed 445 g/t (13 oz./ton) Au. An additional auriferous zone (the 'PA' showing) was discovered ~425 m northeast of the Cook showing during this exploration work, with some samples assaying up to 5.5 g/t (0.161 oz./ton) Au.

Uranerz Exploration and Mining Company Ltd. optioned the property in 1989 and performed rock, soil, and bulk till sampling. The claim subsequently lapsed and remained open until the showing area was restaked by Laurentian Goldfields Inc. in 2011.

Geological Character:
The Cook and PA showings are located in the southeastern Rottenstone Domain, near the western margin of the adjacent La Ronge Domain. They occur in a lens of supracrustal rocks that includes mafic volcanic/volcaniclastic and sedimentary rocks, and is likely a continuation of the 'Rennick Lake greenstone belt' (Figure 20; Macdonald, 1987). This supracrustal lens is intruded by the granodioritic to granitic Hickson Lake pluton and related pegmatitic dykes. Rocks in the area have a strong northeasterly structural trend and steep southeasterly dip, and have been metamorphosed under upper amphibolite facies conditions.

The Cook showing is hosted by an isoclinally folded unit of amphibolite and is within one of several zones of shearing, pervasive silicification, and quartz veining. These zones reach widths of up to 50 m and are typically focussed at or near contacts with the Hickson Lake pluton. Mineralization at the Cook showing is situated within a network of white to rusty auriferous quartz veins, 10 to 25 cm wide; this particular zone might have an overall plunge of about 60° to the southwest (Saskatchewan Ministry of Energy and Resources (SMER) Assessment File 73P15-NW-0070). Gold occurs in native form within the veins as nuggets up to 1.25 mm across. Cubes and sheared cubes of galena up to 2 mm across, as well as sphalerite, were also noted.

Similar to the Cook showing, the PA showing consists of a series of discontinuous, east-trending, white to rusty red quartz veins and pods within a sheared and silicified unit of amphibolite. In addition to gold in the veins, small (<2 mm) grains of platy molybdenite were noted along the margins of some veins.

Pyrite and pyrrhotite are common within quartz veins and adjacent wallrock in the general showing area, and minor amounts of chalcopyrite, native copper, and secondary bornite and malachite were also noted. Epidote veinlets are also present, though their context with respect to gold mineralization is unknown.

Associated Showings: none known

Inferred Deposit Type: ?orogenic gold

Production and Reserves/Resources: none

La Ronge Domain

Location 2 – Waddy Lake Area

EP (SMDI #0425b)

Location: ~1.5 km west of Upper Waddy Lake and 300 m northeast of the Komis showing, ~153 km northeast of La Ronge (NTS 64D/04; UTM 6230002 m N, 568523 m E)

Metal Associations: Au (Cu, Pb, Mo, Ag)

Status: producing mine

Exploration and Development History:
Anomalous gold concentrations in the EP deposit area were first discovered by prospector E. Partridge in 1958 in a gold-enriched glacial dispersion train. The source of this dispersion train, known as the 'Riddle' till, was unknown. Partridge partnered with Falconbridge Nickel Mines Ltd. to form a new company (Ventures Ltd.), which undertook exploration and a limited drilling program (~4215 m) between 1959 and 1961 to identify the gold source. This program was unsuccessful and, outside of a soil survey in 1968, no additional work was done on the showing until 1973, when geological consultants Derry, Michener, and Booth reassessed the existing results and proposed a new exploration program that included an IP survey and additional drilling.

Exploration at the property did not resume in earnest until 1980, when a joint-venture partnership between Waddy Lake Resources Inc. (owner) and Energy Reserves Canada Ltd. undertook a Wacker till drilling program to identify the bedrock source in the area up-ice from the known till anomaly. This was followed by a systematic rotosonic drill program (136 holes spaced at 30 m intervals) in 1983 that better defined the extent of the dispersion train and identified a probable bedrock source area at its northern apex (see Averill and Zimmerman, 1986). Later in 1983, this source area was confirmed by diamond drilling (31 holes) of the bedrock subcrop. Interestingly, the best gold grades were identified not in the bedrock subcrop, but in the immediately overlying material (*i.e.,* the 'pay streak').

Waddy Lake Resources subsequently entered into an option agreement with Placer Dome Inc., which undertook exploration on the property between 1984 and 1990. A reserve calculation was released for the deposit in 1992 and the property was subsequently acquired by Golden Rule Resources Ltd. as part of its takeover of Waddy Lake Resources. In 2003, the property was transferred to Golden Band Resources Inc., which subsequently undertook detailed bulk till sampling and reverse-circulation percussion drilling (27 holes) to better understand the distribution of high gold grades in the till and the bedrock subcrop. Subsequent diamond drilling was carried out by Golden Band in the winter of 2003 (30 holes), in 2004 (11 holes), in 2005-06 (35 holes), and in 2007 (36 holes) to better define the zone of high-grade gold mineralization and allow determination of a Mineral Resource estimate for the deposit (Table 2).

Bulk sampling was performed in 2009 to define the gold grade of the sub-till portion of the deposit. Also in 2009, another bulk till sampling program was initiated to define the gold grade within the overlying till and to determine the economic viability of recovering the contained gold. Golden Band commenced removal and processing of the auriferous till in December of 2011 in preparation for open pit mining of the subcropping portion of the deposit.

Geological Character:

The EP deposit is unique among the many gold showings known in the Waddy Lake area (Figure 22) because it comprises three distinct forms of mineralization: bedrock-hosted mineralization, mineralized glacial till, and an intervening supergene zone. The bedrock-hosted mineralization crosscuts a steeply dipping volcanic succession consisting mainly of andesite and rhyolite, which has been metamorphosed under upper greenschist to lower amphibolite facies conditions (Harper, 1984a). This volcanic succession was likely deposited *ca.* 1880 Ma, as indicated by a U-Pb zircon date (1880 ±7 Ma) from a rhyolite sampled near Upper Waddy Lake (Van Schmus *et al.*, 1987). About 400 m southwest of the EP deposit, near the location of the past-producing Komis gold mine, the host volcanic succession wraps around the northeastern margin of the leucogranitic Round Lake stock (Figure 23).

The bedrock-hosted mineralization is focussed within a gently (15° to 20°) southeast-dipping shear zone that roughly follows the margin of a felsic to intermediate dyke (Figure 23). The shear zone varies from 2 to 10 m in width and is associated with an extensive chloritic alteration zone and a concordant zone of gold-bearing quartz veins. These gold-bearing veins are typically 10 to 50 cm wide and are reportedly cut by two sets of later carbonate veinlets that locally contain native copper and galena (Simpson, 2007). Gold is present as free gold in quartz veins and as inclusions of free gold and Au-Ag–tellurides in pyrite (*op. cit.* and references therein). Poulsen *et al.* (1987)

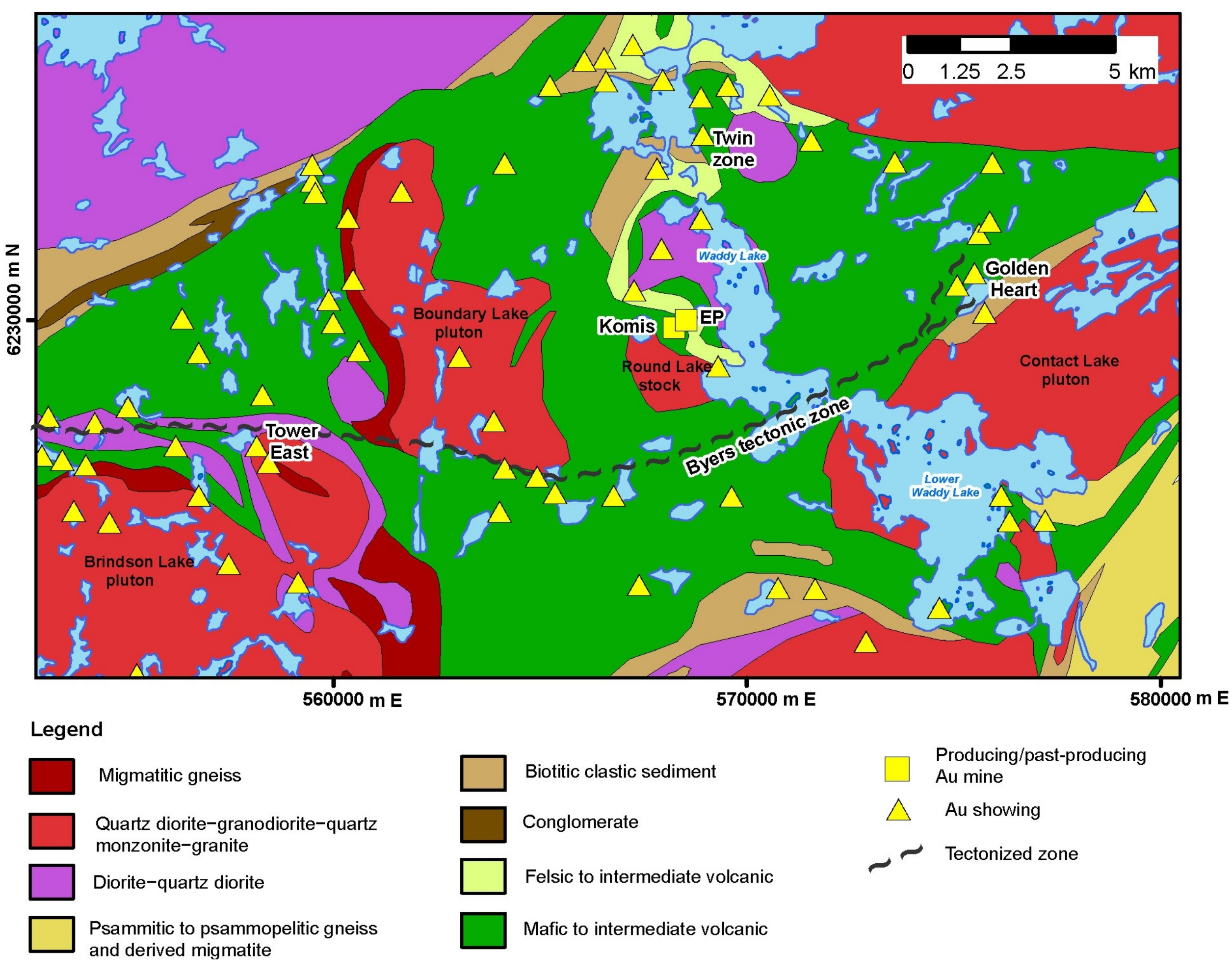

Figure 22 – Generalized geological setting of the Waddy Lake area, with locations of known gold showings (from Slimmon, 2011).

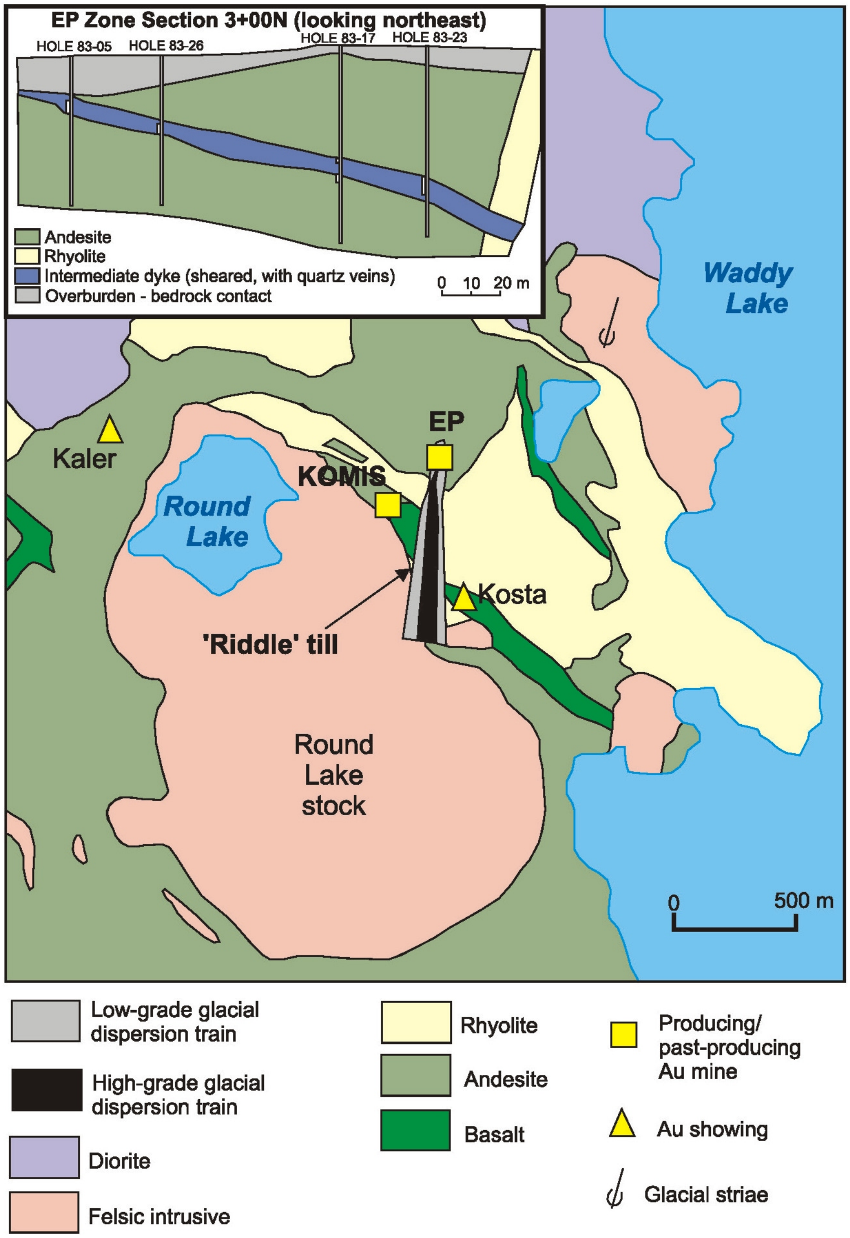

Figure 23 – Generalized geological setting of the western Waddy Lake area, with locations of the Komis and EP deposits (modified from Coombe (1984) and Averill and Zimmerman (1986)). Inset shows a northwest-trending cross-section through the EP deposit (from Asbury, 1986).

suggested that the host structure is a late brittle fault and that the contained gold mineralization was hydrothermally remobilized from an existing deposit and redeposited within chloritic gouge.

The bedrock-hosted mineralization is not exposed, but subcrops a few metres beneath a cover of gold-enriched glacial till. The till comprises part of a glacial dispersion train (Riddle till; Figure 23), which extends ~800 m southward from its apex at the deposit subcrop location. This dispersion train, which facilitated discovery of the deposit, is characterized by an inner zone of higher gold grades with lower grade till on its outer margins. Subcropping beneath the till at the interface with the bedrock-hosted mineralization is a flat-lying, highly gold-enriched zone that yielded some of the highest grades in the deposit. This zone consists of a distinctive quartz 'layer' that is bordered by gouge-like material containing dyke and volcanic wallrock fragments (Simpson, 2007). Gold mineralization is disseminated within both the quartz layer and the adjacent gouge. This zone has been interpreted as a zone of supergene enrichment for the following reasons (from Mysyk, 2004, as reported in Simpson, 2007): 1) the presence of native copper, chalcocite, vanadinite, pyromorphite, and galena, sometimes with complex internal zoning, in both carbonate veinlets in this zone and in the overburden; 2) the morphology of gold grains, which was thought to indicate a saprolitic derivation; and 3) fluid inclusion data from quartz veins, which indicated multiple fluid events and relatively low homogenization temperatures.

Considering all three styles of mineralization (*i.e.,* till, supergene, and bedrock) at the EP deposit, a three-stage sequence of events has been proposed for its formation (Simpson, 2007). First, similar to many other structurally controlled hydrothermal gold deposits in the La Ronge Domain, the primary bedrock-hosted mineralization at EP was formed by infiltration of gold-bearing hydrothermal fluids into a shear zone during the Paleoproterozoic. This deep-seated, primary mineralization was eventually exhumed, perhaps during the Tertiary, and subjected to a prolonged period of oxidative weathering. This caused dissolution and reprecipitation of concentrated gold-sulphide mineralization below the water table, resulting in the development of a supergene enrichment zone above the bedrock-hosted deposit. The less resistant supergene material was preferentially eroded during subsequent (Quaternary) glaciation, leading to deposition of the proximal, gold-rich till dispersion train in a down-ice direction.

The uneroded remnant of the supergene mineralization thus likely represents a portion of the deposit that was protected from glaciation by more competent bedrock.

Inferred Deposit Type: orogenic gold, with overprinting supergene enrichment zone and associated gold-enriched glacial dispersion train

Associated Showings: ?Tower West (SMDI #0903c)

Production and Reserves/Resources: Golden Band Resources Inc. reported a Mineral Resource estimate for the EP deposit in 2008 (Table 2).

Komis (SMDI #0425a)

Location: ~2 km west of Upper Waddy Lake, ~153 km northeast of La Ronge (NTS 64D/04; UTM 6229812 m N, 568234 m E)

Metal Associations: Au (Ag)

Status: past-producing mine with Resources

Exploration and Development History:

Since the initial discovery of gold at the Komis property in 1958 by prospector E. Partridge, a complex history of exploration, development, and mining has ensued. Partridge originally staked the property for Cominco Ltd. but then restaked the property after Cominco allowed the claim to lapse in 1959. Later that year, the property was optioned by Ventures Ltd., a subsidiary of Falconbridge Nickel Mines Ltd., which performed geological mapping, a ground geophysical (magnetic) survey, channel sampling of existing trenches, soil geochemical sampling, and lake-bottom sediment sampling. Privately owned Waddy Lake Mines Ltd. was formed in 1960, under the sponsorship of Falconbridge, to finance continued exploration and development of the project. From 1960 to 1963, Ventures Ltd. used a wide range of exploration approaches, including outcrop stripping, prospecting, geological mapping, and diamond drilling (4215 m), to discover several additional gold occurrences in the area. Partridge acquired control of Waddy Lake Mines from Falconbridge in 1973 and subsequently optioned the property to Chancellor Energy Resources Inc., which completed soil sampling, a geophysical (IP) survey, and 16 diamond-drill holes (1672 m).

In 1980, Waddy Lake Resources Ltd. (previously Waddy Lake Mines Ltd.) reacquired a 100% interest in the property and explored it as a joint-venture partnership with Energy Reserves Canada Ltd., which became the project operator. The partnership excavated a small open pit over the surface exposure of the Komis discovery zone and removed a 1031 ton bulk sample that was processed on site using a portable gravity concentrator. In 1981, 20 diamond-drill holes were completed at the Komis showing, the results of which were used to calculate the first resource estimate. Waddy Lake Resources took over as operating partner in 1982 and completed drilling of 36 vertical holes and one angled hole (2101 m) to better define the deposit in cross-section along a strike length of just over 200 m. A revised reserve estimate for the deposit was subsequently released. Along with geophysical (VLF-EM and magnetic) surveys, a second phase of development drilling (20 holes, 3263 m) was completed at Komis in 1983, leading to a further revision of ore reserves. A third phase of diamond drilling in the Komis area was undertaken in mid-1983 and resulted in the first drill intersections of the nearby EP deposit.

Later in 1983, Waddy Lake Resources Ltd. entered into a joint-venture agreement with Placer Development Ltd., which completed a prefeasibility study for the Komis deposit using an open pit mining model. Based on a newly revised deposit reserve estimate, the study concluded the project was subeconomic in the economic environment of the time. Placer relinquished its option on the property in 1989.

Upon reassessing all previous drilling in 1990, Waddy Lake Resources reoriented the drill grid and drilled another 29 holes (4106 m) at the Komis deposit to better define its geometry. These drilling results confirmed the existing interpretation of the deposit as five distinct mineralized zones and were used to calculate a new ore reserve estimate. Reinterpretation of the geometry of the deposit also shifted the proposed mining approach from a low-grade open-pit model to a high-grade underground model. In 1992, a further 20 holes (2735 m) were drilled and detailed mapping (1:25 scale) and channel sampling were carried out on the subcrop of the Komis deposit.

Dynatec Engineering Ltd. was hired to complete a prefeasibility study on the Komis deposit in 1993. Recommendations from the study included completion of an underground bulk sampling program accessed by decline ramp and extraction of a 10 000 t bulk sample, to be tested at the nearby Jolu mill. Environmental approval was acquired to develop an access decline ramp and to extract the bulk sample from drifts into the 'A' and 'C' zones at the 350 and 400 m levels. The Komis mine portal was collared in November 1993 and the preproduction underground work, including a 480 m decline and extraction of a 10 940 t bulk sample, was completed by April 1994. During this work, in January 1994, Waddy Lake Resources entered into an agreement with Golden Rule Resources, whereby Golden Rule would advance $4 million of the $5 million capital cost for completion of underground exploration and development, test mining of the above-mentioned bulk sample, and rehabilitation of the nearby Jolu mill. In addition to the development work, 60 underground drill holes (2966 m) and 36 surface drill holes were completed and resulted in the release of a revised ore reserve estimate. The bulk sample was processed at the Jolu mill in May 1994 and, in September of that same year, Golden Rule announced that the test results warranted mining of the Komis deposit. Environmental approval was given for the project in February 1996 and ore from the Komis mine was first processed through the Jolu mill in August of that year, with the first gold pour occurring on October 7th.

The mine was in operation until February 1997 when, after production of just over 0.83 t (~26,850 oz.) of gold (Table 1), it was announced that development work would cease pending a reassessment of the project. This ultimately resulted in closure of the mine. Several factors, including a drop in gold price, excessive dilution in development headings, lower-than-forecasted grades, and the greater-than-expected complexity of the ore zone configuration, were given as reasons for cessation of further underground development.

Golden Band Resources Inc. acquired a 100% interest in the Komis property in November 2002 through an acquisition agreement with CDG Investments Inc. (formerly Golden Rule Resources Inc.). In 2005, Golden Band released an independently derived Mineral Resource estimate for the deposit. In April 2007, Golden Band announced a positive scoping study for its 'La Ronge Gold Project', which proposed initial production from three deposits, including Komis, over four years and processing of the ore at the Jolu mill. Another independent economic assessment was released for the project in 2009, which also concluded economic viability for the initial four years of the project, including open pit and underground mining of the Komis deposit. In 2010, a revised geological model and updated Mineral Resource estimate (Table 2) were reported using new results from underground chip and channel sampling, along with the existing drill-hole database; at the time the estimate was released, no additional diamond drilling had been completed at Komis since Golden Band acquired the property. In late 2010, Golden Band announced a new three-phase, 1500 m drill program for Komis, designed to test for the deeper continuation of gold mineralization below and to the west of the existing Resource model, which was based on drilling down to a vertical depth of 175 m. In October of 2010, Golden Band submitted a project proposal to the Saskatchewan Ministry of Environment that detailed plans to develop a mine at the Komis project site. Golden Band has since completed dewatering of existing mine workings and anticipates commencing development from the lowest level of the mine workings late in 2012.

Geological Character:

The Komis deposit is situated near the northeastern margin of a small granodiorite stock (the Round Lake stock; Figure 23), from which a 30 m wide, east-northeast–trending zone of granodiorite and aplite apophyses extend for more than 100 m into the adjacent sequence of andesitic and rhyolitic volcanic rocks. The volcanic rocks were probably deposited *ca.* 1880 Ma, based on a U-Pb zircon age of 1880 ±7 Ma from a rhyolite flow near Waddy Lake (Van Schmus *et al.*, 1987). The undated Round Lake stock, described in detail by Harper (1984a), is classified as a 'Group III' intrusion of the Waddy Lake area, which are typically fine- to medium-grained, light grey tonalitic stocks that were emplaced at shallow crustal depths (Harper, 1985). The Upper Waddy Lake stock, another Group III intrusion in the area, previously yielded a U-Pb zircon date of 1834 ±13 Ma (Bickford *et al.,* 1986), whereas the nearby Corner Lake stock, also of Group III designation, was more recently dated at 1852.6 ±1.5 Ma (Lafrance and Heaman, 2004). These results indicate that the Round Lake stock and associated dykes were probably emplaced into the volcanic pile sometime between 1852 and 1834 Ma. The hostrocks to the deposit have been metamorphosed under upper greenschist to lower amphibolite facies conditions (Harper, 1984a).

The Komis deposit comprises steeply northeast-dipping mineralized zones that crosscut, but are largely confined to, the swarm of apophyses on the northeastern margin of the Round Lake stock. These granodioritic and aplitic dykes dip moderately steeply to the north and typically have widths of <0.1 to 5 m. The dykes crosscut an early foliation (S_1; Lafrance and Heaman, 2004), defined by biotite and hornblende, that wraps around the stock. Near the deposit, this foliation is northwest trending and is subparallel to the contact between andesitic and rhyolitic units. This S_1 foliation is also subparallel to the overall trend of the mineralized zones, although it predates them.

At least 14 mineralized zones have been identified at the Komis deposit, each having complex relationships and diffuse boundaries with adjacent zones. According to Hrdy (2010), the mineralized zones form an *en échelon* pattern in which each individual metre-scale zone pinches out both laterally and vertically before another one begins in the footwall of the adjacent zone. The mineralized zones are also internally complex, comprising swarms of massive, closely spaced quartz veins with individual widths ranging from <1 cm to 1 m. The quartz veins also display an *en échelon* pattern and are dominantly north-northwest trending, approximately perpendicular to the margins of the host dykes, and slightly rotated in a clockwise orientation relative to the strike of the overall mineralized zones. Lafrance (1999) characterized two types of veins at the deposit: ladder veins, which span the width of the dykes and terminate at the dyke margins; and through-going veins, which extend and are refracted across dyke margins and continue into the adjacent volcanic rocks.

Alteration haloes, typically up to 10 cm wide, commonly surround mineralized quartz veins, particularly those that cut intermediate and mafic volcanic rocks. The haloes consist of carbonatized and silicified wallrock, pyrite, and biotite, as well as lesser sericite, microcline, actinolite, magnesium-rich chlorite, apatite, and chalcopyrite. The particular mineral alteration assemblage present in a given locality is controlled mainly by the composition of the hostrock in which it crystallized (Hrdy, 2010). Pyrite is best developed in andesite, where it forms 2 to 10% coarse cubes that sometimes contain inclusions of recrystallized plagioclase as well as biotite, muscovite, carbonate, microcline, epidote, and/or apatite (Lafrance, 1999). Gold occurs in native form as fine (<1 mm) disseminations or coarse (up to 5 mm) flakes in quartz veins, or as fine disseminations associated with pyrite in alteration haloes. Although gold at the deposit is typically found in or around the quartz veins, the overall spatial control on gold mineralization at the deposit scale appears to reflect the orientation of the mineralized zones and not that of the individual veins (Hrdy, 2010).

In an early study of the Komis deposit, Asbury (1986) proposed that the mineralized quartz veins formed by infiltration of pluton-derived hydrothermal fluids into existing fractures during late-stage cooling of the Round Lake stock. Subsequent structural analysis of the deposit (Lafrance, 1999, 2000, 2002), combined with new geochronological data (Lafrance and Heaman, 2004), indicate, however, that gold mineralization at Komis was introduced during a relatively late structural and hydrothermal event that overprinted the stock and related dykes. According to this interpretation, the deposit formed in the strain shadow of the Round Lake stock during north-northwest–directed compression that resulted in development of the regional (S_2) foliation. The mineralized veins fill tensile fractures that opened in response to this stress regime. Lafrance and Heaman (2004) therefore interpreted the mineralization at Komis to have formed during the regional D_2 deformation event.

Inferred Deposit Type: orogenic gold

Associated Showings: ?Weedy Lake A zone (SMDI #0423a)

Production and Reserves/Resources: Limited production from Komis took place in 1996 (Table 1). Golden Band Resources Inc. reported a revised Mineral Resource estimate for the Komis deposit in 2010 (Table 2).

Golden Heart

Weedy Lake / Keewatin B and C Zones (SMDI #0423b, #0423c, and #0423d)

Location: ~4 km east of Upper Waddy Lake, ~157 km northeast of La Ronge (NTS 64D/04; UTM 6230949 m N, 575228 m E)

Metal Associations: Au (Cu, Zn, Pb)

Status: developed prospect with Resources

Exploration and Development History:

The first group of claims covering the Golden Heart property area (‘Keewatin’ claims) was staked in 1948 by prospectors working for the Consolidated Mining and Smelting Company of Canada Ltd. By 1949, geological mapping, trenching, and drilling (nine holes) had led to discovery of the Weedy Lake A, B, and C zones, the latter two of which ultimately became known as the Golden Heart deposit.

No further work was done until 1961, when Hydra Explorations Ltd. carried out an exploration program in the area that included prospecting, gold panning, and trenching. The property was then staked in 1974 by G.B. Allen, however, no exploration work was reported and the claim lapsed in 1976.

In 1979, the property was staked by a 50:50 joint venture between Golden Rule Resources Inc. (operator) and Saskatchewan Mining Development Corp. (SMDC; later Cameco Corp.). Overburden stripping, geological mapping, and trenching were completed shortly thereafter, as well as geophysical (VLF-EM and magnetic) and geochemical (soil and rock) surveys. In 1982, the partnership completed further geological mapping, channel sampling, trenching, soil geochemical surveys, and geophysical (frequency-domain IP) surveys, along with selected basal till sampling by Wacker drilling and diamond drilling (13 holes). Including this first phase of drilling in 1982, 42 diamond-drill holes totalling 4688 m had been completed on the property by 1984, leading to the release of a preliminary ore reserve estimate.

In 1987, Tyler Resources Inc. entered into an option agreement with Golden Rule whereby it could earn a 50% interest in the project. To this end, Tyler Resources completed further overburden stripping, prospecting, geological mapping, trenching, and rock/chip sampling. A total of 46 drill holes (10 844 m) was completed in the deposit area during three separate drill programs between 1987 and 1989, which led to the discovery and definition of an extension of the B zone, referred to as the 'Golden Heart zone'. At this time, a new ore reserve estimate was released for the zone. Golden Rule released another revised reserve calculation for the Golden Heart deposit in 1991, which also included an estimate for the C zone.

A partnership between Golden Rule, Tyler Resources, and Cameco undertook additional definition drilling on the deposit in 1995 and 1996. This drilling comprised two programs of 27 and 29 holes, totalling ~12 031 m. This work resulted in the release of another revised ore reserve estimate for the deposit. Additional mineralized zones (*e.g.,* Weedy A, D, E, and F zones) had been discovered over the course of this and previous drilling on the property, though none of these were significant enough for inclusion in the ore reserve estimates (Wong and Hrdy, 2009).

In 2002, Golden Band Resources Inc. acquired a 49.9% interest in the project through acquisition agreements with Golden Rule and Cameco, and entered into an option agreement with Tyler Resources to acquire half of the remaining interest. In August 2006, Golden Band purchased Tyler Resources' 50.1% interest outright and became 100% owner of the project. In assessing the property, Golden Band released Mineral Resource estimates for the Golden Heart deposit in 2003 and 2006. Soil gas hydrocarbon sampling was done in the property area in 2007, and a small drilling program (four holes, 804 m) was undertaken on the northeastern portion of the deposit in 2008. As of 2008, a total of 145 diamond-drill holes (27 690 m) had been completed on the property, the deepest hole reaching a vertical depth of 373 m (Butrenchuk, 1996).

A revised Mineral Resource estimate was released for the Golden Heart deposit in 2011 (Table 2). Golden Band is reportedly preparing to begin mining of the deposit in 2013, using combined open pit and underground methods.

Geological Character:

The Golden Heart deposit is located near the intrusive contact of a small, undated, quartz diorite stock (Figure 24), informally referred to as the 'B zone' stock (Wong and Hrdy, 2009), within a sequence of *ca.* 1880 to 1870 Ma andesitic to rhyolitic rocks. Both the quartz diorite and the volcanic rocks are crosscut by northerly trending feldspar porphyry dykes. Rocks in the property area have a northeasterly structural trend and have been metamorphosed under upper greenschist to lower amphibolite facies conditions (Harper, 1985).

Drilling in the area originally identified three separate mineralized zones, designated the Weedy Lake A, B, and C zones (Netolitzky, 1986; Figure 24). Of these, the B and C zones were later defined as the Golden Heart deposit. The deposit consists of mineralization in quartz veins and altered wallrock, spatially associated with a series of discontinuous, bifurcating, northwest-dipping shear zones. The mineralized shears are subparallel and subsidiary to the Byers Lake tectonic zone, located <250 m to the north. Recently, Wong and Hrdy (2009) reinterpreted the Golden Heart deposit as consisting of seven subparallel, shear-related mineralized zones, including the B, B2, B3, C, HW1, HW1a, and HW2 zones (Figure 24B). The main shear zone (B zone shear) is 3 to 4 m wide and confined to the quartz diorite body. It dips steeply to the northwest and has a strong internal shear foliation that generally parallels both the shear zone margins and the regional penetrative foliation. Rotated and sheared diorite clasts within the shear zone are enclosed by an anastomosing system of chloritic shear planes. The shear zone exhibits C-S fabrics and tension gash geometries on horizontal surfaces that indicate a component of dextral movement (Schwann, 1989), though a subvertical to steeply northwest-plunging, down-dip extension lineation is also present and is collinear with the regional mineral lineation (Lafrance, 1999).

Gold mineralization associated with the B zone shear is focussed in quartz veins and in pervasively altered wallrock. On the southeastern margin of the B zone shear, mineralization occurs in a single shear-hosted quartz vein that is 50 to 80 cm thick and continuous for 140 m along strike. Adjacent to the shear on the hangingwall side, mineralization

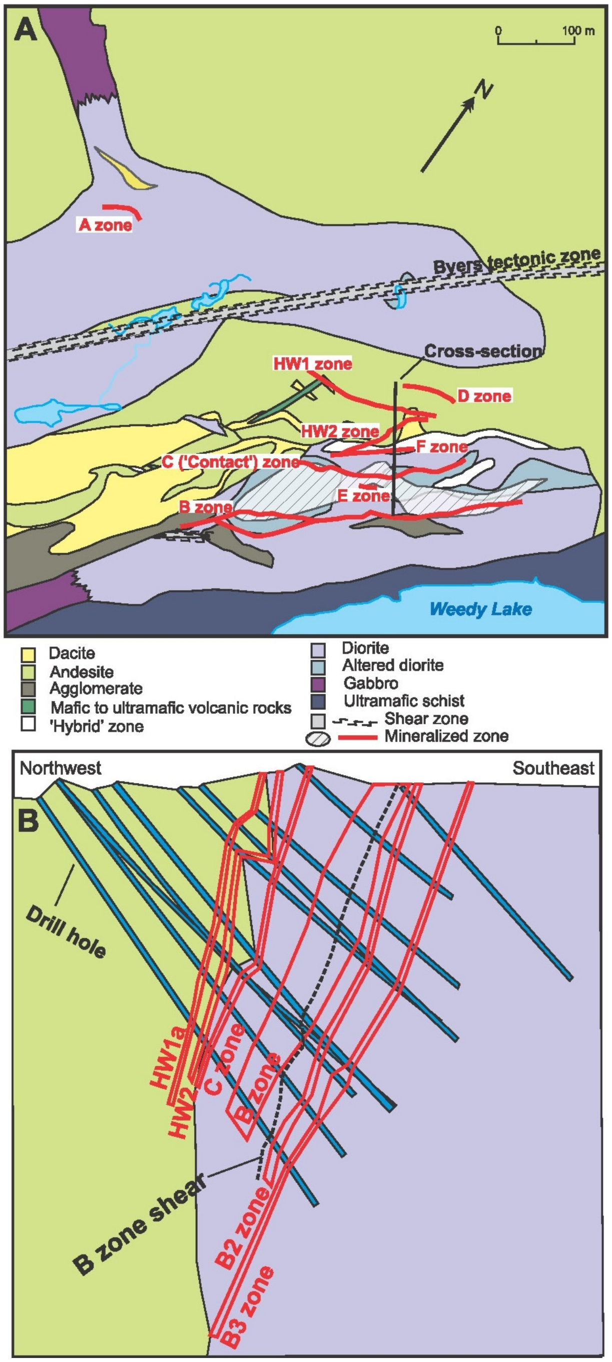

Figure 24 – Geological setting of the Golden Heart deposit: A) generalized geological setting in plan view (from Netolitzky, 1986), overlain by approximate surface projections of the mineralized zone (from Wong and Hrdy, 2009); and B) interpreted sections through the mineralized zones and the B zone shear, based on drill intersections along the 1000W easting line on the property grid (from

occurs in altered wallrock and quartz veining within a stockwork zone >25 m wide. The quartz veins in this stockwork comprise steeply dipping sets that trend about 010°, 050°, and 090°, and an additional set that dips shallowly (<30°) to the north, all of which locally contain mineralization (Wong and Hrdy, 2009).

Mineralization in the C zone (or 'Contact' zone) is situated ~100 m north of the B zone shear and exhibits many of the same features as the B zone shear mineralization. The C zone mineralization is associated with a 20 m wide system of smaller shears, subparallel to the B zone shear, situated at the contact between the quartz diorite and the volcanic rocks. As in the B zone shear, mineralization in the C zone is associated with quartz veins and proximal altered wallrock. The main vein is 80 cm thick and steeply north dipping, and extends for 20 m along a strike of 215°, parallel to the shear foliation (Lafrance, 1999). Numerous smaller veins with widths of 1 to 20 cm are also present and are oriented oblique to the shear zones. Lafrance and Heaman (2004) reported a set of centimetre-thick extensional quartz veins that trend 255° and dip 70° north, and are oriented 20° to 45° clockwise to the shear zone margins. Wong and Hrdy (2009) reported a stockwork of veins of variable orientations, including moderately northwest dipping veins trending between 030° and 050°, north- and west-trending subvertical veins, and west-trending veins with shallow dips to the north.

According to Wong and Hrdy (2009), gold throughout the deposit occurs in native form in the quartz veins and as inclusions in pyrite and silicate minerals in the altered wallrock. Silicification and pyritization of the hostrocks are the main alteration phases, though potassic alteration (biotite and lesser microcline) is also evident. Other alteration phases include chlorite, albite, carbonate, hematite, hornblende, and diopside. Sheared quartz diorite contains up to 15% biotite and is locally cut by millimetre-scale K-feldspar veinlets; actinolite is sometimes present on the margins of quartz veins (Schwann, 1989). Trace to minor chalcopyrite, sphalerite, and galena are the only sulphide minerals present besides pyrite. Gold is irregularly distributed throughout the deposit, and the distribution of free gold in quartz veins is particularly erratic (*i.e.,* 'nuggety'). Netolitzky (1986) proposed that higher gold grades might be focussed in the altered wallrocks adjacent to quartz veins.

Lafrance and Heaman (2004) interpreted the Golden Heart deposit to have formed in shear zones that slightly postdated development of the main regional (D_2) deformational fabrics. This is in contrast to some other gold deposits in the Waddy Lake area, such as the Komis deposit (see above), that are considered to have formed during the development of this fabric.

Inferred Deposit Type: orogenic gold

Associated Showings: Corner Lake (SMDI #0427d), Tower East (SMDI #0903a and #0903b)

Production and Reserves/Resources: Golden Band Resources Inc. reported an updated Mineral Resource estimate for the Golden Heart deposit in 2011 (Table 2).

Tower East

Including Upper East, Lower East, West, South, 22, Rusty, Limy, and PAT Lenses/Zones (SMDI #0903a and #0903b)

Location: at Tower Lake, ~12 km west of Upper Waddy Lake, ~145 km northeast of La Ronge (NTS 74A/01; UTM 6226972 m N, 558139 m E)

Metal Associations: Au (Cu)

Status: developed prospect with Resources

Exploration and Development History:

Gold exploration in the Tower Lake area was first undertaken in the early 1960s by Augustus Exploration Ltd. and comprised mainly geological mapping and prospecting by gold panning. This preliminary work resulted in the discovery of mineralized float and bedrock near the eastern shore of Tower Lake and was followed up by trenching. Multiple mineralized zones, including the Trench 1 and 6 zones at Tower East and the Trench 2 to 5 zones at Tower West (SMDI #0903c), were delineated along an east-trending structural lineament (later identified as the Byers fault). Between 1961 and 1963, 28 drill holes (3668 m) were completed on these showings, including 18 holes at Tower East and 10 holes between Tower and Narrow lakes (SMDI #0914). Despite some initially promising results, exploration was stopped because of the discontinuous nature of mineralization and the unfavourable economics for gold at the time. Claims on the property were allowed to lapse in 1971.

The property was restaked in 1978 by Comaplex Resources International Ltd., which performed prospecting and uncovered extensions of the previously known mineralized zones. The property was optioned by Golden Rule Resources Ltd. in 1981, which performed prospecting, geological mapping, ground geophysical (VLF-EM and magnetic) surveys, and geochemical soil sampling. In 1982, Golden Rule optioned the property to Energy Reserves Canada Ltd., which then entered a joint-venture partnership to explore the project with SMDC. The partnership (Comaplex–Golden Rule–SMDC–Energy Reserves Canada) completed prospecting, geological mapping, and bedrock and soil geochemical sampling. In the winter of 1984, Goldsil Mining and Milling Inc. (previously Energy Reserves Canada Ltd.) completed 10 drill holes (1031 m) on the Tower East zones, all of which intersected gold mineralization.

Golden Rule took over operation of the property for the partnership in 1986 and undertook a significant, multiphase drill program. Forty drill holes (6020 m), completed on the Tower East showing during three separate campaigns, outlined extensions of known mineralized zones and resulted in the discovery of two additional zones, the ‘PAT A and B’ zones (SMDI #0903b). Following completion of detailed ground geophysical (VLF-EM and magnetic) surveys over the Tower East and Tower West showings, an additional 23 drill holes (4048 m) were completed on the Tower East showing in 1987. Later that year, Golden Rule undertook geological mapping and lithogeochemical sampling, and completed five percussion-drill holes.

Golden Rule continued to define, and expand, the extent of the Tower East mineralization by diamond drilling in subsequent years, including 25 holes (4918 m) in 1988, 34 holes (5772 m) in 1989, and 20 holes (3386 m) in 1990. This drilling generally confirmed that the deposit consisted of several high-grade, but discontinuous zones and led to the calculation of an ore reserve estimate, which included the ‘West 1’, ‘West 2’, ‘Upper East’, ‘Lower East’, ‘South’, ‘Rusty’, ‘Limy’, and ‘22’ lenses/zones (Figure 25B). An additional eight large-diameter (PQ) holes (970 m) were drilled vertically into the deposit later in 1990, which yielded a 13.1 t bulk sample that was intended for metallurgical testing. The sample was considered to be of insufficient grade, however, and never underwent testing (Simpson, 2006). In 1994, Golden Rule completed an economic evaluation of the Tower East project to assess the feasibility of developing a starter pit at the site and shipping the ore to the nearby Jolu mill.

A regional till sampling program was undertaken in 1996, which led to the discovery of two gold dispersion trains in the Tower Lake area without known sources. Follow-up work on these dispersion trains led to the discovery of the nearby Fortuna (SMDI #0903c) and Phantom gold showings.

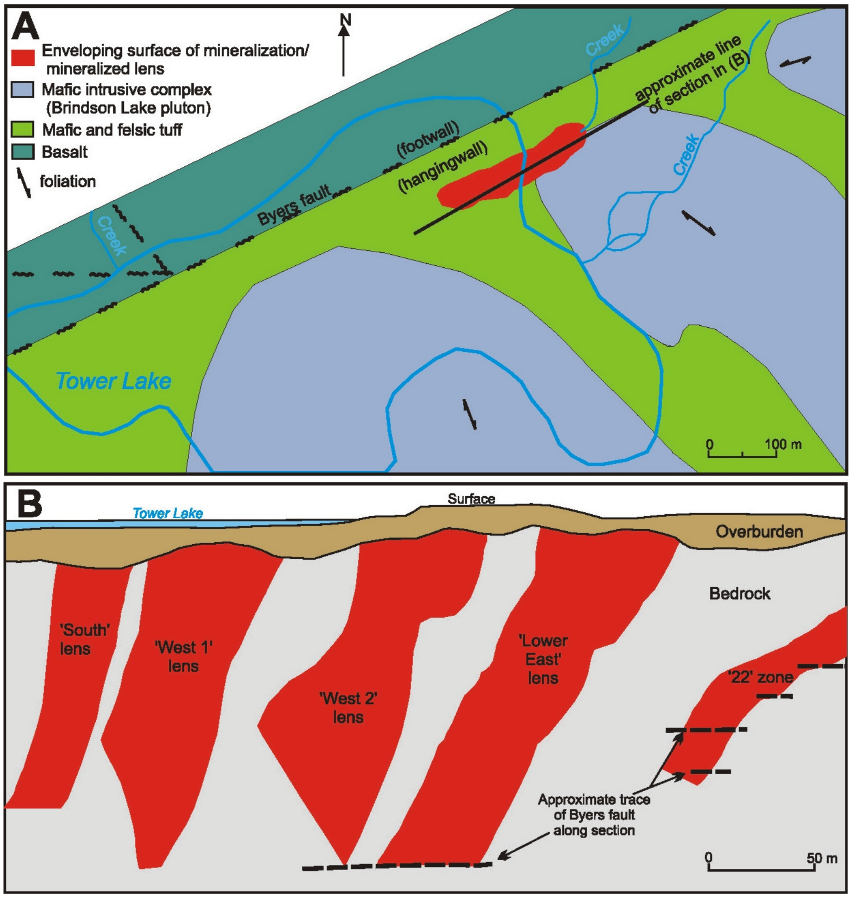

Figure 25 – Generalized geological setting of the Tower East deposit: A)simplified geological setting of the Tower Lake area (after Netolitzky (1986) and Schwann (1990)); and B) schematic longitudinal cross-section, looking north, through some of the mineralized lenses of the Tower Lake deposit (modified from Golden Rule Resources Ltd, 1990).

By 1997, ownership of the Tower East project consisted of a joint-venture partnership between Golden Band Resources Inc. (60%) and Golden Rule (40%). Golden Band subsequently acquired 100% ownership of the property through an acquisition agreement with Golden Rule (known at that time as CDG Investments Inc.). In 2004, Golden Band completed 11 vertically oriented drill holes (911 m) east of the deposit and drilled another 60 holes (6057 m) between late 2004 and 2005. From 1984 to 2006, 254 diamond-drill holes had been drilled on the Tower Lake property, the results from which were used, in part, to calculate a Mineral Resource estimate for the Tower East deposit in 2006. The gold mineralization had been identified along strike for more than 960 m and to a vertical depth of 150 m.

In 2007, Golden Band undertook a small drill program comprising nine vertical holes (1024.1 m) to check for higher grade, near-surface mineralization in the eastern part of the deposit. These results were added to the existing drill database and were used to determine an updated Mineral Resource estimate for the Tower East deposit (Table 2).

Geological Character:

The showing area, mapped at 1:2500 scale by Schwann (1990), is localized at the tectonized contact between mafic volcanic flows to the north and a layered mafic-intermediate intrusive complex cutting volcanic tuff to the south (Figure 25A). The exposed volcanic rocks south of the fault are dominantly mafic tuff, though dacitic tuff is commonly observed in drill core (Schwann, 1990). In the deposit area, the intrusive complex consists of interlayered gabbro, diorite, quartz-phyric diorite, and tonalite, with a more massive granodioritic phase dominating to the south. This mafic complex is a marginal phase of the Brindson Lake pluton, a compositionally zoned 'Group I' intrusion (Harper, 1985) that has yielded U-Pb zircon crystallization ages of 1866 ±12 Ma (Bickford *et al.*, 1986) and 1874 ±1 Ma (Heaman *et al.*, 1991). Subvertical aplitic and quartz-phyric felsic dykes crosscut both volcanic and plutonic rocks, and possibly coalesce into a stock-like body adjacent to the deposit (SMER Assessment File 74A01-NE-0093). Diabase dykes, observed only in drill core, crosscut all other rock types, which have been metamorphosed under upper greenschist to lower amphibolite facies conditions (Harper, 1985).

The Tower East deposit is situated along the Byers tectonic zone (BTZ) and has a clear genetic association with this structure. In the Tower Lake area, the BTZ strikes east-northeast (070°), dips 50° to 60° southeast, and is situated at the contact between the volcanic and plutonic rocks. It consists of a mylonite zone that transitions into a complex, strongly silicified zone of brittle fracturing and brecciation, which is thought to be the focus of the gold mineralization (*e.g.,* Netolitzky, 1986). The BTZ is in the immediate hangingwall of a narrow brittle fault (Byers fault; Figure 25), which represents a later deformational phase along the zone and is considered to postdate gold mineralization at the Tower East deposit (Simpson, 2006). To the north, volcanic rocks exhibit an easterly trending fabric that is slightly oblique to the trend of the BTZ. South of the BTZ, the plutonic rocks have a north to northwest structural trend, whereas the fabric in adjacent volcanic rocks has been rotated into a west-northwest trend (*op. cit.*). A weak, steeply southwest-plunging stretching lineation is exemplified by stretched diorite xenoliths in tonalite (Schwann, 1990).

The deposit itself is located mainly within porphyritic diorite in the hangingwall and comprises multiple contiguous mineralized zones (*e.g.,* East, West, South, 22, Rusty, Limy, PAT, B, and C lenses/zones; *e.g.*, Figure 25B). With the exception of the 22 zone, which is shallowly dipping and possibly an overturned extension of another zone (SMDI #0903a), all zones are steeply dipping and aligned subparallel to the overall zone of intense deformation. A broad zone of albitization was noted at the deposit and, although thought to predate gold and related alteration, does have a spatial correlation with elevated gold grade in places (SMER Assessment File 74A01-NE-0093). The mineralized zones are generally characterized by relatively high grade inner cores that are enveloped by an extensive lower grade alteration halo. Gold emplacement was accompanied by intense sulphidic-potassic-silicic-carbonic alteration, manifested as a wallrock alteration assemblage of pyrite, biotite, and quartz (*i.e.,* silicification and/or micro–quartz veining). Pyrite (3 to 10%) in the alteration zone is present as disseminations, clusters of coarse euhedral crystals, or infill of microfractures, and partially replaces magnetite in some instances; minor chalcopyrite (<2%) and pyrrhotite are the only other sulphide minerals present. Other probable alteration phases include calcite, K-feldspar, sericite, actinolite/tremolite, and chlorite. Fluid flow resulting in alteration and gold mineralization at the deposit might have been preferentially focussed along pre-existing breccia zones (Simpson, 2006).

Gold in the deposit is present as: 1) tabular, disseminated native grains in composite quartz-carbonate-pyrite veinlets that infill microfractures; 2) microscopic (<30 µm) inclusions in pyrite; and/or 3) native grains within altered wallrock (SMER Assessment File 74A01-NE-0093). Free gold 'particles' can also apparently be observed "… in actinolite, hornblende, biotite … or plagioclase porphyroblasts" (Simpson, 2006, p26), perhaps suggestive of a premetamorphic mineralizing event. Hematitization accompanied by ferroan chlorite and goethite is widespread throughout the hangingwall alteration zone, but is probably due to late (post-gold), retrograde fluid flow along the brittle component of the Byers fault (SMER Assessment File 74A01-NE-0156). Mafic volcanic rocks in the footwall of the deformation zone are locally pyrrhotite and chalcopyrite bearing, but lack significant gold values.

Lafrance and Heaman (2004) characterized several gold showings in the Waddy Lake area, specifically focussing on the relations between the gold mineralization and deformational fabrics. Using the criteria presented for other deposits in this study, Simpson (2006) speculated that the Tower East deposit formed by reorientation of extensional quartz veins, produced during development of the main regional foliation, by subsequent shearing along the BTZ; the exact timing of mineralization within this process is, however, currently unclear. This model is similar to that proposed for deposits such as Golden Heart, Corner Lake (SMDI #0427d), and Kaslo/Niko (SMDI #0906/#2451).

Inferred Deposit Type: orogenic gold

Associated Showings: Kaslo/Niko (SMDI #0906/#2451), Golden Heart (SMDI #0423b, #0423c, and #0423d), Birch Crossing

Production and Reserves/Resources: Golden Band Resources Inc. reported a Mineral Resource estimate for the Tower East deposit in 2007 (Table 2).

Twin Zone

Twin North and South Zones (SMDI #2065)

Location: near southeast shore of Wedge Lake, ~5 km north of Komis mine, ~158 km northeast of La Ronge (NTS 64D/04 and /05; UTM 6234492 m N, 568933 m E)

Metal Associations: Au, Fe, As (Cu, Zn, C)

Status: developed prospect without Resources

Exploration and Development History:

Gold was discovered in the Wedge Lake area in the early 1950s, when prospectors working on the Mincor Concession to the Mining Corporation of Canada Ltd. discovered three quartz vein–associated showings called the Trench 6/Vein 1, Trench 12/Vein 2, and Trench 20/Vein 3 zones (SMDI #0453). Little work was done on the property until it was acquired by Golden Rule Resources Ltd. in 1980, which subsequently entered into a joint-venture partnership with Saskatchewan Mining Development Corp. and, operator of the project, Giant Yellowknife Mines Ltd. The partnership undertook surface trenching, channel sampling and diamond drilling on the property in 1981 but, other than some encouraging results at Trench 6, no significant mineralization was found.

In the summer of 1982, detailed prospecting and soil geochemical sampling were undertaken on the property, the results of which led to the discovery of the iron formation–hosted Twin zone. In 1982-83, overburden stripping, trenching, and drilling (25 holes) indicated the presence of two separate mineralized zones (North and South zones). Further exploration was undertaken by the partnership from 1983-84, including geophysical (VLF-EM and magnetic) surveys, prospecting, geological mapping, and drilling (nine holes, 1292 m). A preliminary reserve estimate and metallurgical test results were subsequently released. Golden Rule released a revised ore reserve estimate in 1991. No additional work was done and the claim subsequently lapsed, only to be restaked by Petro Plus Inc. in 1997.

No further work was reported until 2004-05, when ODAAT Inc. completed three drill holes on the zone and ground geophysical (EM and magnetic) surveys in the deposit area. In 2011, La Ronge Gold Corp. acquired the Twin zone property through an option agreement with North-Sask Ventures Ltd.

Geological Character:

The property hosting the Twin zone is underlain by a supracrustal rock sequence consisting mainly of volcanic rocks and exhalative sedimentary rocks (Figure 26). The volcanic rocks comprise dominantly intermediate to felsic flows and volcaniclastic deposits, and are probably broadly contemporaneous with a rhyolite sampled near Upper Waddy Lake that yielded a U-Pb zircon age of 1880 ±7 Ma (Van Schmus *et al.*, 1987). Exhalative sedimentary horizons include chert, iron formation, and massive sulphide accumulations, or mixtures thereof. Based on textural and compositional characteristics, Netolitzky (1986) divided the iron formation into five subunits: 1) pyritic carbonaceous shale, consisting of laminae of very fine grained pyrrhotite and/or pyrite alternating with laminae of

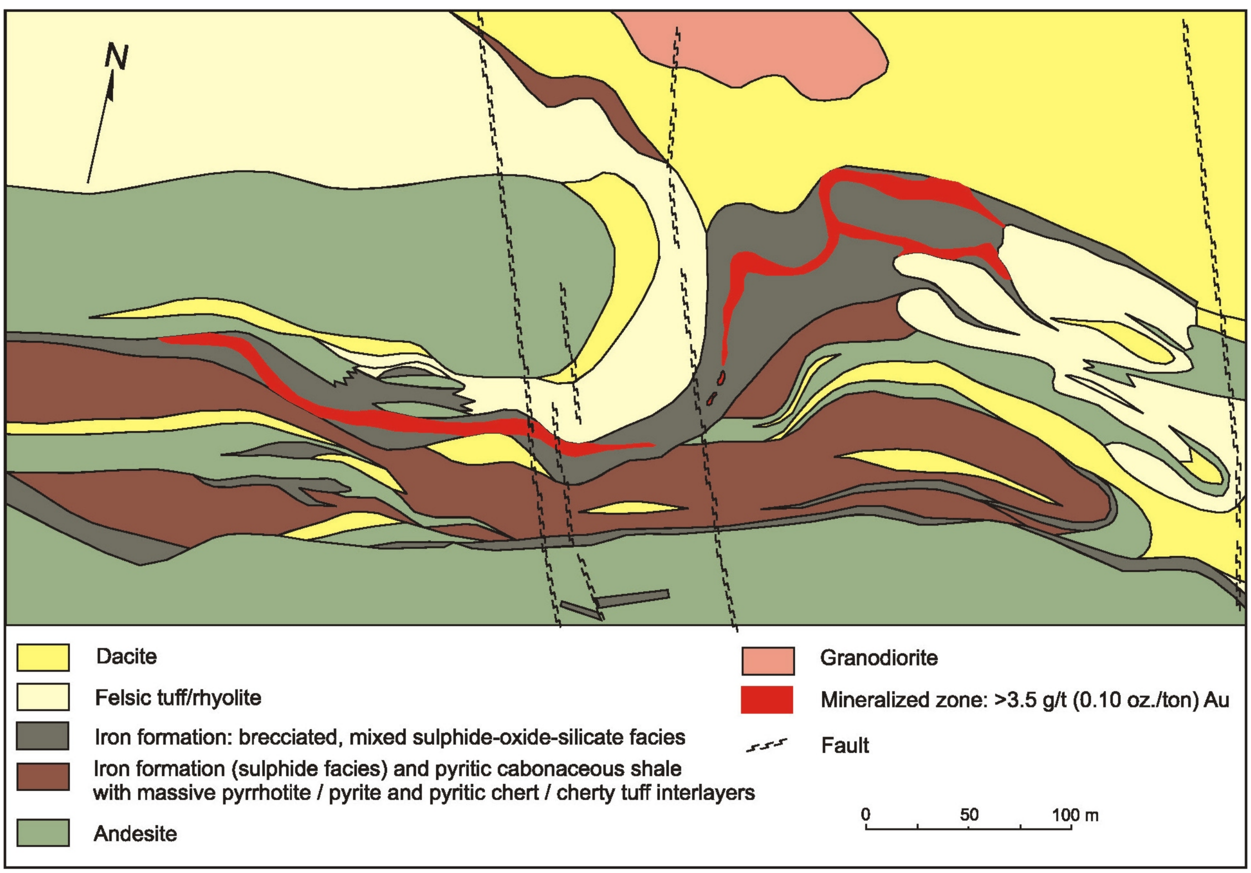

Figure 26 – Geological setting of gold mineralization at the Twin zone (from Netolitzky, 1986).

fine-grained quartz, carbonaceous material, and mica; 2) massive sulphide, consisting of >50% pyrrhotite and pyrite; 3) sulphide-clast breccia, consisting of clasts of very fine grained massive or laminated sulphides in a matrix of coarse pyrrhotite and pyrite; 4) chert breccia, consisting of 1 to 100 mm clasts of recrystallized chert in a pyrrhotite-rich matrix; and 5) quartz-clast breccia, consisting of clasts of mixed sulphide-, oxide-, and silicate-facies iron formation and disrupted chert layers in a matrix of actinolite, clinopyroxene, quartz, garnet, magnetite, and sulphides (pyrite, pyrrhotite±arsenopyrite). The absolute age of the exhalative sequence is unknown, though Harper (1984a) suggested that iron-rich exhalative sedimentation in the nearby Upper Nistoassini Lake (formerly Nistoassini Lake) area succeeded the *ca.* 1880 Ma calc-alkaline felsic volcanism.

The rocks in the property area have been metamorphosed under upper greenschist to lower amphibolite facies conditions and have been subjected to multiple deformational events, now having a dominantly east-southeast strike and subvertical dip (Harper, 1984a, 1984b). In the immediate deposit area, Netolitzky (1986) reported a minimum of two isoclinal fold sets and a set of relatively late, north-northwest–trending brittle faults. A compositional variation of iron formation types is apparent within individual isoclinal fold structures (*i.e.,* carbon-rich sulphide facies in limbs; a mixture of sulphide, oxide, and silicate facies in hinges), the significance of which is not fully understood.

Gold mineralization in the Twin zone is confined to, but crosscuts, a mixed sulphide- and oxide-facies iron formation breccia ('quartz-clast breccia' subunit), and is associated locally with increased magnetite and arsenopyrite contents. Unlike nearby gold showings at the Trench 6/Vein 1, Trench 12/Vein 2, and Trench 20/Vein 3 zones (SMDI #0453), gold at the Twin zone has no association with quartz veins. Due to its being stratabound within iron formation and because of the lack of quartz veining, both Harper (1984a) and Netolitzky (1986) considered the gold to be of exhalative origin, deposited on the seafloor contemporaneously with its hostrocks. In this model, the hostrock is thought to be a slump breccia that was deposited over an active hydrothermal vent on the seafloor, consequently resulting in the co-precipitation of 'syngenetic' arsenopyrite and gold within the breccia; localized redistribution of ore within the iron formation during later metamorphism/deformation was considered possible (Netolitzky, 1986). In contrast to this 'syngenetic' gold mineralization model, Lafrance (2002) proposed that gold mineralization at the Twin zone is epigenetic, citing as supporting evidence the presence of arsenopyrite, the crosscutting nature of the mineralized zones, the close relationship between deformational features and mineralization, and the proximity of structurally controlled mineralization elsewhere in the area (*e.g.*, Trench 6). In this model, the iron formation is viewed as a rheologically and chemically suitable trap for precipitating gold from an externally sourced hydrothermal fluid, but not as a source for the gold.

Associated Showings: Wedge Lake showings (SMDI #0453), Tansi (SMDI #0788), Sulphide Lake / Studer A, B, and F zones (SMDI #0763)

Inferred Deposit Type: orogenic gold (iron formation hosted); ?stratiform syngenetic

Production and Reserves/Resources: Historical reserves have been reported for the Twin zone.

Location 3 – Star Lake Area

Jolu Mine
Rod Main / Rod C, Rod South, and Alimak zones (SMDI #1877a, #1877b), and Decade/Mallard Zones (SMDI #0901)

Location: ~2.5 km northeast of Star Lake, ~120 km northeast of La Ronge (NTS 74A/1; UTM 6206622 m N, 544866 m E)

Metal Associations: Au, Ag (Cu, Mo, Co, Bi, B)

Status: past-producing mine without Resources

Exploration and Development History:

Prospectors working for the Consolidated Mining and Smelting Company of Canada Ltd. (later Cominco) made the first discovery of gold in the 'Mallard Lake' area in 1944 (Figure 27). This led to extensive trenching and a drilling program (32 holes totalling ~1400 m) that resulted in the definition of a relatively small gold deposit (Mallard zone). Intermittent work was performed on the property between 1945 and 1972, including a five-hole drill program in 1962, as part of a short-lived option agreement between Cominco and Oklend Mines Ltd.

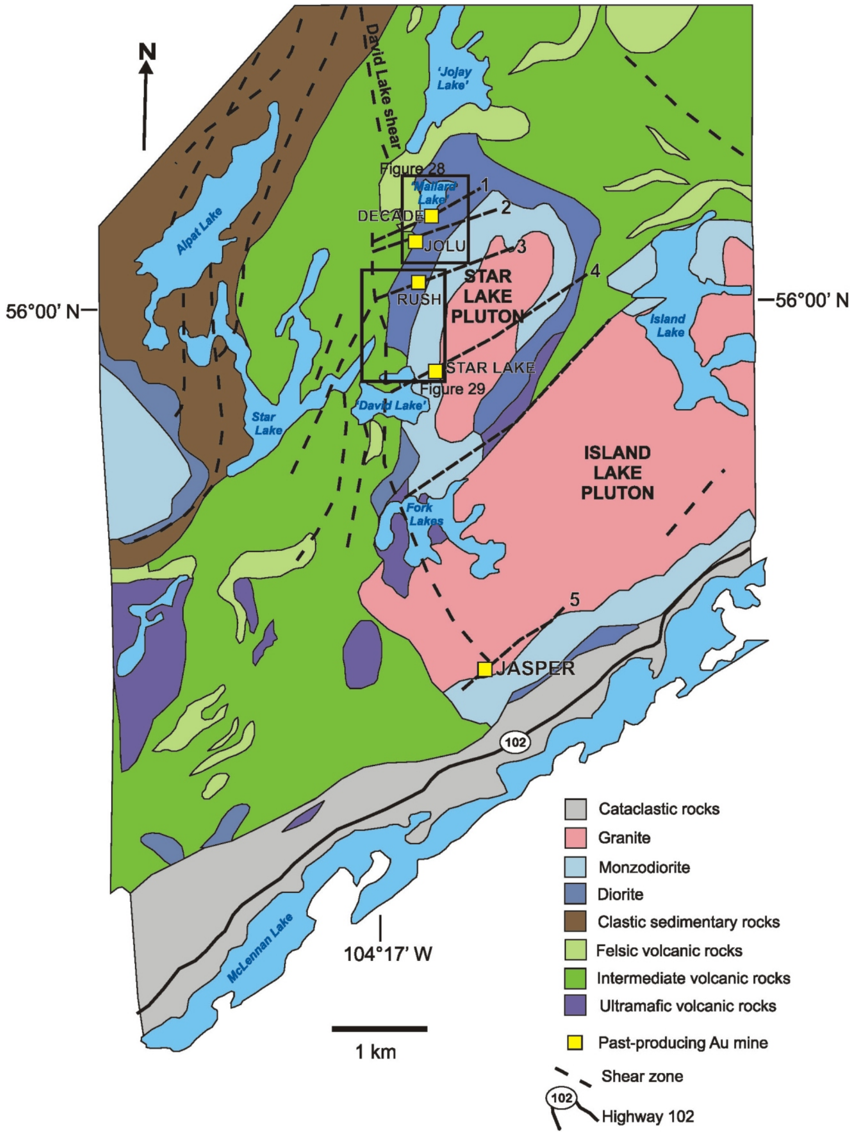

Figure 27 – Geological setting of the Star Lake area, with locations of past-producing gold mines (modified from Hrdy and Kyser, 1995). Mineralized shear zones: 1, Decade/Mallard; 2, Rod Main and South; 3, Rush; 4, 21; and 5, Jasper-James.

The property was optioned from Cominco by Decade Development Ltd. in 1972, which carried out small-scale commercial production from the Mallard zone from 1973 to 1975 (Table 1). This project involved construction of a small open pit and two parallel declines (the 24 m long 'Decade' and the 'Argyle'). Although a 50 tons/day mill was constructed on site, some concentrate was also shipped to the American Smelting and Refining Co. in Helena, Montana, which yielded 4.9 kg (173 oz.) of gold and 0.6 kg (20 oz.) of silver (Coombe, 1984). During mine development in 1974, Decade entered into an agreement with Nemco Explorations Ltd., Balfour Mining Ltd., and L.J. Manning and Associates Ltd. (mine operator). During a period of intermittent production in the spring of 1975, Jolu Mining Ltd. took over as property manager and continued mining the deposit between June and October of that year. At least 1.4 kg (50 oz.) of silver were produced during this period as a by-product of gold mining.

An option on the property was acquired in 1982 by Mahogany Minerals Resources Inc. (controlled by Goldsil Resources Ltd.), which went on to obtain full property ownership shortly thereafter. In 1984, Mahogany undertook geological mapping, soil sampling, and geophysical (magnetic and VLF-EM) surveying in the area, which led to the eventual discovery of the Rod Main and Rod South zones, located 0.5 km south of the Mallard zone. As part of a partnership with Canadian Premium Resources Corp., soil, till, and biogeochemical sampling was undertaken as follow-up exploration work, in addition to further geological mapping and geophysical surveys. Following a 204-hole drill program in 1985 and 1986, which defined existing zones and identified additional mineralized zones, an 1800 m exploration decline ('Jolu decline') was constructed to evaluate the structural character and continuity of the Rod zone. New reserve estimates were reported for the deposit and a feasibility study for the project was completed in the spring of 1987.

In 1987, Royex Gold Mining Corp. acquired a 30% interest in the property and became operator of the mine. Royex subsequently amalgamated with International Corona Resources Ltd., Lacana Mining Corp., Mascot Gold Mines Ltd., and Galveston Resources Inc. to become Corona Corp. Under an agreement between Corona (30%, operator) and International Mahogany Corp. (70%), construction of the Jolu mine, including a 400 tons/day mill, began in June of 1988. Underground mining from the Rod C / South zones and Mallard zone took place from May 1988 until May 1991 (Table 1), at which time it was determined that all ore had been extracted.

In 1992, during final decommissioning of the Jolu mining operation, a partnership between Waddy Lake Resources Inc. and Golden Rule Resources Ltd. agreed to purchase the mine and mill assets. The mill was rehabilitated and used to process bulk samples from the Komis deposit in 1994 and ore from the short-lived Komis mine in 1996 and 1997. In 2002, Golden Band Resources Inc. began a process of land acquisition throughout the La Ronge Domain, including the Jolu-Decade properties, with the intent of producing gold from several deposits. In 2003, Golden Band acquired the Jolu mill through an agreement with CDG Investments Inc. (formerly Golden Rule Resources) to form a private company known as Jolu Development Corp. By 2006, Golden Band (through Jolu Development Corp.) had acquired 100% ownership of the mill and purchased outright an outstanding production royalty held by CDG. Between 2006 and 2008, Golden Band carried out a drill program (39 holes, 4317 m) in the Jolu-Decade mines area to test for additional gold mineralization. This drilling confirmed the presence of previously known, unmined mineralization at the 'Alimak' zone, extending to the southwest from the mined-out Rod zone (Figure 28). In 2011, Golden Band completed bulk sampling at the Alimak zone to test its near-surface mining potential. The bulk sample reportedly yielded 6284 t of ore with an average grade of 6.76 g/t Au.

Geological Character[1]:

Gold mineralization in the greater Star Lake area is associated with mineralized shear zones that transect the *ca.* 1846 Ma (Thomas and Heaman, 1994) Star Lake pluton (Figure 27). The pluton is of roughly elliptical shape in map view, is of calc-alkaline geochemical affinity, and transitions from diorite at its outer margins inwards to monzodiorite, monzonite-granodiorite, and quartz monzonite–porphyritic granite at its core (*op. cit.*). It has been designated as a 'Group 1' intrusion according to the classification of Thomas (1993) and is cut by a series of north-northeast–trending, subvertical dykes of mafic to felsic composition that range in width from <5 cm to 3 m. Mineralization at Jolu is situated within a dioritic phase at the pluton's northwestern exposed margin. The pluton locally exhibits weak to moderate regional fabrics, including a foliation with a dominant 030° strike and moderate to steep dip to the northwest, and an associated down-dip mineral lineation. The pluton and its hostrocks in the Star Lake area have been metamorphosed under upper greenschist to lower amphibolite facies conditions.

The Star Lake pluton is cut by a series of steeply northwest- (to southeast-) dipping shear zones (Figure 27) that are typically 1 to 4 km in strike length, up to 30 m thick and have a 400 to 500 m spacing. The shear zones and auriferous mineralization are commonly localized within the mafic dykes that cut the pluton (Thomas and Heaman, 1994). Mineralization at the past-producing Decade (or Mallard) zone, located just south of Mallard Lake (Figure 28), is situated within the northeast-trending Decade/Mallard shear zone. In the Jolu mine area, the bulk of mineralization is situated within the Rod Main shear (Rod Main zone), which is ~2 km long and 5 to 20 m thick, and strikes 055° to 060°. Some mineralization is also associated with the subordinate Rod South shear (Rod South zone), which strikes ~080° (Figure 28) and is probably a splay off of the Rod Main shear (Thomas, 1993). The orientation of the northeastern and central segments of the Rod Main shear is apparently controlled by the contact of the pluton with a mafic dyke, whereas, to the southwest, the

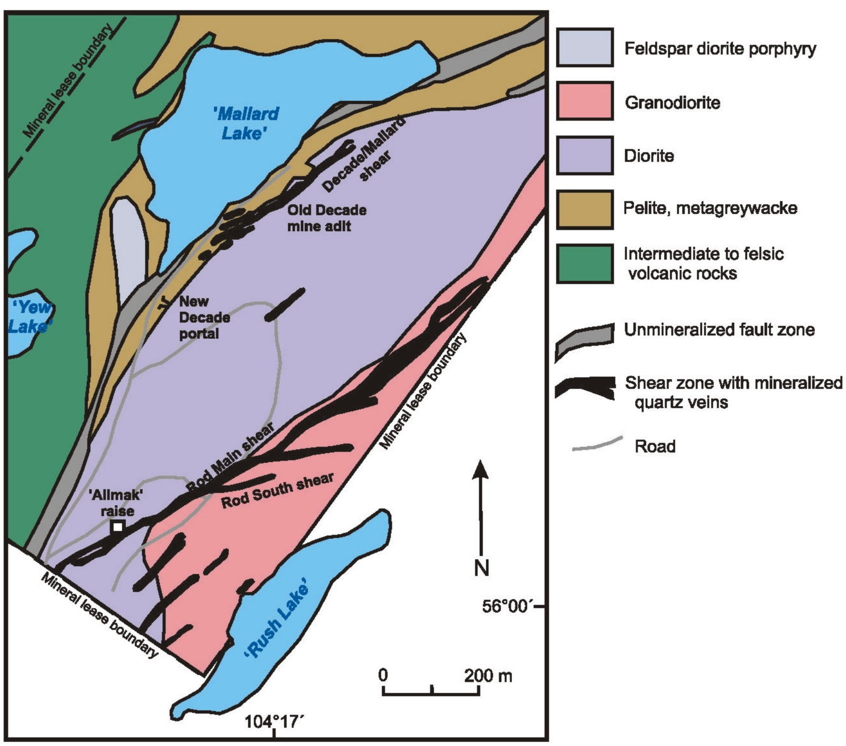

Figure 28 – Geological setting of the Jolu (Rod Main, Rod South) mine, including location of the Decade mine portal and Alimak raise (from Thomas, 1993).

[1] Although the ore has been mined, the description is in the present tense for consistency.

shear partly follows the contact between granodioritic and dioritic phases of the host pluton (He, 1997). The shear zone dips subvertically to steeply north-northwest along most of its length but locally changes to steeply south-southeast dipping. The regional foliation is typically oblique to, and deflects into, the shear zone, and the interior portions of the shear zone commonly exhibit a well-developed, overprinting (proto-) mylonitic to phyllonitic shear foliation. This internal shear foliation is commonly oblique to the shear zone boundaries and, in places, exhibits a steeply plunging mineral lineation and shear fabrics that indicate dip-slip movement (Roberts, 1993). In other places within the shear zone, sections perpendicular to the lineation reveal kinematic indicators that commonly show evidence of dextral displacement, though sinistral offset is noted on more northerly trending shears (*op. cit.*).

Mineralization at the Rod Main zone occurs in a lozenge-shaped system of synkinematic quartz veins within the shear. The veins range from large, composite fault-fill veins to a stockwork of thin veinlets that are thought to be open space infillings (Burrill, 1987a). The larger fault-fill veins commonly exhibit a 'crack-seal' texture, containing millimetre- to centimetre-scale inclusions of wallrock. The quartz vein system at the Rod Main zone extends for ~200 m along strike, is ~7 m thick, and dips steeply to the south, though individual veins commonly occupy more shallowly dipping structures (Thomas and Heaman, 1994). The overall orebody generally plunges 60° to the southwest (*op. cit.*). In detail, however, it is irregular and segmented, with individual segments plunging variably from steeply northeast to moderately southwest in longitudinal section (Roberts, 1993). Below about 410 m, the quartz vein system transitions into a quartz stockwork, characterizing the down-plunge limits of the orebody (Thomas, 1993). Gold is present as coarse grains associated with pyrrhotite, although this gives way at depth to an association of fine gold with pyrite (Burrill, 1987a). Less common sulphide and sulphosalt phases within the mineralized veins include chalcopyrite, molybdenite, cobaltite, and wittichenite. Alteration assemblages of microcline, carbonate, biotite, actinolite, and tourmaline are variably present within and adjacent to veins.

The complex relationship between deformational fabrics and mineralized veins in the Jolu mine area (*i.e.,* at the Rod Main and Rod South zones) has resulted in varying interpretations of the structural and mineralization history. The presence of a steeply plunging mineral lineation within the Rod Main shear indicates a component of dip-slip displacement, interpreted as northwest (hangingwall) side down relative movement (Poulsen *et al.*, 1986; Burrill, 1987a; Roberts, 1993). Other structural fabrics viewed on horizontal surfaces indicate transcurrent, dominantly dextral displacement along these shear zones (Roberts, 1993). These fabrics were viewed by Roberts (1993) and He (1997) as having resulted from a transpressional deformational regime, such that the host shears developed progressively during alternating episodes of horizontal shortening (dip-slip) and transcurrent displacement. These studies suggested that development of the mylonitic shear zones initiated during dominantly transcurrent movement, but then transitioned into a period of dip-slip displacement that was contemporaneous with the emplacement of mineralized quartz veins. These veins were then isoclinally refolded and sheared during renewed dextral strike- or oblique-slip movement within the shears.

In contrast, Poulsen (1986) proposed that the orientation and kinematics of the mineralized shear zones were dictated by the shortening direction during formation of the regional foliation, and related the orientation of mineralized ore shoots to the orientation of the intermediate strain axis during this deformation. Moreover, Poulsen (1989) interpreted the internal anastomosing pattern of shear zone fabrics to reflect localized deviation in the orientation of shear zone segments along zones of weakness (*e.g.*, mafic dykes), with dilational jogs thought to occur at points of intersection/bifurcation. Burrill (1987b) instead suggested that there exists a correlation between the most significantly mineralized zone at Rod Main and the change of the host shear zones from steeply north to steeply south dipping. In contrast to the structural setting of the Rod Main zone within a shear zone, mineralization at the Rod South zone is considered to be in extensional quartz veins adjacent to the Rod South shear zone (Poulsen, 1989).

Inferred Deposit Type: orogenic gold

Associated Showings: Jasper mine (SMDI #2073), Star Lake mine (SMDI #0889a, #0889b), Rush/Pie (SMDI #0890)

Production and Reserves/Resources: A small amount of production occurred from the Decade mine (Mallard zone) between 1973 and 1975 (Table 1). Mining at Jolu took place between 1988 and 1991, and included an unspecified amount of ore from the existing Mallard zone (see Table 1 for details). There are no currently defined Mineral Resource estimates for ore zones at the Jolu property.

Star Lake Mine
Starrex 21 and 29 Zones (SMDI #0889b); also Kahn 18 and 28 Zones (SMDI #0889a), and Star Lake A to D Zones and Rush/Pie Zone (SMDI #0890)

Location: northeast of Fork Lake, 2 km south of the Jolu mine site, ~118 km northeast of La Ronge (NTS 73P/16; UTM 6204583 m N, 544974 m E)

Metal Associations: Au (Cu, Mo, B, W)

Status: past-producing mine without Resources

Exploration and Development History:

Gold mineralization was first identified in the immediate Star Lake area (Figure 27) in 1960 by prospector E. Partridge, with the discovery of the 'Kahn 18' and 'Kahn 28' zones (Figure 29A). The Kahn zones were trenched and sampled, and a small amount of drilling was completed. In 1961, gold was discovered by E. and M. Hird in an outcrop immediately southwest of 'Rush Lake', ~1200 m north of the Kahn zones (Figure 29A). Trenching was completed and the showing became known as the 'Rush' (or 'Pie') zone. Further prospecting in the area led to the discovery of several other gold showings. Small-scale open pit mining was undertaken on the Rush zone in 1970, during which about 20 tons of high-grade ore from the 'main' and 'northeastern' pits were crushed, reportedly yielding gold grades between 10 and 290 g/t (0.30 and 8.5 oz./ton; Coombe, 1984). In 1980, the property was optioned and subsequently purchased by Phoenix Canada Oil Co. Ltd., which performed ground geophysical surveying (VLF-EM and magnetic) and drilling (12 holes, 629 m) in the area of the Rush zone.

In 1981, a joint venture (50:50) between Saskatchewan Mining Development Corp. (SMDC) and Starrex Mining Corp. Ltd. (a subsidiary of Phoenix Canada Oil Co. Ltd.) undertook geological mapping, biogeochemical surveying, and geophysical (magnetic, VLF-EM, and IP/resistivity) surveying in the immediate Star Lake area. This was followed by a nine-hole, 1500 m drill program designed to test newly detected geophysical anomalies and the extent of known mineralization. A second, two-phase drill program, totalling 15 holes, was initiated in 1983 and resulted in the discovery of the '21 zone', the main mineralized zone on the Star Lake property. Subsequent drilling was used to define the extent of ore mineralization at the 21 zone and also led to the discovery of additional mineralized zones, including the '29 zone', located about 80 m southeast of the 21 zone (Figure 29B).

Following a reserve determination for the deposit in 1984, a joint ownership group involving Cameco Corp. (formerly SMDC; 50%), Starrex (35%), and Uranerz Exploration and Mining Ltd. (15%) decided to take the project to production. A decline was sunk to the 21 zone in late 1985, and a 200 tons/day mill began operation in late 1986. In 1988, a decline was developed at the Rush zone and the deposit was mined out, the ore being added to the Star Lake stockpile (Table 1). The Star Lake mining operation was active for just over two years, with an estimated 10 000 t of unmined ore grading 8.2 g/t (0.24 oz./ton) remaining at the time of mine closure in March of 1989 (see SMDI #0889b). No additional work has been done on the property, which is currently owned by Golden Band Resources Inc.

Geological Character[2]:

As at the Jolu mine (see previous showing description), gold mineralization in the Star Lake mine area is situated within shear zones that transect the *ca.* 1846 Ma (Thomas and Heaman, 1994) Star Lake pluton (Figure 27). The pluton is roughly elliptical in map view and is compositionally zoned, changing from diorite at its outer margins inwards to monzodiorite and granodiorite-monzonite, and to quartz monzonite–porphyritic granite at its core (*op. cit.*). It has been designated as a 'Group 1' intrusion according to the classification scheme of Thomas (1993), and is cut by a series of north-northeast–trending, subvertical dykes of mafic to felsic composition and widths ranging from <5 cm to 3 m. The pluton exhibits a weak to moderate regional foliation with a dominant 030° strike and moderate to steep dip to the northwest, and an associated down-dip mineral lineation. The pluton and its hostrocks in the Star Lake area have been metamorphosed under upper greenschist to lower amphibolite facies conditions.

Shear zones that crosscut the Star Lake pluton are dominantly northeast-striking and consist of steeply dipping to subvertical networks of anastomosing shears, with cumulative strike lengths of several kilometres (Figure 27). Many of these high-strain zones locally coincide with the location of mafic dykes, likely due to the rheological contrast between the dykes and adjacent plutonic rock (Thomas, 1993). The shear zones typically exhibit a strain gradient from relatively undeformed rock into a mylonitic interior, marked by replacement of hornblende by biotite and grain

[2] Although the ore has been mined, the description is in the present tense for consistency.

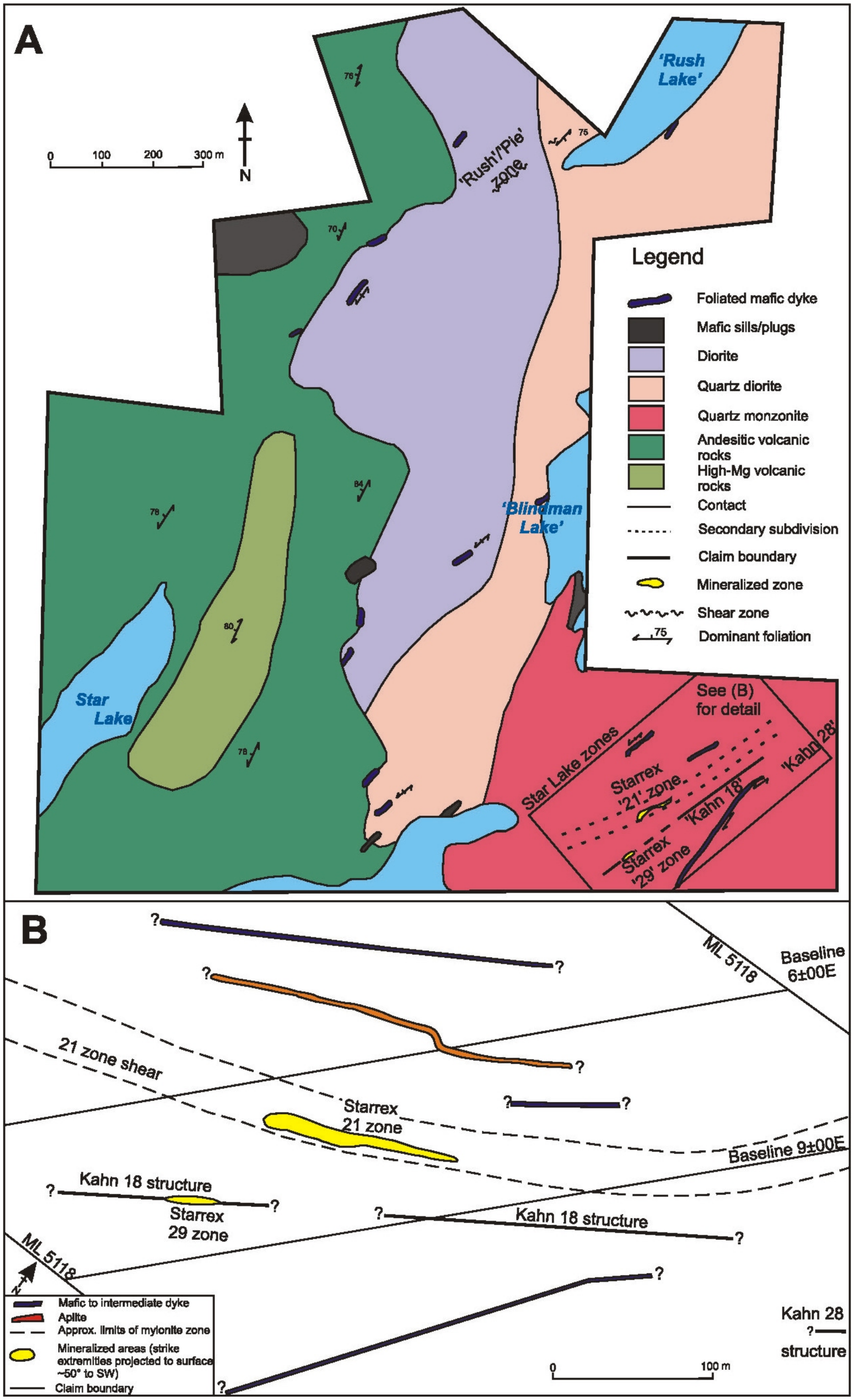

Figure 29 – Geological setting of the Star–Rush lakes area: A) generalized geological setting, with locations of the Starrex 21 and 29 zones, the Kahn 18 and 28 zones, and the Rush/Pie zone; and B) close-up showing structural elements in the Star Lake zones (modified from Canadian Institute of Mining, Metallurgy and Petroleum, 1985).

size reduction of quartz and feldspar (Poulsen *et al.*, 1986). A steeply plunging mineral lineation is commonly present down dip of the internal shear foliation (Roberts, 1993). Narrow (1 to 3 cm) zones of cataclasis are also locally present and are generally subparallel to the mylonitic fabrics. A component of dextral movement along the northeast-trending shear zones is indicated in plan view by deflections of the regional penetrative foliation and by offsets of transected dykes. Asymmetric structures are virtually absent in sections perpendicular to the shear foliation (*i.e.,* parallel to the steeply plunging lineation).

The main zone of gold mineralization at Star Lake, the 21 zone (Figure 29), is associated with one of these northeast-trending, anastomosing shear zone networks known as the 'Star Lake shear zone' ('4' on Figure 27; also referred to as the 'Kahn structural zone'; Thomas, 1993). In detail, the 21 zone orebody lies within a smaller segment of this shear network that is referred to as the '21 zone shear' (Figure 29B). This steeply northwest-dipping shear has a 1 km strike length, ranges from 1 to 30 m wide, and cuts mafic dykes and quartz monzonite. Other known mineralized zones in the vicinity of the 21 zone (*e.g.,* the 29, Kahn 18, and Kahn 28 zones; Figure 29B) are associated with similar subparallel structures. Gold mineralization at the 21 zone is situated within a shear-hosted quartz-pyrite body, consisting of a complex of composite veins, lenses and/or irregular masses of quartz that are commonly separated by wallrock fragments (Thomas, 1993). This collective quartz vein complex is subvertical, moderately southwest-plunging, and approximately 1 to 13 m thick, 80 m in strike length, and at least 80 m in vertical extent. Emplacement of the veins was ongoing during shearing, as indicated by the observation that some veins have been folded and/or brecciated and are locally intruded by other veins (*op. cit.*).

Gold mineralization within the orebody is thought to be localized within moderately to shallowly southwest-plunging ore shoots (Poulsen *et al.*, 1986). Free gold in the veins is rare; most gold is present as inclusions within, or along, late fractures cutting coarse pyrite crystals. Associated minor minerals include pyrrhotite, chalcopyrite, molybdenite, calcite, tourmaline, arsenopyrite, and scheelite. Alteration associated with mineralized veins is cryptic in the Star Lake area, though Thomas (1993) noted a discontinuous, pale green alteration of wallrock and wallrock fragments adjacent to quartz veins, and attributed this to sericitization of microcline and saussuritization of plagioclase.

The gold-bearing shear zones at Star Lake were considered by Roberts (1993) to be a distinct set of planar structures that postdate the regional foliation, mylonitic shears, and cataclastic zones. These gold-bearing shears are viewed as having developed in a regime of transpressive deformation, involving continuous folding and shearing of mineralized veins and earlier shear fabrics (*op. cit.*). Poulsen (1986) did not distinctly identify a late generation of shears, instead interpreting the mineralizing event to have occurred during formation of the mylonitic shears, and relating the orientation of the mineralized ore shoots to the intersection of shear zone segments (*i.e.,* the orientation of the intermediate axis of strain during shear zone formation). To explain the observed deviation between the orientation of the orebody and that expected for the intermediate strain axis of the shear zone, Robert *et al.* (1994) subsequently invoked reorientation of the orebody during post-mineralization shear zone reactivation, coincident with static metamorphism that overprinted the mineralization.

Inferred Deposit Type: orogenic gold

Associated Showings: Jolu mine (SMDI #1877a, #1877b), Jasper mine (SMDI #2073), Rush/Pie (SMDI #0890), Blindman (SMDI #2312), Tamar (SMDI #0891)

Production and Reserves/Resources: Production from the Star Lake mine occurred between 1986 and 1989 (Table 1).

Jasper Mine

Jasper-James Zones and Muskeg, Roxy, and Joyce Zones; Fork Lakes and Transom Lakes Properties (SMDI #2073)

Location: ~1 km south of Fork Lake, ~115 km northeast of La Ronge (NTS 73P/16; UTM 6199951 m N, 545543 m E).

Metal Associations: Au (Ag, Cu, Zn, Pb, Te, B)

Status: past-producing mine without Resources

Exploration and Development History:

Although gold had been known in the Star Lake area since the late 1950s, the Jasper mineralized zone was not discovered until 1987. The discovery was made by Saskatchewan Mining Development Corp. (SMDC) on its 'Fork Lakes' property during a geological mapping and prospecting program. Further geological mapping was undertaken, as well as overburden stripping, trenching, and bulk till and soil sampling, to determine the extent of the mineralization and to detect proximal gold-bearing zones. An extensive drilling program (119 holes, 17 359 m) was undertaken in 1987 and 1988 to test the continuity of the zone at depth, to delineate ore reserves, and to test other targets on the property. The continuation of the mineralization, known as the James zone, was discovered on the adjacent 'Transom Lake' property.

Later in 1988, Cameco Corp. (formerly SMDC), along with joint-venture partners Golden Rule Resources Ltd. (30%), International Mahogany Corp. (19%), and Goldsil Resources Ltd. (51%), developed an exploration decline to the Jasper zone to a vertical depth of 135 m. In 1989, Cameco (80%) and Shore Gold Fund Inc. (20%) purchased the property from the other joint-venture partners and mining of the Jasper and James zones began in April 1990. Ore was processed at the 250 tons/day Star Lake mill until mining was completed in May 1991. A follow-up exploration program, completed in 1991, was unsuccessful in identifying further reserves at depth and down plunge of the orebody. Wescan Goldfields Inc. acquired the property in 2004 and performed drilling between 2005 and 2007 to test the continuity of the previously mined Jasper zone, to test pre-existing targets and to follow up soil geochemical anomalies. This work traced the continuation of Jasper zone mineralization to the north of the former mine workings ('Deep Jasper') and identified several new prospective zones of anomalous gold mineralization. Wescan completed nine drill holes (2314 m) in 2011, which confirmed the presence of gold mineralization adjacent to the old mine workings.

Geological Character[3]:

The Jasper-James zones are hosted by a northeast-trending shear zone that cuts the Island Lake pluton (Figure 27). The Island Lake pluton is a 'Group 2' (Thomas, 1993) compositionally variable (quartz monzonitic to granitic) intrusion, a component of which has been dated at 1855 ±8 Ma (Hrdy *et al.*, 1991). The pluton exhibits a weakly to moderately developed penetrative foliation and is cut by numerous northeast-trending, steeply northwest-dipping shear zones. A population of relatively late, north-trending and steeply west-dipping shears of more limited strike length has also been recognized (Roberts, 1993).

Gold mineralization at the Jasper-James zones are confined to quartz veins within the highly strained interior of a subvertical, northeast-trending shear zone that cuts the southwestern margin of the pluton (Figure 27). This shear zone, known as the 'Jasper-James' shear zone ('5' on Figure 27), has a total strike length exceeding 600 m, though the auriferous zone is restricted to a smaller segment that cuts a granitic phase of the pluton. The internal shear foliation contains a down-dip, steeply plunging mineral lineation. Both fabrics are, in places, overprinted by a spaced foliation and associated shallowly southwest-plunging mineral striae (Roberts, 1993).

The quartz veins within the shear zone commonly exhibit a discontinuous 'pinch-and-swell' morphology, contain abundant wallrock inclusions, and can be either barren or auriferous. The auriferous veins, which were probably subjected to heterogeneous deformation after emplacement, are distinguished by their typical dull grey colour, ribboned to chert-like appearance, and elevated sulphide content (Hrdy and Kyser, 1995). Individual ore shoots within the veins are 1 to 2 m wide, are concentrated in veins in the most highly strained portions of the shear zone, and are steeply plunging (*op. cit.),* parallel to the steeply plunging mineral lineation. Barren veins in the deposit area are typically discontinuous, <1 m long and 30 cm wide, sigmoidal shaped, milky white in colour, and situated peripheral to the most highly strained portions of the shear zone (*op. cit.*).

Pyrite is the dominant sulphide phase in the mineralized veins, though chalcopyrite, sphalerite, bornite, galena, and Au-Ag–tellurides can also be present. Gold is present mainly along late microfractures and on recrystallized sub-grain boundaries within quartz veins (Hrdy *et al.*, 1991). Alteration and accessory hydrothermal minerals include muscovite, tourmaline, biotite, chlorite, and carbonate. Thin sericitic alteration selvages are common on the margins of veins.

The Jasper-James zones and proximal showings exhibit strong similarities in structural style to other deposits in the Star Lake area, including that at the Jolu and Star Lake mines (see relevant showing descriptions). Roberts (1993) and He (1997) have suggested that the auriferous veins were emplaced in the northeast-trending shear zones during

[3] Although the ore has been mined out, the description is in the present tense for consistency.

transpressive deformation. In this model, the mineralized veins were emplaced in the host shears during relatively early dip-slip movement and then, as the transcurrent shear component became more prominent than the dip-slip component, were subsequently folded and sheared in a dextral sense.

Inferred Deposit Type: orogenic gold

Associated Showings: Jolu mine (SMDI #1877a, #1877b), Star Lake mine (SMDI #0889a, #0889b, #0890), MacLeod Au zone (SMDI #2556)

Production and Reserves/Resources: Production from the Jasper mine occurred in 1990-91 (Table 1).

Jojay
Red/Main, Blue, Orange, Purple, and Footwall Zones (SMDI #0902)

Location: ~2 km northeast of Jojay Lake, ~125 km northeast of La Ronge (NTS 74A/01; UTM 6212047 m N, 546194 m E)

Metal Associations: Au, Ag (Pb, Zn, Cu)

Status: developed prospect with Resources

Exploration and Development History:
The original discovery of anomalous gold near Jojay Lake was made in 1940 by prospectors J.B. Coffyne and J. Krauchi. The Consolidated Mining and Smelting Company of Canada Ltd. staked the property in 1941 and performed geological mapping, prospecting, and trenching. A drilling program (37 holes, ~2500 m) was subsequently initiated, the results of which confirmed several gold-bearing zones for which preliminary ore reserve estimates were determined.

After a hiatus in exploration, further drilling was carried out in 1962 (seven holes, ~675 m) and 1967 (one hole, 139 m). Claude Resources Inc. acquired the property in 1984 and, two years later along with joint-venture partner Saskatchewan Mining Development Corp. (SMDC; 66%), completed ground geophysical (magnetic and VLF-EM) surveys, geological mapping, prospecting, and bulk till and humus sampling. Trenching and 17 drill holes were subsequently completed to test the previous reports of mineralization. A preliminary reserve estimate was calculated from this drilling and the mineralization was determined to be open down plunge. In 1987, SMDC performed further ground geophysical (VLF-EM, magnetic, and IP/resistivity) surveying on the property, completed trenching and sampling of several zones (‘Red’, ‘Blue’, and ‘Orange’) and undertook a 17-hole drill program, which led to the discovery of the ‘Purple’ zone. Later that year, a further 18 drill holes and geological mapping were completed on the property, allowing for an updated reserve calculation. Another exploration program, comprising prospecting, geochemical sampling (rock, soil, humus, and bulk till), and 19 drill holes, commenced in 1988 and resulted in another modified reserve calculation in 1990.

In 2004, Wescan Goldfields Inc. acquired a 25% stake in the property from parent company Shore Gold Inc. and obtained the remaining 75% interest from Claude Resources Inc. in 2006. Wescan carried out a two-phase drilling program in 2007 and 2008 (21 holes) that, along with new trenching and historical drill results for the deposit, enabled the calculation of an updated Mineral Resource estimate (Table 2).

Geological Character:
In contrast to other shear zone–hosted gold deposits in the Star Lake area (*e.g.*, Jolu, Star Lake, Jasper; see relevant showing descriptions), which are hosted by plutonic rocks, the Jojay deposit is hosted by supracrustal rocks (Figure 30). Specifically, the mineralized zone is situated in a highly brecciated zone near and slightly oblique to the contact between mafic volcanic rocks and adjacent volcanogenic sedimentary rocks. A felsic tuff sequence, to the west of and stratigraphically above the mineralized zone, is intruded by quartz-feldspar–phyric felsic dykes, which are themselves cut by later mafic to intermediate dykes (Harper, 1986). The felsic dykes commonly follow or are parallel to the breccia zone and are themselves brecciated in places. Hostrocks of the deposit have been metamorphosed under upper greenschist to lower amphibolite conditions.

The breccia zone trends ~172°, is traceable for ~2100 m along strike, and is typically 2 to 3 m wide. It truncates volcanic horizons (Coombe, 1984) and is probably part of a larger brittle fault (‘Jojay structural zone’; Roy and Trinder, 2010). Fractures and interclast spaces within the mineralized zone are filled by quartz, thereby forming a

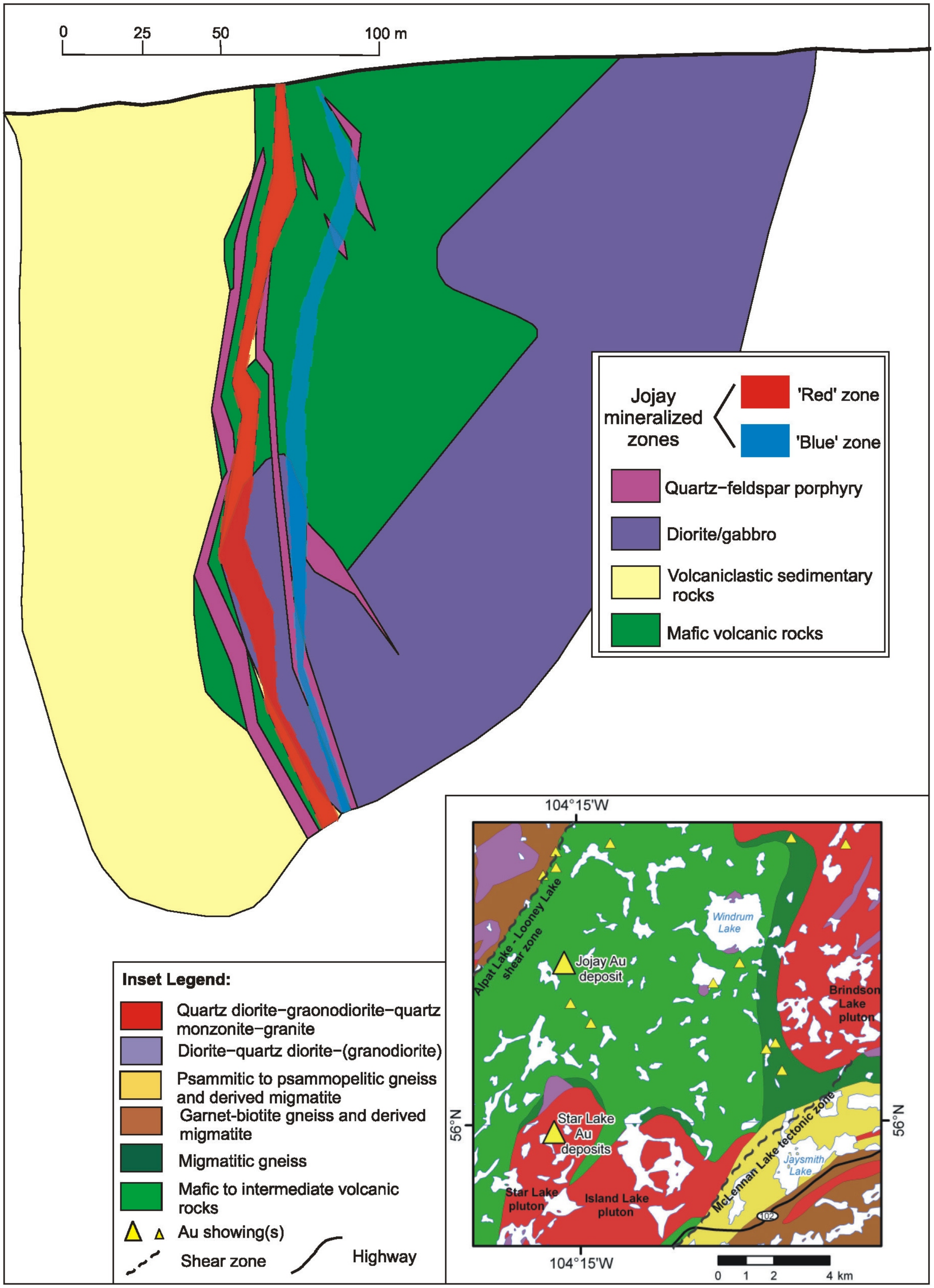

Figure 30 – Cross-section through the 'Red' and 'Blue' mineralized zones at the Jojay deposit (looking approximately north; modified from Roy and Trinder, 2010). Inset shows regional geological setting of the deposit and its location relative to gold showings of the Star Lake area (from Slimmon, 2011).

stockwork of quartz veinlets. The wallrock clasts between veinlets are also commonly silicified. Within the breccia zone, gold mineralization appears to be situated within ore shoots that are localized within a smaller, 335 m by 35 m zone (Coombe, 1984). Gold and sulphide minerals (pyrrhotite, chalcopyrite, pyrite, galena, and sphalerite) are present in the quartz veins and within the silicified wallrock. Coombe (1984) stated that galena can be an indicator of gold mineralization. Alteration minerals proximal to quartz veins include variable proportions of biotite, Fe-carbonate, and plagioclase.

Based on the above observations, Coombe (1984) suggested that the Jojay deposit might be situated at either a deflection/bend in the Jojay structural zone or at an intersection of the structural zone with a plane of weakness along the contact between the volcanic and sedimentary rocks. Harper (1986) observed crenulation and folding of the quartz veinlets and suggested that their emplacement predated a phase of north-trending regional faulting known to occur in the vicinity of the zone.

Inferred Deposit Type: ?orogenic gold; ?modified epithermal gold (see Harper, 1986)

Associated Showings: possibly has a genetic association with mineralization in the Jolu mine area (SMDI #1877a, #1877b) and other pluton-hosted deposits in the Star Lake area

Production and Reserves/Resources: Wescan Goldfields Inc. reported a Mineral Resource estimate for the Jojay deposit in 2010 (Table 2).

Location 4 – Berven–Roundish Lakes Area

Wilson Lake Showings

Anomalies A, B, C, and D (SMDI #2273); Anomalies E and F (SMDI #2271); Anomalies G and H (SMDI #2272)

Location: ~4 km west of Highway 102 ~100 km northeast of La Ronge, (NTS 74A/1; UTM 6193901 m N, 533062 m E)

Metal Associations: Au (Cu)

Status: occurrences

Exploration and Development History:

Airborne geophysical surveying (INPUT-EM and magnetic) was completed over the showing area in 1977 by joint-venture partners Saskatchewan Mining Development Corp. (SMDC) and International Mogul Mines Ltd. The claims lapsed and the area was restaked by Golden Rule Resources Ltd. in 1980, which subsequently optioned the property to Energy Reserves Canada Ltd. in 1981. Following completion of lake-sediment sampling by the partnership, SMDC took over as operator of the project and Energy Reserves Canada Ltd. sold its interest in the property to Goldsil Mining and Milling Inc. The claim was subsequently allowed to lapse.

In 1986, Ingot Exploration Ltd. completed airborne geophysical (EM and magnetic) surveys over the area for Goldsil–SMDC and the showing area was restaked by a partnership involving SMDC, Goldsil, and Golden Rule at the beginning of 1987. During the following two years, the partners undertook an exploration program that included prospecting, geological mapping, and rock and soil sampling. This work resulted in the discovery of rock samples with anomalous gold values (anomalies A to E) and was followed by a 26-hole diamond-drill program on anomalies A, B, C, and D.

Further work was completed in 1989, when a partnership involving Goldsil (90%) and Cameco Corp. (formerly SMDC; 10%) undertook geological mapping, prospecting, and rock and till sampling. The claim was allowed to lapse following this work. The area was not restaked until 2005, when Golden Band Resources Inc. acquired the ground. After lapsing again, the showing area was staked by Fuhua Mining Ltd. in 2009.

Geological Character:

The immediate showing area is underlain by the Wilson Lake leucogranitic stock, which hosts all of the Wilson Lake gold showings. This ovoid 'Group 3' (Thomas, 1993) intrusion is exposed over an area of ~6 km^2 and intrudes northeast-trending volcanic sequences of mafic, intermediate, and felsic compositions. Rocks in the Wilson Lake area have been metamorphosed under lower amphibolite facies conditions (*op. cit.*).

There is little published information on the detailed geological setting of the Wilson Lake gold showings. The showings consist of mineralized quartz veins and fracture fillings within shear zones that cut the Wilson Lake stock. The host shear zones trend between about 035° and 080°, broadly parallel to the main regional fabric in the area. Up to 5% pyrite is present in the quartz veins, along with traces of chalcopyrite. Gold is present in both native form and in association with the pyrite. Silicification and sericitization of the host leucogranite are noted adjacent to the mineralized veins.

Inferred Deposit Type: ?orogenic gold

Associated Showings: Italy Lake (SMDI #2669)

Production and Reserves/Resources: none

Berven Lake Showings

Including Road (SMDI #2267), Joey (SMDI #2421), Harmony (SMDI #2422), Digger (SMDI #2423), Smurfette (SMDI #2424), Happy (SMDI #2425), and Blue (SMDI #2426), as well as Campbell, Brainy, Poppa, and Hailstone (SMDI #2268)

Location: adjacent to Highway 102, ~90 km northeast of La Ronge (NTS 74A/01; in the vicinity of the Joey showing at UTM 6183960 m N, 526033 m E)

Metal Associations: Au (Cu)

Status: occurrences

Exploration and Development History:

Exploration in the Berven Lake area has been ongoing since 1977. Between 1977 and 1983, various companies conducted airborne geophysical (INPUT electromagnetic and magnetic) surveys, prospecting, regional mapping, and lake-sediment sampling.

In 1986, a joint-venture partnership between Saskatchewan Mining Development Corp. (SMDC; 50%) and Troymin Resources Ltd. (50%) completed airborne and ground geophysical (VLF-EM and magnetic) surveys, along with geological mapping, prospecting, outcrop stripping, and rock sampling. The Joey showing, one of several minor gold showings in the Berven Lake area, was discovered in 1987. Later that same year, another phase of exploration involving geological mapping, outcrop stripping, trenching, and sampling led to the discovery of several other gold showings in the area (Campbell, Road, Brainy, Poppa, Digger, Harmony, and Smurfette). Chip samples from one of the showings returned gold values ranging from 2.3 to 59 g/t (0.065 to 1.73 oz./ton).

A small drill program commenced in the winter of 1988 on the Joey (seven holes, 540 m), Road (two holes), Brainy (one hole), and Poppa (one hole) showings. Additional drilling (four holes) was completed at Joey the following year. Only the drilling at Joey yielded anomalously gold-mineralized intervals, generally of 0.5 m width and with grades ranging from 5.1 to 31 g/t (0.015 to 0.908 oz./ton) Au.

In 1997, the property covering the Joey showing was acquired by Petro Plus Inc., which completed a small drill program (seven holes) that yielded results similar to those obtained during the earlier drilling. Golden Band Resources Inc. acquired claims in the Berven Lake area in 2002, on which it completed a bulk till sampling program. Claims covering the showings were subsequently staked by North-Sask Ventures Ltd. in 2005 and 2009, which undertook an exploration program consisting of rock channel sampling at existing trenches and soil–bulk till sampling (Studer, 2010).

Geological Character:

The Berven Lake showings are situated within a dominantly mafic to intermediate volcanic rock sequence, near the southeastern margin of the crosscutting, leucodioritic to granitic Berven Lake pluton (a ‘Group 1’ intrusion; Thomas, 1993). The rocks exhibit a strong northeast-trending structural trend and have been metamorphosed under lower to middle amphibolite facies conditions (Thomas, 1985).

Little information is available on the detailed geological settings of the Berven Lake showings. In general, they are associated with gossanous and pyritic shear zones (±quartz veins) that cut volcanic rocks or felsic dykes. Of all these showings, the best documented is the Joey showing; short descriptions of some other showings are available in associated SMDI files or from Studer (2010).

Mineralization at the Joey showing is situated in rusty, vuggy quartz veins contained within a northeast-trending shear zone. This shear zone crosscuts intermediate to felsic volcanic rocks and a small granodiorite dyke (SMER Assessment File 73P15-0084). Gold is found in association with pyrite, which is present as fracture coatings in wallrock and as blebs, stringers, and disseminations in the quartz veins. Minor disseminations of pyrrhotite and chalcopyrite are locally present in the quartz veins. Auriferous veins are associated with potassic and carbonate alteration and are offset by a later shear zone that trends ~065°. Barren sulphidic quartz veins have also been reported.

Inferred Deposit Type: ?orogenic gold

Associated Showings: Texas Grid (SMDI #2303), D.J./Joe's (SMDI #2269), Yates (SMDI #2270), Teacher's Point (SMDA #2514), V.G. (SMDI #2515), Sulphide Island (SMDI #2516), and P.R. (SMDI #2517)

Production and Reserves/Resources: none

Location 5 – Dickens Lake Area

Roy Lloyd Mine / Bingo
Bingo North, Bingo South, Adit and East Zones (SMDI #2627)

Location: ~92 km northeast of La Ronge along Highway 102 (NTS 73P/10 and /15; UTM 6172939 m N, 516759 m E)

Metal Associations: Au (Cu)

Status: producing mine

Exploration and Development History:

Gold mineralization at the Roy Lloyd mine consists of separate mineralized zones, including the Bingo North, Bingo South, and Adit showings (Figure 31). The Bingo North and South showings were discovered in 1991 by a partnership involving Cameco Corp. (50%) and Uranerz Exploration and Mining Ltd. (50%), through a program of geological mapping, prospecting, and rock and bulk till sampling. This was followed in 1992 by ground geophysical (VLF-EM, IP, and magnetic) surveys and drilling of four holes on the North and South showings. Subsequent geological mapping, prospecting, and outcrop/soil sampling by the partnership in 1993 led to the discovery of the Bingo East showing, situated 240 m east of Bingo North (Figure 31). Several other gold showings were discovered in the vicinity of Bingo, including Arseno, JKL, Lonely, Firepit, and Devil. By 1997, 60 drill holes had been completed in the area, including 43 on the Bingo zones, and a preliminary resource estimate for the deposit was released.

In 2002, Golden Band Resources Inc. acquired the property from Cameco and performed an 11-hole drill program to further investigate the deposit and confirm previously established grade and reserve estimates. Additional surface drilling was undertaken in 2005 to confirm the location of gold mineralization in advance of planned underground testing at Bingo. As part of this drilling program, two unexpected high-grade gold zones ('Cockrum' and 'Quarry' showings) were encountered proximal to the Bingo deposit. An updated Mineral Resource estimate was reported following this work. Golden Band undertook an underground exploration program at Bingo in 2007 and 2008 that included development of a 675 m decline ramp, followed by development of two exploration drifts totalling ~317 m at vertical depths of 67.5 m and 95 m below surface (1325 and 1295 levels, respectively). A further 1135 m of underground drilling was performed in the summer of 2008 to test the extent of mineralization parallel to the underground development workings. As a result of the underground exploration, a 4000 t bulk sample was extracted and stockpiled at the site. An updated Mineral Resource estimate for the deposit was released in 2009 as part of a Pre-Feasibility Report for Golden Band's La Ronge Gold Project, a proposed four-year mining project that was to begin with mining of the Bingo deposit. Following underground exploration, additional surface drilling was completed in 2009 to test for the down-plunge continuation of high-grade gold mineralization at Bingo and, along with a prospecting and rock/channel sampling program, to test the extent of mineralization at the nearby Cockrum zone and Quarry showing. This drilling successfully demonstrated the down-plunge continuity of the Bingo high-

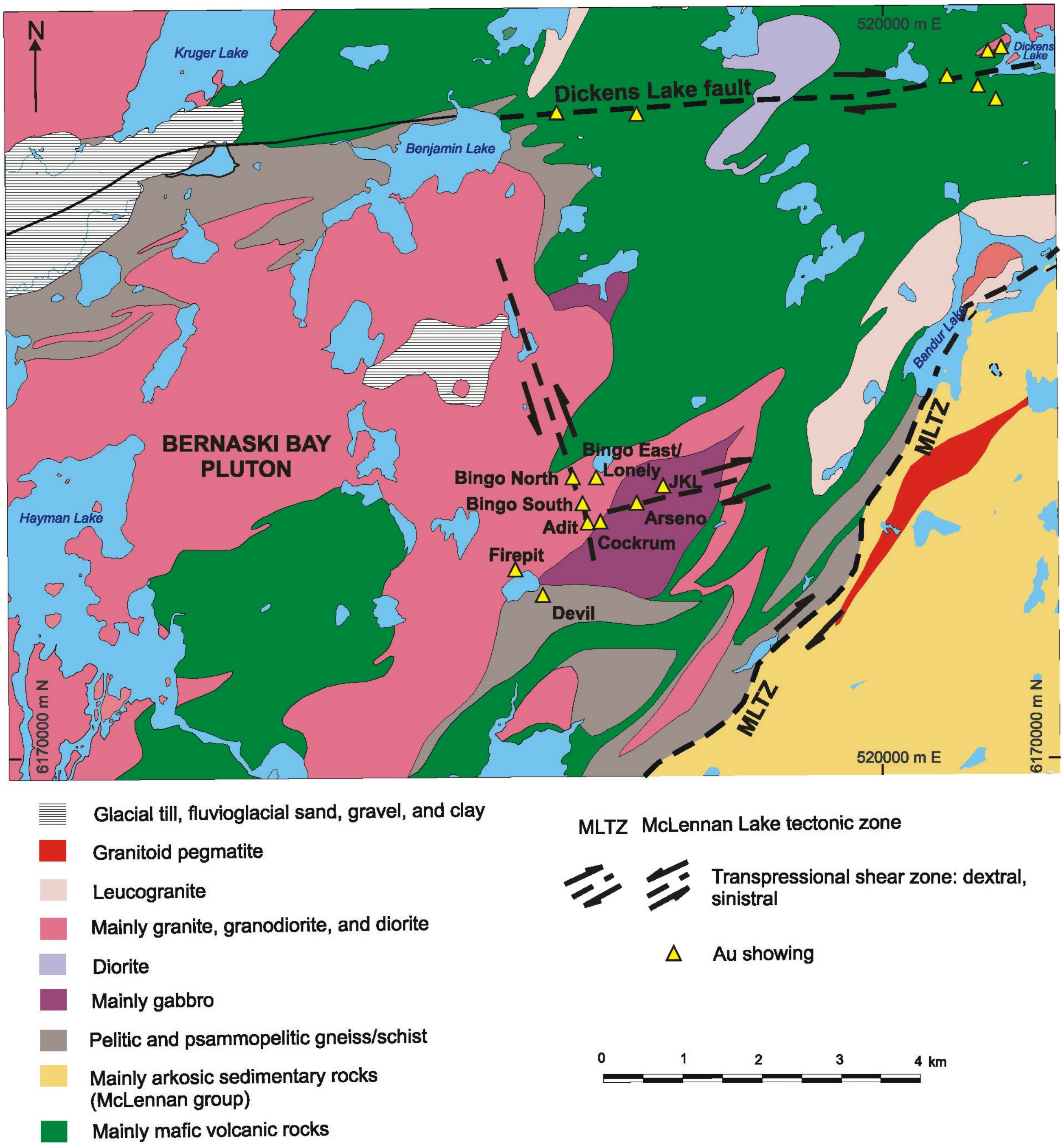

Figure 31 – Generalized geological setting of the Roy Lloyd mine area, including location of the various Bingo gold showings (modified from Thomas (1993) and Tourigny (2003a)).

grade gold mineralization to a vertical depth of 525 m below surface. A new high-grade zone of gold mineralization (the '188' zone), situated ~300 m west of Bingo, was also discovered as a result of this drilling.

Golden Band continued with underground exploration and preproduction development work at Bingo in 2010. Ore extracted during this underground work was stockpiled on site and subsequently shipped to the Jolu mill, which was being refurbished in preparation for processing the ore from the La Ronge Gold Project. A production decision for the Bingo deposit was approved in September 2010 and processing of ore at the Jolu mill commenced on December 23, 2010 at a rate of 400 t/day. The new mine, which included both open pit and underground extraction, was named the Roy Lloyd mine in honour of a long-time company director. The first gold bar was poured on

January 12, 2011 and official commercial production was announced on April 1, 2011. Golden Band continued with underground exploration of the deposit after mining commenced in order to expand the existing Mineral Resource, which had been determined in April 2011 (Table 2).

Geological Character:

The Bingo deposit is hosted by shear zones on the northeastern margin of the Bernaski Bay pluton, a compositionally zoned 'Group 1' pluton that consists of early gneissic phases and later massive to weakly foliated phases of biotite granite and granodiorite, quartz diorite, diorite, and gabbro (Thomas, 1993). At the deposit, the pluton consists mainly of inequigranular, medium-grained granodiorite and subordinate diorite. It is cut by several younger dykes, including hornblende- and biotite-rich quartz diorite varieties that, due to competency contrasts with the adjacent pluton, are locally overprinted by shear zones (*op. cit.*; Tourigny, 2003a).

Gold mineralization at Bingo is located within part of a northwest- to north-northeast–trending, brittle-ductile shear system (the 'Bingo' shear system) that crosscuts the Bernaski Bay pluton. Individual shears range from 0.50 to 5 m in width, and the cumulative shear system has a minimum strike length of >300 m and vertical extent of >100 m. The shear zones contain an intense internal mylonitic foliation that is steeply dipping to the west or southwest and generally parallels the shear zone boundaries, but is slightly oblique to the dominant west- to northwest-dipping regional (S_1/S_2) fabric. A prominent, moderate to steeply northwest-plunging stretching lineation is present along the dip of the mylonitic fabric (Tourigny, 2003a). The timing of development of the shear zones and contained fabrics with respect to the regional foliation is currently unknown.

The Bingo deposit consists of multiple mineralized showings (Figure 31), including Bingo North and Bingo South, which are confined to smaller portions of the overall shear system. The mineralized shear is steeply dipping and consists of hornblende-biotite schist, the protolith of which is not definitively known but was probably either a quartz diorite dyke (Tourigny, 2003a) or a lens of mafic to intermediate volcanic rock within the pluton (*e.g.,* SMER Assessment File 73P10-0185). The trend of the host shear at individual mineralized zones is variable, ranging from northwesterly at the Bingo North showing, to north-northeasterly over the main part of the shear zone, to northeasterly at the Bingo South showing. This variation was originally attributed to later open folding of one continuous, dominantly northwest-trending, brittle-ductile shear zone (Tourigny, 2003a; Simpson, 2006). Tourigny (2005), however, subsequently proposed that, although this shear zone is clearly affected by later (D_3) folding, this variation was also partly due to shear refraction across rock units of variable competencies, as well as the fact that the Bingo zones were situated along two separate mineralized shear zones of differing orientation. These shear zone segments were defined as the northwest-trending 'Bingo Northwest' shear zone and the north-trending 'Bingo Main' shear zone (Figure 32). Available kinematic indicators show that both of these shear zones have undergone reverse-sinistral movement, with an overall southeast-verging transport direction (Tourigny, 2005).

Gold mineralization at the various zones of the Bingo deposit is associated with a set of white quartz veins that generally parallels the local shear zone foliation (*i.e.*, 'fault-fill' veins). The mineralized veins are <60 cm wide and up to 10 m long; in addition to visible gold, they contain sparse pyrite, chalcopyrite, pyrrhotite, and hematite. Zones of potassic (biotite-sericite) and chloritic alteration are spatially associated with the veins. This mineralized vein set, the second of three generations noted in the shear zone, commonly exhibits deformational features such as fracturing, subvertical elongation, pinching and swelling, symmetric and asymmetric boudinage structures, and occasional northwest-plunging S-folds. Available kinematic indicators in these veins corroborate a component of sinistral movement within the shear zone around the time of mineralization (Tourigny, 2003a). An earlier set of deformed quartz-biotite-chlorite veins, possibly a deformed vein stockwork, is northeast- to east-striking and discordant to the shear zone. A later set comprises millimetre-scale, east-northeast– to northeast-striking, *en échelon* quartz veins within weakly deformed rocks on the western boundary of the shear zone (*op. cit.*). Neither of these other two vein sets is known to contain gold.

Multiple ore shoot orientations have been proposed for the Bingo and satellite deposits, resulting from the complex geometry and kinematic history of the shear zones, as well as later structural modification. Tourigny (2005) proposed that the ore at the Bingo North showing parallels the northwest-plunging hinge of a relatively late (D_3), outcrop-scale open fold due to remobilization of gold into structures associated with this folding. Furthermore, the intersection of the Bingo Northwest and Bingo Main shear zones is interpreted to coincide with a northwest-plunging dilational jog (Figure 32A), whereas another northwest-plunging ore shoot is thought to be localized at a contractional fault bend along the southern part of the Bingo Main shear zone at the Bingo South showing (Figure 32B). Tourigny (2005) also hypothesized the presence of additional, shallowly to moderately north-plunging ore shoots at places along the Bingo Main shear zone, including its intersection with the Cockrum zone. Based on structural modelling, these hypothetical ore shoots were envisaged to have formed along lines of intersection

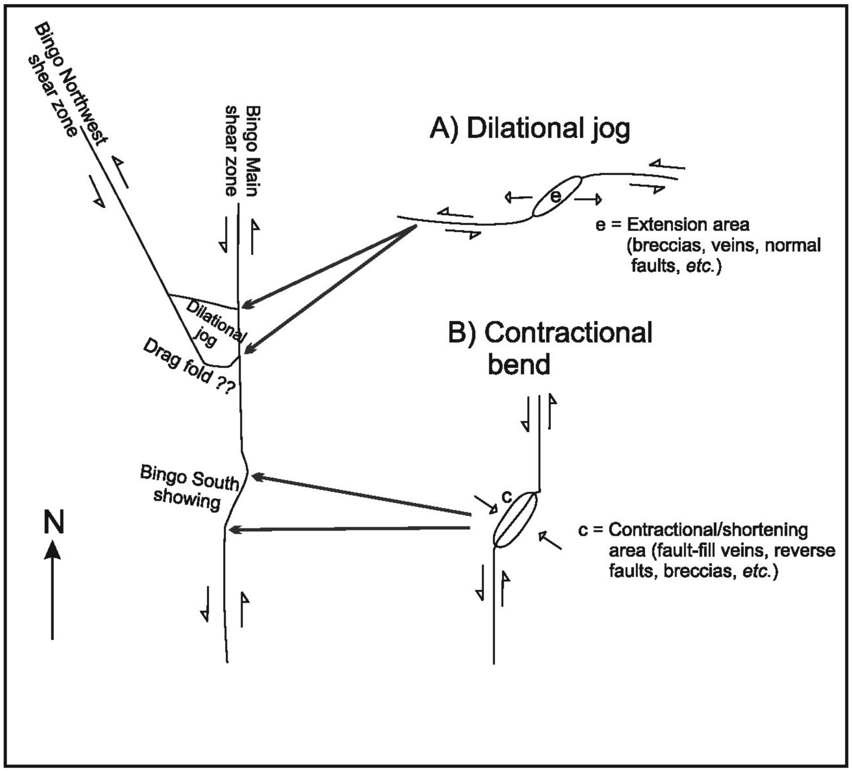

Figure 32 – Model for the geometry of the Bingo mineralized shear system, including the dilational jog (A) proposed to occur at the junction between the Bingo Northwest and Bingo Main shear zones, and the contractional bend (B) proposed to occur at the Bingo South showing (from Tourigny, 2005).

between a steeply dipping shear zone boundary and a set of shallowly dipping fractures/veins that are observed at surface.

Two general models have been put forth to explain the kinetics of the Bingo shear zone system at the approximate time of gold mineralization. The overall northwesterly trend of the Bingo shear zone(s) and the presence of sinistral kinematic indicators led Tourigny (2003a) to originally propose that the Bingo shear system formed as an antithetic zone of oblique-sinistral transpression during relatively late, dextral transpression along the northeast-trending McLennan Lake tectonic zone and the east-trending Dickens Lake fault (see Figure 31). The reverse-sinistral movement along the Bingo shear zones was subsequently reinterpreted to have occurred either during a single episode of oblique-slip displacement that was unrelated to regional dextral transpression or, possibly, due to sinistral reactivation of an earlier reverse fault (Tourigny, 2005).

Inferred Deposit Type: orogenic gold

Associated Showings: Firepit (SMDI #2501), Devil (SMDI #2625), Arseno (SMDI #2626), JKL (SMDI #2628), Lonely (SMDI #2631)

Production and Reserves/Resources: Commercial production from the Roy Lloyd mine (Bingo deposit) commenced in April 2011 and is ongoing (Table 1). This was preceded by disclosure of several Mineral Resource estimates for the deposit, most recently at the start of mining in 2011 (Table 2).

Location 6 – Contact Lake Area

Contact Lake Mine / Bakos
Including the MZ1/BK-1, MZ2/BK-2, M, P0, and BK-3 Zones (SMDI #0619, #0619a, #0619b); and the B-1 (SMDI #0619a), Keya (SMDI #0619b), and Owl (SMDI #2434) Zones

Location: west shore of Contact Lake, ~45 km northeast of La Ronge (NTS 73P/07; UTM 6141414 m N, 507983 m E)

Metal Associations: Au (Cu, Pb, Zn)

Status: past-producing mine without Resources

Exploration and Development History:

In 1978, a gold anomaly in lake sediment was identified at Turtle Lake, approximately 1 km southwest of Contact Lake. Follow-up exploration on this anomaly resulted in the eventual discovery of the Bakos deposit (Chapman *et* *al.*, 1990). The nearby Preview Lake area (including the area of the later Contact Lake mine) was staked by Saskatchewan Mining Development Corp. (now Cameco Corp.) in 1979. Follow-up bulk till sampling undertaken from 1984 to 1986 traced the anomaly about 2 km up-ice to Contact Lake. In 1987, a regional shear zone (the Bakos shear zone) was discovered during prospecting and mapping at the head of the bulk till anomaly and was drilled early in 1988. Following an IP/resistivity survey in 1989, a 113-hole winter drilling program (18 057 m) was undertaken to delineate the 'Main' zone, which consisted of two orebodies known as the BK-1 and BK-2 zones. As of December 1989, the deposit comprised a zone extending for 600 m along strike and down to depths ranging from 180 to 280 m.

At that time, a feasibility study based on a production rate of 750 tons/day was completed and an environmental impact statement (EIS) was submitted. The EIS was approved in 1991 and a surface lease was subsequently executed. In July 1991, Cameco received permission from the provincial government to proceed with development of a mine. During the 1990 delineation drilling program, drill hole TU90-141 discovered the BK-3 zone. The 1992 fall and winter drilling programs defined reserves in the BK-3 zone and upgraded reserves in the Main zone. A drilling program in the summer of 1993 extended the reserves along strike and down plunge of the Main zone, and drilling during a fall program confirmed the continuity of ore on levels planned for the first phase of underground development. Between 1993 and 1994, Cameco completed site work, decline driving, and underground drift development at the minesite. In December 1994, the property area was reduced and Cameco (66.7%) partnered with Uranerz Exploration and Mining Ltd. (33.3%) to further advance the project. A development announcement was made in April 1994 and full production at the mine started in January 1995, with the first official gold pour occurring on February 22, 1995. Between 1995 and 1996, the partnership completed a drilling program to test the Bakos East (four holes) and Bakos West extensions (four holes). Underground exploration programs undertaken in 1996 and 1997 failed to replace the mined-out reserves and no new extensions to the main zone were found. Mining operations ceased in 1997. Milling of existing ore was completed at the Jolu mill, which was subsequently decommissioned in June 1998. In 2011, Golden Band Resources Inc. purchased Cameco's interest (50%) in the property immediately adjacent to the Contact Lake minesite (the 'Little Deer Lake project').

Geological Character[4]*:*

Gold mineralization in the Contact Lake area is hosted by quartz veins along major structures, including the Bakos, Keya, and Owl shear zones (Figure 33). The Contact Lake deposit occurs within the northeast-trending Bakos shear zone, which, along with the other mineralized shears, cuts the Little Deer Lake pluton. This pluton, which intrudes volcanic and sedimentary rocks, is multiphase, comprising an outer zone of gabbro, diorite, and quartz diorite, with a core dominated by granite, quartz monzonite, and granodiorite (Figure 34). Existing U-Pb zircon dates indicate an age of 1854 ±3 Ma for the dioritic phase (Kyser and Stauffer, 1995) and 1837 ±5 Ma (Kyser *et al.*, 1992) for the granitic phase. The central granitic phase is cut by a southward-branching, pink felsic dyke, which is ~2 km long and 150 m wide at its widest point near the Bakos shear zone (Lee and Roberts, 1999; Figure 33). The shear zone and the veins crosscut the felsic dyke, as well as an early regionally penetrative fabric.

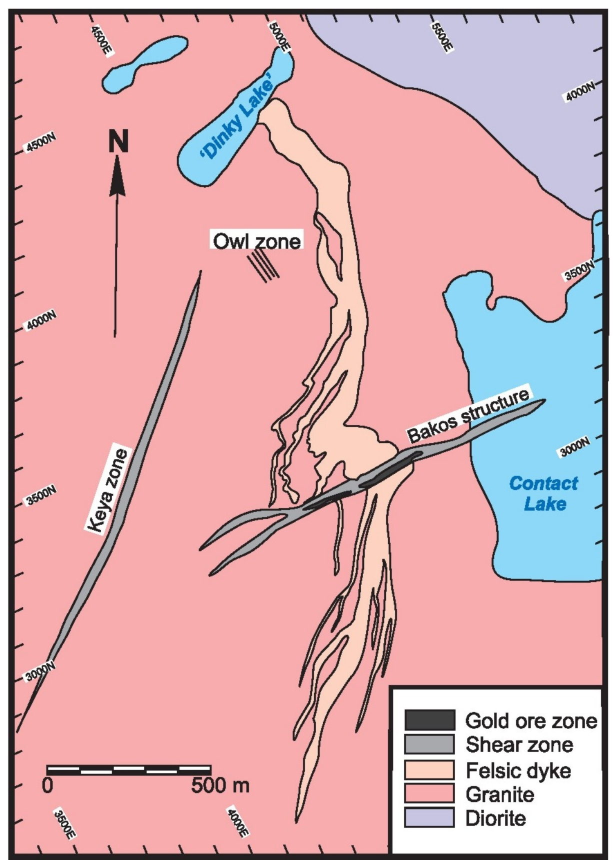

Figure 33 – Geological setting of the Contact Lake deposit (from Lee and Roberts, 1999).

The earliest recognized fabrics (D_1) in the Little Deer Lake pluton are a west-southwest–trending, steeply north-dipping foliation and an associated southwest-plunging stretching lineation. Though designated as S_1

[4] Although the ore has been mined out, the description is in the present tense for consistency.

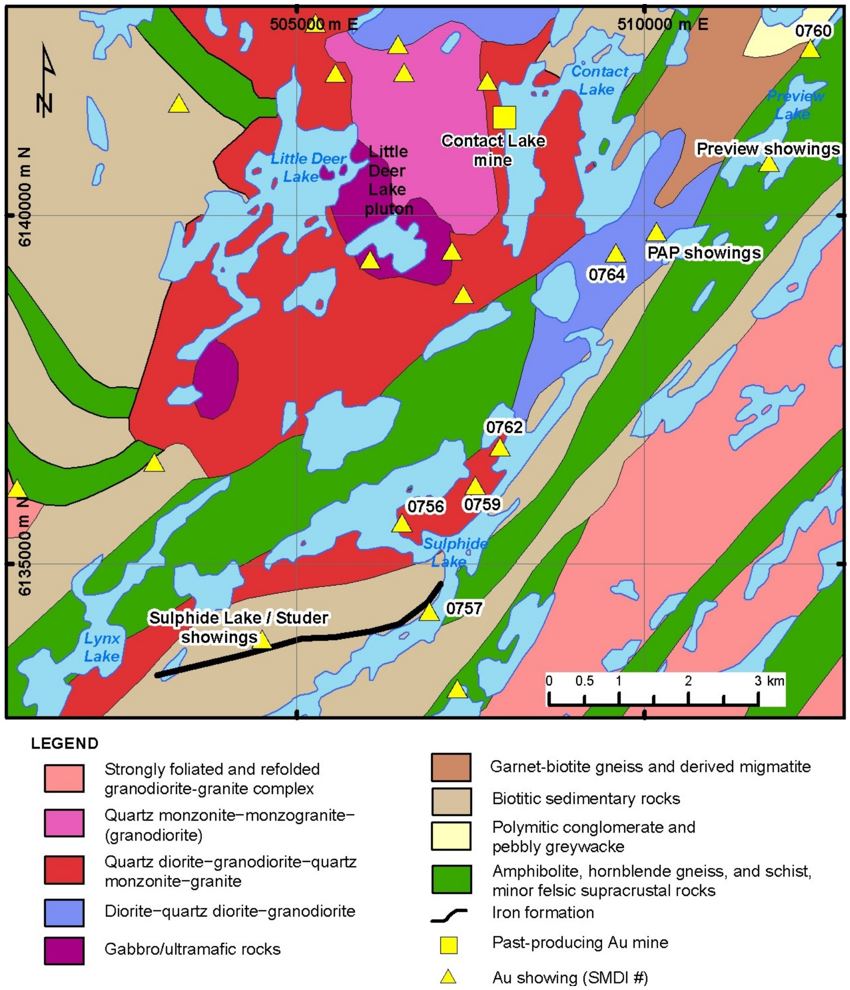

Figure 34 – Generalized geological setting and gold showings of the Sulphide–'PAP'–Preview lakes area (after Coombe* et al.*, 1986).

and L_1 with respect to deformation in the pluton (Lee and Roberts, 1999), these fabrics are not necessarily correlative with the regional S_1/L_1 fabric elsewhere in the La Ronge Domain. The Bakos shear zone is a composite structure within which Lee and Roberts (1999) recognized five distinct episodes of deformation (D_2 to D_6). Formation of the Bakos zone was interpreted to have originally occurred during the D_2 event, with subsequent deformation being strongly partitioned into it, such that fabrics and veins formed during D_3 to D_5 occur only within its immediate vicinity. The nearby Owl and Keya zones (Figure 33) are both interpreted as D_4 structures.

Within this framework, Lee and Roberts (1999) also recognized four distinct generations of quartz veins (V_2 to V_5) and associated hydrothermal alteration, the development of each attributed to the corresponding deformational event. Most of the gold mineralization in the Bakos structure was thought to have been emplaced during the coincident D_3/V_3 events. In contrast, Fayek and Kyser (1995) identified a four-stage (I to IV) vein paragenesis with a different relative timing interpreted for episodes of veining, deformation, and gold mineralization, the latter proposed to coincide with crosscutting 'stage IV' veins. The classification of Lee and Roberts (1999) is retained here because their study benefited from underground mapping in determining the relative order of veining events, and because clear crosscutting relationships are described. The details of their classification are provided below.

Early deformation in the Bakos shear zone (D_2) is characterized by a foliation (S_2) defined by preferred mineral orientations and a coincident stretching lineation (L_2). The S_2 foliation has an average orientation of 066°/75°S, with L_2 plunging steeply to the southwest. The S_2 fabric curves into narrow high-strain zones that define a shear direction compatible with reverse or reverse-oblique movement parallel to L_2. This deformation was accompanied by intense silica replacement (V_2), manifested as silicic breccias and anastomosing networks of pervasive silicification (±sericite). The form and distribution of this silicification varies with strain state. This phase of deformation and coincident silica alteration did not introduce any gold into the system.

The second phase of deformation (D_3) recognized in the Bakos shear zone, together with coincident veining and alteration (V_3), is the most significant in terms of quartz-gold-sulphide emplacement. The D_3 fabrics include a spaced or anastomosing sericitic foliation (S_3) with an average orientation of 087°/70°S, and a variably developed stretching lineation with a moderate to steep southwesterly plunge down the foliation plane. The relationship of S_3 to the shear zone margins, along with the orientation of L_3, suggest that D_3 was an episode of reverse-oblique shearing, parallel to L_3 and in the same general sense as L_2. In the granite of the Little Deer Lake pluton, V_3 features are best developed in the zone of V_2-related silicification and include sheeted extension veins and alteration stringers. In the felsic dyke, V_3 veins occur as *en échelon* extension veins in unaltered rocks and as stockwork veins in V_2-related silicification zones. All of the V_3 veins are folded and rotated into the S_3 fabric. Ore zones are associated with high densities of V_3 veins, intense sericite alteration, and well-developed D_3 fabrics. The vein mineralogy comprises quartz, sericite, and pyrite (±gold±chalcopyrite±galena±sphalerite±magnetite). Wallrock alteration includes moderately to well-developed sericitization and local disseminations and stringers of pyrite.

The D_4 event formed gold-bearing brittle-ductile shear zones (*e.g.,* the Owl and Keya zones), as well as associated shear and extension veins that occur throughout the Little Deer Lake pluton and within the Bakos structure. The shear zones are typically up to 400 m in strike length and 3 to 50 cm wide. The variably oriented S_4 fabric is locally mylonitic and characterized by development of biotite, K-feldspar ribbons, and differential layering. It is also associated with a moderate to steeply, generally southwest-plunging stretching lineation. Shear veins comprise quartz, K-feldspar, and biotite (±pyrite±gold). The related extension veins have similar compositions but are pegmatitic and are situated adjacent to the shear zones. The V_4 veins commonly exhibit a K-feldspar±biotite alteration halo that may penetrate into the wallrock for up to 1 m. Shear zones that formed during the D_4 event have a variety of orientations, but all are consistent with a reverse or reverse-oblique sense of displacement.

The D_5 event involved predominantly brittle deformation and was accompanied by the emplacement of gold-rich, sericite-pyrite-chalcopyrite (±galena-sphalerite) fracture fill and replacement veins (V_5). These veins are confined to the Bakos structure and occur mainly in subvertical, meso- and micro-scale fractures in the wallrock and all earlier vein generations. The youngest deformation event (D_6) produced chlorite-rich brittle faults and joints, both of which can be either parallel or at a high angle to earlier penetrative fabrics and shear zones. These structures have negligible displacement and are not related to mineralization.

According to Lee and Roberts (1999), each of the three main orebodies of the Contact Lake deposit (BK-1, BK-2, and M) have a high concentration of D_3 and D_4 structures, preferentially developed near the hangingwall contacts of the V_2 alteration envelope. They are developed at and adjacent to intersections of the Bakos structure with branches of the felsic dyke, the size of each orebody correlating with dyke width. Accordingly, they suggested that the early brittle response of the felsic dykes compared to the more ductile response of the granite is the significant factor controlling the location of ore. Based on these observations, they further suggested that the ore was emplaced during a protracted period of north-northwest to south-southeast crustal shortening and subvertical extension during regional greenschist to lower amphibolite facies metamorphism.

Inferred Deposit Type: orogenic gold

Associated Showings: Preview North and South/PAP-C zones (SMDI #0754), PAP-A and -B zones (SMDI #0758), PAP-SW/Preview-SW zone (SMDI #1147)

Production and Reserves/Resources: Production from the Contact Lake mine occurred between 1995 and 1998 (Table 1).

Glennie Domain

Location 7 – North Lac La Ronge Area

Anglo-Rouyn Mine
A, B, and C Zones; Rio Algom Mine; Moose Point Cu-Zn Showing; Anglo-Rouyn Tailings Recovery Project (SMDI #0732)

Location: on Williams Peninsula on the northwest shore of Lac La Ronge, ~35 km northeast of La Ronge (NTS 73P/06; UTM 6127496 m N, 499735 m E)

Metal Associations: Au with Cu (Ag, Zn, Fe, Mo, Pb, Ni, Co)

Status: past-producing mine without Resources

Exploration and Development History:

A copper showing on Moose Point of northern Lac La Ronge, the eventual site of the Anglo-Rouyn mine, was noted in 1909 by W. McInnes of the Geological Survey of Canada (McInnes, 1910). Claims were staked over the showing area in 1915 by R. and G. Hall. In 1929, the Consolidated Mining and Smelting Company of Canada Ltd. undertook the first trenching and drilling on the property, subsequently dropping their option. The claims lapsed in 1950, but were restaked and then acquired by Anglo-Rouyn Mines Ltd. in 1951 through an option agreement. Rio Algom Mines Ltd. optioned the property in 1952.

During the following two years, Rio Algom undertook extensive geological mapping, trenching, and sampling on the Anglo-Rouyn property, as well as a 50-hole diamond-drilling program (3655 m). The company commenced an underground development program in 1955 and, by 1956, a vertical shaft had been completed to a depth of 166 m, with lateral development at 53, 84, 188, and 151 m. Underground activity was suspended in 1956. In 1957, 27 surface holes totalling 6868 m were drilled, after which the property remained inactive until 1963.

In 1963-64, further exploration work was carried out by Rio Algom and a decision was made to bring the deposit into production. In 1964, approval was granted for a 10.5 km road connecting the property with the La Ronge highway. Plans were made to operate the mine at a production rate of 900 tons/day, the ore to be shipped by truck to Flin Flon for smelting. In 1964-65, a further 33 holes totalling 7786 m were drilled on the Anglo-Rouyn deposit.

In 1965, construction of the mining and milling plants began, the old shaft was dewatered and deepened to more than 244 m, and lateral development commenced. A small open pit was also developed on the 'A zone' at this time to supplement the ore taken from underground. The mill was completed and the first concentrate was shipped in February 1966. Total underground development between 1965 and 1968 was 13 334 m. In May of 1969, a second pit was completed 1.5 km to the northeast of the original open pit. Between 1969 and 1970, a 600 m decline was driven southwest from the lowest mine level (level 5) to access additional ore in the southwest extension of the A zone. Another decline, driven to the east from 'C Lake', became operational in 1970. The Anglo-Rouyn mine horizon was mined over a strike length of approximately 3.5 km. Mining ceased in 1972 (Table 1) and the lease lapsed in November of 1983 following decommissioning.

The property was subsequently acquired by Spectra Management Corp., which then optioned it to Noranda Exploration Company Ltd. and TexPex Oil and Gas Corp. in 1984. In 1984-85, Noranda completed diamond drilling (nine holes, 817 m), geological mapping, soil sampling, sampling of old core, and ground magnetic surveys. The property was acquired by Kristo Gold Ltd. in October 1986. Between 1988 and 1989, Kristo and Tusk Resources Inc. completed geological mapping, prospecting, and ground geophysical surveys. Their program identified a previously unknown zone, likely a western extension of the Anglo-Rouyn orebody. In 1990, Kristo and Trimark Resources Ltd. optioned the property and completed geological mapping, prospecting, stripping, trenching, and sampling on the minesite grid. The Anglo-Rouyn mine property was acquired by New Moon Minerals Corp. in 2011.

In addition to mineralization hosted in bedrock, economic mineralization is known to remain in the original Anglo-Rouyn mine tailings that were deposited in and along the shoreline of Lac La Ronge. Since cessation of the mining operation, several studies have assessed the economic viability of reprocessing the existing mine tailings for gold, copper, silver, and other metals. One of the most extensive studies was carried out by Kristo between 1987 to 1997, in which Wacker and sonic drill holes and results of a pilot plant operation were used to model the tailings pile and assess the feasibility of the proposed project. The pilot operation was reported to have recovered 3.8 kg (122.9 oz.) of gold and 3.0 kg (97.5 oz.) of silver from 4300 tons of tailings in 1993 (SMDI #0732). This study concluded that the pile contained in excess of 1.2 million tons of mineable tailings grading 0.55 g/t (0.016 oz./ton) Au and 0.19% Cu, and estimated that 72% of the contained gold and 50% of the contained copper could be recovered (SMER Assessment File 73P06-0155). Construction of a magnetic-gravity separator plant took place on site in 2004 and two feeder lines were completed to pump tailings from the pond to the separator plant. The plant was configured to process 250 tons/hour and was expected to recover 70 to 80% of the gold and 50% of the copper from an estimated 1.3 million tons of tailings averaging 5.1 g/t (0.016 oz./ton) Au and 0.19% Cu. According to unconfirmed reports, recoveries did not meet economic expectations and, after two partial operating seasons and numerous engineering modifications, the plant was mothballed. No production totals were reported from this work. The Anglo-Rouyn tailings recovery project was acquired by Skeena Resources Ltd. in February 2009.

Geological Character[5]:

The Anglo-Rouyn deposit is located in the southwesternmost extension of the Glennie Domain. The area is underlain by a strongly deformed, northeast-trending sequence of middle amphibolite facies granitoid and supracrustal gneisses (formerly the 'Nut Bay' belt). Although orthogneiss generally predominates in this sequence, the Anglo-Rouyn deposit is hosted by supracrustal rocks, including both mafic and felsic volcanic rocks, psammitic to pelitic to calcareous sedimentary rocks, and iron formation (Maxeiner, 1994).

This summary of the geological setting of the mine area is from the work of Roberts and Maxeiner (1999). The immediate hostrocks to the deposit have a northeasterly trend and dip steeply to the northwest. In the southeast, the host succession consists of mafic volcanic rocks with intercalated layers of siliceous greywacke, and quartz-plagioclase gneiss. The adjacent rocks to the northwest, interpreted as the footwall sequence to the deposit, consist of hornblende-plagioclase gneiss, magnetite-bearing iron formation, and calc-silicate gneiss (Figure 35). The stratabound ore, comprising copper-iron sulphides, overlies the iron formation and is hosted by quartz-hornblende-plagioclase and quartz-plagioclase gneiss. The protolith(s) of the ore zone units is not readily identifiable, but might consist of mixed clastic and exhalative sedimentary rocks. The Jepson Lake pluton, a regional sill-like body, intruded rocks of the hangingwall before or during deformation.

According to Forsythe (1971), the orebody consists of a number of elongate sulphide lenses distributed over a strike length of about 3000 m (Figure 35). The lenses are grouped into three orebodies: ‘A’, ‘B’, and ‘C’. The entire deposit lies approximately along a single plane, although in detail the four lenses that constitute the ‘A’ orebody lie on two planes about 10 m apart. The largest lens of the deposit is about 15 m thick at its widest, has a down-dip extent of 60 m and extends down plunge for about 1750 m. The ore-related minerals, in order of decreasing abundance, are chalcopyrite, pyrite, pyrrhotite, and magnetite, with trace amounts of sphalerite, molybdenite, and skutterudite. Coombe Geoconsultants Ltd. (1991) also noted the occurrence of galena, pentlandite, and chalcocite. The setting of the gold mineralization within the deposit is not known.

The current configuration of the deposit is a consequence of postdepositional deformation, which was described by Roberts and Maxeiner (1999). Rocks of the immediate deposit area are thought to have undergone three phases of deformation (defined in the immediate deposit area and not correlated with any specific regional events), the first of which was coeval with amphibolite facies metamorphism. The S_1-L_1 fabric developed during D_1 and is defined by

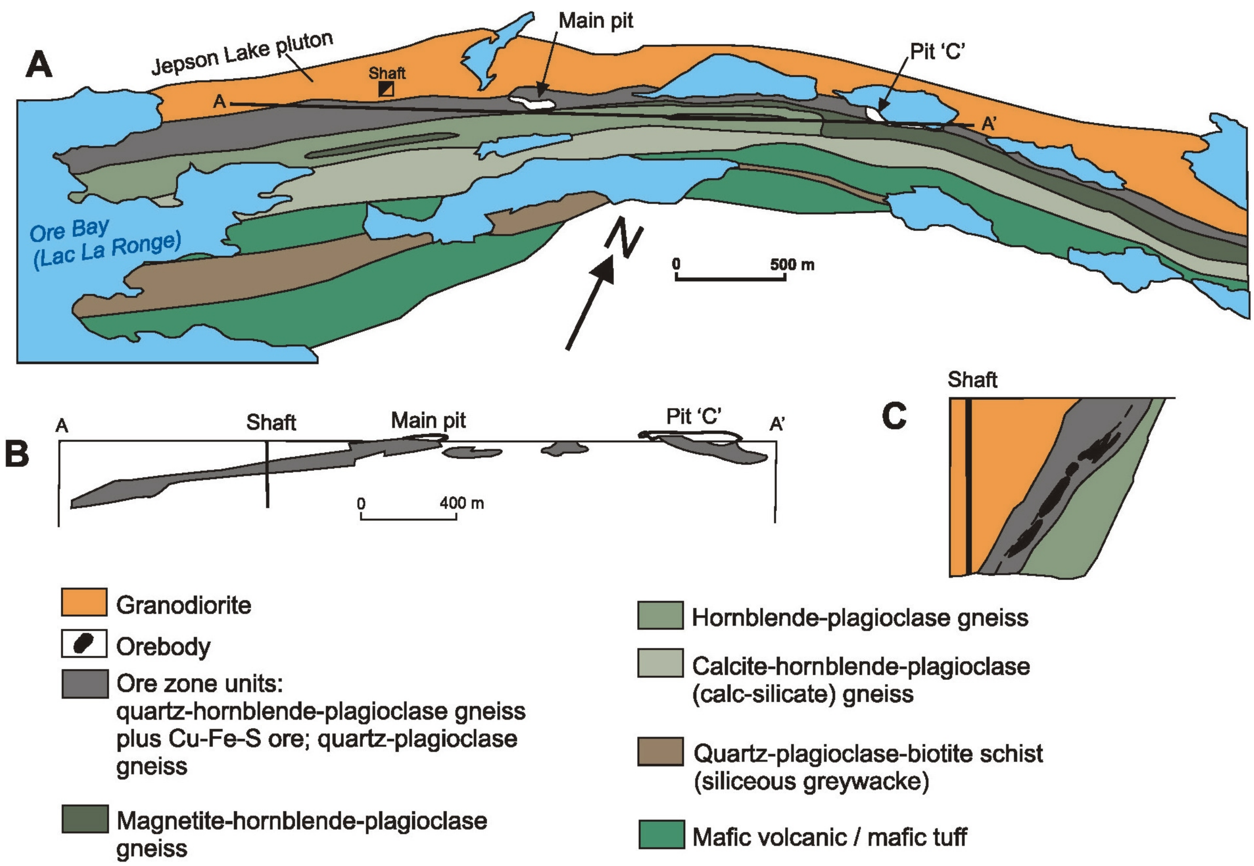

Figure 35 – Anglo-Rouyn mine: A) geological setting of the mine area; B) longitudinal cross-section through the orebody; and C) close-up of orebody cross-section at the shaft location (from Roberts and Maxeiner, 1999).

[5] Although the ore has been mined out, the description is in the present tense for consistency.

the preferred orientation of amphibolite facies minerals and the gneissosity. The gneissosity is a combination of metamorphic segregation and transposition of earlier layering, inferred to be bedding, into the S_1 fabric. The S_1 foliation strikes approximately parallel to the rock unit contacts and dips 45° to 85°. South of the main open pit, the L_1 mineral lineation plunges 0° to 20° to the southwest, whereas, north of the open pit, it plunges to the northeast. Intrafolial folds associated with transposition are parallel to L_1. The second deformation event is characterized by the development of shear zones subparallel to the gneissic layering by reverse dip-slip displacement. These shear zones are most extensively developed in the calc-silicate gneiss and the sulphide ore. The third phase of deformation is characterized by open to close folds of both the gneissic layering and the D_2 shear zones. The F_3 folds plunge 30° to 60° to the north and their axial surfaces dip 60° to 85° to the east. They formed by a combination of buckling and flexural slip, and die out rapidly along strike of their axial surfaces. Effects of all three deformation events are found in the ore zone, most notably as chalcopyrite and pyrite that are locally remobilized into pull-apart structures associated with D_1 boudins, and as chalcopyrite and iron sulphides that occur in quartz veins associated with F_3 folds. The ore lenses themselves are coaxial with the L_1 lineation.

The geochemical composition of the volcanic hostrocks and their association with greywacke suggest that these rocks formed in a volcano-sedimentary basin in an arc environment, probably a back-arc basin (Roberts and Maxeiner, 1999). This interpretation suggests that the succession represents a transition from mafic-dominated volcanism and associated deposition of proximally derived greywacke to an episode in which clastic sedimentation competed with exhalative chemical sedimentation. Based on this interpretation, Roberts and Maxeiner (1999) suggested that the Anglo-Rouyn deposit is a 'Besshi-type' (*i.e.,* pelitic-mafic type; see Chapter 2) volcanogenic massive sulphide deposit because: 1) the metal content is Cu±Zn, Au, and low Pb; 2) the orebody is associated with mafic volcanic rocks and greywacke in a probable back-arc setting; 3) the sulphides form a sheet-like body with no evidence of a focussed discharge site; and 4) the ore is closely spatially associated with exhalative-clastic sedimentary rocks in which silica-carbonate exhalite is widely dispersed, iron oxide (magnetite iron formation) is more restricted, and the sulphide ore is associated with iron oxide exhalite.

Inferred Deposit Type: volcanogenic massive sulphide (pelitic-mafic type)

Associated Showings: Rio Tinto R-1 to -11 trenches (SMDI #2365), Elizabeth Lake Cu-Zn deposit (SMDI #0733), drill hole CSP-3 (SMDI #2698)

Production and Reserves/Resources: Some gold and silver were produced during copper mining at the Anglo-Rouyn mine between 1966 and 1972 (Table 1). Historical mineral reserve/resource estimates have been reported for the Anglo-Rouyn deposit, though much of this ore has since been mined and known remaining reserves are mainly in unmined pillars. In 1990, as part of a pilot operation to reprocess existing mine tailings, approximately 3.8 kg (122.9 oz.) of gold and 3.0 kg (97.5 oz.) of silver were recovered from of about 4,300 tons of tailings (SMDI #0732).

Sulphide–PAP–Preview Lakes Showings
Including Sulphide Lake / Studer A to F, Camp, Chalcopyrite, and 4088 Zones (SMDI #0763); Preview North and South / PAP-C Zones (SMDI #0754); PAP-A and PAP-B Zones (SMDI #0758); and PAP-SW / Preview-SW Zone, Including PAP-K, -L, -M, and -R Zones (SMDI #1147)

Location: several showings in the area between Sulphide and Preview lakes, ~50 km northeast of La Ronge (NTS 73P/07; in the vicinity of the PAP-SW / Preview-SW showing at UTM 6139780 m N, 510167 m E)

Metal Associations: Au, Ag (±As±Cu±Zn±Pb±Ni±Bi±Hg±Sb±Te)

Status: developed prospects without Resources

Exploration and Development History:

Gold exploration in the Sulphide–Preview–'PAP' lakes area dates back to the 1930s and has resulted in the delineation of multiple gold showings. This exploration was prompted, in part, by the discovery of gold in a quartz vein by prospector A. Studer near Sulphide Lake in 1937, following a recommendation in a report by University of Saskatchewan professor J.B. Mawdsley (Mawdsley, 1931). Claims were originally staked around Preview Lake for the 'Legend Group' in 1937 and were acquired by Preview Mines Ltd. in 1938, which also staked ground in the PAP Lake area at that time. Claims were staked in the vicinity of Sulphide Lake in 1939-40 by prospectors A. Studer and B. Lier, who optioned the property to the Consolidated Mining and Smelting Company of Canada

Ltd. in 1940. Prospecting, geological mapping, and trenching in these early years resulted in the discovery of several gold-bearing zones.

Several of the zones were explored, sampled, and assayed at this time. A 450 kg bulk sample of high-grade ore was also extracted from the PAP-A zone in 1939-40, which reportedly returned ~300 g (10 oz.) of gold (Kupsch and Hanson, 1986). Preview Mines established a 5 tons/day mill and undertook small-scale open-pit mining ('high-grading') at the Preview North and PAP-A zones in 1940. A total of 14 tons of ore grading approximately 85 g/t (2.5 oz./ton) Au and 7 g/t (0.2 oz./ton) Ag were shipped to Flin Flon for smelting and yielded a single gold brick in 1941 (Kupsch and Hanson, 1986). A small-scale milling operation was established by A. Studer in 1942 to process stockpiled high-grade ore at Sulphide Lake; no production totals were reported from this work.

By 1949, properties covering the Preview, PAP, and Sulphide Lake showings had been acquired by the newly incorporated Studer Mines Ltd. Minor exploration, including prospecting, geological mapping, trenching, geophysical (magnetic) surveying, and diamond drilling (one hole each at the Sulphide Lake A and B zones), was performed on various parts of the claims. By 1953, many of these claims had lapsed.

Between 1950 and 1980, the area was the subject of sporadic exploration by several companies, including Benz Gold Resources Ltd., Contact Gold Mines Ltd. / Contact Ventures Ltd., Great Plains Development Company of Canada Ltd., Rio Canadian Exploration Company, Studer Mines Ltd., and Westfield Minerals Ltd. Much of this work was of little significance, though some high-grade surface mining and drilling (30 X-ray and diamond-drill holes) were completed by Studer Mines between 1960 and 1967 on the Sulphide Lake showings. This drilling enabled the determination of an ore reserve estimate for the A, B, and C zones. Also at this time, Contact Gold Mines Ltd. completed six diamond-drill holes and a 25 m adit at Preview North, allowing determination of a reserve estimate for this deposit in 1963.

In the late 1970s, Saskatchewan Mining Development Corp. (now Cameco Corp.) acquired several of the properties and, either as sole operator or within joint-venture partnerships, performed exploration on several of the Preview, PAP, and Sulphide Lake showings throughout the 1980s and early 1990s. This work comprised mainly geological mapping, rock/till/soil/biogeochemical sampling, trenching, and ground geophysics (EM and magnetic). Diamond drilling was also performed intermittently during this period, including multiple holes at the Sulphide Lake zones (1985-87 and 1997) and 93 holes (14 120 m) at the PAP-SW zone (1985 to 1989). In 1990, based on results from the earlier drilling, Cameco published a reserve estimate for the PAP-SW zone and contemplated mining the zone, filing an application to develop an adit. In 1997, it was decided by Cameco and Uranerz Exploration and Mining Ltd., operators of the nearby Contact Lake mine, that mining of the PAP-SW zone would not go ahead because of modifications that would be required to the milling process. In 2011, mineral dispositions covering the Sulphide Lake, PAP, and Preview showings were held by North-Sask Ventures Ltd. In October 2011, La Ronge Gold Corp. optioned the property covering the PAP-SW / Preview-SW showing.

Geological Character:

Gold showings in the Sulphide–PAP–Preview lakes area, situated in the southwestern extent of the Glennie Domain[6], are hosted by a dominantly northeast-trending sequence of supracrustal rocks, including volcanic and sedimentary rocks and derived gneiss, that were intruded by plutonic rocks of varying composition (Figure 34; *e.g.,* Sibbald, 1987). In the immediate Sulphide Lake area, Sibbald (1986) subdivided the supracrustal succession into six generalized stratigraphic units (from interpreted oldest to youngest): 1) partly calcareous psammopelite/greywacke; 2) interlayered felsic flows / volcaniclastic rocks, calcareous sedimentary rocks and silicate-sulphide facies iron formation; 3) mafic pillowed flows and intercalated mafic sills; 4) felsic to intermediate volcaniclastic rocks, minor pillowed andesite, and interlayered pelite (in part 'lean' iron formation, *i.e.*, sulphidic argillite); 5) well-laminated psammopelite/greywacke; and 6) calcareous sedimentary rocks and mixed oxide-silicate-sulphide facies iron formation. Structural features in the immediate area are dominated by a prominent northeast-trending regional foliation and later open, north-plunging and steeply west- to west-northwest–dipping major and minor folds (*op. cit.*). Foliation-parallel shear zones and fracture sets of various orientations are also present throughout the area. The rocks in the area have been metamorphosed under upper greenschist to lower amphibolite facies conditions.

Detailed descriptions of several showings in the area have been provided by Forsythe (1971), Coombe (1984), and Armstrong and Parslow (1987). At Sulphide Lake, lithological units are easterly to northeasterly striking and, near the gold showings, comprise mainly felsic volcaniclastic rocks with subordinate mafic to intermediate volcanic

[6] Due to their location near domain boundaries, some of these showings have previously been included within the La Ronge Domain.

rocks and intercalated argillite, siltstone, and chert ('unit 2' of Sibbald, 1986). Argillitic intervals are locally graphitic and/or sulphidic. The units are intruded by dioritic to gabbroic rocks and are folded about steep, north-northeast–trending, upright to overturned folds (Forsythe, 1971). The Sulphide Lake A, B, and F auriferous zones are mainly stratabound within a single layer of carbonaceous and sulphidic argillite, with lesser mineralization in adjacent mafic to intermediate volcanic rocks. The mineralization, consisting of both layer-parallel pyrite/pyrrhotite stringers and disseminated arsenopyrite, is associated with zones of increased deformation and alteration (carbonatization and silicification). Thin quartz stringers are also noted parallel to the foliation (Armstrong and Parslow, 1987). Though less common, galena, chalcopyrite, and sphalerite also accompany auriferous mineralization. Forsythe (1971) noted sporadic northerly and easterly striking shears in the vicinity of the A zone, and fractures containing quartz veinlets and sulphides at the B zone. The Sulphide Lake C zone is distinct from other zones due to the absence of the sulphidic argillite unit; in this zone, brecciated and/or boudinaged quartz veins and stockworks transect felsic crystal tuff within northeasterly and easterly trending shears. Quartz veins are oriented both along the dominant foliation and in fractures along axial planes of late northerly plunging folds (Coombe, 1984). Other known gold zones along this trend include Gem (SMDI #0761), and Island and Galena (SMDI #0757).

At the PAP zones, auriferous mineralization is associated with quartz veins in northeast-trending, subvertical shear zones that parallel the dominant structural trend of the hostrocks. The mineralized shear zones are typically curvilinear and comprise a system, up to 1 to 10 m wide, of multiple smaller, bifurcating shears (SMER Assessment File 73P07-0296). The shears exhibit dominantly dextral shear sense and are commonly situated at or near lithological contacts (Armstrong and Parslow, 1987). Sheared hostrocks at the showings include quartz diorite (PAP-A), gabbro and sulphidic argillite (PAP-B), and gabbro (to diorite) sills (PAP-SW). Quartz veins are typically 15 to 30 cm wide, are subparallel to the host shear zones, and contain arsenopyrite, pyrite, and, less commonly, chalcopyrite, galena, sphalerite, free gold, and/or tourmaline. In some cases, arsenopyrite forms masses that constitute up to 50% of individual veins. A second set of narrow quartz veins, oriented perpendicular to the shear zones, is also present (*op. cit.*). Carbonate alteration is present in the wallrock at the PAP-A zone (Coombe, 1984), and Sibbald (1986) interpreted biotite schist near the shear zones to be the product of intense potassic metasomatism. Other gold showings along this trend to the southwest (Figure 34) include the Lucky Strike (SMDI #0756), Discovery / South Camp (SMDI #0759), Main Camp (SMDI #0762), and Clearwater A and B (SMDI #0764) zones.

At Preview Lake, quartz vein–associated gold mineralization is found within sheared gabbro and diorite sills near their intrusive contacts with felsic to mafic volcanic rocks and intercalated pelitic rocks. At Preview North, shears oriented parallel to the main foliation are prevalent and quartz veins are typically associated with fractures of multiple orientations (see Forsythe, 1971). The veins are commonly folded, boudinaged, and/or rodded; in addition to quartz, they contain calcite, pyrite (sometimes as stringers or coarse cubes), and, less commonly, arsenopyrite and chalcopyrite. Gold occurs both within sulphides and in native form, the latter sometimes obvious on limonitic fracture surfaces (*op. cit.*). At Preview South / PAP-C, quartz veins typically 1 m wide are associated with northeast-trending, foliation-parallel shears that cut gabbro. The quartz veins are commonly fractured and, along with adjacent wallrock, contain pyrite, arsenopyrite, and/or chalcopyrite. Veins of massive arsenopyrite up to 30 cm wide have also been described (Coombe, 1984). The Preview zones occur along the same trend as the PAP zones, as do the Joe (SMDI #0760) and Socko-Tyon (SMDI #0766) showings to the northeast.

As emphasized by Armstrong and Parslow (1987), auriferous mineralization in the Sulphide–PAP–Preview lakes area has a clear structural (*i.e.,* epigenetic) control. It has been speculated (Coombe, 1984; Sibbald, 1986) that some of the gold, particularly at the Sulphide Lake A, B, and F showings, was originally deposited as syngenetic/stratiform mineralization on the seafloor along with the host metalliferous sediment (*i.e.,* sulphidic argillite) and was later partially remobilized. Other than the stratabound character of some of the showings, however, there is no direct evidence that such processes occurred. An alternative interpretation is that gold was externally derived and transported to the depositional site via metamorphic or magmatic fluids, and was focussed into the observed depositional sites due to favourable physicochemical properties of the hostrocks (Armstrong and Parslow, 1987).

Inferred Deposit Type: orogenic gold ± ?stratiform syngenetic (?Sulphide Lake A, B, and F)

Associated Showings: Contact Lake / Bakos (SMDI #0619), Ramsland Lakes showings (SMDI #0768 to #0771)

Production and Reserves/Resources: There has been very minor historical gold production from 'high-grading' of the Preview North, PAP-A, and Sulphide Lake zones. Historical reserves have also been reported for some of the Sulphide Lake–PAP–Preview zones (*e.g.*, PAP-SW / Preview-SW).

Location 8 – Laonil Lake Area

Seabee Mine
Nos. 2, 5, 19, 153, 154, and 161 Shears/Zones/Lenses; Currie Rose Option (SMDI #0382)

Location: north end of Laonil Lake, ~125 km northeast of La Ronge (NTS 63M/12; UTM 6171924 m N, 587199 m E)

Metal Associations: Au (B, Cu, Te)

Status: producing mine

Exploration and Development History:
The initial discovery of gold in the Laonil Lake area was made by prospectors J. Coffyne and B. Corrigan in 1947. The Consolidated Mining and Smelting Company of Canada Ltd. (later Cominco) acquired the property in 1948 and, by 1950, had explored multiple veins in the area through trenching and drilling (79 holes, 4414 m). No further exploration was done on the property at that time, with the exception of two drill holes during a 1961 review program that allowed for estimation of a small gold resource for the property. Cominco resumed limited exploratory drilling at Seabee in 1974 (16 holes, 458 m) and initiated another drill program in 1982-83, which was terminated after 20 holes (3776 m) due to the outright sale of the property to BEC International Corp.

In 1984, Claude Resources Inc. acquired the Seabee property and subsequently optioned it to Placer Development Ltd. in 1985. Placer proceeded with an extensive drilling and exploration program adjacent to two existing zones (No. 2 and No. 5), leading to the discovery of two new mineralized zones (No. 2 South and No. 5 South); all four zones were included in the first estimate of ore reserves at the deposit. In the meantime, Placer had been exploring as a joint-venture partner with Currie Rose Resources Inc. on a 4614 ha (11,400 acre) property immediately surrounding the Seabee showing (the 'Currie Rose property'). In 1987, Currie Rose Resources, Claude Resources, and Placer (now Placer Dome Inc.) formed another joint-venture partnership to examine all gold showings in the Laonil Lake area.

By 1987, Placer had completed a 95-hole drill program (~12 635 m) on the property, as well as overburden stripping, geophysical and geochemical surveying, and detailed mapping. Placer also undertook an underground exploration program in 1987 that consisted of ~1000 m of underground development, bulk sampling, and >6000 m (72 holes) of underground drilling. This work identified new gold zones and was used to prepare a revised reserve estimate for the deposit. The option agreement expired in 1988, after which Claude retained 100% ownership of the project and became sole operator. Placer's option on the Currie Rose Property expired in 1991.

In 1989, Claude undertook surface drilling, underground drilling, and further underground development (~460 m), and made the decision to take the deposit to production. In 1990, just prior to the start of production, the original feasibility study estimated a total recovery of 11.8 t (379,241 oz.) of gold (Basnett, 1999). Following receipt of government approval and mine construction, including a 440 tons/day mill, production at the Seabee operation commenced in November 1991. The first gold pour took place on November 20, 1991. Mining began in the No. 2 zone and a second decline was developed in 1992 to access the No. 5 zone.

In 1994, Claude and Currie Rose Resources reached an agreement whereby Claude acquired a 100% working interest in the Currie Rose property, subject to a 30% net profits interest. A second shaft was sunk at the mine in 1997, which was deepened in 2003. Production at Seabee has been continuous since 1991 (for a more detailed history of mining at Seabee, see Saskatchewan Geological Survey, 2003) and mill capacity was doubled to 1100 t/day in 2007 to accommodate input of ore from surrounding satellite deposits (*e.g.,* Santoy 7 and 8, Porky West; see relevant descriptions). Claude has continued to undertake underground exploration at 'Seabee Deep', which has resulted in the delineation of several additional mineralized zones and additional ore reserves during the past 20 years. In 2011, a new zone of mineralization (the 'L62' zone) was discovered 1000 m below surface and approximately 200 m from existing Seabee mine workings in the hangingwall of the known deposit. Extensive surface exploration on adjacent properties has also identified several 'satellite' deposits, some of which have undergone development and have contributed ore to the Seabee mill.

Geological Character:

The Seabee deposit is situated in the northern Glennie Domain, in rocks of the Pine Lake greenstone belt (Figure 20). This greenstone belt is an arcuate feature that pinches out about 10 km northwest of the Seabee deposit (Figure 36) and comprises two distinct, arc-derived supracrustal sequences ('Assemblages A and B'; Delaney and Cutler, 1992). The stratigraphically lower sequence consists mainly of mafic, intermediate, and felsic volcanic and volcaniclastic rocks, whereas the upper sequence is dominated by volcaniclastic and clastic sedimentary rocks, including a basal conglomerate. Field relationships and existing geochronological constraints suggest deposition of the two sequences at *ca.* 1890 to 1880 Ma and 1840 to 1830 Ma, respectively (McNicoll *et al.*, 1992; Delaney, 1999). The upper sequence is partly equivalent to clastic sedimentary rocks of the Ourom group, known elsewhere in the Glennie Domain. The possibility of a spatial association between gold mineralization and the stratigraphic break between Assemblages A and B has been proposed (Delaney, 1995). The supracrustal belt has been intruded by numerous plutons of variable composition (ultramafic to granitic) and age (*ca.* 1890 to 1830 Ma), generally showing an evolution towards more felsic compositions with time. All of the rocks predate or are synchronous with lower to middle amphibolite facies peak metamorphism between about 1820 and 1800 Ma.

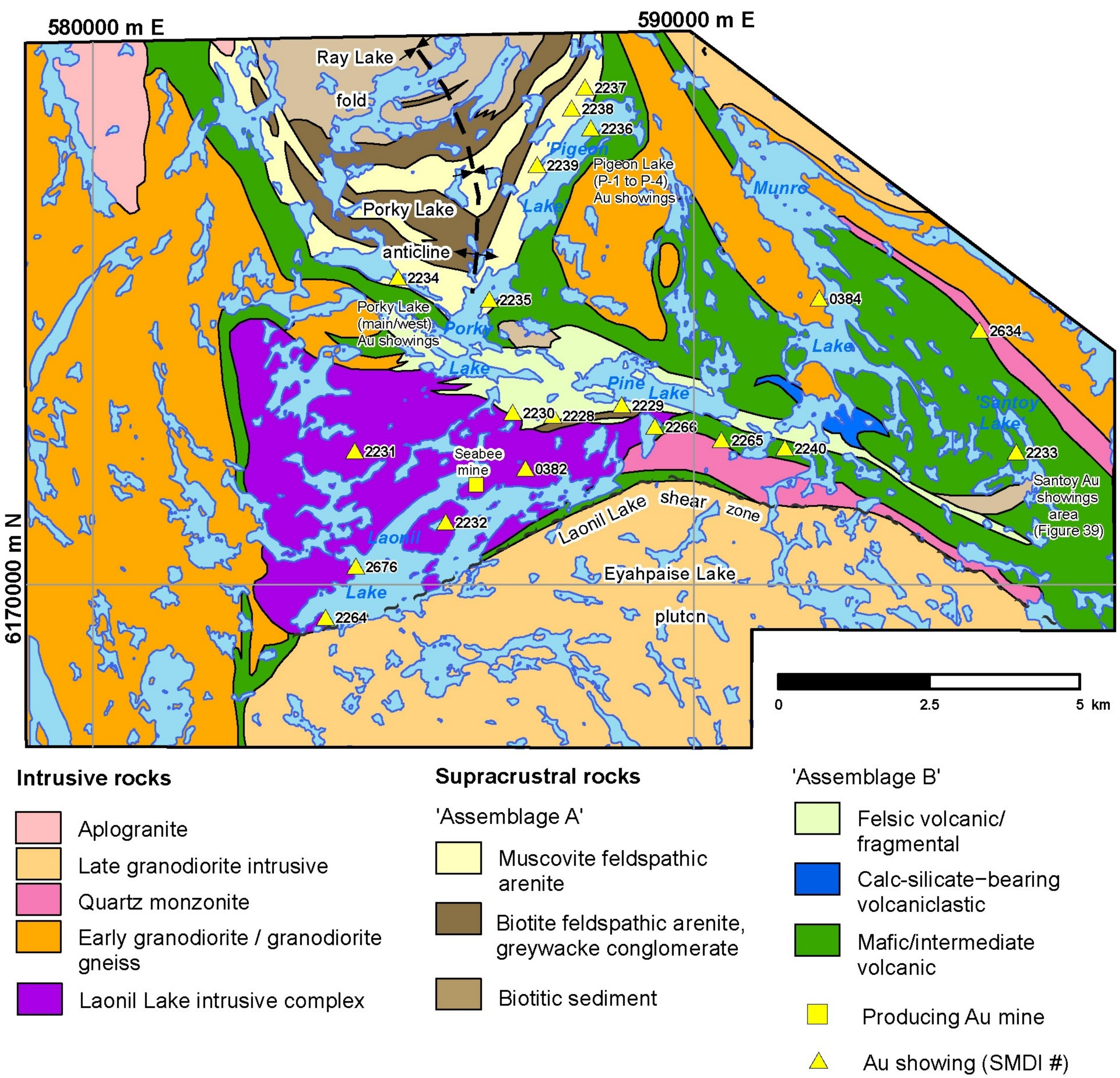

Figure 36 – Geological setting and gold showings of the Laonil–Porky–'Pigeon' lakes area (after Delaney, 1986).

In detail, the Seabee deposit is hosted by shear zones cutting gabbro of the Laonil Lake intrusive complex (Figure 36), a composite intrusive suite of ultramafic to quartz dioritic rocks that intrudes the southwestern margin of the Pine Lake greenstone belt (Figure 36). A quartz diorite phase of the intrusive complex has been dated by U-Pb zircon analysis at 1889 +9/-8 Ma, suggesting that it was, in part, synvolcanic (Chiarenzelli *et al.*, 1998). The intrusive complex contains rafts and xenoliths of mafic volcanic, mafic volcaniclastic, and other supracrustal rocks (McNicoll *et al.*, 1992). A number of east- to northeast-trending, foliated dykes of mafic through felsic compositions crosscut the intrusive complex, and are probably of variable age. The southern margin of the Laonil Lake intrusive complex, where it is in contact with granodiorite of the 1859 ±5 Ma Eyahpaise Lake pluton (Van Schmus *et al.*, 1987), is marked by the extensive Laonil Lake shear zone (Figure 36).

The Seabee deposit area is transected by several extensive shear zones, possibly related to the Laonil Lake shear zone, some of which have a strong spatial association with the gold mineralization. Detailed structural studies at the Seabee deposit (Tourigny, 2003b; Tourigny *et al.*, 2004) concluded that these shear zones define a well-organized, anastomosing, *en échelon* network of smaller subparallel shears and subsidiary conjugate networks ('Seabee shear structure'; Figure 37). Of these, the '2' and '5' shears have produced the majority of the ore at Seabee. Within these shears, the hostrock has been converted from a medium- to coarse-grained, equigranular gabbro to variably mylonitized hornblende-actinolite-biotite-chlorite schist (Figure 38A). The shears are dominantly east-northeast to east trending and subvertical, and exhibit both ductile and brittle-ductile features (Basnett, 1999). They are subparallel to the regional foliation, exhibit a pervasive internal foliation that generally parallels the shear zone boundaries, and contain a subvertical stretching lineation. Available kinematic indicators in the shear zones suggest that, although dominated by coaxial shortening (*i.e.,* 'pure shear'; *e.g.*, *op. cit.*), as indicated by the subvertical

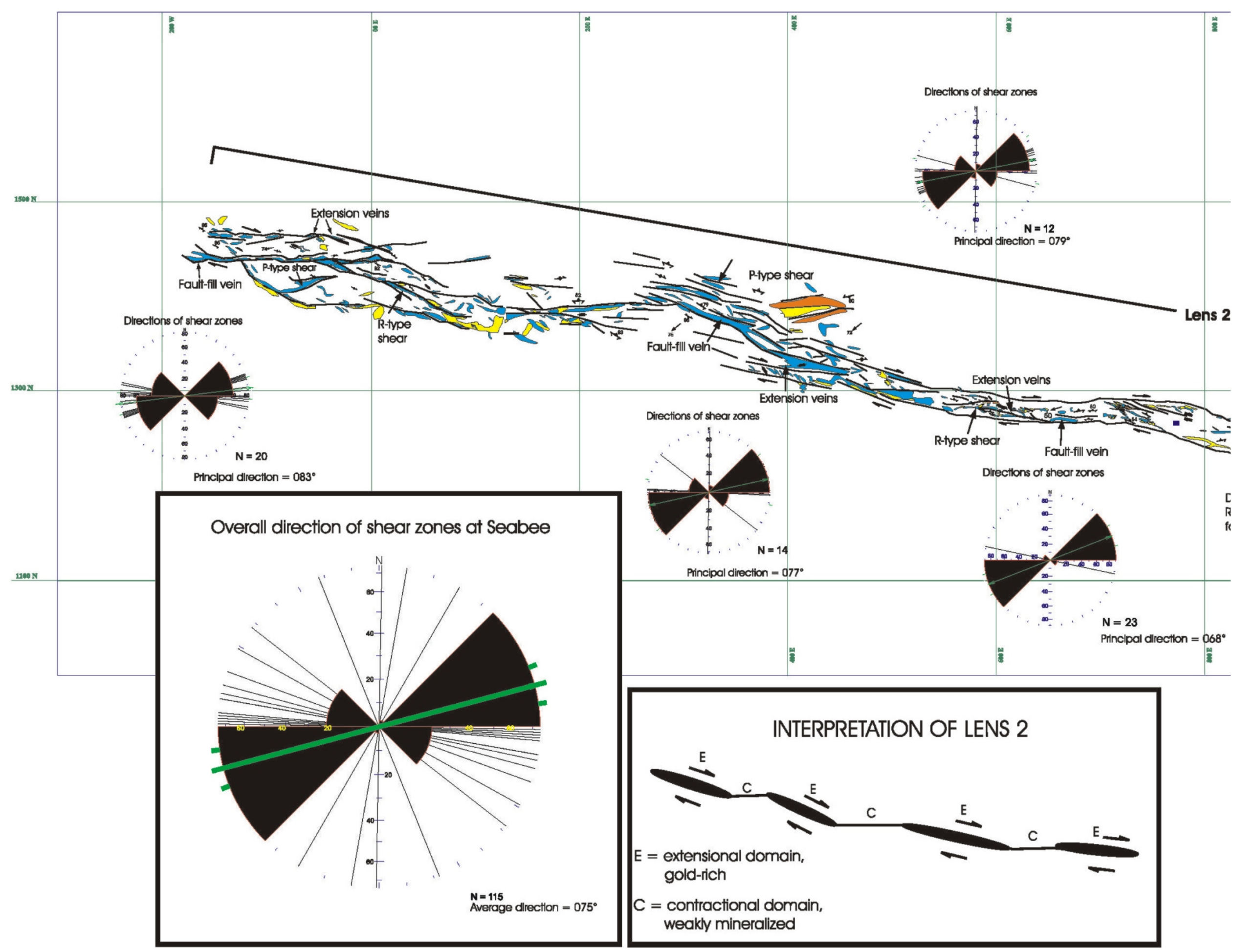

Figure 37 – Synoptic structural map, including structural interpretation, of the Seabee shear structure as observed between 0 and 680 m below surface (simplified from Tourigny* et al.*, 2004; see original map for detailed version). The four principal types of auriferous veins at Seabee (fault-fill, R-type, P-type, and extensional; see text) are designated along the shear zone.

stretching lineation, shearing was accompanied by a subordinate component of dextral strike-slip movement (Schultz, 1996). This has been explained using deformational models that invoke either dextral transpression (Tourigny *et al.*, 2004) or separate episodes of movement involving relatively earlier pure shear and later simple shear (Yuhasz *et al.*, 2006).

Much of the economic gold mineralization at the Seabee deposit is hosted by synkinematic quartz-sulphide-tourmaline veins, with mineralized ‘zones’ or ‘lenses’ typically comprising multiple auriferous veins. The veins are invariably confined to the shear zone network, although they locally crosscut the shear foliation (*e.g.,* Figure 38A). They are commonly adjacent to strongly silicified wallrock and are associated with a proximal zone of potassic alteration (*e.g.,* biotite schist in zone 2) and/or chlorite, sericite, epidote, and carbonate alteration. Pyrite, pyrrhotite, and chalcopyrite are the dominant sulphide minerals, although minor arsenopyrite, sphalerite, scheelite, and tellurides are also present. Tourmaline is a common accessory phase in the veins (Figure 38B). Gold is present in native form in quartz veins but is most strongly associated with sulphides, both in the quartz veins and in the sheared and altered wallrock.

Mineralized veins are typically subvertical and of several different orientations. Their formation was interpreted to be related to a single shearing event that postdated the onset of regional D_2 deformation and peak metamorphism (Tourigny, 2003b; Tourigny *et al.*, 2004). In this model, ‘fault-fill’ (or ‘shear’) veins, which commonly contain laminations of wallrock material (Figure 38C), are those oriented subparallel to the shear zone boundaries. Veins oriented slightly oblique (5° to 15°) to the main shear foliation in a clockwise sense are considered to have infilled clockwise-rotated Riedel shear fractures, whereas less common oblique veins oriented in a counter-clockwise sense from the main shear zone are interpreted as fills of P-type shears. The fault-fill, R-type, and P-type veins have lateral

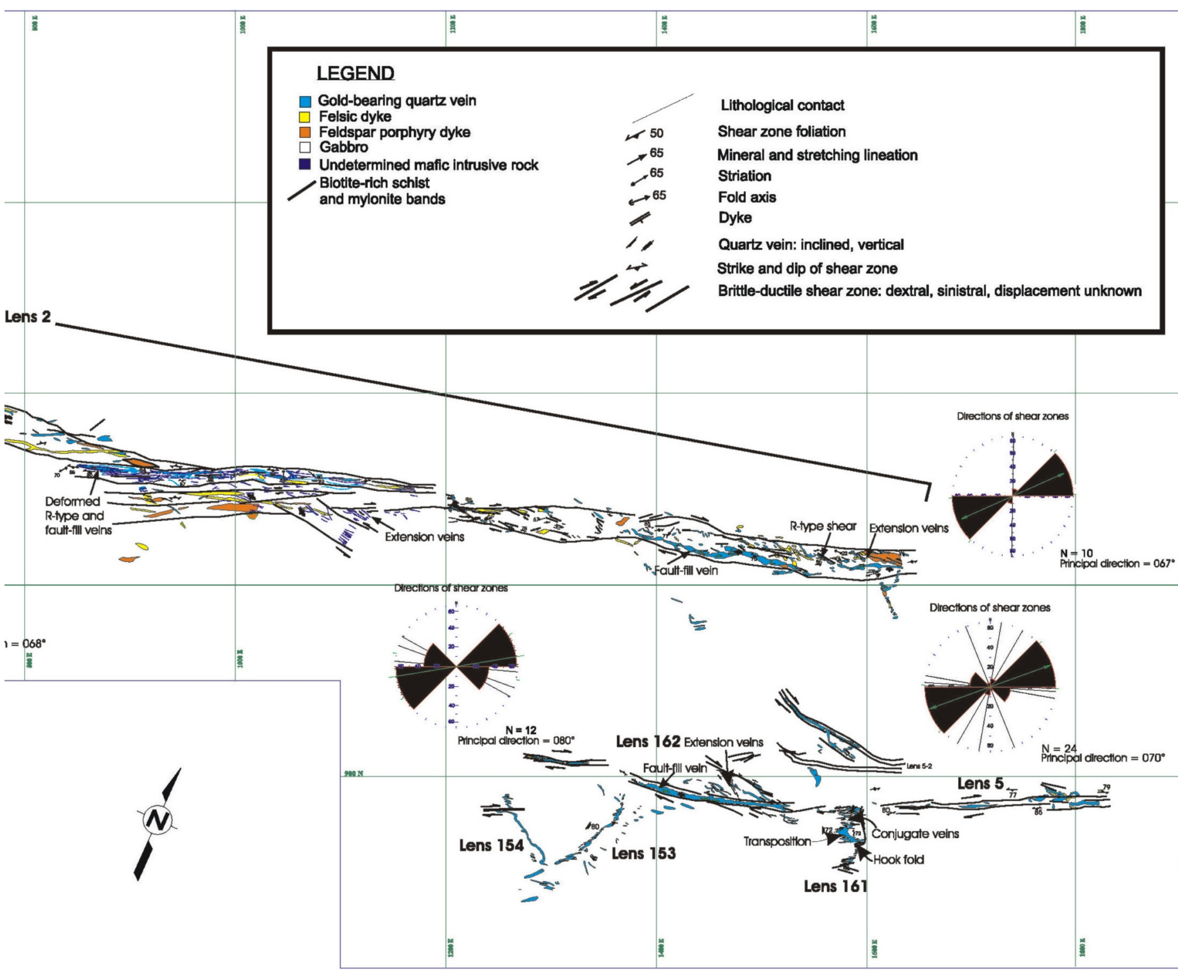

Figure 37 (continued)

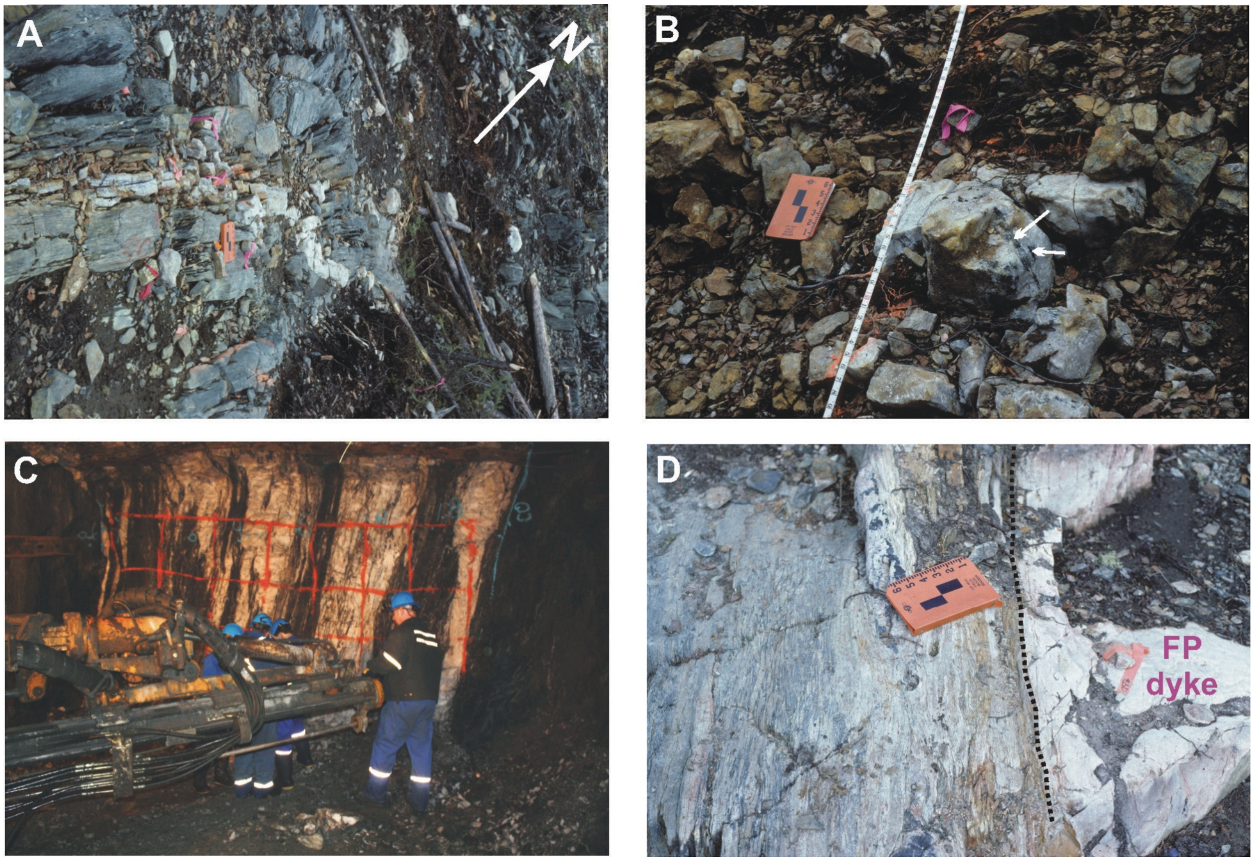

Figure 38 – Gold-related features of the Seabee mine area: A) outcrop view of mineralized quartz vein in brittle-ductile shear zone ('2' shear) cutting gabbroic protolith; B) outcrop photo of coarse tourmaline crystals (arrows) in auriferous '2A' vein; C) underground exposure (11-013 sill drift) of a wallrock-laminated, fault-fill vein ('2B' vein set) at the Seabee mine; and D) feldspar porphyry (FP) dyke (right) adjacent to mineralized shear ('13' shear) in the Seabee area. All photos courtesy of G. Delaney (*ca.* 1986, Saskatchewan Geological Survey) except for (C), which is courtesy of Claude Resources (*ca.* 2011).

connections with one another and commonly record internal deformation, including vertical and lateral boudinage, transposition into the main foliation, and rare parasitic folding (Tourigny *et al.*, 2004), thereby indicating ongoing deformation during vein emplacement and gold mineralization. This is consistent with the interpretation that several cycles of brittle and ductile deformation were coincident with periodic peaks in fluid pressure (Basnett, 1999). Minor *en échelon* veins, oriented moderately to highly oblique to shear zone boundaries, are also noted. Other mineralized zones (*e.g.,* the '153', '154', and '161' zones; Figure 37) are interpreted as being related to a relatively early conjugate-vein network. Individual veins within the Seabee shear structure range from <1 to 12 m in width and can extend both vertically and laterally for hundreds of metres. Not all veins are auriferous, and Basnett (1999) suggested that barren veins might have undergone less deformation and metamorphism than mineralized veins.

The geometric relationships of high-grade ore zones at the Seabee deposit remain somewhat debated. Basnett (1999) proposed that the highest grade ore at Seabee coincides with the intersection of the east-northeast– to east-trending shears and the oblique shear veins. In the model of Tourigny *et al.* (2004), ore zones are interpreted to be prolate bodies plunging ~50° to the east, approximately orthogonal to the mineral stretching lineation in the shear zone. Yuhasz *et al.* (2006) suggested that this could reflect opening of dilational zones at the intersection of separate sets of structures related to pure and simple shear, respectively, along the shear zones. In contrast, Schultz (1996) interpreted ore zones in the 2 shear to be steeply west plunging, localized in proposed dilational jogs at the intersection of shears containing paragenetically early ('stage 1') quartz-tourmaline-pyrite veins and later microfractures that focussed paragenetically late ('stage 2') gold, sulphides, and tellurides into the hydrothermal system. In this model, the gold is thought to have precipitated preferentially at sites where the late microfractures cut pyrite-rich portions of stage 1 veins.

An interesting but controversial feature of the mineralized veins at Seabee is their close spatial relationship with a suite of sulphidic feldspar porphyry dykes within the shear zones (*e.g.*, Figure 38D), particularly along the 2 shear. Basnett (1999) observed that these dykes commonly exhibit a potassic alteration halo that can indicate proximity to ore. The close spatial relationship between the feldspar-phyric dykes and auriferous veins was viewed as mechanical by many early workers, such that the competency contrast between the dykes and the adjacent gabbroic wallrock focussed deformational strain. This view was supported by the results of a geochronological study by Schultz (1996), who reported a $^{207}Pb/^{206}Pb$ evaporation age of 1877 ±10 Ma for magmatic zircon from a feldspar porphyry dyke and much younger $^{40}Ar/^{39}Ar$ plateau ages of 1769 ±7 Ma and 1728 ±5 Ma for hydrothermal biotite thought to be roughly contemporaneous with gold mineralization. Tourigny *et al.* (2004) argued, however, that the $^{40}Ar/^{39}Ar$ ages reflect disturbance of the chronometer by a late (post–gold mineralization) thermal event, and suggested a close genetic association between the emplacement of dykes, precipitation of quartz veins, and gold mineralization. This follows the model of Helmstaedt (1986), which proposes that gold and quartz veins were originally introduced into fractures during emplacement of the porphyry dykes and prior to shear zone development, and that gold was subsequently remobilized when shear fabrics were superimposed on the fractures. Further work is required to resolve the relationship between the feldspar porphyry dykes, quartz veins, and gold mineralization.

Inferred Deposit Type: orogenic gold

Associated Showings: Munro-Shane lakes (SMDI #2240), Santoy (SMDI #2233), Porky Lake (SMDI #2234 to #2239)

Production and Reserves/Resources: Gold production at the Seabee mining operation has been continuous since mining commenced in 1991 to 2012 (Table 1), and is ongoing. A revised Mineral Reserve/Resource estimate for the Seabee deposit was reported in 2010 (Table 2), some of which has since been mined.

Porky Lake and Pigeon Lake Showings
Including Porky Lake Main, West/GAS, South Shore, and Western Limb ('WL') Zones (SMDI #2234, #2235); Porky Lake East / Pigeon Lake (P-1 to P-4; SMDI #2236, #2237, #2238, #2239); and Newly Discovered 'Neptune' and 'Trident' Zones

Location: ~3 to 6 km northeast of the Seabee mine, ~135 km northeast of La Ronge (NTS 63M/12; Porky Main/West, UTM 6175098 m N, 585076 m E; Pigeon P-1, UTM 6177574 m N, 588290 m E)

Metal Associations: Au (As, Cu)

Status: developed prospects with Resources

Exploration and Development History:

The original gold showing (zone P-4) at 'Pigeon Lake' was discovered in 1969 by prospector E. Partridge, who staked the showing area later that year. Partridge restaked the property in 1980 and subsequently optioned it to Currie Rose Resources Inc. Both the Pigeon Lake and Porky Lake showings are situated within the original Currie Rose property, covering an 11 400 ha area surrounding the original Seabee claim. In 1981, Currie Rose had an airborne geophysical (INPUT-EM and magnetic) survey flown over the area, leading to the discovery of additional showings at Pigeon Lake. The original Porky Lake (PL-1) showing was discovered by follow-up drilling of geophysical anomalies in 1984. A ground geophysical (EM and magnetic) survey was conducted by Currie Rose in 1985 in the area proximal to the original Porky Lake showing.

Placer Development Inc. entered into a joint-venture agreement with Currie Rose in 1986 to further explore the Porky–Pigeon lakes area. In 1986-87, showings at Pigeon Lake were stripped and trenched, and five drill holes were completed. In the following three years, the partnership completed geological mapping, prospecting, and soil and bedrock sampling at Pigeon and Porky lakes, and also completed ground geophysical (VLF-EM and magnetic) surveys.

In 1994, Claude Resources Inc. acquired a 100% interest in the properties from Currie Rose, subject to a 30% net profits interest, and completed a drill program at the Porky Lake showings. Prospecting along the south shore of Porky Lake in 1999 resulted in the discovery of the Porky Lake South Shore showing (SMDI #2235), which was drill tested by Claude in 2000. In the same year, prospectors D. Olson and W. Fisher, employed by Claude at the time, discovered an outcrop bearing visible gold while following up a soil geochemical anomaly. This showing was designated the 'Porky Main' zone and was drill tested (18 holes, 3355 m) in 2002 to confirm the continuity of the mineralized zone. Further diamond drilling in 2003 and 2004 outlined two additional mineralized zones, the 'Porky West' and 'Porky East' zones (the latter including the Pigeon Lake showings), effectively confirming the continuity of mineralization around the closure of a regional anticlinal structure ('Porky Lake anticline'). Ground geophysical surveys were performed at Porky West in 2003, and prospecting and geological mapping were carried out at Pigeon Lake. Additional drilling was done at Porky West (17 holes, 4830 m) and at Porky East / Pigeon Lake (three holes, 643 m). In 2006, Mineral Resource estimates were reported for the Porky West and Main zones, and an 8757 t bulk sample was extracted from the 45 and 65 m levels at Porky West and processed at the Seabee mill. Claude reportedly plans to undertake further bulk sampling at Porky West.

In 2010, based on geological, geochemical, and geophysical surveys and historical drill data, Claude outlined two new targets referred to as 'Neptune' and 'Trident'. In the same year, Claude completed two drill holes on a gold-in-soil anomaly at Neptune. This anomaly is one of three with subparallel trends that collectively extend for a distance of >1.8 km and span a width of >200 m. A subsequent 13-hole (4051 m) winter drill program was conducted at Neptune in 2011, resulting in intersection of visible gold in ten holes, including an intersection of 84.7 g/t Au (2.5 oz./ton) over 3.2 m (Claude Resources Inc., 2011a). Results are pending from additional drilling undertaken at Neptune in 2011.

Geological Character:

Gold showings in the Porky and Pigeon lakes areas (Figure 36) are located in the Pine Lake greenstone belt, focussed at or near the boundary between a *ca.* 1890 to 1880 Ma volcanic-dominated sequence (Assemblage A; Delaney and Cutler, 1992) and a younger, *ca.* 1840 to 1830 Ma siliciclastic-dominated sequence (Assemblage B; Delaney and Cutler, 1992). The majority of the showings are hosted by pervasively foliated and/or lineated mafic volcanic rocks of the older assemblage, though some are situated within sedimentary rocks of the younger. At many of the showings (*e.g.,* P-2, P-3, and P-4 at Pigeon Lake), there is evidence of shearing along the contact between the two assemblages (Delaney, 1992). Peak metamorphic conditions are not well constrained for rocks in the area, although available evidence suggests that they were subjected to (lower?) amphibolite facies conditions (*e.g.,* Lewry, 1977).

The Porky Lake and Pigeon Lake zones are situated on opposite limbs of the Ray Lake fold (Figure 36), which is a moderately to steeply, south-southeast–plunging antiform at this location (*i.e.,* the 'Porky Lake anticline') but changes orientation and increases in complexity both north and south of Porky Lake (Lewry, 1977). Little information is currently available on the setting or character of gold mineralization in the Porky Lake and Pigeon Lake zones. Delaney (1992) suggested that some of the showings are within zones of brecciation and/or shearing, some of which are associated with quartz and/or carbonate veins containing massive to disseminated pyrrhotite and/or disseminated arsenopyrite, pyrite, and chalcopyrite.

Information accessed on the Claude website in 2010 indicated that the mineralized structure at Porky West plunges moderately southeast and either pinches out or is truncated by a felsic dyke along its eastern margin. The main mineralized zone is situated within a shear zone that is continuous for more than 400 m along strike and to a depth of up to 250 m, and that is superimposed on diopside-bearing mafic volcanic rocks near its contact with feldspathic arenite. Gold values correlate positively with the presence of pyrite, pyrrhotite, and minor arsenopyrite. Arsenopyrite is a constituent of both calc-silicate– and arenite-hosted mineralization, and has a weak association with elevated gold values. Alteration is noted proximal to the shear zone.

According to Claude Resources Inc. (2011a), the Neptune target consists of "multiple gold-bearing vein sets (that) are situated proximal to the arenite-basalt contact, a regional structure that hosts gold mineralization at the Porky West and Porky Main deposits. Sheeted quartz veins and associated alteration are hosted within both arenite and basalt-derived, biotite-chlorite schist."

Inferred Deposit Type: orogenic gold

Associated Showings: Seabee mine (SMDI #0382), Santoy showings (SMDI #2233)

Production and Reserves/Resources: In 2006, an 8757 t bulk sample was extracted from the 45 m and 65 m levels of Porky West and processed at the Seabee mill as part of the Seabee mining operation (Table 1). Updated Mineral Resource estimates were reported for the Porky West and Main zones in 2010 (Table 2).

Santoy Showings
Santoy 8 Mine, Santoy 7 Mine, Santoy Zones 1 to 8, and Santoy Gap (SMDI #2233)

Location: 11 to 14 km east of the Seabee mine, ~135 km northeast of La Ronge (NTS 63M/12; near UTM 6172188 m N, 595353 m E)

Metal Associations: Au (As, Cu, Pb, Te)

Status: producing mine (Santoy 8); past-producing mine without Resources (Santoy 7)

Exploration and Development History:

Auriferous quartz veins were first discovered in the 'Santoy Lake' area by Cominco Ltd. in 1974. The claim covering the Santoy showings was acquired by Saskatchewan Mining Development Corp. (SMDC) in 1980, which performed airborne geophysical (INPUT-EM and magnetic) surveys, geological mapping, and bedrock sampling.

The property was optioned from SMDC by Claude Resources Inc. later in 1980. Claude divided the property into smaller claim blocks and performed geological mapping and prospecting. One of these smaller claim blocks was optioned to Kenton Natural Resources Corp., which subsequently optioned the property to Manchester Resources Corp. As a joint venture, Claude and Manchester completed ground geophysical (EM and magnetic) surveys over the property in 1988. The auriferous Santoy zones were discovered by the partnership in 1990-91. Santoy zones 1 to 4, 6, and 8 were mapped, stripped, trenched, and sampled, and soil sampling was undertaken in the surrounding area. In the summer of 1991, an exploration program comprising drilling, prospecting, sampling, sluicing, and trenching was undertaken to further delineate the known Santoy zones. A seven-hole, 750 m drill program was initiated in 1992 to test the extent of mineralization in Santoy zones 2 and 6.

In April 1992, Santoy Resources Ltd. entered into an option agreement with Claude on the Santoy project. The joint-venture partnership completed drilling (16 holes) on zones 2, 3, and 4 in 1994. Further prospecting and soil sampling were also conducted on zones 3 and 7, and on other known targets in the Santoy Lake area. An additional four holes were drilled in 1997 on zones 7 and 8. Geological mapping, prospecting, and bedrock sampling were completed over several of the zones in 1998.

Claude acquired 100% ownership of the claims by 2002 and completed 14 drill holes on zones 1 to 4 later that year. In 2003, Claude undertook a prospecting program in which sampling was carried out along a 4 km long, northwest-trending corridor that followed a known mineralized trend. This was followed up in 2004 by an extensive (97 holes, 12 237 m) drilling program that focussed on zones 6, 7, and 8, and some of the intervening area. Another drill program (68 holes, 15 296 m) was completed in 2005, focussing on Santoy zone 8 and zone 8E (located 150 m northeast of zone 8). Several step-out holes in zone 7 were also completed during this program. A new Inferred Mineral Resource estimate for the Santoy 8 zone was released by Claude following this work. Infill drilling of zones 7 and 8 was done in 2006, after which Claude reported a Mineral Resource estimate for Santoy 7. Between late 2006 and early 2007, Claude undertook bulk sampling at the Santoy 7 deposit and continued exploration and infill drilling on the zone. Ore from the bulk sampling program was processed at the Seabee mill, located 11.5 km to the west. Further drilling (147 holes, 31 670 m) was also undertaken at Santoy 8 and 8E in 2007 to provide 25 m infill data to a depth of 250 m and to test strike and plunge extensions at the deposit.

Commercial production from Santoy 7 began in October of 2007 following completion of bulk sampling, with production amounts from the deposit being incorporated into the overall Seabee mine operation totals (Table 1). In 2008, Claude released an updated Mineral Resource estimate for Santoy 8/8E. In April 2010, Claude received provincial ministerial approval and an operating permit to advance the Santoy 8 project from an exploration project to a production project. Preproduction activities at Santoy 8 commenced in the second quarter of 2010 and commercial production was achieved in early 2011. Within the original life-of-mine plan, Claude anticipates that the Santoy 8 mine could provide up to 50% of the overall Seabee mill feed (Claude Resources, 2011b). In 2011, Claude also completed an extensive drilling program (~56 holes, 22 000 m) in the area between the Santoy 7 and 8 zones, referred to as the Santoy 'Gap'. Along with historical drilling results, the results of this drilling will reportedly be used to prepare a Mineral Resource estimate for the Santoy Gap early in 2012.

Geological Character:

The Santoy gold showings constitute a cluster of eight showings located in the vicinity of Santoy Lake, referred to as Santoy zones 1 through 8/8E, and the Santoy 'Gap' (Figure 39). The zones are hosted by rocks of the Pine Lake greenstone belt, most commonly by 1890 to 1880 Ma mafic to intermediate volcanic rocks of 'Assemblage A'

(Figure 39; Durocher *et al.*, 1992), the older of two supracrustal-dominated assemblages making up the greenstone belt. Durocher *et al.* (1992) and Delaney (1995) emphasized that the bulk of the showings actually occur near (<400 m from) the (?tectonized) boundary between Assemblage A and the unconformably overlying, *ca.* 1840 to 1830 Ma, siliciclastic-dominated 'Assemblage B'. Rocks in the Santoy Lake area have been affected by at least four deformational events and have attained upper amphibolite facies peak metamorphic conditions (655° to 705°C and 6.1 to 7.3 kbar; M_2 event of Durocher *et al.*, 2001).

The Santoy showings are situated within a series of variably oriented, though dominantly northwest-trending, shears that are up to 600 m in strike length and 10 m in width. Some of these shears cumulatively define a north-northwest–trending, kilometre-scale high-strain zone north of Santoy Lake (Delaney and Cutler, 1992; Figure 39).

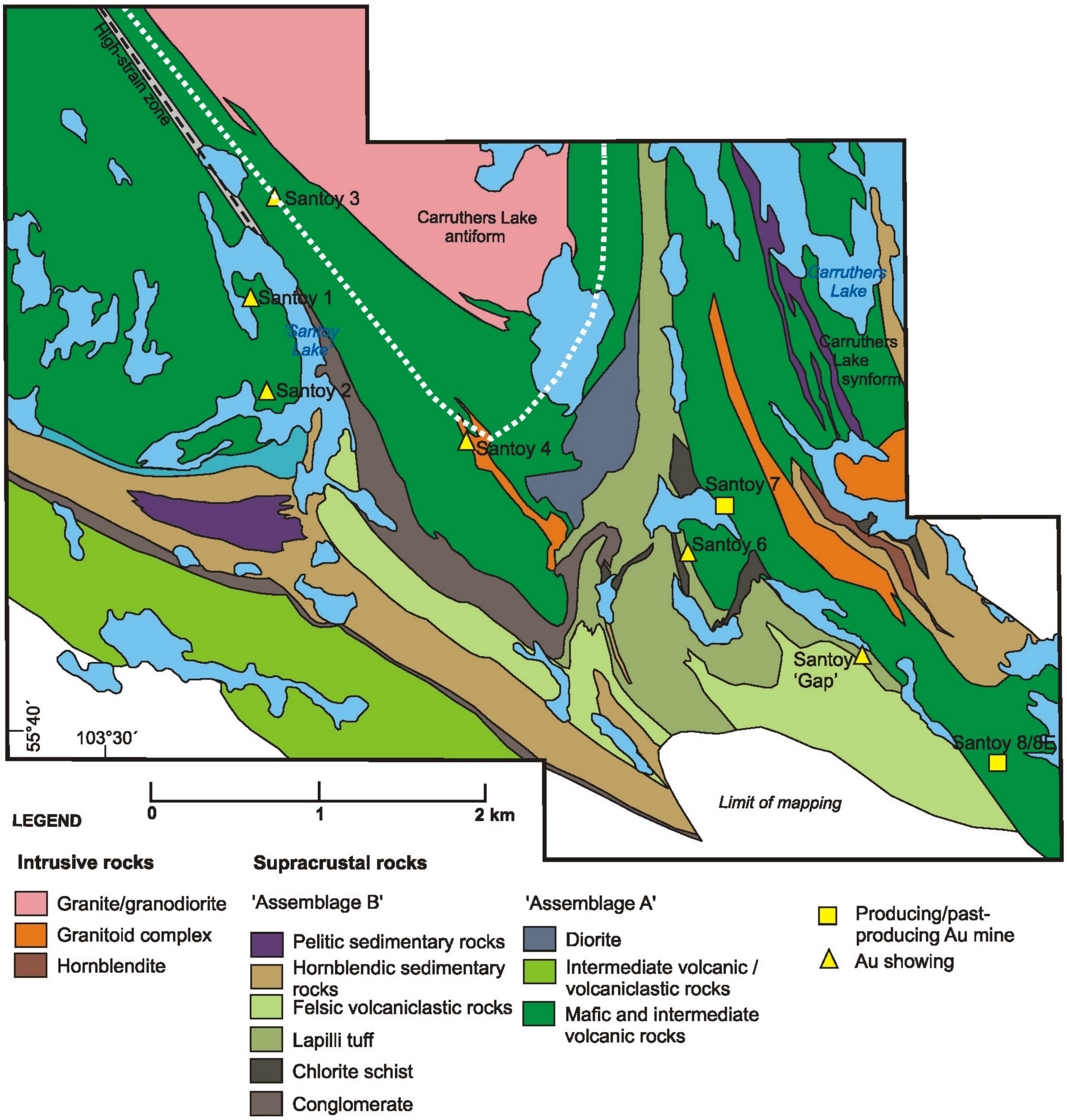

Figure 39 – Generalized geological setting of the 'Santoy' Lake area, showing locations of Santoy gold zones (excluding zone 5; from Durocher* et al., *1992). White dotted line shows approximate trace of the closure of the Carruthers Lake antiform.

The shears are typically characterized by a strong, steeply dipping foliation that is locally associated with a subhorizontal to moderately plunging, downdip stretching lineation (Durocher, 1997). Based on C-S fabrics, deflected foliation, and rotated mineral fabrics observed at Santoy zones 1, 2, and 3, the shear zones were interpreted to have initiated during regional D_2 deformation as a result of sinistral transcurrent or oblique-slip movement (*op. cit.*). The mineralized shears and gold zones are situated in the western limb and the nose of a mesoscopic antiform known as the Carruthers Lake antiform, part of a continuous antiform-synform pair with the adjacent Carruthers Lake synform to the east (Figure 39; Delaney and Cutler, 1992). Some of the mineralized shears (*e.g.,* at zones 2 and 8) are locally reoriented by these later (F_3), shallowly to moderately north- to north-northwest (or south-southeast)–plunging, tight folds or related D_3 structures (Durocher, 1997).

Gold at the Santoy zones is spatially associated with quartz veins within the shear zones, commonly within or adjacent to sheared granitic to granodioritic sills that intrude the volcanic rocks. Two generations of quartz veins have been described (Durocher, 1997), referred to as 'stage 1' and 'stage 2' veins. Stage 1 veins contain mainly quartz and diopside; are commonly highly strained, isoclinally folded, and/or boudinaged; and are interpreted to either predate or be synchronous with peak metamorphism. They are often associated with biotite-muscovite alteration zones up to 1 m in width and exhibit evidence of retrograde metamorphism. Stage 2 veins are dominated by quartz, which is thought to represent recrystallized stage 1 quartz, and lesser carbonate. Sulphide minerals, mainly pyrrhotite and pyrite but also arsenopyrite, chalcopyrite, and galena, are commonly present in the veins in collective proportions of up to 3%. Trace tellurides and clinozoisite are also present. Gold, along with associated sulphides, is situated most commonly in the wallrock adjacent to the veins and rarely in late fractures cutting the veins. Interpretation of the preserved textures indicates that, paragenetically, gold is most closely related to chalcopyrite, galena, tellurides, sphalerite, and clinozoisite in stage 2 veins, which are interpreted to postdate peak metamorphism (Durocher, 1997).

More detailed descriptions of some of the individual auriferous zones at Santoy Lake (*i.e.,* Santoy zones 1 to 8) are available in Delaney (1992) and Durocher *et al.* (1992). The Santoy 8 deposit, which came into production in 2011, is described by Durocher *et al.* (1992) as being hosted by quartz veins and the adjacent silicified mafic volcanic and granitoid sills within a shear zone. The main shear zone is 3 to 9 m wide, extends for >400 m along strike, and is northwest to north-northwest trending and moderately to steeply northeast dipping. Subsidiary shears up to 5 m wide occur within 15 m of either side of the main shear zone. Gold is associated both with disseminated chalcopyrite, pyrite, bornite, and arsenopyrite in the shears and the adjacent wallrock, and with sulphide veinlets along microfractures that cut 1 cm to 2 m thick quartz veins. Distinct alteration assemblages include diopside+ hornblende, as well as biotite, epidote, and a 'felsitic' assemblage comprising mainly quartz+plagioclase +K-feldspar. Although rare, tightly to isoclinally folded quartz veins are present. The northernmost portion of the Santoy 8 zone was reoriented by later (F_3), regional, north-trending and north-plunging S-folds.

Inferred Deposit Type: orogenic gold

Associated Showings: Seabee mine (SMDI #0382), Porky Lake (SMDI #2234 to #2239)

Production and Reserves/Resources: A Mineral Reserve/Resource estimate for the Santoy 7 and 8/8E zones was released in 2008. After release of this estimate, ore was extracted from Santoy 7 and, in 2011, commercial production commenced at Santoy 8. Ore from the Santoy deposits is processed at the Seabee mill as part of the Seabee mining operation (Table 1). An updated Mineral Reserve/Resource estimate was reported for Santoy 8 in 2010 (Table 2).

Location 9 – Prongua–Lariviere Lakes Area

Prongua–Lariviere Lakes Showings
Including Eureka (SMDI #2568), Tourma (SMDI #2576), Carb (SMDI #2577), Second Lake South/Northeast (SMDI #2578, #2643), D-Day (SMDI #2642), Terra / Three-Way / Golden Pond (SMDI #2644), Tim's Au (SMDI #2645), Orchid/Homestake Trench (SMDI #2646), and Till (SMDI #2647)

Location: scattered near Prongua and Lariviere lakes, ~19 km west-southwest of Pelican Narrows (NTS 63M/03; near UTM 6110559 m N, 615070 m E)

Metal Associations: Au (±B±Cu±As±Mo)

Status: occurrences

Exploration and Development History:

Minor copper mineralization (*e.g.,* Prongua Lake (SMDI #2251), Wing Lake (SMDI #0335), and West Wing Lake (SMDI #2250) showings) was first discovered in the western Prongua–Lariviere lakes area during a Saskatchewan Geological Survey regional mapping project (Sibbald, 1972). Gold exploration in the area did not begin until 1986-87, when prospector W. Fisher staked several claims and carried out prospecting, soil sampling, and trenching around the known copper showings. This work resulted in the discovery of anomalous gold mineralization, and an option agreement with Placer Dome Inc. was established in 1989.

Placer undertook exploration on the claims in 1989-90, including prospecting, surficial and bedrock geological mapping, ground geophysical (VLF-EM and magnetic) surveys, a Landsat lineament study, and geochemical (till, soil, and bedrock) sampling. This exploration, along with work completed elsewhere on the property later in 1990, led to the discovery of several small showings, including 'Carb', 'Eureka', 'Second Lake South', 'Till', and 'Tourma'. Further exploration was undertaken in the northern Lariviere Lake area in 1991, including geological mapping, ground geophysical (VLF-EM and magnetic) surveys, and completion of seven diamond-drill holes near the Till showing. Drill results were disappointing, with only a single short intersection of elevated gold values (1.62 g/t; 0.05 oz./ton). According to assessment file information (SMER Assessment File 63M03-0041), Fisher subsequently performed independent prospecting just to the east of this drilled area and discovered 'rubble' on the shore of Lariviere Lake that graded ~70 g/t (2.0 oz./ton) Au.

Homestake Canada Ltd. acquired the property in 1992 through an option agreement with Fisher and completed prospecting, geological mapping, and soil and rock sampling in the vicinity of southern Lariviere Lake. Several rock samples containing 1 g/t Au were identified during this program, including six that graded >6 g/t (0.18 oz./ton) Au. The D-Day, Orchid/Homestake trench, Second Lake Northeast, Terra/Three-Way/Golden Pond, and Tim's Au showings were identified during this exploration program.

The property was optioned by Consolidated Pine Channel Gold Corp. in 1994, which completed a ground geophysical (IP and resistivity) survey over a portion of the area. The claims covering the showings eventually lapsed but were restaked by an unnamed company in 2011.

Geological Character:

The Prongua–Lariviere lakes area is underlain by a sequence of north-trending mafic to intermediate volcanic rocks of the 'Prongua Lake volcanic belt', a possible extension of the Pine Lake greenstone belt (Figure 20), which are crosscut by plutons and sheets of granodiorite, tonalite, and subordinate diorite and gabbro (Sibbald, 1972; Wilcox, 1990). Penetrative structural fabrics in the area are controlled by a 200 to 1500 m wide zone of heterogeneous strain in the north-trending Tabbernor fault zone, which exhibits brittle-ductile, sinistral, strike-slip displacement in the showing area (Wilcox, 1991). This brittle-ductile strain was overprinted by late brittle movement along the fault zone (*op. cit.*). Lower amphibolite facies assemblages in the rocks are overprinted by greenschist facies assemblages, the formation of which accompanied late brittle movement along the Tabbernor fault zone (Wilcox, 1990).

There is little information available on the detailed geological setting of the gold showings in the Prongua–Lariviere lakes area, although known characteristics indicate a structural control to the mineralization. Weakly auriferous mineralization is most commonly associated with chloritic shear zones that cut the granodiorite and are sometimes focussed along mafic dykes and/or large rafts of mafic volcanic rocks in the granodiorite. The mineralized shear zones are typically steeply dipping to subvertical, north to northwest trending, and probably related to early ductile or brittle-ductile deformation associated with the Tabbernor fault zone (Wilcox, 1990).

The gold mineralization is commonly focussed in narrow (~1 to 50 cm wide), sulphidic shear–hosted and/or fracture-controlled quartz-calcite veins of varying orientation, or with disseminated sulphides in wallrock adjacent to shears. The mineralization is generally associated with 2 to 5% disseminated pyrite, and tourmaline is a common component of mineralized quartz veins. Disseminated pyrrhotite and trace arsenopyrite, chalcopyrite, and molybdenite are also noted at some showings.

Although most showings in the area are hosted in the granodiorite near the contact with adjacent volcanic rocks, a few occurrences (*e.g.,* Eureka, Second Lake South and Northeast) are hosted by the mafic volcanic rocks. At these showings, the volcanic rocks are sheared and silicified, and seem to be associated with higher arsenic values.

Inferred Deposit Type: ?orogenic gold

Associated Showings: Prongua Lake Cu-Au showing (SMDI #2251), Wood Lake / Kirkland / S-5 / Cliff zone (SMDI #1869), Versary zone (SMDI #2258), Fish Dot gold zone (SMDI #2257) and Yak (SMDI #2491)

Production and Reserves/Resources: none

Location 10 – Brownell Lake Area

Brownell Lake Showings
Including Point (SMDI #0249a, #0249b), Amp (SMDI #1728), Olson and Spartan (SMDI #2217a, #2217b), Tuscan (SMDI #2218), the Carina Gold Showings (Abaco, Dosco, Emco, Kaldo, Siskin, and Talco (SMDI #2219a to #2219f)), Juba (SMDI #2220), Jena (SMDI #2221), and Kalix (SMDI #2222)

Location: ~1 km southeast of Brownell Lake, ~103 km east of La Ronge (NTS 63L/13; in the vicinity of the Point showing at UTM 6092591 m N, 581202 m E)

Metal Associations: Au (±As±Cu±Zn±Mo±Ag±Co±Ni)

Status: prospects and occurrences

Exploration and Development History:

Gold exploration in the Brownell Lake area was initiated in 1957 by the Knox Saskatchewan Syndicate, which had completed geological mapping, prospecting, trenching, ground geophysical surveys, and a five-hole diamond-drill program by 1961. Minor gold mineralization was intersected in one hole. United Comstock Mines Ltd. drilled a single hole between Brownell and Havard lakes (Figure 40) in 1960, although no anomalous gold mineralization was intersected. In 1963, Selco Exploration Company Ltd. completed an airborne geophysical (INPUT-EM and magnetic) survey over >1300 km^2 of the area. This was followed by a ground geophysical (vertical coil EM and magnetic) survey in 1965-66. Selco subsequently completed at least eight diamond-drill holes in the Brownell–Havard lakes area in 1967, though mainly on Ni-Cu targets. In 1968, Saskatchewan Geological Survey geologist W.A. Padgham discovered a gold showing (SMDI #0249a) while conducting a regional mapping project in the Brownell Lake area (Padgham, 1968).

After staking an area with known gold showings near Brownell Lake in 1981, prospector E. Partridge completed an extensive prospecting and Wacker-drill soil sampling program that resulted in the discovery of six additional gold-mineralized zones (Abaco, Emco, Talco, Dosco, Kaldo, and Siskin zones). In 1982, Partridge formed Carina Resources Corp. and completed prospecting and geochemical sampling on the six known zones (the 'Carina' showings). This work led to the discovery of additional gold showings, including the Spartan and Tuscan zones. Carina completed a 22-hole diamond-drill program on several of the zones in 1984 to better define the mineralization. Further prospecting in 1985 led to the discovery of the Jena, Juba, and Kalix zones to the east of the known Carina zones.

An agreement was reached in 1986 for Waddy Lake Resources Inc. to earn a 50% interest in the property by completing exploration. In partial fulfillment of this requirement, Waddy commissioned Questor Surveys Ltd. in 1986 to conduct an airborne geophysical (VLF-EM and magnetic) survey over the claim area, as well as follow-up ground surveys. In 1987, the partnership completed an 11-hole diamond-drill program to test for mineralization at the Emco, Talco, Jena, and Kalix zones. Around this time, Saskatchewan Geological Survey geologist G. Delaney reported assay results of ~28 g/t (0.82 oz./ton) and 11 g/t (0.32 oz./ton) Au from grab samples taken during regional mapping from the Kalix and Siskin showings, respectively (Delaney, 1988). Results from Waddy's drilling program, however, were generally disappointing and, except for some detailed geological mapping and channel sampling in 1993, no additional work was done on the showings. The claims lapsed in 1994.

Shortly after the showing area became available, it was restaked by Uranerz Exploration and Mining Ltd., which performed prospecting, geological mapping, and soil sampling near the existing showings in 1996. The claims lapsed in 1999 and the area was restaked by an unnamed company in 2004, remaining under disposition in 2011.

Geological Character:

Gold showings in the Brownell–Havard lakes area (Figure 40) consist of both plutonic- and volcanic-hosted varieties. Several showings are located near the Brownell Lake pluton, a composite calc-alkaline body of gabbroic to granitic composition (Delaney, 1988) that yielded a U-Pb zircon crystallization age of 1831 ±9 Ma (McNicoll *et al.*, 1992). This pluton intruded an undated, dominantly northwest-trending supracrustal sequence consisting of

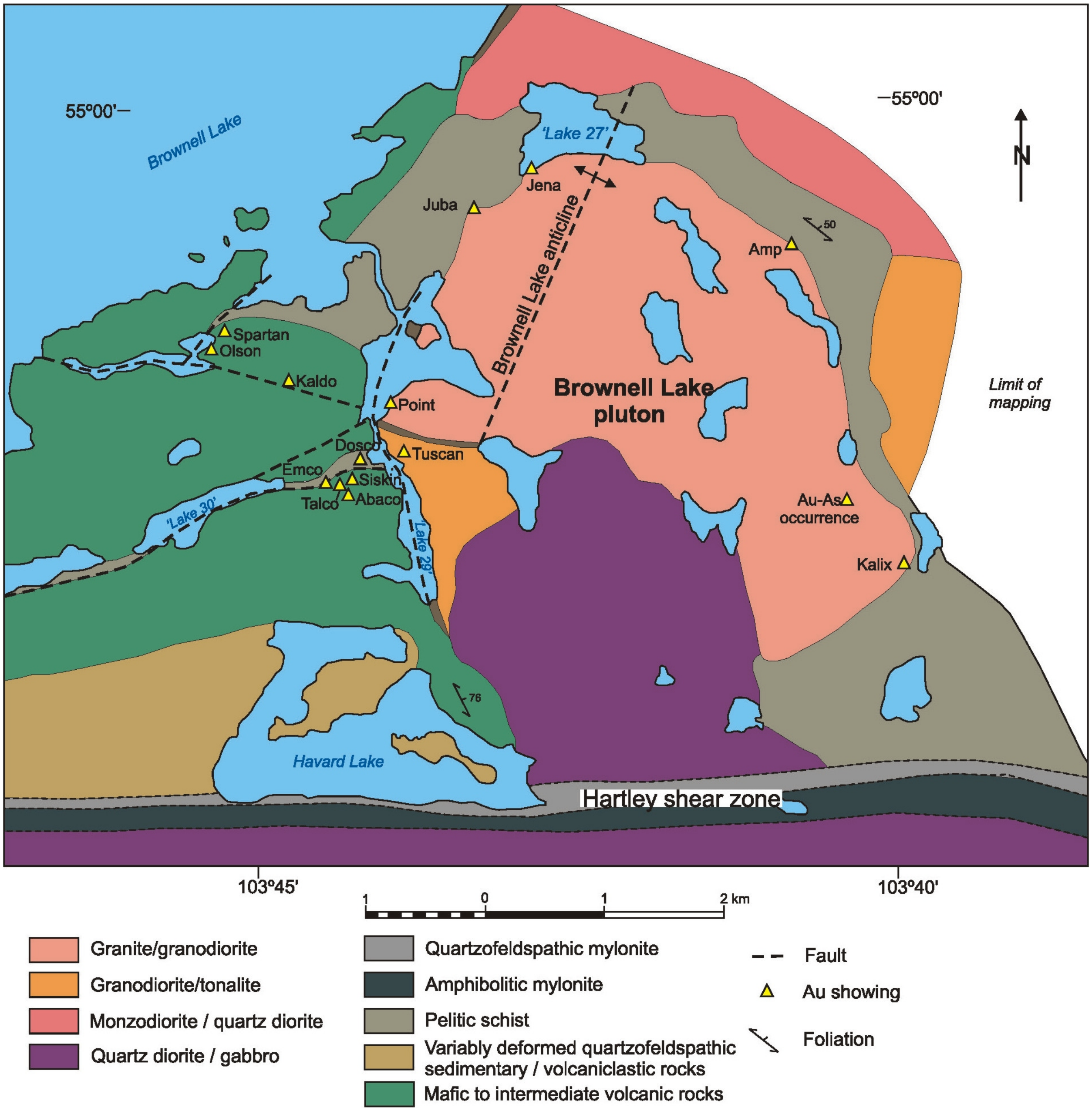

Figure 40 – Geological setting and gold showings of the Brownell Lake area (after Delaney, 1988).

pelitic schist to the north and east, and mafic to intermediate volcanic rocks to the west (Figure 40). Abundant staurolite porphyroblasts in pelitic schist (Delaney, 1988) record lower amphibolite facies metamorphic conditions for rocks in the area. The Amp, Jena, Juba, Kalix, Point, and Tuscan showings are scattered around the northern part the Brownell Lake pluton, whereas the other showings in the area are hosted by the intermediate to mafic volcanic rocks to the west.

Known plutonic-hosted gold showings are situated at or near the northern margin of the Brownell Lake pluton, where it consists of microcline-phyric granite/granodiorite. Here, the pluton typically carries a moderate lineation and foliation, and occupies the hinge of the regional Brownell Lake anticline (Padgham, 1968; Delaney, 1988; Figure 40). Brief descriptions of the geological setting of the plutonic-associated mineralization have been provided by Delaney (1992), Durocher *et al.* (1994), and Durocher (1997). The showings are generally situated within tens of metres of the pluton margin and are associated with centimetre- to metre-scale, biotite-rich shear zones and vein systems that are subparallel to the pluton margins. Gold is typically associated with disseminated sulphides in shear zones and along shear zone margins, although it can also be associated with narrow quartz veins in or proximal to shear zones. The Kalix showing, for example, consists of an irregular system of quartz veins that are variably oriented, though preferentially north to northwest trending, and subparallel to proximal shear zones (Delaney, 1992). Veins and vein systems extend over strike lengths of 50 to 100 m but tend to pinch out abruptly along strike. Generations of non-auriferous veins are also present. Delaney (1992) noted patchy arsenopyrite, pyrite, chalcopyrite, and molybdenite, along with visible gold, in quartz veins at the Kalix showing and reported associated geochemical enrichments in Ag, As, Cu, and Zn.

The volcanic-associated showings in the Brownell Lake area (including the Carina gold showings of Abaco, Dosco, Emco, Kaldo, Siskin, and Talco (SMDI #2219a to #2219f), as well as Olson and Spartan (SMDI #2217a and #2217b)) are hosted by mafic to intermediate volcanic rocks of the Brownell-Wapawekka greenstone belt (Figure 20), and are clustered about 0.5 to 1.5 km west of the Brownell Lake pluton's western margin (Figure 40). These showings are invariably associated with quartz±calcite veins in small shear zones that cut the volcanic rocks; the shear zones are interpreted to be subsidiary thrusts off the regional Hartley shear zone to the south (Delaney, 1992).

The Emco showing, as described by Delaney (1992), contains the most significant gold grades identified to date in the volcanic-hosted showings. It is characterized by arsenopyrite-bearing quartz veins and siliceous hostrocks in a north-dipping fault that separates footwall volcanic rocks and hangingwall staurolite schist (Figure 40). Mineralization at the nearby Siskin showing (Delaney, 1992) is present in: 1) millimetre-scale, chalcopyrite- and arsenopyrite-bearing, quartz-calcite-hornblende veinlets in strongly foliated amphibolite; 2) a rusty shear zone in amphibolite; and 3) an irregular network of centimetre-scale quartz-calcite-arsenopyrite-chalcopyrite veins in pillowed intermediate volcanic rocks. Assay values in these veins indicate enrichment in As, Au, and Ag, as well as slightly elevated Co and Ni.

No direct genetic association has been proposed between the plutonic- and volcanic-hosted styles of auriferous mineralization in the Brownell Lake area. Some common features of the two styles, including quartz veins, metal associations (Au, As, Cu), and associations with faults or shear zones, do, however, suggest a common origin.

Minor gold mineralization has also been discovered 12 to 15 km to the west near Maynard Lake (M-10, SMDI #1729; Alex, SMDI #1730). These showings are situated in plutons and, like the Brownell Lake showings, are hosted by quartz veins in shear zones that are likely related to the Hartley shear zone (Delaney, 1992).

Inferred Deposit Type: ?orogenic gold

Associated Showings: M-10 (SMDI #1729), Alex (SMDI #1730), Wapa No. 13 (SMDI #0674), Sample 11112 (SMDI #2375), Drill holes DES-78, -79 and-111 (SMDI #0269)

Production and Reserves/Resources: none

Flin Flon Domain

Location 11 – Phantom Lake–Flin Flon Area

Flin Flon Mine (SMDI #0071)

Location: in the town of Flin Flon on the Saskatchewan-Manitoba border (NTS 63K/13; UTM 6072214 m N, 700842 m E)

Metal Associations: Au with Cu, Zn, Ag, Cd (Se, Te, As, Pb)

Status: past-producing mine without Resources

Exploration and Development History:

As of 2012, the Flin Flon mine, one of the world's largest Proterozoic volcanogenic massive sulphide (VMS) deposits, had produced more copper and gold than all other deposits in Saskatchewan combined. The Flin Flon copper-zinc discovery was staked by T. Creighton and the Mosher and Dion brothers in 1915. From 1916 to 1918, 44 diamond-drill holes totalling 7822 m outlined the deposit to 274 m below surface. In 1920, two shafts (the No. 1 to 64 m and the No. 2 to 93 m) were sunk 150 m apart and drilling was completed on the 30, 61, and 91 m levels.

In 1921, the Mining Corporation of Canada acquired a majority interest in the property and carried out exploration work in the vicinity of the deposit. The property was optioned by the Whitney Group of New York in 1925 and, during the following two years, the company set up a test mill. In 1927, the Whitney Group acquired a majority interest, with the Mining Corporation of Canada retaining 15%. In the same year, the Hudson Bay Mining and Smelting Co. Ltd. (HBMS) was incorporated, which, in 1928, began mine development and construction of the mill, zinc-recovery plant, and copper smelter. It also undertook construction of a hydroelectric plant at Island Falls on the Churchill River and the railway line from the town of The Pas. Production commenced in 1930. Mining was initially by open pit (792 m long by 137 m wide), to a depth of about 100 m. After 1937, the mining emphasis shifted to underground and was entirely underground after 1941. Mine workings extended to the 1125 m level, with the ore zone terminating at about 1140 m. The mine had three vertical shafts: the original 676 m North Main shaft in Manitoba; the 1241 m South Main shaft, located 1.6 km south of the North Main shaft in Saskatchewan; and the 991 m No. 3 shaft, located 715 m south-southeast of North Main shaft, also in Saskatchewan. South Main was the main production shaft in the final years of mining and, from the time of mine closure in 1992 until 2008, it continued to be used for hoisting ore from the nearby Callinan and Triple 7 mines. The South Main shaft was decommissioned in 2009 and the headframe was subsequently demolished.

The Callinan deposit (SMDI #0072), identical in mineralization style to the Flin Flon VMS deposit, also straddled the provincial boundary with Manitoba. The deposit consisted of three orebodies: the Callinan North, South, and East lenses. Only the upper portion of the Callinan North, located about 2 km north of the Flin Flon deposit, was situated within Saskatchewan. In 1989, HBMS drove a drift from the South Main shaft of the Flin Flon mine to the Callinan South deposit and commenced mining in April of 1990. Development work on the North zone continued in 1994 and 1995, and mining of the Saskatchewan portion of the zone started in 1997. The Callinan North lens was accessed from three different levels of the existing Flin Flon South and North Main shafts. Mining of the Callinan deposit ceased in 2005.

Geological Character[7]*:*

VMS base metal deposits are known throughout the Reindeer Zone and particularly in the Flin Flon area (Figure 41). The Flin Flon and Callinan (and Triple 7 in Manitoba) gold- and silver-bearing zinc-copper deposits are of the proximal, bimodal-mafic VMS subtype of Franklin *et al.* (2005) and formed in a rifted oceanic island-arc setting.

The greater Flin Flon area is underlain mainly by Paleoproterozoic, mafic-dominated volcanic rocks of the Flin Flon arc assemblage (Lucas *et al.,* 1996; Figure 41). Rocks in the Flin Flon mine area consist of a steeply dipping, east-facing sequence of volcanic rocks of the Flin Flon formation (Simard *et al.*, 2010), a component of which has been dated at *ca.* 1889 Ma (Rayner, 2010). These volcanic rocks are interpreted to represent the remnants of a large, fault-bounded caldera that consisted of numerous internal, fault-bounded sub-basins (Figure 42). The immediate ore-hosting sequence of the Flin Flon formation, deposited in this caldera, is known as the Millrock member (Simard *et al.*, 2010). In the mine area, the stratigraphically lowest part of this bimodal succession comprises a thick sequence of predominantly mafic volcaniclastic rocks, including minor mafic flows and, at the top, a distinctive pillow-fragment breccia. Immediately overlying the mafic fragmental rocks is the 'Mine rhyolite', the host to the Flin Flon massive sulphide deposit (Figure 42). This rhyolitic unit is up to 150 to 180 m thick and can be traced along strike for about 3 km. It comprises two distinct phases: a lower, quartz- and plagioclase-phyric flow breccia, and an upper, massive, flow-banded, quartz- and plagioclase-phyric rhyolite flow. The latter is overlain by transported rhyolite breccia that commonly contains slabs of flow-banded rhyolite.

The Mine rhyolite and related sulphide bodies are immediately overlain by rocks of the Hidden formation, consisting of thin-bedded to laminated mafic tuff and an overlying thick succession of relatively uniform, aphyric to porphyritic, pillowed mafic flows. Subvolcanic sills and dykes of diorite intrude the volcanic rocks, as do younger, postvolcanic gabbroic bodies (*e.g.,* the Boundary intrusions).

Rocks of the Flin Flon formation, including the Millrock member, are folded about the regional, northwest-striking Hidden Lake syncline. The massive sulphide lenses are situated on the western limb of this fold (Figure 41B). The axis of this fold plunges moderately to the south-southeast and is parallel to a strong regional stretching lineation. The extensional event responsible for this regional stretching lineation exerted a strong control on the orientation of

[7] Although the ore has been mined out, the description is in the present tense for consistency.

bedding features at all scales, including elongation of the ore lenses themselves. The ore lenses are also transected by a series of east-dipping thrust faults that are known to cause stratigraphic repetitions in the Flin Flon camp (*e.g.,* Lewis *et al.*, 2007 and references therein).

The characteristics of Flin Flon deposit mineralization were described by Coombe Geoconsultants Ltd. (1991). The overall mineralized zone has a length of ~800 m, a width of 150 m, and a vertical extent of ~1140 m from surface. This zone dips east at approximately 70° and plunges ~35° to the southeast for about 2000 m. Approximately 70% of the contained ore is in six massive sulphide lenses, whereas the remaining 30% is in adjacent zones of disseminated sulphides. Pyrite, pyrrhotite, sphalerite, and chalcopyrite are the dominant sulphide minerals and commonly define a compositional banding in the ore. Less common mineralogical constituents in the massive sulphide lenses include arsenopyrite, cubanite, galena, tetrahedrite-tennantite, sylvanite, tetradymite, altaite, magnetite, electrum, and gold. Sphalerite, galena, tetrahedrite, and electrum are enriched, relative to chalcopyrite, toward the hangingwall portions of the lenses. A close association between zinc and gold/silver has been noted, and copper is known to increase in proportion, relative to zinc, gold and silver, with increasing depth. An extensive zone of footwall alteration, comprising chlorite and chlorite-talc schists, is associated with the sulphide mineralization.

Inferred Deposit Type: volcanogenic massive sulphide (bimodal-mafic type)

Associated Showings: Callinan mine (SMDI #0072), Triple 7 mine (in Manitoba)

Production and Reserves/Resources: Production of gold from the Flin Flon mine occurred between 1930 and 1992. Although gold was not directly targeted and was extracted as a by-product of base metal mining, the Flin Flon mine produced a total of about 170 t (5.47 million oz.) of gold in Saskatchewan and Manitoba combined (HudBay Minerals Inc., unpublished data, 2011). Although only about two-thirds of this total was mined in Saskatchewan (Table 1), the deposit still stands as Saskatchewan's largest-ever gold producer. By-product gold was also produced from the nearby Callinan deposit between 1989 and 2005 (about 14 t, 0.45 million oz.), and from the currently operating Triple 7 mine, which opened in 1998. Of these latter two, only a portion of the North ore lens of the Callinan deposit was mined in Saskatchewan between 1997 and 2005 (Table 1).

Rio (Reo) / Bootleg Mine
WC, AJ, B, and Phantom Lake Granite Dyke Zones (SMDI #0011); also including Henning-Maloney (SMDI #0006), McMillan (SMDI #0010), Wekach Lake (SMDI #0021)

Location: at the south end of Douglas Lake, ~4 km south-southwest of Creighton (NTS 63K/012; UTM 6067745 m N, 699178 m E)

Metal Associations: Au (Ag, As±Cu±Zn)

Status: past-producing mine without Resources

Exploration and Development History:

The Rio property was first staked in 1931 by P. Maloney and A.J. Henning. Between 1931 and 1940, they completed 17 drill holes and 12 trenches over a strike length of 183 m, as well as a two-compartment shaft to a depth of 50 m. Around this time, development activities and small-scale, high-grade mining were also being undertaken at several other gold showings in the Phantom Lake area (*e.g.,* Phantom Lake, Wekach Lake, Newcor, Henning-Maloney, McMillan historical mines). Although actual production totals are available for only some of these historical operations, none yielded significant amounts of gold (*i.e.,* <10 kg/325 oz. each).

Between 1960 and 1967, C. Hogg and Central Manitoba Mines Ltd. undertook further diamond drilling and a ground EM survey in the Rio property area. Flin Flon Mines Ltd. acquired the property in 1968 and undertook further drilling. By 1970, an additional 3684 m of drilling had been completed at the Rio zone, in addition to ground EM and geochemical surveys. An IP survey was completed over the area in 1973 and further drilling, the following year, extended the along-strike extent of the deposit. Between 1979 and 1980, drilling had outlined the main orebody, which was traced continuously along strike for almost 200 m and extended down dip and down plunge to a depth of at least 213 m.

In 1981, Flin Flon Mines Ltd. received government approval for the mining project, and development of a decline was initiated the same year. A 259 m decline ramp was completed in 1982 to a vertical depth of 22.9 m, which was subsequently extended to a depth of 45.7 m and then to 106.7 m. Gold production from the Rio deposit was slated to begin in 1982, but was delayed due to depressed gold prices. Production was subsequently rescheduled to start by the final quarter of 1983 but was again delayed, this time due to technical problems, until mid-1984. A 300 tons/day mill was set up to process ore from the Rio/Bootleg mine, as well as the nearby Henning-Maloney and Newcor deposits. Initial production was slated for 100 tons/day, with production increases planned in stages to a maximum of 300 tons/day. The mine closed just three months after start-up (Table 1) due to low (60%) recovery rates. The mine went into receivership, and Vista Mines Inc. gained possession of the property shortly thereafter.

In 1986, Vista initiated the first phase of a new exploration project on the property. A surface sampling program on the original discovery trenches and a geophysical survey on the deposit were both completed in 1986. An underground diamond-drilling program was planned to test the gold-bearing zones and to increase the mineable reserves. This drilling resulted in the discovery of the 'B' zone. The drill program was followed by further surface and underground drilling to delineate mineable reserves. A total of 41 holes was completed during this program, 37

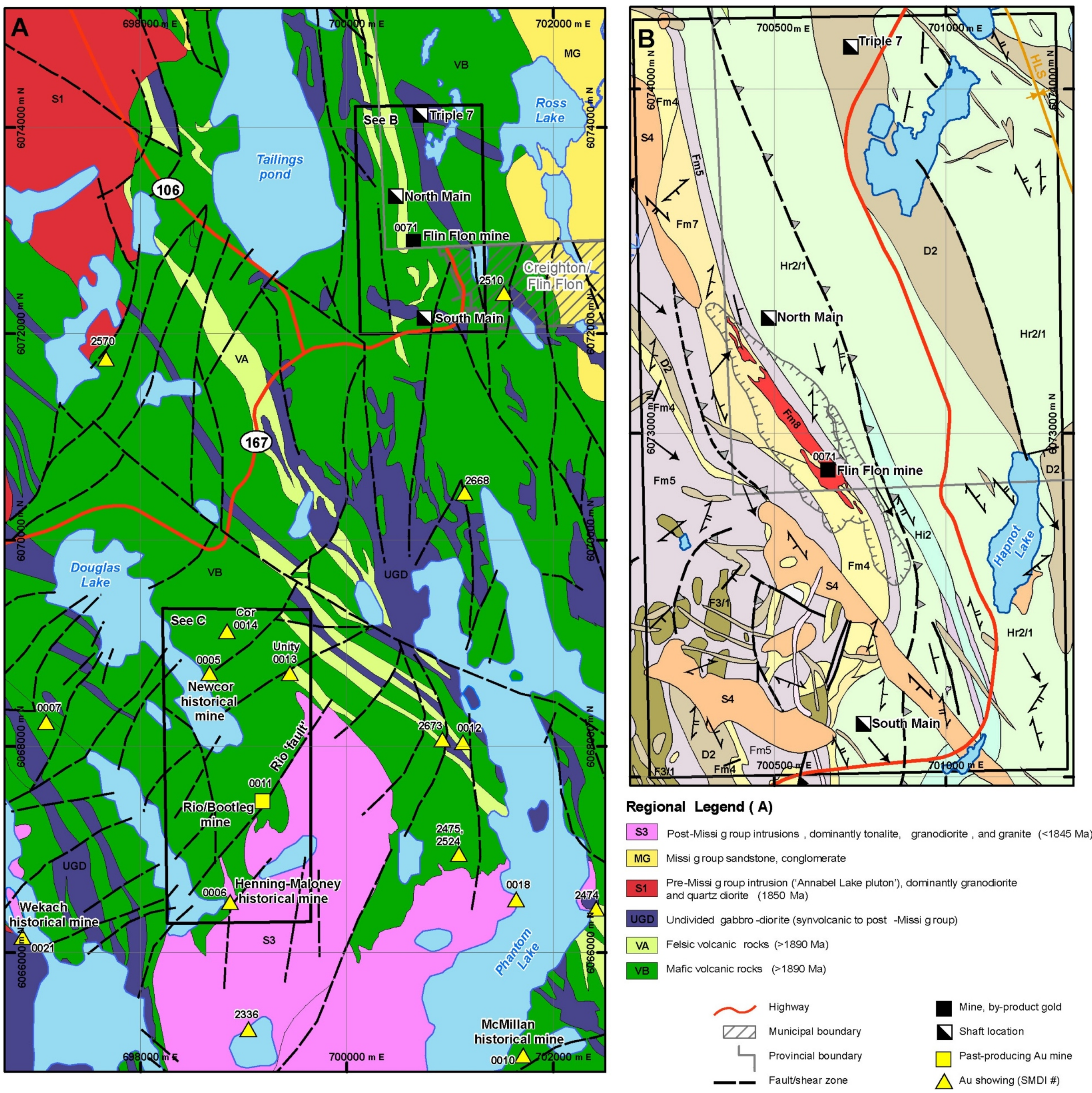

Figure 41 – A) Generalized geological setting of the Flin Flon–Phantom Lake area, with locations of known gold showings and past-producing mines (after Slimmon, 2011). Inset maps are modified from Simard* et al. *(2010) and show B) detailed geological map of the immediate Flin Flon area, and C) detailed geological map of the Douglas–Phantom lakes area.

of which intersected mineralization. In 1987, a $3 million budget was approved for exploration on the deposit. A decline was started in July 1987 to enable Vista to explore the lower mine levels and to allow further drilling to update the reserves. A second phase of exploration was carried out, which consisted of an extensive drilling program (~6096 m) that included underground drilling. A third phase of exploration was planned to include bulk sampling and further drilling to upgrade presently known reserve categories and to test the inferred reserves to the 304.8 m (1000 ft.) level. Early in 1988, Vista completed a 20,000 ton bulk sample, taken from various levels down to the 121.9 m (400 ft.) level. Gold grades from this sample were determined to be too low to warrant production. No further work was reported from the project and the claim eventually lapsed. A claim covering the property was subsequently restaked and, most recently, was acquired by New Moon Minerals Corp.

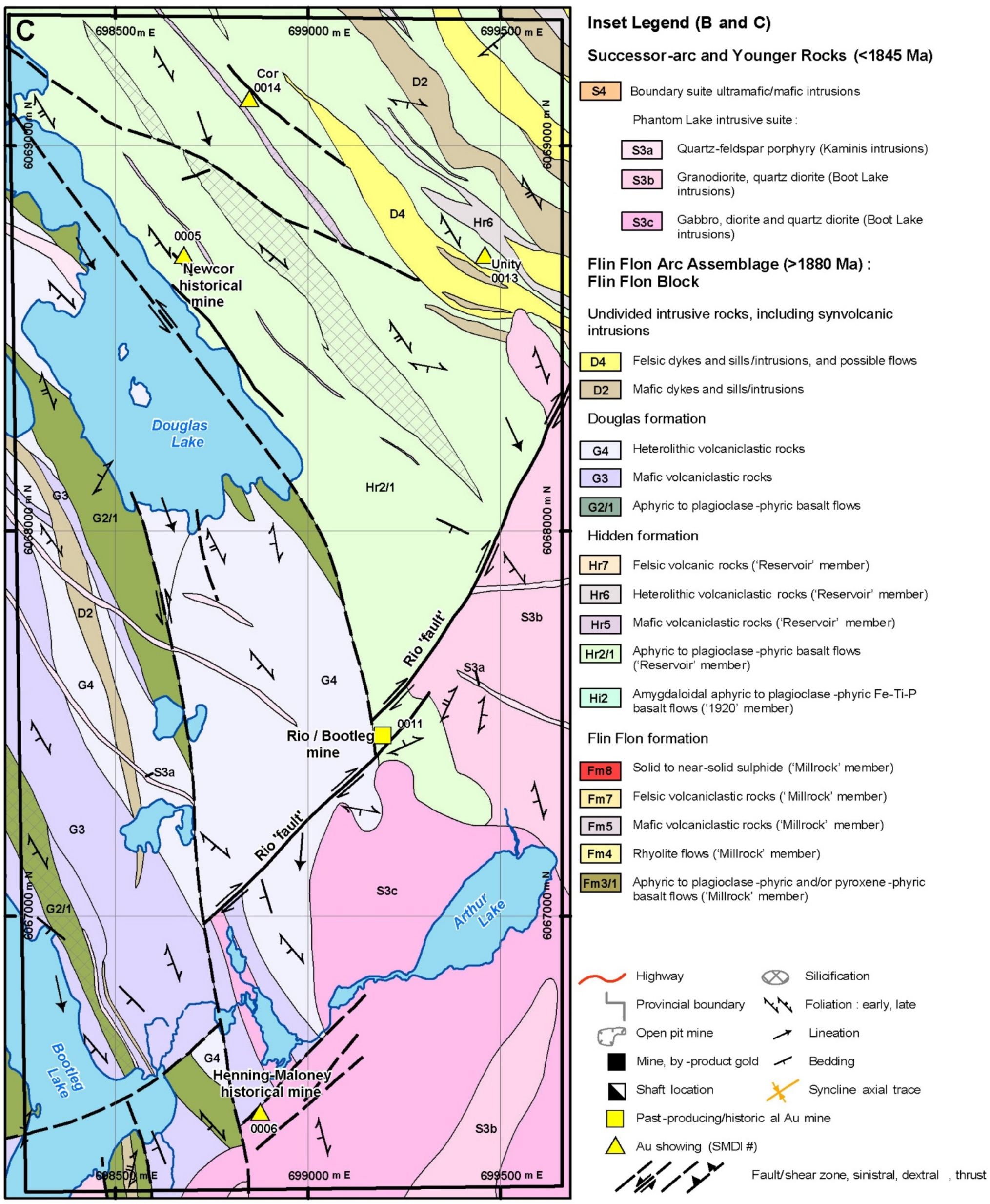

Figure 41 (continued)

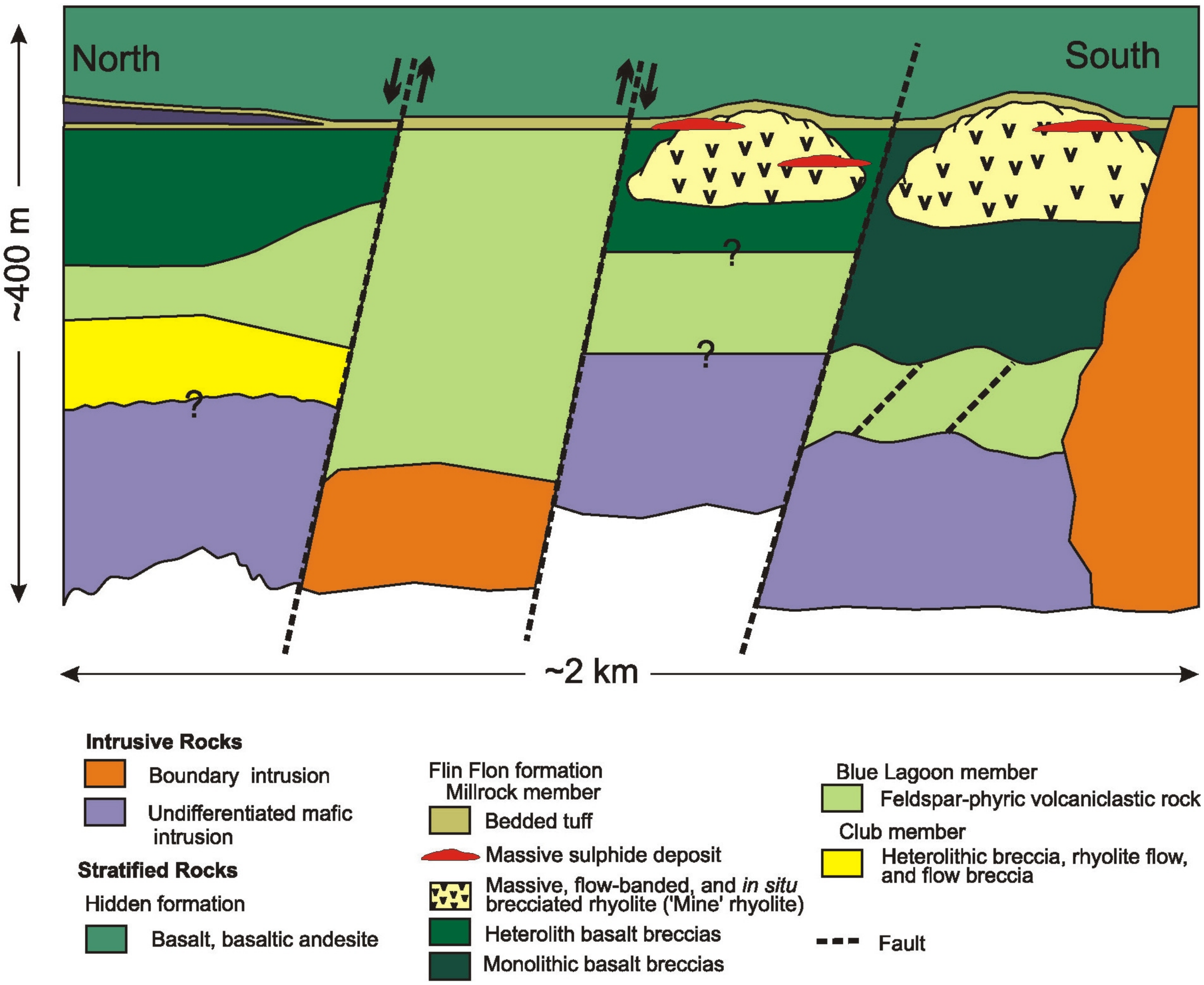

Figure 42 – Schematic diagram of the volcanic depressions in which the Flin Flon formation, including contained volcanogenic massive sulphide deposits, was deposited (from Devine* et al.*, 2002).

Geological Character:

The Rio deposit is located in the Flin Flon block (Bailes and Syme, 1989) of the Flin Flon arc assemblage (Lucas *et al.,* 1996). The deposit occurs along the steeply northwest-dipping Rio 'fault', a brittle-ductile shear zone that extends at surface for >2 km to the northeast of Bootleg Lake (Figure 41A and 41C). The fault cuts across north-northwest–striking and steeply west-dipping volcanic and volcaniclastic rocks of the Hidden and Douglas formations (Simard *et al.,* 2010). South of the Rio fault, the volcanic rocks are intruded by the Boot Lake–Phantom Lake Intrusive Complex (PLIC), in which Galley and Franklin (1989) recognized five intrusive phases, representing an evolution from earlier mafic to later felsic phases. A granodiorite phase of the pluton has yielded U-Pb zircon ages of 1838 ±2 Ma (Heaman *et al.,* 1992) and 1841 ±3 Ma (Heaman *et al.,* 1991). For much of its length, the Rio fault forms the contact between volcanic rocks to the northwest and the PLIC to the southeast. The Rio deposit itself occurs in an embayment along the intrusive contact of the pluton, such that mafic volcanic rocks of the Hidden formation (Reservoir member) occur on both sides of the fault (Figure 41C).

Galley and Franklin (1987, 1989) studied gold metallogeny in the Phantom Lake area and recognized three phases of alteration and mineralization that are spatially related to the PLIC. The earliest phase of alteration is characterized by hematite-quartz-carbonate-epidote alteration and associated Cu-W-Mo (±minor Au and Ag) mineralization (*e.g.,* Phantom Lake, SMDI #0009; IMC-B, SMDI #0017). The second phase consists of sericite-quartz-carbonate and associated W-Cu (±minor Au and Ag) mineralization (*e.g.,* Dion Lake Cu showing, SMDI #0025). Both of these mineralization styles are restricted to the intrusion and are controlled by small-scale fractures that parallel regional fault systems and were thought to be active during intrusion. Galley and Franklin (1987) interpreted these two episodes of mineralization to represent a porphyry-style system related to intrusion of the PLIC, and suggested the gold content of this style of mineralization to be uneconomic. The third alteration phase recognized by Galley and Franklin (1987) comprises chlorite-quartz-ankerite-pyrite and associated Au-Ag mineralization controlled by a conjugate system of dextral north-northeast–trending and sinistral east-trending faults. It is this third style of epigenetic mineralization that characterizes the Rio deposit and other structurally controlled gold deposits in the Phantom Lake area, as described below.

The Rio fault comprises two discreet, 5 m wide, north-northeast–trending structures, located northeast and southwest of the deposit (Stockwell, 1960; Figures 41A and 41C). These structures are generally characterized by intense shearing and little proximal alteration. The character of the fault and related structures at the Rio deposit was described by Pearson (1984). Here, the two structures overlap and form a broad zone of intense shearing, fracturing, and alteration up to 90 m wide. Away from the fault zones, there are numerous minor fractures of several preferred orientations, presumed to be related to movement on the Rio fault. Northwest of the fault, there are two preferred fracture orientations: an earlier set that strikes 270° and dips steeply north; and a later set that strikes 205°, dips steeply northwest, and commonly shows minor dextral offset. Near the Rio fault, the fractures striking 205° are drag folded into a third set of faults that strike 170° and dip 60° west, creating fold axes that plunge 60° towards 340°.

According to Pearson (1984), the orebodies are enveloped by a wide zone of silicic-ankeritic alteration that is within the broad zone of fracturing and deformation. The ankerite occurs as disseminations and veinlets within the cherty silicic alteration. The basalt is the most intensely altered rock, although diorite and granite of the PLIC are also deformed and altered. Underground, Ansdell and Kyser (1992) identified three different alteration and vein associations (Figure 43). In all three types, gold grade is correlated with pyrite abundance and gold occurs as inclusions in pyrite and along pyrite grain boundaries. In the 'AJ' zone, mineralization consists of a zone of branching, *en échelon* quartz veins and associated alteration that is up to 2 m wide, strikes approximately north, and dips moderately to steeply west (>60°). The earliest veins are ankerite-quartz stringers that have been folded and boudinaged by later deformation. Later veins oriented parallel to the foliation consist of either massive but irregular quartz-ankerite±tourmaline±chlorite±pyrite veins, or banded veins with a similar mineralogy but with textures indicative of a 'crack-and-seal' mechanism of emplacement (*op. cit.*). This type of mineralization corresponds to the 'footwall' type described by Pearson (1984), which typically grades 1.5 to 4.25 g/t (0.05 to 0.15 oz./ton) Au. According to Ansdell and Kyser (1992), alteration adjacent to the veins, consisting of quartz-ankerite-albite-pyrite-chlorite, commonly has a brecciated appearance. This 'brecciated' alteration style exhibits a sharp contact with a buff-coloured, outer alteration zone that comprises ankerite, quartz, chlorite, and pyrite, and is itself commonly cut by chlorite-ankerite-pyrite veinlets. The relatively unaltered mafic hostrocks between the alteration zones consist of chlorite-plagioclase-epidote-calcite-muscovite-pyrite and are commonly cut by calcite-quartz veinlets (*op. cit.*). These alteration assemblages collectively postdate the lower greenschist facies peak metamorphic mineral assemblages that are dominant in the region (Digel and Gordon, 1991).

Gold mineralization in the 'WC' zone is associated with lensoid bodies of intense alteration that trend about 205° and overprint both the mafic volcanic rocks and rocks of the PLIC (Ansdell and Kyser, 1992). The alteration zone is about 20 m wide and comprises fine-grained quartz, ankerite, albite, and pyrite, with irregularly developed quartz-pyrite veins. This type of mineralization corresponds to the 'hangingwall'-type described by Pearson (1984), which typically grades around 34 g/t (~1 oz./ton) over a few tens of centimetres.

The 'Phantom Lake granite dyke' zone consists of tension-gash quartz veins hosted in a granite dyke. Ansdell and Kyser (1992) stated that the quartz veins trend north (parallel to the 'footwall'-type of Pearson (1984)) and are concentrated along the margins of the dyke or are parallel to the axial plane of minor folds. The veins do not continue into the surrounding hostrocks. Quartz is the main vein mineral, whereas pyrite, muscovite, and ankerite, where they occur, are intergrown along the vein margins. Adjacent to the veins, the granite is bleached and consists of quartz, albite, sericite, carbonate, pyrite, and minor hematite and stilpnomelane. The mineralogy of unaltered granite is quartz-microcline-plagioclase-biotite-amphibolite-

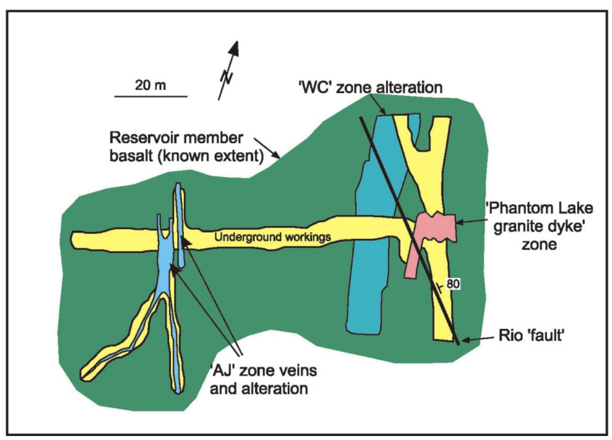

Figure 43 – Geological plan of the 65.5 m (215 ft.) level of the Rio mine, showing the three different ore associations known at the deposit (from Ansdell and Kyser, 1992).

titanite and magnetite. Thus, the alteration process involved albitization, sericitization, carbonatization, and pyritization.

A geochemical study of the alteration at the Rio deposit by Appleyard (1992) showed that Ca, (Mg), Na, C, O, As, Sr, Nb, and Au had been introduced to both the basalt and the PLIC rocks during hydrothermal alteration, whereas Cu and possibly K, Rb, and Ba were either depleted or fluctuated independently. Furthermore, it was demonstrated that the chemical constituents most characteristic of the PLIC (Cu, Mo, W, Au, K, and F) did not consistently correlate with, or even show an inverse relationship with, zones of carbonatization and gold mineralization, thus indicating that the gold-mineralizing fluids were not derived from the PLIC.

Inferred Deposit Type: orogenic gold

Associated Showings:

The ***Henning-Maloney*** prospect (SMDI #0006) is situated in an unnamed, north-northeast–trending shear zone located <1 km south of and parallel to the Rio fault (Figures 41A and 41C), and entirely within diorite of the PLIC (Byers *et al.*, 1965). There are two shear zone orientations at the deposit: one set striking north-northeast and dipping 65° to 80° southeast, and the second striking northeast and dipping 58° to 70° southeast (*op. cit.*). Shear-associated alteration at the deposit is typified by a quartz-chlorite-ankerite-pyrite assemblage (Ansdell and Kyser, 1992). The gold mineralization is associated with shear-hosted quartz-carbonate stringers and veins up to several inches wide (Byers *et al.*, 1965). The 'shaft shear', which is most strongly mineralized, is 1.5 to 2.5 m wide, strikes 043°, dips about 70° southeast, and lies parallel to and on the hangingwall side of a fine-grained mafic dyke (*op. cit.*). The dyke is 0.5 to 2 m wide and is sheared, chloritized, and carbonatized. Mineralized veins occur parallel to this dyke in both its hangingwall and footwall. According to Galley and Franklin (1989), gold zones at Henning-Maloney plunge steeply southwest. Ore samples recovered from a surface loading shoot consisted of cherty, greenish-grey quartz, visible gold, chalcopyrite, pyrite, and arsenopyrite (Byers *et al.,* 1965). In polished thin sections, Byers *et al.* (1965) observed that chalcopyrite is the most abundant sulphide and occurs as stringers and blebs cutting and replacing quartz. Irregular grains of pyrite are next in abundance, and arsenopyrite is the least abundant and occurs as small irregular clusters of variably oriented crystals in quartz and pyrite. Gold forms small irregular blebs, stringers, and subhedral cubic crystals. Byers *et al.* (1965) also observed minute grains of native gold in thin sections of altered diorite. The deposit typically grades around 9.5 g/t (0.28 oz./ton) Au over about 1 m for up to 25 m along strike in the footwall vein and 12 m along strike in the hangingwall vein (*op. cit.*).

The ***McMillan*** prospect (SMDI #0010) is located on the southeastern shore of Phantom Lake and occurs in mafic volcanic rocks and gabbro (Figure 41A). The hostrock assemblage was previously designated as the Newcor formation (Thomas, 1989), but is now considered to be part of the Hidden formation (Simard *et al.*, 2010). The deposit consists of four veins, three of which (Nos. 1, 2, and 4) strike north and dip 45° to 65° east, whereas the No. 3 vein strikes west-northwest and dips 20° to 35° northeast (Byers *et al.,* 1965). The veins are composed of fine- to medium-grained, white to grey quartz that contains veinlets of ankerite and inclusions of highly altered wallrock (*op cit.*) and up to 10% sulphides (Pearson 1981). The wallrock is sheared, silicified, and ankeritized, and contains very fine to medium-grained, disseminated pyrite (*op. cit.*). The No. 1 vein, the widest and most continuous along strike, contains visible gold that occurs as small blebs and minute veinlets in quartz (Byers *et al.*, 1965). At the north end, this vein has an average assay value of 7.5 g/t (0.22 oz./ton) gold over a length of 24 m, whereas the southern end averages 19.9 g/t (0.58 oz./ton) over 47 m. The veins are cut by two sets of vertically dipping faults, one striking northeast with dextral offset of up to 2 m, and the other striking northwest with sinistral offset of similar magnitude.

The ***Wekach Lake*** occurrence (SMDI #0021) is located along the western extension of the Rio fault or one of its splays (Pearson, 1983) on the west shore of Wekach Lake (Figure 41A). The shear zone cuts interbedded mafic volcanic rocks and well-bedded tuff (*op. cit.*) near the contact with heterogeneous, synvolcanic gabbro-diorite sills (Thomas, 1991). The mineralization occurs in a 5 m wide shear zone containing lens-like quartz-carbonate veins with small amounts of gold, pyrite, and chalcopyrite. The quartz veins are brecciated, displaced, and drag folded by subsequent movement on the fault.

Production and Reserves/Resources: There was minor gold production between 1934 and 1941 from high-grade mining of several showings in the Phantom Lake–Flin Flon area, including the Rio, Phantom Lake, Wekach Lake, Newcor, Henning-Maloney, and McMillan showings. Minor gold production also occurred at the Rio/Bootleg mine during the 1980s. The actual amount of gold produced is known for only some of these operations (see available information in Table 1), but was generally insignificant. Historical reserve/resource estimates exist for the Rio/Bootleg and Henning-Maloney deposits.

Newcor (SMDI #0005)
Including Unity (SMDI #0013), Cor (SMDI #0014)

Location: on the east shore of Douglas Lake, ~1.5 km northwest of Rio/Bootleg mine and ~3.5 km southwest of Creighton (NTS 63K/12; UTM 6068680 m N, 698617 m E)

Metal Associations: Au, As (Zn, Cu, Ag)

Status: developed prospect without Reserves

Exploration and Development History:

Gold mineralization at the Newcor showing was discovered, staked, and trenched in 1933 by J. Tikkanen. The following year, the Flin Flon Gold Mining Syndicate Ltd. was formed to acquire and develop the prospect. The property was acquired by Flin Flon Gold Mines Ltd. in 1936 and then by Douglas Lake Mines Ltd. in 1937, which subsequently leased it to Wampum Gold Mines Ltd. in 1942. The property was purchased by Newcor Mining & Refining Ltd. in 1943. Development work up to 1948 consisted of a two-compartment vertical shaft to a depth of about 140 m, about 1036 m of lateral work on several levels, and 4570 m of drilling from surface. The mining plant at this time consisted of a 200 tons/day reduction mill and a 100 tons/day smelter. The plant was operated for a few months and a small (unknown) amount of gold and arsenic were produced.

In 1951, the property was purchased by Asfe Mines Ltd., which held it until the claim lapsed in 1959. The property was restaked later that year by G.F. Thompson, who held the property intermittently until 1978. During that time, Thompson drilled five holes and dug a number of trenches. In 1980, the property was restaked by Abaco Canada Consultants Ltd., with an unregistered option to Flin Flon Mines Ltd. (which eventually became Vista Mines Ltd.). Between 1980 and 1983, Abaco undertook geological mapping, a ground EM survey, a 19-hole drilling program, and metallurgical tests on the ore. From 1988 to 2005, Hudson Bay Exploration and Development Co. Ltd. intermittently held claims over the area. A ground geophysical (VLF and magnetic) survey over a broad area encompassing the old Newcor minesite was completed in 1988. As of 2011, a disposition covering the Newcor property was held by New Moon Minerals Corp.

Geological Character:

The Newcor showing occurs in a steeply southwest-dipping shear zone that cuts mafic volcanic rocks of the Hidden formation of the Flin Flon arc assemblage (Figures 41A and 41C; Simard *et al.*, 2010). Byers *et al.* (1965) classified the Newcor showing as a typical example of quartz-arsenopyrite vein-type gold occurrence, a style known elsewhere in the Flin Flon area. Joints in the wallrock are ubiquitous and occur in three predominant orientations: 1) steeply north dipping; 2) subvertical, striking north-northwest; and 3) subvertical, striking northeast. Mineralization along the main shear zone consists of a lenticular, 0.75 m wide quartz vein interlayered with massive arsenopyrite and slices of altered wallrock. The ore has a banded structure consisting of alternating layers of quartz and arsenopyrite, locally with thin seams of pyrite and sphalerite. The mafic volcanic wallrocks are altered to chlorite schist over widths up to 1.8 m. The schist contains stringers, lenses, and veins composed of quartz and arsenopyrite, or massive arsenopyrite with very little quartz.

Arsenopyrite in quartz-arsenopyrite–type veins described by Byers *et al.* (1965) occurs as: 1) disseminated grains and crystals in the quartz and altered wallrocks, 2) veinlets and irregular masses within the quartz, or 3) large masses that form almost the entire vein. The arsenopyrite occurs as automorphic grains that replace quartz and is, in turn, fractured and replaced by later quartz. Arsenopyrite is also cut and replaced by other sulphides. Pyrite, for example, locally replaces arsenopyrite and is itself replaced by sphalerite and/or chalcopyrite. Pearson *et al.* (1986) suggested that deposits of this type predate intrusion of the *ca.* 1840 Ma Boot Lake–Phantom Lake intrusive suite, indicating that it was a relatively early phase of shear zone–hosted gold mineralization in the Flin Flon area. In contrast, Ansdell and Kyser (1992) related the host shear zone at the Newcor deposit to regional ‘phase 3’ deformation, implying that it is of similar, relatively late timing to other shear zone–associated deposits in the area (*e.g.,* Rio/Bootleg), which postdate emplacement of the Phantom–Boot Lake Intrusive Complex. Further work is required to resolve the absolute timing of the style of mineralization at Newcor and to determine conclusively whether it was cogenetic with the style of mineralization at the Rio/Bootleg showing.

Inferred Deposit Type: ?orogenic gold

Associated Showings:

The ***Unity*** showing (SMDI #0013) is about 500 m southeast of the Cor showing (Figure 41C) and is hosted by quartz veins and stringers in a fault zone, up to 6 m wide, that consists of several parallel shears. The shears cut massive rhyolite along its contact with a small mafic sill. The zone of quartz veining varies from a single vuggy vein about 50 cm wide at the contact to a 4 m wide zone of multiple quartz veins and vuggy breccia veins entirely within the rhyolite (Pearson *et al.,* 1986). Pyrite and chalcopyrite fill or line vugs and are disseminated in the quartz. Alteration products consist of chlorite and pyrite along foliation planes.

The ***Cor*** showing (SMDI #0014) is hosted by a quartz vein occurring in a northwest-striking shear zone a few hundred metres northwest of the Newcor showing (Figure 41C). Mineralization has been exposed in ten pits over a strike length of about 90 m. According to Pearson *et al.* (1986), the quartz vein, up to 35 cm thick, is massive to banded along its margins and becomes vuggy toward the centre. Sulphide mineralization occurs as massive bands or as an anastomosing stockwork within the veins, and is locally zoned, with pyrite and arsenopyrite along the margins and chalcopyrite in the centre. The quartz veins also locally contain tourmaline (Byers *et al.*, 1965). The main quartz vein is accompanied by stringers and veinlets of quartz that occupy three sets of fractures in the wallrock (*op. cit.*). Intense chlorite-carbonate alteration extends up to 2 m into the wallrock and is characterized by disseminations and veinlets of arsenopyrite, pyrite, and rare chalcopyrite and tourmaline (*op. cit.*).

Production and Reserves/Resources: There are unconfirmed reports that a 6 ton bulk sample from the Newcor prospect was processed in 1936 by the Department of Mines in Ottawa, and reportedly assayed 21.5 g/t (0.625 oz./ton) Au, 30 g/t (0.88 oz./ton) Ag, 4.08% Zn, 0.44% Cu, and 22.65% As (Coombe, 1984). Historical resources have been reported for the Newcor deposit.

Location 12 – Amisk Lake Area

Konuto Lake Mine (SMDI #2671)
Including Birch Lake (SMDI #0113), Coronation (SMDI #0023), Flexar (SMDI #0117), and Hanson Lake / Western Nuclear Mine (SMDI #0209) and McIlvenna Bay Deposit (SMDI #2169)

Location: just north of Konuto Lake, about 1 km east of Denare Beach (NTS 63L/09; UTM 6060104 m N, 689895 m E)

Metal Associations: Au with Cu, Zn (As, Fe, Ag)

Status: past-producing mine without Resources

Exploration and Development History:

Although mineral exploration has been prevalent in the area since the early 1900s, the Konuto Lake deposit was not discovered until 1995, when Hudson Bay Mining and Smelting Inc. (HBMS) drill tested a moderate-strength airborne EM anomaly. Project permits were received in 1996 and the first phase of underground exploration began in August with development of a ramp to the 140 m level. The underground ramp reached the 240 m level, and undercutting of the first two (of five) ore lenses on the 140 m level began in 1997. Production officially commenced in 1998 and gold was recovered as a by-product of the copper-zinc mining (Table 1). By September of 1999, the ramp reached the 315 m level of the third ore lens. Mining was suspended in March of 2001 due to depressed base metal prices. It recommenced in August of that year and continued until all of the ore was depleted in November of 2005.

By-product gold mining has occurred from several other deposits in the eastern Amisk Lake area that are of a similar mineralization style to that at the Konuto Lake deposit. The ***Birch Lake deposit*** (SMDI #0113), located ~2 km to the northeast (Figure 44), was discovered by prospector J. Brain in 1949 and optioned by HBMS later that year. Development work between 1952 and 1956 consisted of sinking a 502 m, three-compartment shaft and lateral work on six levels. Production commenced in 1957 and continued until the ore reserves were exhausted in 1960 (Table 1).

The ***Coronation deposit*** (SMDI #0023), located ~8.5 km southeast of the Konuto Lake minesite (Figure 44), was discovered in 1953 by HBMS through diamond drilling of an EM anomaly. In 1955 and 1956, a three-compartment shaft was sunk to a depth of 455 m and lateral workings were established at 46 m intervals. An adjacent two-compartment shaft was sunk to 322 m in 1958 and underground drilling was carried out to establish reserves. Production from the mine took place between 1960 and 1965 (Table 1).

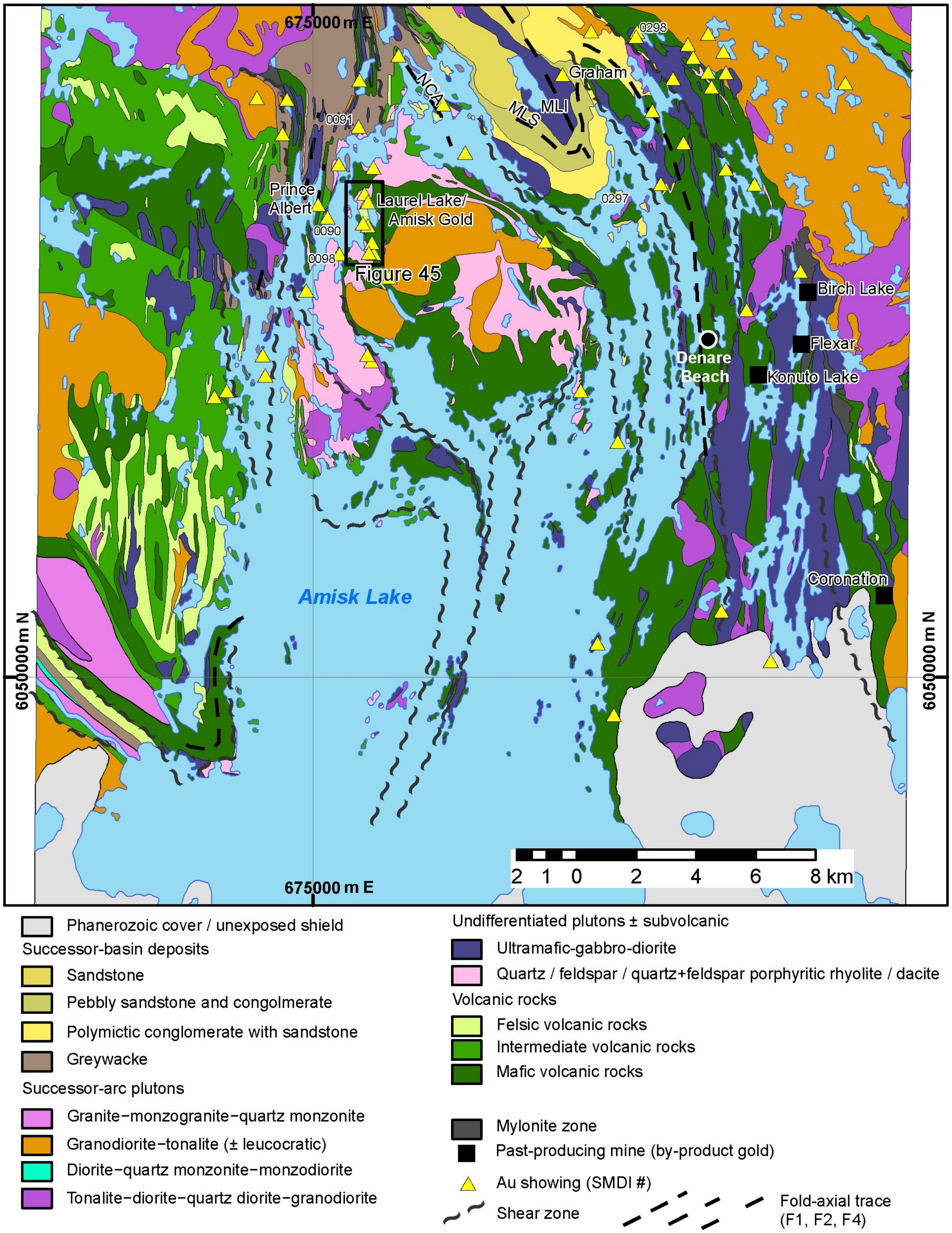

Figure 44 – Geological setting of the Amisk Lake area, including locations of past-producing volcanogenic massive sulphide deposits and known gold showings (from Slimmon, 2011). Abbreviations: MLI, Magdalen Lake intrusion; MLS Magdalen Lake syncline; and NCA, North Channel anticline.

The ***Flexar deposit*** (SMDI #0117), located ~3 km northeast of the Konuto Lake minesite, was discovered in 1952, when HBMS drilled an EM anomaly. In 1963, mine development was initiated and a shaft was sunk to 356 m. The shaft was deepened to 418 m in 1968, and the mine was brought into production in 1969 (Table 1). Mining ceased in 1972.

In the western Flin Flon Domain, ~50 km west of Konuto Lake on southern Hanson Lake, by-product gold was produced by a joint-venture partnership between Western Nuclear Mines Ltd. and Share Mines & Oils Ltd. at the ***Hanson Lake / Western Nuclear mine***; SMDI #0209). Discovered in 1957, the deposit produced by-product gold along with Zn, Pb, Cu, and Ag between 1967 and 1969 (Table 1). The ***McIlvenna Bay deposit*** (SMDI #2169) was discovered beneath Phanerozoic cover in 1988, ~6 km south of the Western Nuclear minesite. Drilling of the deposit by Foran Mining Corp. in 2011 defined significant gold mineralization in the 'Copper Stockwork zone' of the deposit (Table 2).

Geological Character[8]*:*

The Konuto Lake deposit is hosted by *ca.* 1890 Ma mafic volcanic rocks of the Birch Lake assemblage (Figure 44). Rocks of this assemblage, which probably originated in a juvenile island-arc (Reilly, 1995) or back-arc (Watters *et al.*, 1994) setting, also host the past-producing Coronation, Birch Lake, and Flexar mines. These deposits are representative of the mafic lithostratigraphic type of volcanogenic massive sulphide deposits (see Franklin *et al.*, 2005; Chapter 2). Hostrocks to the Konuto Lake deposit are tholeiitic basaltic flows with intercalated mafic to ultramafic intrusions and minor tuffaceous layers, all of which were metamorphosed under upper greenschist to lower amphibolite facies conditions (Tourigny *et al*., 2002). The deposit consists of five narrow, steeply east- to steeply west-dipping and south-plunging massive sulphide lenses ('Nos. 1 to 5') that are rich in Cu, Zn, Ag, and Au. The lenses, of which No. 1 is the largest, have individual strike lengths of 40 to 130 m, widths of 3 to 8 m and vertical dimensions of 100 to 300 m (*op cit.*). They are bounded by north-trending, steeply dipping, brittle-ductile shear zones that record oblique-reverse movement and, along with attendant metamorphism, caused localized remobilization of the massive sulphide ore (*op. cit.*).

Hydrothermal alteration zones, dominated by green-black, magnesium-rich chlorite, occur between the ore lenses. Locally, the alteration zones include a nearly ore-grade stringer zone of disseminated chalcopyrite-pyrrhotite (*e.g.,* at the No. 2 zone). This stringer zone is hosted by variably chloritized, carbonatized, and silicified rocks. Sulphide mineralization in the stringer, massive, and remobilized ore consists mainly of chalcopyrite, pyrrhotite, sphalerite, and lesser pyrite, arsenopyrite, and magnetite. Microscopically, the ore contains significant bornite intergrowths in chalcopyrite and trace amounts of chalcocite, pentlandite, cubanite, mackinawite, valleriite, tellurobismuthite, molybdenite, and native gold.

Inferred Deposit Type: volcanogenic massive sulphide (mafic type)

Associated Showings: Birch Lake (SMDI #0113), Coronation (SMDI #0023), Flexar (SMDI #0117), Hanson Lake / Western Nuclear mine (SMDI #0209), McIlvenna Bay (SMDI #2169)

Production and Reserves/Resources: Gold production occurred as a by-product of base metal mining east of Amisk Lake at the Konuto (1998-2005), Coronation (1960-65), Birch Lake (1957-60) and Flexar (1969-72) mines, and on southern Hanson Lake at the Hanson Lake / Western Nuclear mine (1967-69; Table 1). Gold mineralization was also defined in the Copper Stockwork zone of the McIlvenna Bay deposit in 2011 (Table 2).

Laurel Lake / Amisk Gold
Laural Lake, Laurel Lake North (SMDI #2133)

Location: northwestern Missi Island on Amisk Lake, ~25 km west-southwest of Flin Flon (NTS 63L/09; UTM 6066079 m N, 676787 m E)

Metal Associations: Au, Ag, Cu, Zn, Pb, Sb (As, Mo, Te, Bi)

Status: developed prospect with Resources

[8] Although the ore has been mined out, the description is in the present tense for consistency.
[9] The Laurel Lake showings occur in the vicinity of Laural Lake. Reference to the mineralized zones has historically been spelled as Laurel.

Exploration and Development History:

Gold exploration was undertaken as early as 1913 in the western Missi Island area of Amisk Lake and, between 1930 and 1960, resulted in the discovery of seven shear zone–associated auriferous zones to the west and southwest of Laural Lake[9] (Laurel Lake A to G showings). The main Laurel Lake deposit, which is geologically distinct from the historical showings, was not discovered until 1982, when auriferous alteration was found by geologists mapping for Saskatchewan Mining Development Corp. (SMDC).

Drilling on the main Laurel Lake deposit commenced in 1983 and targeted previously identified geochemical anomalies and elevated induced-polarization responses. A systematic exploration program was undertaken in 1984 by a joint venture between SMDC (operator) and Hudson Bay Exploration and Development Co. Ltd. (HBED), including further property-scale geological mapping, geochemistry, ground geophysical (IP, resistivity, and localized magnetic and EM) surveys and drilling. This work led to the delineation of a 550 m long, west-northwest–trending zone of alteration and gold- and silver-bearing sulphide mineralization that extends from the northern tip of Laurel Lake to the southern tip of 'Gull Island' (Figure 45; Walker and MacDougall, 1987). This zone was tested by surface drilling between 1985 and 1987.

Following the replacement of HBED in the joint venture by Husky Oil Ltd. in 1987, additional geophysical (IP, magnetic, pole-dipole, and VLF-EM) surveying was undertaken in the deposit area. This was followed by further drilling and the incorporation of prior drill results into a preliminary ore reserve calculation for the Laurel Lake deposit. A feasibility study was prepared in 1988 and a decision was made to commence underground exploration to assess the continuity of the mineralized zone at depth. Construction of a decline took place between June and October 1988, eventually reaching a vertical depth of 154 m. Exploration drifts were developed at 40 and 80 m below surface, facilitating the completion of ~2000 m of underground drilling. The bulk sample that was extracted during the underground exploration program was stockpiled at the site and, in 1989, transported to the mill at the nearby Rio mine (Vista Mines Inc.) near Flin Flon for processing. The results from this bulk sample were not publicly released. Following a small surface-drilling campaign in 1989, the deposit was deemed uneconomic and work at the property ceased.

In October 1995, interest in the property was renewed when Claude Resources Inc. entered into an option agreement with the existing joint-venture partners (Cameco Corp. (formerly SMDC) and Husky Oil) and became operator of the project. The following year, a four-phase, 35-hole surface-drilling program was carried out to test for mineralization along the Laurel Lake zone, resulting in the release of an updated ore reserve estimate for the deposit. Detailed geological mapping of the property was undertaken in 1997, and 22 holes were drilled from surface between 1997 and 1999.

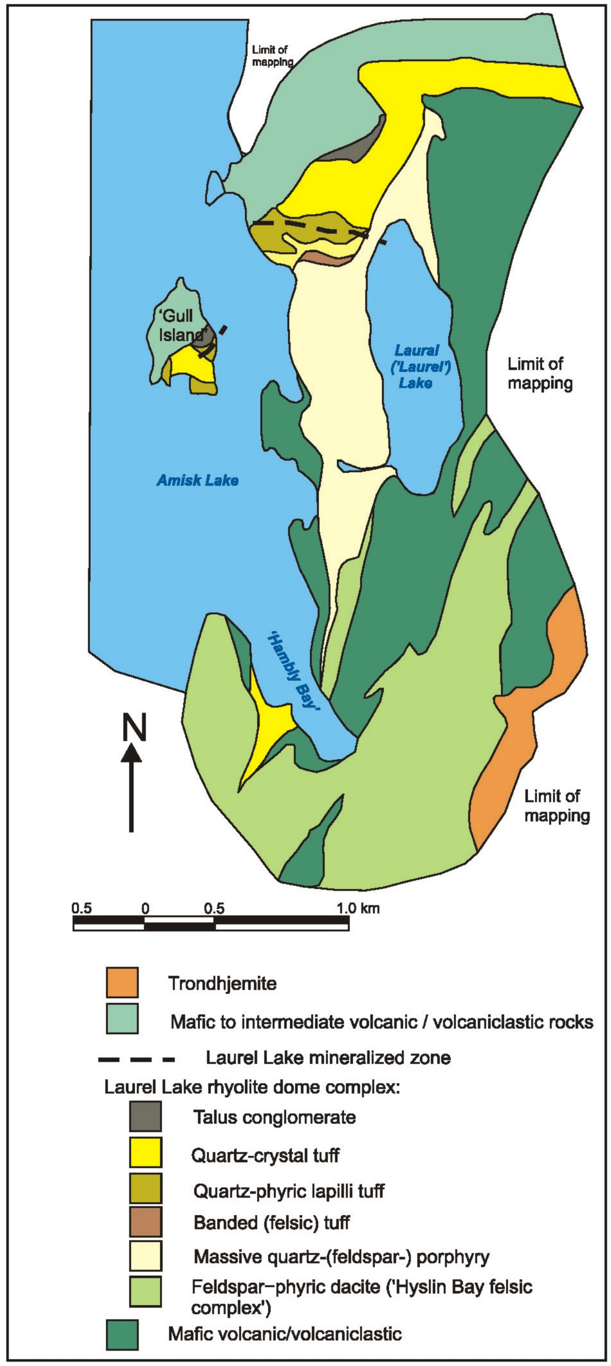

Figure 45 – Geological setting of the Laurel Lake (Amisk Gold) deposit on northwestern Missi Island, Amisk Lake (modified after Walker and McDougall, 1987).

No further work was completed at the property until April 2010, when Claude (65%) entered a joint-venture partnership with St. Eugene Mining Corp. Ltd. (35%) to undertake exploration within its ‘Amisk Gold Project’, which included the Laurel Lake (‘Amisk Gold’) deposit. In contrast to historical exploration at the deposit that targeted the highest grade portions of the mineralization, this renewed exploration was focussed on evaluation of the deposit within a bulk tonnage, open pit mining model. An initial 11-hole winter drilling program was followed by assaying of >22 000 m of historical drill core from 278 holes over intervals that had not been previously sampled. These new data, combined with results from an additional 10 drill holes in the fall of 2010, were used in the calculation of a new Mineral Resource estimate for the deposit (Table 2). The joint-venture partners completed additional step-out and infill drilling in the winter of 2010-11 (eight holes, 3234 m) and undertook preliminary metallurgical and engineering testing on the property. Claude subsequently acquired St. Eugene, and its interest in the Laurel Lake property, to become sole owner and operator.

Geological Character:

The Laurel Lake (Amisk Gold) deposit is hosted by a sequence dominated by mafic and felsic volcanic/ volcaniclastic rocks and contemporaneous hypabyssal intrusions that underlie northwestern Missi Island (Figure 44). Detailed mapping in the immediate Laural Lake area (1:10 000 scale; Harper, 1993a) indicated that the base of the volcanic stratigraphy consists of massive to pillowed basaltic flows, which contain subordinate flow breccia and interflow ash tuff. This unit is overlain to the west by a domed complex of felsic volcanic rocks (‘Laurel Lake rhyolite dome complex’) that extends to Gull Island and can be divided into several subunits (Walker and McDougall, 1987; Figure 45). The lowermost unit of the complex is a poorly exposed feldspar-phyric dacite, which might correlate with more widely exposed dacite of the ‘Hyslin Bay felsic complex’ to the immediate southwest (Harper, 1993b). The majority of the exposed Laurel Lake rhyolite dome complex consists of distinct rhyolitic subunits, including massive quartz-(feldspar) porphyry, quartz-phyric lapilli tuff, and quartz-crystal tuff (Walker and McDougall, 1987). The first of these subunits is massive and homogeneous, and probably a stock-like intrusion. The latter subunits, which occur along with felsic banded tuff and ‘talus’ conglomerate, are fine-grained to fragmental quartzofeldspathic rocks that probably represent extrusive constituents of the dome complex. The fragmental rocks, which contain quartz-phyric rhyolite fragments ranging in size from <5 to 50 mm, form an ‘apron’ up to 100 m thick around the stock (*op. cit.*). This feature has been interpreted as either a pyroclastic/epiclastic dome carapace (Harper, 1993b) or an explosive upper portion of the stock that did not penetrate the paleosurface (McDougall, 1997). The rhyolite dome complex is stratigraphically overlain by a sequence of mafic to intermediate volcanic rocks, including flows, ash tuffs and tuff breccias (Walker and McDougall, 1987; Harper, 1993a). The deposit host sequence is polydeformed and has undergone greenschist facies metamorphism (Harper, 1993b).

Gold mineralization at the Laurel Lake deposit, stretching from the northern tip of Laural Lake westward to Gull Island, is associated with a large (hundreds of metres wide) alteration envelope of extensive sericitization, as well as localized silicification and carbonatization. This is demonstrated geochemically by a broad zone of K_2O enrichment, which corresponds to Na_2O depletion and increased gold content (Walker and MacDougall, 1987). Muscovite in close spatial association with the gold mineralization commonly exhibits a yellow-green colour, resulting from increased vanadium and chromium contents (SMER Assessment File 63L09-0431). A zone of hematitization, resulting in a pink colouration of the rocks, is restricted to near-surface mineralization in the porphyritic rhyolite. Carbonatization and iron enrichment are reported to occur in the fragmental rocks overlying the massive portion of the stock, as are MgO and K_2O enrichment in mafic to intermediate tuffs that overlie the rhyolite dome complex (Walker and MacDougall, 1987).

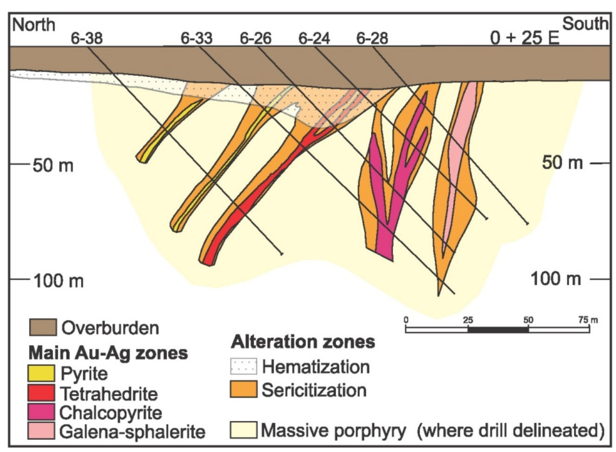

Figure 46 – Interpretive cross-section of mineralized subzones in the Laurel Lake (Amisk Gold) deposit (from Walker and MacDougall, 1987).

Auriferous mineralization at Laurel Lake is confined to the massive quartz porphyry and consists of a broad alteration envelope, hundreds of metres wide, with low gold grades. Within this alteration envelope are several zones of higher gold grades that are associated with specific sulphide assemblages. Walker and MacDougall (1987) outlined these as a series of subparallel, sulphide-rich ‘subzones’ that are west-northwest striking and either moderately to steeply north dipping (Figure 46) or, locally, steeply south dipping. The individual subzones, ~1 to 7.5 m wide and spaced at about 30 m intervals, are fracture controlled and characterized by their dominant sulphide-sulphosalt mineralogy (from north to south, the ‘Pyrite’, ‘Tetrahedrite’, ‘Chalcopyrite’, and ‘Sphalerite-Galena’ subzones). This metal zonation, along with an observed trend of a stratigraphically upwards decreasing Au/Ag ratio, was interpreted to result from a stratigraphic control on mineralization, such that higher temperature sulphide assemblages were deposited more deeply in the volcanic stratigraphy (SMER Assessment File 63L09-0431). Sulphide mineralization ranges from massive to disseminated to vuggy to fracture controlled within the subzones; pyrite, sphalerite, tennantite, galena, and chalcopyrite are most common, with rare arsenopyrite, stibnite, altaite, and electrum. Electrum and tennantite are the main gold and silver ores, and are paragenetically late in the mineralizing sequence (Ansdell and Kyser, 1991). Free gold is present as fine specks within the fractures and along sulphide grain boundaries.

Alteration and sulphide mineralization at the Laurel Lake deposit are believed to have predated the earliest deformational event to affect the hostrocks, since alteration-related muscovite clots are flattened within the earliest recognized foliation (Walker and MacDougall, 1987). Subsequent workers speculated that extensional features related to formation of this early fabric might have also diminished the continuity of the earlier mineralized stringers (SMER Assessment File 63L09-0431). The apparent predeformational timing of the Laurel Lake gold mineralization distinguishes it genetically from the many shear zone–associated gold occurrences known in the northern Amisk Lake area (*e.g.,* Prince Albert, Graham showings; see relevant descriptions). This, along with the physical and mineralogical character of the deposit and its lithological and metal associations, led to its classification as an epithermal-style deposit (Walker and MacDougall, 1987). Ansdell and Kyser (1991) subsequently presented fluid inclusion and stable isotope data from hydrothermal quartz suggesting that the mineralizing fluids were relatively saline, CO_2 bearing, of high temperature (300°C), and derived from modified seawater. The deviation of these conclusions from accepted genetic models for (Tertiary) epithermal deposits led them to interpret the deposit as a distinct type of epigenetic gold mineralization originating from deeply circulating seawater that leached metals from the volcanic substrate. Galley *et al.* (2007a, 2007b) subsequently classified the Laurel Lake deposit as a ‘hybrid bimodal-felsic’ subtype of VMS deposit.

Inferred Deposit Type: volcanogenic massive sulphide (hybrid bimodal-felsic subtype)

Associated Showings: Gull Island (SMDI #0081), Beaver (SMDI #0098), Amisk Gold Syndicate / Victory exploration adit (SMDI #0090)

Production and Reserves/Resources: In 1989, a small (unknown) amount of gold was recovered from a bulk sample of the Laurel Lake deposit that was processed at the Rio mine in Flin Flon. A Mineral Resource estimate for the Laurel Lake deposit was reported in 2011 (Table 2).

Graham

Graham Historical Mine, Graham Zones 1 to 4 / Frank Zone (SMDI #0296, #0299a, #0299b); Bruce and 87-1 to -7 Zones (SMDI #2383); K/Ken/Al Zones (SMDI #2483)

Location: ~2.5 km north of the north shore of Amisk Lake, ~20 km west of Flin Flon (NTS 63L/16; UTM 6073528 m N, 680673 m E)

Metal Associations: Au (Cu, Zn, Ni, As)

Status: past-producing mine without Reserves

Exploration and Development History:

Gold mineralization at the Graham showing was first discovered in 1915 by R. Graham, who staked six claims over the property that year. Information on early exploration and development activities is limited, but some trenching and drilling are known to have occurred by 1932. Available records also indicate the development of a 10.7 m shaft and a 10 tons/day mill by W.W. Bowe, with some limited gold production in 1932-33 (Kupsch and Hanson, 1986). Actual production figures are not known, but are thought to be insignificant.

No further work was done on the property until 1961, when Riocanex Ltd. (Rio Tinto Canadian Exploration Ltd.) mapped the area and discovered the Graham ‘No. 3’ and ‘No. 4’ zones. In 1964, Riocanex performed sampling and limited drilling on two of the known mineralized zones. In 1973, R. McKenzie and J. Stewart completed one trench. Between 1983 and 1984, Saskatchewan Mining Development Corp. (SMDC) staked the area surrounding the property and optioned the claim covering the showing from J. Campbell and R. McKenzie as part of a joint-venture partnership with Vista Mines Inc.

SMDC completed geological mapping, soil and bedrock sampling, trenching, and a four-hole diamond-drilling program. One grab sample taken from the Graham 'No. 2' zone is reported to have yielded a grade of 10.6 g/t (0.31 oz./ton) Au. In 1986 and 1987, Cameco Corp. (previously SMDC) performed ground geophysical (VLF-EM, magnetic, and IP/resistivity) surveys over the showing area, as well as reconnaissance geological mapping, prospecting, trench channel sampling, and soil and lithogeochemical sampling. This was followed by further exploration work in 1987, including Wacker overburden drilling, soil surveys, lithogeochemical sampling, prospecting work, and six shallow drill holes. This phase of exploration led to the discovery of the 'K' and '87-1 to -8' gold showings, which were stripped, mapped, and sampled. Overburden stripping, mapping, and grab/channel sampling of the Graham No. 3 and No. 4 zones were also completed. In 1988, Cameco entered into a 50% partnership with Vista Mines and completed overburden stripping, mapping, and sampling on these new showings. Cameco carried out drilling (2083 m) at the Graham No. 1, No. 2, and 'Frank' zones in 1988, and at the Graham No. 3 and No. 4 zones in 1989. The company also completed geophysical (VLF-EM and IP/resistivity) surveys over the Graham and Frank showings. Additional mapping, prospecting, and soil sampling that year led to the discovery of two additional gold showings ('Al' and 'Ken') in the area.

Geological Character:

Gold mineralization at the Graham showing is hosted by a sequence of Missi group conglomerate, arkose, and greywacke that was deposited *ca.* 1845 Ma (Ansdell, 1993). These clastic sedimentary rocks occupy the core a steeply dipping, northwest-plunging isoclinal F_1 fold, known as the 'Magdalen Lake syncline' (Slimmon, 1993), on the north shore of Amisk Lake (Figure 44). Northwest of the showing, the hostrocks are cut by an elongate and lenticular plagioclase-phyric intrusion known as the 'Batty Lake intrusion' (Reilly, 1993b). A small intrusion of similar composition ('Graham Trail tonalite'), which intrudes the sedimentary rocks just south of the Graham showing area, has been dated at 1841 ±18 Ma (Ansdell and Kyser, 1992). This porphyry is itself intruded by a larger, porphyritic gabbro-ultramafic intrusion, the 'Magdalen Lake intrusion' (Slimmon, 1993), which forms part of the suite of *circa* 1840 Ma 'Boundary intrusions' recognized in the greater Flin Flon area (*e.g.,* Simard *et al.*, 2010). All of these rocks predate the gold mineralization and have been metamorphosed under lower to upper greenschist facies conditions.

Gold mineralization at the Graham showing is hosted by a series of centimetre- to metre-wide quartz veins within northwest-trending brittle-ductile shear zones that cut Missi group conglomerate. The mineralized shears are situated in the hinge of a steeply northwest-plunging fold. Four mineralized zones in the immediate vicinity of the Graham shaft (Graham Nos. 1 to 4 zones) occupy shear zones ranging from 2 to 10 m in width and up to 75 m in strike length. Pearson (1986a) suggested that these are subsidiary shears to the prominent northwest-trending, gold-mineralized shear system known to occur in the northern Amisk Lake area (Reilly, 1993b; *e.g.,* Prince Albert, Robinson Creek, Sonora showings). Some mineralized zones (*e.g.,* Graham No. 3) are large, northwesterly plunging, sigmoidal quartz veins (Pearson, 1986a; Figure 47). Thus, as also suggested for the Duplex (SMDI #0091) and Golden Cross (SMDI #0297) showings (Pearson, 1983), some of the Graham zones might represent tension gashes at acute angles to the trends of the main shear zones.

The mineralized zones at Graham comprise mainly northwest-trending, subvertical quartz veins that generally parallel the host shear zone, as well as up to

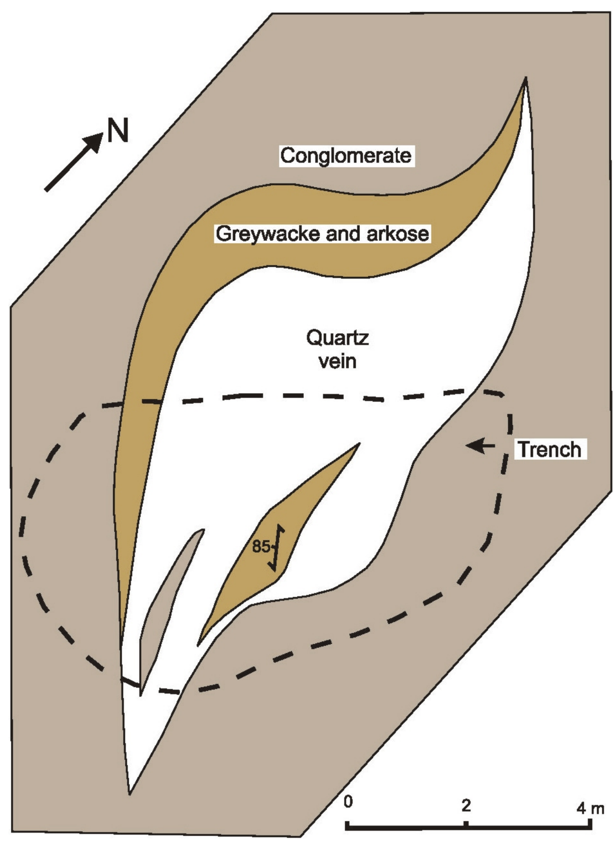

Figure 47 – Geological setting of the Graham No. 3 showing (after geological sketch map by Pearson, 1986a).

20% irregular and discontinuous quartz stringers ranging in width from 1 to 6 cm. The individual zones are currently known to extend 50 to 130 m along strike, 2 to 7 m in width, and 110 to 160 m in vertical depth. The terminations of some of the larger, central quartz veins transition along strike into smaller veins and stringers (Mawdsley, 1934).

The vein and stringer quartz typically has a semitransparent appearance and a whitish-grey colour. The veins commonly contain ankerite, and smaller stringers locally have pink feldspar along their margins. Alteration assemblages comprising chlorite, sericite, carbonate, and/or feldspar are common in the wallrock adjacent to the auriferous veins. In some places, aplitic veinlets are also noted proximal to mineralized veins. Mawdsley (1934) reported the presence of 1 to 15 cm wide quartz-feldspar porphyry dykelets that pass along strike into narrow, feldspar-bearing quartz veins. A spatial relationship between chlorite-carbonate–altered mafic dykes and auriferous veins has been noted, possibly indicating that these pretectonic dykes provided a competency contrast that focussed shearing and faulting (SMER Assessment File 63L16-0126). The mineralized veins typically contain <1 to 5% pyrite disseminations and/or stringers, and up to 1% disseminated chalcopyrite and arsenopyrite. Gold is present as free grains within the veins and narrow stringers. Disseminated pyrite, present in proportions of 3 to 10% or more, as well as trace chalcopyrite, are common in the wallrock adjacent to mineralized veins. Anomalous concentrations of Cu, Zn, Ni, and/or As in proximal dispersion trains might be related to the gold mineralization (SMER Assessment File 63L16-0112).

Inferred Deposit Type: orogenic gold

Associated Showings: several on and around northern Amisk Lake, including Duplex (SMDI #0091), Golden Cross (SMDI #0297), Prince Albert (SMDI #0086), and Robinson Creek (SMDI #0298)

Production and Reserves/Resources: There was minor gold production from the Graham mine in 1932-33, though the actual amount of gold recovered is unknown. Historical resources have been reported for the Graham No. 1 to No. 4 zones.

Prince Albert

Prince Albert, Monarch or Pamon historical mine (SMDI #0086)

Location: northwestern shore of Amisk Lake, ~26 km west-southwest of Flin Flon (NTS 63L/09; UTM 6067041 m N, 675746 m E)

Metal Associations: Au (Ag, As, Cu, Pb, Mo)

Status: past-producing mine without Reserves

Exploration and Development History:

The property hosting the showing was originally staked in 1913 by T. Creighton, J. Mosher, and L. Dion, who then transferred the claim to the Beaver Lake Gold Mining Company. The deposit was discovered the following year by prospectors working for J. Hammel, during a period of intensive prospecting in the Flin Flon–Amisk Lake area. An inclined shaft was sunk along the dip of the mineralized vein to a depth of about 21 m.

The property was acquired by Prince Albert Gold Mines Ltd. in 1921 and was subsequently leased to Monarch Gold Miners Syndicate in 1936. Monarch set up a small (25 to 35 tons/day) mill to process ore from the deposit. Exploration work, including a small drilling program (?two holes) and detailed sampling, was also undertaken by Monarch on the property in 1937. Later that year, the shaft was extended to a depth of about 40 m and new horizontal drifts were developed. Almost 21 kg (736 oz.) of gold and 5 kg (172 oz.) of silver were produced from 2,047 tons of ore between February and December of 1937 (Byers and Dahlstrom, 1954) before operations at the mine ceased in October 1937.

In the summer of 1938, the property was acquired from Prince Albert Gold Mines Ltd. by Pamon Gold Mines Ltd. The property was optioned by Hudson Bay Exploration Co. Ltd. in 1939, which carried out a 610 m drilling program. In 1940, O.G. Macdonald leased the property from Pamon and subsequently dewatered the shaft and re-established the mining operation. From 1940 to 1942, a further 117.5 kg (4146.6 oz.) of gold and 19 kg (664.8 oz.) of silver were produced from 3775 tons of ore. Some of this ore was shipped to the Flin Flon smelter of Hudson Bay Mining and Smelting Co. Ltd. for processing. Operations ceased when the mill and headframe were destroyed by fire in May 1942, though a small drilling program (?five holes) was carried out in 1944.

Although portions of the property were staked by Greenstone Resources Ltd. and BEC International Resource Corporation in 1982 and 1986, respectively, no substantial exploration was done until 1986. That year, Kenton Natural Resource Corporation completed geological mapping, geochemical sampling, and ground geophysical (VLF-EM and magnetic) surveys as part of a joint-venture agreement. Follow-up work on these initial surveys included more detailed geological mapping, soil sampling, prospecting, and trenching, as well as an eight-hole diamond-drilling program. Greenstone Resources carried out prospecting and bedrock sampling on its portion of the property in 1989.

Claude Resources Inc. acquired an interest in the property in the 1990s and, in 1997-98, performed geological mapping, prospecting, bedrock sampling, and geophysical (VLF-EM and magnetic) surveys on and around the deposit. As of 2011, the property lies within Claude's 24 350 ha Amisk Gold Project.

Geological Character:

The Prince Albert showing is hosted by a kilometre-scale sequence of turbiditic greywacke ('Welsh Lake assemblage') considered to have a maximum depositional age of *ca.* 1884 to 1882 Ma (Heaman *et al.*, 1993; Stern and Lucas, 1994). Stratigraphically, the greywacke unit is interpreted to be both overlain and underlain by volcanic and volcaniclastic rocks of the West Amisk assemblage, and is consequently thought to have been deposited in an approximately synvolcanic turbidite basin (Stern and Lucas, 1994). At the showing, the host greywacke has been intruded by small plugs or dykes of diorite, quartz porphyry, and aplite (Byers and Dahlstrom, 1954).

The host greywacke and adjacent volcanic rocks are polydeformed, having been affected by at least two deformational events prior to gold mineralization (Reilly, 1992). The earliest recognized event (D_1) is manifested as bedding-parallel foliation and high-strain zones, and as (originally) east-trending folds, indicating north-south shortening (Reilly, 1993b; *e.g.,* Errington Lake anticline, Magdalen syncline). A later deformational event is evident from a regionally prevalent set of north-trending, north-plunging F_2 folds, along with an axial-planar foliation and associated north-plunging stretching lineation. The superposition of these two fold generations resulted in Type 3 fold interference patterns in the western Amisk Lake area. The hostrocks to the deposit have undergone upper greenschist facies regional metamorphism, the peak of which was likely synchronous with deformation that produced the north-trending folds (Reilly, 1993b).

The Prince Albert deposit is situated on a minor fold on the western limb of the North Channel anticline (Figure 44), one of the roughly north-trending F_2 folds that dominate the structural character of the area (Reilly, 1993b). Gold mineralization is hosted by a quartz vein situated within a brittle-ductile shear zone, the northerly trend of which roughly parallels the axial plane of the smaller fold (Byers and Dahlstrom, 1954). The shear is 1 to 4 m wide, extends for about 500 m along strike, and is characterized by an intense micaceous shear foliation within greywacke and quartz porphyry. The shear zone hosting the Prince Albert deposit is one of a series of moderately to steeply west-dipping brittle-ductile shear zones that wrap around Missi Island. These shears are interpreted to have undergone reverse-sinistral displacement during regional D_3 deformation, and commonly host gold mineralization (Reilly, 1993b). This episode of shearing, which might have reactivated earlier shears, has been variably interpreted to predate (Pearson, 1986a), postdate (Reilly, 1993b), or be synchronous with (Slimmon, 1993) development of the F_2 folds.

Gold mineralization within the shear zone is hosted by a massive white quartz vein ('No. 1' vein), up to 2.4 m wide. The vein extends for ~46 m along strike, dips moderately to the west, and tapers at its ends to numerous thin veinlets (Coombe, 1984). Although dominated by quartz, it also contains subordinate ankerite and calcite, and rare pyrite, arsenopyrite, chalcopyrite, galena, and molybdenite, and is locally crosscut by fine sericite-coated fractures. Small specks and larger grains of native gold are present within the sericitic fractures and the quartz vein, which locally contains inclusions of the wallrock. Wallrock bordering the shear zone commonly exhibits a pervasive, 1 to 4 m wide zone of quartz-carbonate-sericite alteration with disseminated pyrite and arsenopyrite. A second mineralized quartz vein ('No. 2' vein), northwest-trending and 0.5 to 1.2 m in width, is exposed immediately east of the main quartz vein. These and additional mineralized quartz veins are known to extend down dip towards the west/southwest for up to 50 m (Figure 48).

Inferred Deposit Type: orogenic gold

Associated Showings: Duplex (SMDI #0091), Sonora (SMDI #0094), Robinson Creek (SMDI #0298), Black Diamond (SMDI #2489), Graham (SMDI #0296)

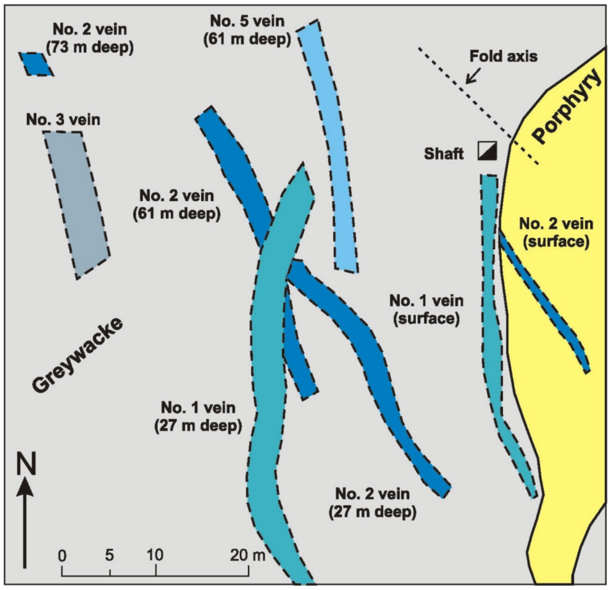

Figure 48 – Plan view of Prince Albert deposit vein system (modified from Coombe, 1984; originally derived from a Goldwin Exploration Co. informational bulletin).

Production and Reserves/Resources: There was minor gold production from high-grade mining at the Prince Albert deposit between 1937 and 1942 (Table 1).

Kisseynew Domain

Location 13 – MacKay Lake Area

North Lake (SMDI #2081)

Location: ~52 km northeast of La Ronge and ~500 m west of Highway 102 (NTS 73P/07; UTM 6149794 m N, 509442 m E)

Metal Associations: Au (Ag, Cu±Pb±Mo±Zn)

Status: developed prospect without Resources

Exploration and Development History:

The mineral claim covering the North Lake deposit was originally optioned to Majorem Minerals Ltd. in 1985, and later assumed by Radcliffe Resources Ltd. An airborne geophysical survey over the area in 1987 detected adjacent linear magnetic and electromagnetic anomalies. This was followed up later that year by ground geophysical (magnetic and VLF-EM) surveys. Geological mapping, overburden stripping, and trenching were also undertaken on the property. In late November 1987, a 43-hole diamond-drill program (5723 m) commenced, which continued into 1988. Limited additional drilling was done in 1988 to further delineate the orebody. A preliminary ore reserve estimate was reported in 1990. In 2011, Golden Band Resources Inc. optioned the property and, later in the year, completed geological reconnaissance mapping, prospecting, and rock and soil sampling on and around the known mineralization.

Geological Character:

The North Lake showing is a 600 m long mineralized zone hosted within a distinctive, moderately west-northwest–dipping sequence of pink quartzofeldspathic 'felsite', arkosic grit, pebble conglomerate, psammite, and trachytic andesite. The host sequence at this location has been metamorphosed under upper greenschist to lower amphibolite facies peak conditions and might occur on the eastern limb of a large syncline (Thomas, 1990). The results of recent mapping (Maxeiner and Kamber, 2011) suggest, however, that the showing is not situated on the limb of a fold but instead occupies the eastern margin of a high-level, quartz-phyric granite intrusion. A steep-sided valley occupied by a small lake ('North Lake') immediately east of the mineralized zone might represent a fault or high-strain zone (Appleyard, 1994), and a northwest-trending fault has been mapped at the southern boundary of the mineralized zone (Thomas, 1993). The mineralized zone is a north-northeast–trending, southwest-dipping system of branching, extensional quartz veins. The zone apparently pinches and swells along strike, ranging in width from 5 to 40 m, and is confined mainly to the pink felsite. The protolith of this 1843 ±2 Ma host unit (L. Heaman, reported in Kyser *et al.*, 1992) is one of the more contentious aspects of the showing, having been variably interpreted as an arkosic sandstone or siltstone (Lewry, 1986), a fine-grained quartzitic arenite (Thomas, 1993), a rhyolite (Appleyard, 1994), or an aplitic sill (Maxeiner and Sibbald, 1995). Recent mapping at the showing, at which new exposure is available due to forest fires, has supported the interpretation of the unit as a marginal, aplitic phase of a proximal granitic intrusion (Maxeiner and Kamber, 2011; Figure 49).

The showing comprises a network of 0.1 to 10 cm wide, straight-sided quartz veins with tapered terminations. Individual veins dip 60° to 70° to the northwest, with the exception of uncommon high-angle oblique veins (Thomas, 1993). Veins are associated with pale greenish-grey alteration envelopes that are one to ten times the width of individual veins; alteration consists of widespread albitization (Appleyard, 1994) with pinhead garnet, small muscovite aggregates, and small euhedral pyrite crystals (Thomas, 1993). Altered rocks have experienced an overall increase in mass, having undergone net addition of Si, Al, Na, S, Cu, Ag, and Au, and locally Pb and Mo, with relative depletions in K, Rb, and Ba (Appleyard, 1994). Pyrite is the most abundant sulphide mineral (1 to 5%)

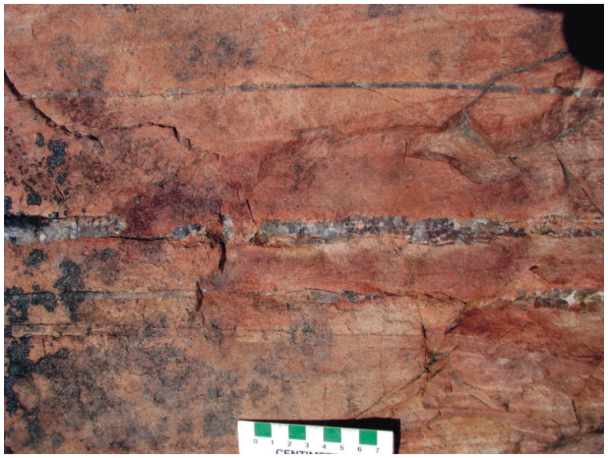

Figure 49 – Outcrop photograph of the North Lake deposit, showing auriferous quartz veins in host 'felsite' (courtesy of R. Maxeiner).

within the veins and is accompanied by minor pyrrhotite, chalcopyrite, galena, and sphalerite. Gold is present in chloritic seams along vein margins and, less commonly, within the quartz veins (Thomas, 1993).

Maxeiner and Sibbald (1995) speculated that there is both a lithological and a structural control on the mineralization, such that the hard and brittle character of the felsite provided an ideal structural trap for auriferous fluids. Similarly, Appleyard (1994) favoured a model whereby auriferous metamorphic fluids were introduced into brittle faults and/or fractures in the felsite during and after the main episode of cataclastic deformation. This contrasts with the model of Thomas (1990), who viewed the auriferous quartz veins as predating the last phase of folding and deriving from localized remobilization of gold from the hostrocks, which he presumed to have a sedimentary origin.

Inferred Deposit Type: ?orogenic gold

Associated Showings: Socko-Tyon (SMDI #0766), ?Ramsland Lakes showings (SMDI #0768 to #0771)

Production and Reserves/Resources: A historical mineral resource estimate has been reported for the North Lake showing.

Location 14 – Stewart River Area

Greywacke
North, Central, and South Zones (SMDI #2420)

Location: ~3 km north of the Stewart River between Dickens and Stauffer lakes, ~85 km northeast of La Ronge (NTS 73P/10; UTM 6177542 m N, 527990 m E)

Metal Associations: Au (Cu, Zn, Pb, Mo, Fe)

Status: developed prospect with Resources

Exploration and Development History:

The first discovery of anomalous gold in the immediate deposit area, by Saskatchewan Mining Development Corp. (SMDC) in 1987-88, was from lake-sediment geochemical sampling on the west side of 'Greywacke Lake' and from grab sampling of the southeastern portion of the nearby 'Shandy' grid. A showing consisting of three separate mineralized zones (Greywacke 'North', 'Central', and 'South') was delineated as a result of outcrop stripping and channel sampling in 1989. Subsequent mapping, prospecting, and ground EM/magnetic surveys along strike identified a 7 km long, discontinuously mineralized horizon that included the Hoover (SMDI #2544) and Lyons (SMDI #2550) prospects, and the Closure Lake occurrence (SMDI #2539).

The first drilling was done on the Greywacke and Hoover showings by Cameco Corp. (formerly SMDC), which completed 30 drill holes in 1989 and 1990. This was followed by further ground magnetic surveying, geological mapping, and sampling in 1990, which led to the identification of the Wasp Lake showing (SMDI #2569) about 6 km along strike to the northeast of the Greywacke zones. Four additional holes were drilled in 1994, but the claims lapsed in 2001.

The zone was restaked in 2001 by M. Lederhouse and acquired by a partnership between JNR Resources Ltd. (50%) and Shane Resources Ltd. (50%) shortly thereafter. Later in 2001, Masuparia Gold Corp. optioned the property and subsequently completed 23 drill holes on the North and South zones, in addition to ground magnetic surveys and soil sampling in selected areas throughout the property. In 2002, a partnership involving Masuparia, JNR, United Carina Resources Corp., and Consolidated Pine Channel Gold Corp. completed lake-sediment sampling at the Greywacke zone, and geological mapping, prospecting, and soil sampling in the area between 'Closure Lake' and the Greywacke zone. A further 16 holes were also drilled on the Greywacke North zone. An additional two holes were drilled in the Greywacke North zone in 2005, which served to constrain the width and vertical extent of the orebody.

In 2006, Golden Band Resources Inc. joined Masuparia Gold Corp. (51%), the project operator, by acquiring the 49% interest in the property that had previously been held by Shane Resources (24.5%) and JNR Resources (24.5%). The North zone has since reached the advanced exploration stage. A Mineral Resource estimate was reported for the near-surface portion of the deposit (Table 2). As of 2011, more than 70 drill holes had penetrated the North zone. In 2011, Golden Band and Masuparia entered into a joint-venture agreement in order to advance the project towards development.

Geological Character:

The Greywacke deposit is hosted by epiclastic sedimentary rocks of the western extension of the Kisseynew Domain (Figure 20), at the boundary between the McLean Lake gneisses and the overlying McLennan group. Based on detailed outcrop mapping and limited drill core inspection (Poulsen and Robert, 1994), the host stratigraphy (Figure 50) includes a sequence of conglomerate and conglomeratic sandstone, feldspathic arenite, polymictic conglomerate, lithic arenite, arkose, calc-silicate rocks, and greywacke. Diamond-drill logs (SMER Assessment File 73P10-0169) also indicate the presence of mafic to intermediate volcanic rocks and/or subvolcanic intrusions. Relatively small, localized intrusions of tonalite, monzodiorite, and quartz-feldspar porphyry are also present, as are multiple generations of pegmatite.

Mineral assemblages in the sedimentary rocks indicate peak metamorphic temperatures of 550° to 650°C and loosely constrained pressures between 2 and 7 kbar (Poulsen and Robert, 1994), which suggest middle to upper amphibolite facies conditions. The host sequence has been affected by multiple phases of deformation that, together with the effects of metamorphic recrystallization, obscure original bedding features and rock protoliths. The earliest recognized deformational event produced the dominant control on the orientation of the hostrocks. Related fabrics include a strong, bedding-parallel, northwest-dipping penetrative foliation, which is axial planar to an outcrop-scale, reclined, isoclinal anticline that plunges moderately to the north-northwest (340°/55°; *op. cit.*) and closes to the northeast of the deposit.

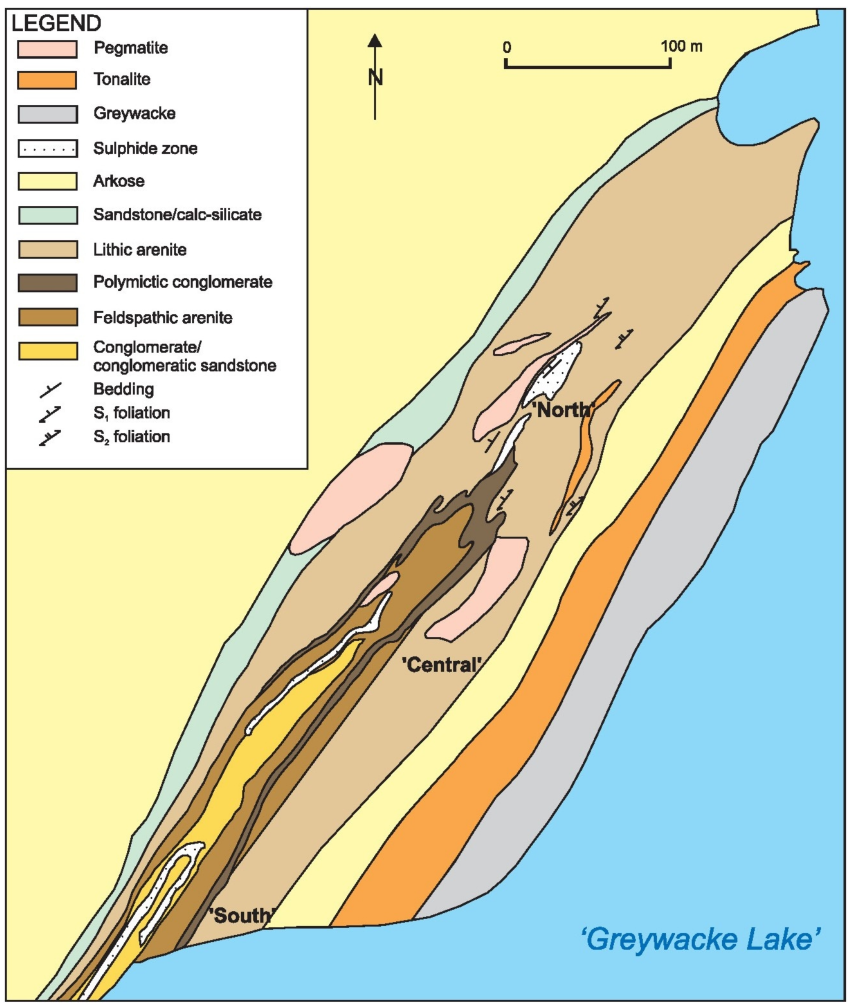

Figure 50 – Geological setting of the Greywacke deposit, with location of the main gold-bearing sulphide zones (from Poulsen and Robert, 1994).

The deposit consists of three subparallel zones (North, Central and South; Figure 50), which are up to 15 m in true thickness and contain 1 to 3% disseminated sulphides and fine-grained native gold. The hostrock to the mineralization, now quartz-plagioclase-muscovite±biotite schist, is of varying protolith, including conglomerate and conglomeratic sandstone, polymictic conglomerate, and feldspathic to lithic arenite (Poulsen and Robert, 1994; Figure 50). The sulphide mineralization comprises discontinuous trains of disseminated, elongate grains and grain aggregates that generally parallel the main foliation. Pyrrhotite and pyrite are the main sulphide minerals, although chalcopyrite, molybdenite, sphalerite, galena, and magnetite are also present. Drilling of the North zone has resulted in identification of a sporadic zone that contains more densely disseminated dark brown sphalerite, whereas gahnite was identified in drill cuttings from the South zone. Gold throughout the deposit consists of irregular grains up to 1 mm in size, and might also be present within sulphide and silicate grains. The gold-bearing zones are roughly tabular in shape and generally coincide with the sulphide-rich zone, though in detail the thicknesses of the gold and sulphide zones vary independently of one another. The sulphide zone is barren of gold in places. Both the sulphide and gold zones are foliated and folded, and thus were interpreted to be synchronous with, if not predate, the earliest recognized deformational and metamorphic events (Poulsen and Robert, 1994). The Greywacke North zone is situated along the fold axis of the mapped anticline (Figure 50).

Hydrothermal alteration associated with the sulphide and gold mineralization is not readily identifiable. It is currently unclear whether this is because: 1) there was little or no alteration associated with the mineralization, or 2) it is present but difficult to distinguish through the effect of the metamorphic overprint. Where alteration minerals are observed, they cannot be confidently linked to the gold mineralizing event. Examples of possible alteration features (from Poulsen and Robert, 1994; SMER Assessment File 73P10-0169) include aggregates of quartz and microcline surrounding sulphide grains; cryptic pervasive silicification (North zone); minor quartz veining in the gold zone and the hangingwall sulphide zone (North zone) and only in the hangingwall sulphide zone (South Zone); bleached rocks with anomalous muscovite, biotite±?fuchsite/?gahnite contents (North zone); and siliceous rocks containing quartz, green mica and albite (South zone). Widespread garnet and sillimanite proximal to the mineralized zones might be an alteration product, although they could instead reflect an originally aluminous protolith composition.

The Greywacke deposit is atypical of most known gold showings in the western Reindeer Zone because it is hosted by sedimentary rocks of the Kisseynew Domain, it is not observed to be in the immediate vicinity of a fault or shear zone, it apparently predates the main regional phase of deformation and peak metamorphism, and it is associated with widespread disseminated sulphide mineralization. Genetic models proposed for the deposit are varied and have included intrusion-related replacement gold ('Manto'-style; Poulsen and Robert, 1994), VMS replacement gold (SMER Assessment File 73P10-0169), and disseminated sedimentary rock–hosted sulphidic gold (Robert *et al.*, 1994). The Greywacke deposit has characteristics that are generally consistent with other 'atypical greenstone-hosted gold deposits', as defined by Robert *et al.* (2007).

Inferred Deposit Type: disseminated sedimentary-hosted gold-sulphide (*i.e.,* 'atypical greenstone-hosted gold deposit'; see Robert *et al.*, 2007)

Associated Showings: Hoover (SMDI #2544), Lyons (SMDI #2550), Closure Lake (SMDI #2539), Wasp Lake (SMDI #2569)

Production and Reserves/Resources: Masuparia Gold Corp. reported a Mineral Resource estimate for the Greywacke deposit in 2008 (Table 2).

Location 15 – Wood Lake Area

Fish Dot Gold Zone (SMDI #2257), **Yak** (SMDI #2491)

Location: eastern Wood Lake, ~17 km northeast of Pelican Narrows (NTS 63M/03; near UTM 6121374 m N, 618238 m E)

Metal Associations: Au±As±Cu±Ni

Status: prospect (Fish Dot) and occurrence (Yak)

Exploration and Development History:

Exploration in this part of the Kisseynew Domain started in 1959, when Guggenheim Exploration Company Inc. completed an EM survey and follow-up diamond drilling (two holes) for Straus Exploration Inc. in the Wood Lake area. One of the two drill holes intersected intermittent massive pyrrhotite (±pyrite±trace chalcopyrite) over ~36 m that yielded ~3.5 g/t (0.10 oz./ton) Au over 0.5 to 1 m intervals (S-99217 showing, SMDI #0332). The only other work done on this showing was in 1986, when Great Bend Resource Corp. stripped, trenched, and sampled the showing, with no appreciable findings.

Guggenheim staked the property covering the Fish Dot gold zone in 1968 and conducted an EM survey over part of the area. A three-hole drilling program was completed with no significant intersections and the claim lapsed. Great Bend staked the showing in 1986 and performed prospecting and rock sampling, which resulted in the discovery of anomalous gold in two rock samples (1 to 4 g/t; 0.03 to 0.12 oz./ton). No further work was completed on the showing until 1993, when Consolidated Pine Channel Gold Corp. optioned the property from W. Fisher and completed prospecting, trenching, and channel sampling. A single drill hole was completed in 1994; no subsequent work was reported.

An area just north of the Fish Dot gold zone was staked in 1968 for New North Minerals Ltd. and was optioned to Canadian Reserve Oil and Gas Ltd. in 1970. The company carried out prospecting, geological mapping, a ground geophysical (HLEM and magnetic) survey, and geochemical sampling on the property, leading to discovery of the Yak showing. Nine trenches were completed at the showing in 1971 and yielded minor copper and nickel mineralization, although gold was not assayed. Claude Resources Inc. staked the showing area in 1980 and completed an airborne (INPUT-EM and magnetic) geophysical survey. In 1981, Saskatchewan Mining Development Corp. optioned the property and performed reconnaissance geological mapping. Highrock Contracting Ltd. staked the showing area in 1988 and completed prospecting, geological mapping, soil sampling, and grab sampling at existing trenches. One rock sample returned appreciable gold (~7 g/t; 0.20 oz./ton), as well as minor Cu and Ni. Claims covering showings in the western Kisseynew Domain eventually lapsed, but were restaked in 2011 by W. Fisher.

Geological Character:

Little is known about the detailed geological character of gold showings in the Wood Lake area of the western Kisseynew Domain. A common and obvious theme, which distinguishes them from nearby gold showings of the Glennie Domain, is that they are hosted by sedimentary-dominated rock sequences. The eastern Wood Lake area is underlain largely by variably deformed Burntwood group psammite and pelite, containing tectonically interleaved slices of mafic to intermediate volcanic and plutonic rocks, all of which have been metamorphosed under lower to upper amphibolite facies conditions (Tran *et al.*, 1996).

Auriferous mineralization at the Fish Dot gold zone is associated with zones of quartz veining in sedimentary and volcanic rocks. The quartz veins also contain arsenopyrite. The Yak showing is hosted in a gabbroic sill within a sequence of psammopelite and graphitic pelite, all of which are folded by a moderately south-plunging syncline. Mineralization is associated with a zone of shearing and silicification in the gabbro and consists of up to 20% disseminations or 'blebs' of pyrite, as well as traces of chalcopyrite and pyrrhotite.

From this limited information, an epigenetic origin can be postulated for both the Fish Dot and Yak showings, similar to that for strictly volcano-plutonic–hosted, shear and quartz vein–associated showings of the western Wood Lake (*e.g.*, Kirkland showing, SMDI #1869) and Prongua–Lariviere lakes areas of the western Glennie Domain. Therefore, these showings might have formed during a contemporaneous episode of epigenetic hydrothermal activity and are differentiated mainly by their hostrock associations. This style of mineralization contrasts with that of the S-99217 showing (SMDI #0332), located ~3.5 km southeast of the Yak zone, which available geological information suggests is of syngenetic exhalative origin.

Inferred Deposit Type: ?orogenic gold

Associated Showings: Kirkland (SMDI #1869), Prongua–Lariviere lakes showings

Production and Reserves/Resources: none

Location 16 – Mari Lake Area

Dolly
Eccles Lake (SMDI #0411)

Location: on the east arm of Mari Lake, ~35 km north of Creighton (NTS 63N/04; UTM 6108397 m N, 694434 m E)

Metal Associations: Au with Cu, Mo

Status: prospect

Exploration and Development History:

Gold mineralization at the Dolly occurrence was originally discovered in 1930 by prospector W.M. Boehme. The first reported work on the property consisted of minor trenching and drilling in 1939. A parcel of claims, including that covering the Dolly property, was optioned to Nesnah Mining and Exploration Co. Ltd. in 1945. The option was, however, dropped by Nesnah Mining in 1946 following further trenching and a minor drilling program (16 holes, 521 m).

Overburden stripping and further trenching were undertaken in 1959, following re-staking of the property by Boehme and W. Jonasson. The claim lapsed but was again restaked in 1965 by Boehme, Jonasson, and E. Kostuchuk. Minor trenching and sampling were done, but the claim again lapsed in 1974. In 1980, the property was staked by D. Kostuchuk and a single trench was completed. The mineral claim on the property was taken to lease in 1984.

In 1984, the mineral lease was acquired by a joint-venture partnership between Wapa Minerals Ltd. (20%), Comaplex Resources International Ltd. (60%), and Canamera Explorations Inc. (20%). Later that year, the partnership carried out ground geophysical (magnetic and EM) surveys, geological mapping, prospecting, and biogeochemical surveys over the showing area, and completed a small drill program (six holes, 708 m) in 1985. In 1986-87, detailed property mapping was independently performed by the Government of Saskatchewan (Pearson, 1986b) and the partnership, the latter also carrying out prospecting, trenching, bedrock sampling, and ground magnetic surveying. The mineral lease subsequently lapsed but was restaked in 2010 by Dog Lake Exploration Inc.

Geological Character:

In contrast to the relative abundance of gold showings in the westernmost extension of the Kisseynew Domain that parallels the La Ronge Domain, the central portion of the Kisseynew Domain in eastern Saskatchewan is virtually devoid of known gold showings (Figure 20). In addition to the Dolly prospect, gold showings known in the central portion of the Kisseynew Domain are limited to the S-99217 (SMDI #0332), Fish Dot gold zone (SMDI #2257) Kamuchawie Lake (SMDI #2396), Yak (SMDI #2491), Naza (SMDI #2582), and Aga (SMDI #2641) showings, as well as grab sample 4528 (SMDI #2259) and drill hole NAW-73 (SMDI #1862). Of these, most are at or near the currently defined boundaries between the Kisseynew and neighbouring (Flin Flon, Glennie) domains.

The geological character of the Dolly prospect was described in detail by Pearson (1986b, 1986c). The showing is hosted within a moderately northeast-dipping homoclinal sequence of paragneissic rocks. The gneissic rocks are dominated by psammite, which interfingers with and overlies subordinate conglomerate and hornblende-plagioclase gneiss, the latter presumed to derive from mafic to intermediate sills or volcanic flows. Arkose, exposed west of the mineralized zone, is gradational into psammite and feldspathic quartzite. A feldspar-phyric gabbro and at least three distinct phases of granite intrude the supracrustal rocks proximal to the showing. Rocks in the general area have been metamorphosed under upper amphibolite facies conditions (Ashton *et al.*, 2009b).

Gold mineralization at Dolly is hosted by massive, white quartz veins. Pyrite, chalcopyrite, tourmaline, and possibly molybdenite are also present in mineralized veins. The quartz veins are associated with moderately northeast-dipping shear zones that, in plan view, displace granitic dykes in a sinistral sense. The earliest granitic phase at the showing ('Dolly' granite) exhibits a gradational texture into one of the mineralized quartz veins, whereas a later phase ('Kipahigan' granite) is sheared along one of its margins and contains several narrow, barren quartz veins (Pearson, 1986b).

Pearson (1986b) considered there to be a genetic relationship between the Dolly granite and the gold mineralization, based on the observed textural relationships between the granite and mineralized quartz veins. These veins are thought to have relatively shallow (30°) northeasterly plunges and are interpreted as open-space fillings that were emplaced early in the strain history.

Inferred Deposit Type: ?orogenic gold; ?intrusion-related gold

Associated Showings: unknown

Production and Reserves/Resources: none

Gold Metallogenesis

Mineralization Styles

Gold mineralization is widespread throughout the Reindeer Zone, particularly in the La Ronge, Glennie, and Flin Flon domains, and, to a lesser extent, in the Kisseynew and Rottenstone domains. Two broad mineralization styles have been identified: those that formed synchronously with or shortly after the hostrocks were deposited, thereby predating the major thermotectonism (syngenetic); and those that formed significantly later than the hostrocks, during thermotectonism (epigenetic).

Syngenetic gold deposits in the Reindeer Zone include two distinct types: VMS and disseminated, sediment hosted, gold-sulphide deposits (see Chapter 2). VMS deposits are widespread, occurring in *ca.* 1895 to 1865 Ma volcanic assemblages in both the Flin Flon and Glennie domains, and can be significant gold producers. In particular, the Flin Flon deposit, the Saskatchewan portion of which produced about 112 t (3.6 million oz.) of gold as a by-product of base metal mining (Table 1), is the largest historical gold producer in the entire Reindeer Zone. The Laurel Lake (Amisk Gold) deposit on northern Amisk Lake also has potential to be a significant gold producer, with a currently defined Mineral Resource estimate of >58 t (1.57 million oz.) of contained gold.[10] This deposit, hosted by a *ca.* 1880 Ma rhyolite dome complex, exhibits mineralization and alteration styles, sulphide/sulphosalt assemblages, and fluid characteristics (Ansdell and Kyser, 1991) that are distinct from other VMS deposits in the Reindeer Zone, and has been classified as a 'hybrid bimodal-felsic type' VMS deposit (Galley *et al.*, 2007a, 2007b). According to the four-fold classification for gold-bearing VMS deposits of Mercier-Langevin *et al.* (2011), both the Flin Flon and Laurel Lake deposits are considered 'anomalous' in their overall gold content (*i.e.,*   31 t gold with average gold grade <3.46 g/t; see Chapter 2). By comparison, all other VMS deposits known in the Reindeer Zone (*e.g.,* the Anglo-Rouyn, McIlvenna Bay, Birch Lake, Flexar, and Konuto Lake deposits) are considered 'ordinary' in this classification (*i.e.,* <31 t gold with average gold grade <3.46 g/t), despite some having produced by-product gold during base metal mining.

Unique syngenetic gold mineralization is also present in the Stewart River area (*e.g.,* Greywacke deposit), situated in *ca.* 1855 to 1840 Ma siliciclastic sedimentary rocks of the western Kisseynew Domain, adjacent to the boundary with volcanic rocks of the La Ronge Domain. This deposit comprises auriferous disseminated sulphide mineralization, hosted by arenite and conglomerate, that predates the main deformational fabrics. The Greywacke mineralization, previously classified as a 'disseminated (sediment-hosted) gold-sulphide' deposit (Robert *et al.*, 1994), exhibits characteristics similar to those of other unique gold deposits that have been designated 'atypical greenstone-hosted deposits' (see Robert *et al.*, 2007). A key exploration criterion in the search for these syngenetic (to slightly epigenetic) gold deposit types in the Reindeer Zone will be the identification of lithological assemblages that were deposited in lithotectonic settings comparable to those hosting the known deposits.

There is another group of sediment-hosted gold deposits in the Reindeer Zone for which the genesis (*i.e.,* syngenetic *vs.* epigenetic) is not fully resolved. Such deposits (*e.g.,* Twin zone, La Ronge Domain; Sulphide Lake / Studer A, B, and F zones, western Glennie Domain) comprise conformable to disconformable, auriferous sulphide zones and/or quartz veins that are stratabound within iron formation and/or sulphidic argillite. A syngenetic origin, whereby gold was originally introduced by venting at the seafloor at the time of hostrock deposition, is favoured by some for the origin of gold at these deposits (*e.g.,* Coombe, 1984; Netolitzky, 1986; Sibbald, 1986). Others (*e.g.,* Armstrong, 1990; Lafrance, 2002), in contrast, consider this style of mineralization to be epigenetic, whereby the rheological and/or chemical properties of the hostrock provide a favourable site for deposition of gold from hydrothermal fluids during thermotectonism (*i.e.,* 'orogenic' style). Based on available information, an epigenetic interpretation for these deposits is favoured here. Regardless of genetic process, the recognition that this specific style of mineralization has a clear association with iron formation and sulphidic argillite provides a first-order exploration target. Deposits of similar style are known elsewhere in Saskatchewan (*e.g.,* Nirdac Creek, Mudjatik Domain) and throughout North America (*e.g.,* Homestake mine, South Dakota; Lupin mine, Northwest Territories).

The remainder of the known gold showings in the Reindeer Zone, prevalent in rocks of the La Ronge, Glennie, and Flin Flon domains, are of probable epigenetic origin and most (if not all) are considered here to be orogenic gold deposits (see Chapter 2). This designation is supported by such key features as a clear structural control, a dominance of shear- and fracture-associated quartz vein systems with relatively low sulphide contents, and textural relations indicating a close temporal association with regional metamorphism. Studies of fluid characteristics carried out at many of these deposits (*e.g.,* Armstrong, 1990; Fedorowich *et al.*, 1991; Ibrahim and Kyser, 1991; Ansdell

[10] This total includes the combined Indicated and Inferred Mineral Resource estimates, and includes silver as gold equivalent (see Table 2).

and Kyser, 1992; Appleyard, 1994; Fayek and Kyser, 1995; Hrdy and Kyser, 1995; Schultz, 1996; Durocher, 1997; Tourigny *et al.*, 2004) generally support this designation, consistently pointing to an aqueous-carbonic, low- to moderate-salinity, 300° to 450°C mineralizing fluid derived from metamorphic devolatization, similar to other orogenic gold deposits globally.

Epigenetic Gold Mineralization of the La Ronge Domain

Orogenic-style gold showings of the La Ronge Domain occur in, or proximal to, brittle-ductile shear zones in several types of metamorphosed rocks. Many of the mineralized shear zones are specifically associated with calc-alkaline, arc-derived plutons of varying shapes, compositions, and sizes (‘Group 1 to 3’ plutons; Thomas, 1993), particularly at or near their external margins or along internal lithological heterogeneities (*e.g.,* dykes, xenoliths, phase transitions). The mineralized shears are typically steep localized structures that are subsidiary (third or fourth order) to major regional high-strain zones that are themselves unmineralized. For example, the northeast-trending McLennan Lake tectonic zone, situated along the margin between the La Ronge and Kisseynew domains (Figure 20), is a regional high-strain zone that is thought to have provided an important structural control on the overall gold mineralizing system in the area (Coombe *et al.*, 1986; Poulsen, 1989; Thomas, 1993). Second-order splays off the McLennan Lake tectonic zone, such as the east-northeast–trending Byers tectonic zone and the north-northeast–trending David Lake shear zone (Figure 51A), branch directly into smaller shears that host the deposits (*e.g.*, the Rod, James-Jasper shears, *etc.*). This model envisages the mineralizing system as a multiscale, interconnected shear network in which the McLennan Lake tectonic zone provided a crustal-scale discontinuity that facilitated the focussing and transport of mineralizing fluids, which were then channelled into and deposited along second- and higher order shears (Figure 51B). At the deposit scale, Thomas (1993) emphasized the importance of structural ‘irregularities’ (*e.g.*, jogs, kinks, offsets, bifurcations, *etc.*) within the shear zones for providing zones of dilatancy for deposition of hydrothermal fluids. Thomas (1993) also noted a strong correlation between the number of shear-associated gold showings and their proximity to the brittle-ductile transition at the time of deposition. Some

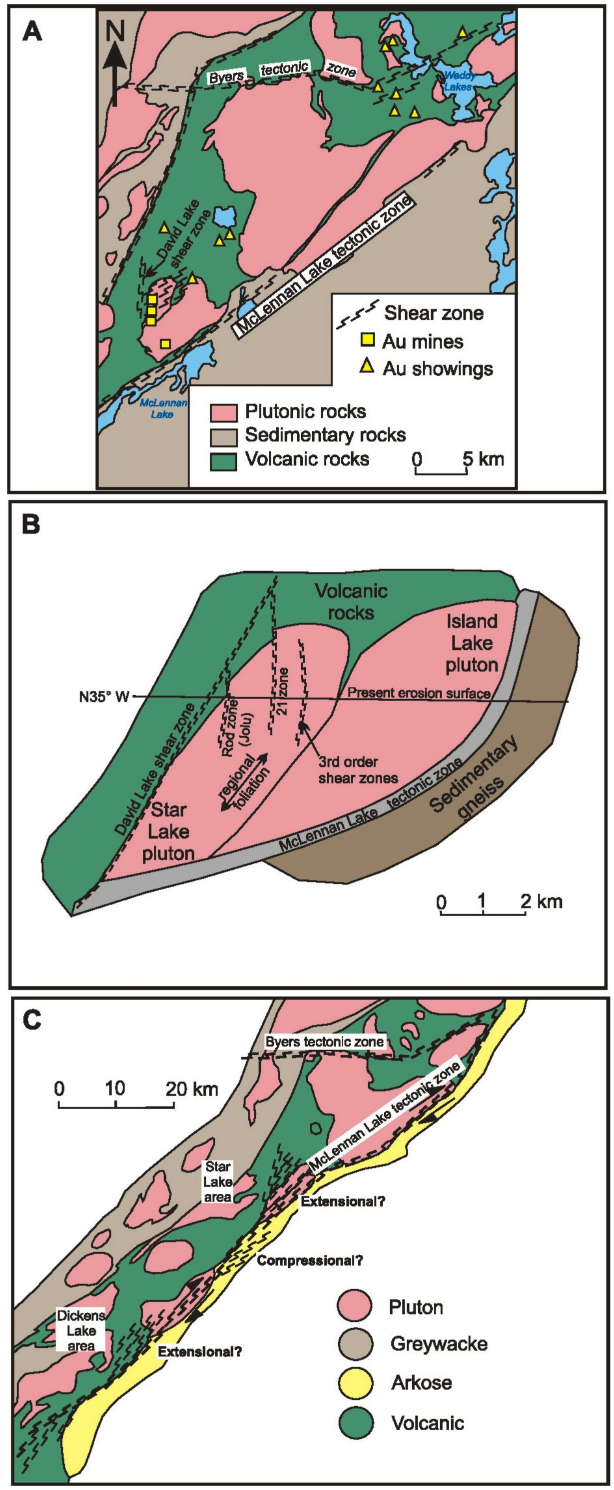

Figure 51 – Relationships between regional shear zones (and their subsidiaries) and gold showings in the western Reindeer Zone: A) distribution of gold deposits in the Star–Waddy lakes area of the La Ronge Domain in relation to major shear zones (from Poulsen, 1989); B) schematic conceptual model (Poulsen, 1989) showing the relationship between the hierarchy of contemporaneous shear zones and location of gold deposits in the Star Lake area of the La Ronge Domain; and C) as proposed by Thomas (1993), possible sites of extensional and compressional strike-slip deformation along the McLennan Lake tectonic zone that could have facilitated the localized deposition of gold deposits.

of these shears were subsequently reactivated as brittle faults (*e.g.*, the Byers fault, a late brittle overprint along the Byers tectonic zone), causing minor remobilization of earlier gold.

Detailed structural analyses of several gold showings of the La Ronge Domain have indicated that mineralization was coeval with, and occurred throughout, the protracted regional D_2 deformational event (Figure 21). Gold showings in the Waddy Lake area were classified by Lafrance and Heaman (2004) as belonging to one of two 'groups', depending on their inferred timing relative to development of D_2 deformational fabrics. Early ('Group I') gold showings (*e.g.,* Komis) were interpreted to have formed contemporaneously with development of the main regional D_2 fabrics (*i.e.,* S_2 foliation, L_2 lineation). These fabrics and contemporaneous gold showings were, in turn, overprinted by shear zones that formed later during progressive D_2 deformation and that host later ('Group II') gold showings (*e.g.,* Golden Heart). Similarities in structural and mineralogical character suggest that deposits in the Star Lake and Dickens Lake areas are of similar origin and timing to those in the Waddy Lake area (*op. cit.*).

Kinematic indicators in the mineralized shear zones throughout the La Ronge Domain consistently indicate episodes of both dip-slip and transcurrent, predominantly dextral movement (*e.g.,* Roberts, 1993; Thomas, 1993; Lafrance, 2002). These contradictory indicators have been interpreted as resulting from: 1) an initial period of dip-slip shear followed by transcurrent reactivation during a single protracted event (*e.g.,* Poulsen *et al.*, 1987), 2) as near-simultaneous increments of dip-slip and strike-slip movement during regional transpression (*e.g.,* Roberts, 1993), or 3) possibly from some combination of both (Thomas, 1993). Mineralized sinistral shears (*e.g.,* Roy Lloyd mine (Bingo deposit); Tourigny, 2003a) might have formed contemporaneously with the more common dextral shears as antithetic sinistral transpression zones, or perhaps during a distinct episode of oblique-slip displacement or during late sinistral reactivation of a pre-existing reverse fault (Tourigny, 2005). Thomas (1993) suggested that the apparent contradictory strain interpretations of deposit-hosting shears along the McLennan Lake tectonic zone, and the distribution of deposits along the zone in general, could perhaps be explained as a system of alternating extensional and contractional zones ('duplexes') that formed during strike-slip reactivation of the zone (Figure 51C).

The D_2 deformational event, and therefore main-stage gold mineralization in the La Ronge Domain, were broadly coincident with peak regional metamorphism, with the majority of known gold showings having a close association with rocks of the upper greenschist to lower amphibolite facies (Thomas, 1993). Lafrance and Heaman (2004) proposed that overprinting of D_2 fabrics by biotite and aluminosilicate porphyroblasts indicates that at least some of the epigenetic gold mineralization in the La Ronge Domain predated peak metamorphism, which is bracketed between 1822 and 1804 Ma for the higher grade rocks in the Reindeer Lake area to the north (Corrigan *et al.*, 2001). The best estimate of the absolute timing of epigenetic gold mineralization in the La Ronge Domain comes from the Jolu mine area, where an 1807 +8/-5 Ma date for hydrothermal titanite (three fractions; 2.6 to 5.1% discordance) from a sheared mafic dyke has a close spatial and temporal relationship to quartz vein mineralization (Thomas and Heaman, 1994). Along with structural relationships and observed mineral textures, this date was interpreted to indicate that gold mineralization at high crustal levels in the La Ronge Domain was contemporaneous with devolatilization of rocks undergoing high-grade metamorphism at depth (*op. cit.*).

Epigenetic Gold Mineralization of the Glennie Domain

Epigenetic gold deposits in rocks of the Glennie Domain, like those of the La Ronge Domain, are spatially associated with major regional shear zones and their subsidiary structures. Most of these shears originated during the regional D_2 deformation event[11] (following the classification of Lewry *et al.*, 1990), which resulted from overthrusting of allochthons of Paleoproterozoic rocks southwestwards over the Sask Craton (Ashton *et al.*, 2005). Known gold showings of the Glennie Domain are confined mainly to greenstone belts (Figure 20), particularly the Pine (–Prongua) Lake belt (*e.g.,* near Laonil, Porky, Santoy, and Prongua lakes), the Brownell–Wapawekka lakes belt and, to a lesser extent, the Leland–Robinson lakes belt. Several gold showings are also known west of the Stanley fault, near the junction between the Glennie, Kisseynew, La Ronge, and Rottenstone domains (Figure 20). This spatial distribution likely reflects the presence of favourable structures imposed on the rocks at these locations, as opposed to any inherent compositional characteristics of the supracrustal rocks themselves. Auriferous mineralization is commonly associated with multistage quartz vein systems, some of which are themselves deformed, within the shear zones. The main mineral phases accompanying the gold vary between camps, and include tourmaline with pyrite and chalcopyrite at Laonil Lake; arsenopyrite at Santoy and Brownell lakes; and pyrite, pyrrhotite and disseminated arsenopyrite at Sulphide Lake. Hostrocks to the mineralization are variable, both within and between individual camps, and include volcanic and clastic sedimentary rocks within the greenstone

[11] Neither the timing nor the cause of this tectonism is necessarily equivalent to that of D_2 fabrics in rocks of the adjacent La Ronge Domain (see Figure 21).

belts, and plutonic rocks along the greenstone belt margins. Similar to the case for the La Ronge Domain, lithological contacts appear to be a favourable site for localization of epigenetic gold mineralization in rocks of the Glennie Domain. For example, both Durocher *et al.* (1992) and Delaney (1995) emphasized that epigenetic gold deposits in the Pine Lake greenstone belt are typically localized near the unconformable (and locally tectonized) contact between *ca.* 1890 to 1870 Ma, volcanic-dominated rocks (Assemblage A) and *ca.* 1840 Ma, clastic sedimentary rocks (Assemblage B). This association probably reflects the favourability of this contact as a focus of fluid flow due to extension/dilation during regional deformation.

Although many of the mineralized shear zones of the Glennie Domain were probably initiated as D_2 structures, structural studies at some of the gold showings (*e.g.,* Seabee; Tourigny, 2003c; Tourigny *et al.*, 2004) indicate that the mineralization itself probably occurred after the onset of D_2 deformation. Durocher (1997) combined observations from field and petrographic analysis with thermometric, mineral equilibria, and stable and radiogenic isotopic data to conclude that gold mineralization in the Santoy Lake area was introduced during D_3 sinistral strike- to oblique-slip reactivation of both D_2 shears and D_2-related quartz veins. Furthermore, it was concluded that gold in the Brownell Lake area was introduced late during the regional D_3 event, both within reactivated D_2 shears and along biotite-rich D_3 foliation planes. From structural analysis of the Seabee mine area of the Pine Lake greenstone belt, Tourigny (2003c) and Tourigny *et al.* (2004) concluded that the mineralized shears formed during dextral transpression, sometime after development of the regional S_2 foliation, possibly synchronously with D_3 deformation.

Collectively, providing they are accurate, the conclusions of these studies imply that epigenetic gold mineralization was a slightly protracted event across the Glennie Domain that began after the onset of D_2 deformation. Current knowledge of the timing of deformational events in the Reindeer Zone indicates, therefore, that gold mineralization was introduced sometime after about 1835 Ma (Figure 21). Additional temporal constraints are provided from relationships in the Santoy Lake and Brownell Lake areas, where gold is interpreted to have been transported in metamorphic fluids but deposited after the onset of peak thermal metamorphism (*i.e.,* after 1815 to 1805 Ma; M_2 of Durocher (1997)). Direct dates from Glennie Domain gold mineralization are lacking, with the possible exception of a 1725 Ma $^{40}Ar/^{39}Ar$ age from alteration biotite at the Seabee deposit (Schultz, 1996). This result likely reflects prolonged cooling of the chronometer through its closure temperature, however, as opposed to the actual time of gold mineralization (see Tourigny *et al.*, 2004). Based on comparisons between determined P-T-t paths for hostrocks and thermobarometric calculations from gold-associated mineral phases, Durocher (1997) proposed that gold mineralization occurred *ca.* 1795 to 1780 Ma in the Brownell Lake area, but after 1715 Ma in the Santoy Lake area. Whereas the proposed 1795 to 1780 Ma timing for the Brownell mineralization is generally consistent with known estimates of the timing of thermotectonism in the Glennie Domain, the 1715 Ma age for Santoy mineralization, which significantly postdates the timing of peak metamorphism, is at odds with these constraints (Figure 21). This apparent discrepancy might also be evidenced by the presence of diopside in paragenetically early hydrothermal alteration assemblages at the Santoy showings, perhaps reflecting deposition of hydrothermal fluids either during or just prior to peak metamorphism.

Based on the relationships described above, along with current knowledge of the timing of deformational and metamorphic events in the Reindeer Zone, the main influx of gold in the Glennie Domain is proposed here to have originally occurred at *ca.* 1800 Ma, during or shortly after the onset of peak regional metamorphism. The auriferous mineralization event involved the transport of gold-bearing hydrothermal fluids along reactivated D_2 shear zones during protracted D_3 deformation, possibly occurring at slightly different times at different crustal levels. The major shear zones acted as fluid conduits and, along with subsidiary shears and related fabrics, as depositional sites for auriferous quartz veins.

The majority of gold showings in the Glennie Domain are hosted by rocks of relatively low metamorphic grade (*i.e.,* lower to middle amphibolite facies), in comparison to the upper amphibolite facies rocks prevalent throughout the domain. Therefore, exploration in the domain should perhaps be focussed in rocks of similarly low metamorphic grade, all other parameters being equal. The presence, however, of significant gold mineralization in rocks of the Santoy Lake area, interpreted to have undergone upper amphibolite facies peak metamorphism (Durocher *et al.*, 2001), indicates that the higher grade parts of the domain might also be prospective for shear-associated mineralization.

Epigenetic Gold Mineralization of the Flin Flon Domain

Although renowned mainly for its widespread VMS deposits, epigenetic gold mineralization is also known in the Flin Flon Domain and, in Saskatchewan, is situated mainly in the east, near the Manitoba border. Whereas much of the western Flin Flon Domain is characterized by upper amphibolite facies metamorphic mineral assemblages, the eastern part of the domain (*i.e.,* the immediate Flin Flon–Amisk Lake area) is characterized by sub-greenschist to lower amphibolite facies assemblages. In these lower grade rocks, epigenetic gold mineralization is spatially associated with quartz-carbonate veins in steeply dipping, brittle-ductile shear zones. The mineralized shear zones transect an array of rock types, including *ca.* 1890 to 1880 Ma volcanic rocks, *ca.* 1855 to 1840 Ma sedimentary rocks (*i.e.,* 'Burntwood' and 'Missi'-type) and 1860 to 1840 Ma successor-arc plutonic rocks. Galley *et al.* (2007b) emphasized the localization of mineralized shears along lithological contacts at which large competency contrasts exist between rock types, particularly at jogs or dilations along these sheared contacts. These shear zones vary in orientation, ranging from north to northwest to northeast striking. In addition to quartz and carbonate, such alteration minerals as chlorite, albite, and sericite are common in or adjacent to shear zones. Sulphide minerals, mainly pyrite and/or arsenopyrite, are also common in veins and altered wallrock, and tourmaline is locally present in veins at some showings. Gold grade is reportedly proportional to the modal abundance of sulphide minerals (Ansdell and Kyser, 1992).

As is the case for mineralization of the La Ronge and Glennie domains, hydrothermal fluids responsible for epigenetic gold mineralization in Flin Flon Domain rocks are interpreted to derive from prograde metamorphic devolatilization and dissolution reactions (Ansdell and Kyser, 1992). Metamorphic mineral assemblages in sheared hostrocks were not, however, in equilibrium with the auriferous fluids, as evidenced by extensive chloritization in shear zones adjacent to mineralized veins. This relationship implies that the mineralizing event postdated peak metamorphism (*op. cit.*).

A detailed structural analysis by Fedorowich *et al.* (1991) of the Tartan Lake deposit, located 12 km northeast of Flin Flon in Manitoba, provides valuable insight into the genesis of the Flin Flon–Amisk Lake deposits, since this deposit exhibits characteristics identical to many of the Saskatchewan deposits and was interpreted by the authors to have formed contemporaneously with them. This study concluded that the mineralized shear zones originally formed as sinistral-reverse ductile structures during D_3 deformation (based on a proposed five-phase subdivision of deformational fabrics in the Flin Flon area; Figure 21), along with north-south isoclinal folds and the dominant regional penetrative foliation and lineation. This deformational event occurred due to west-northwest–directed transpression between 1820 and 1790 Ma, and is interpreted to have been contemporaneous with peak metamorphism (Fedorowich *et al.*, 1995). Subsequent deformation (D_4) resulted in the formation of a regional-scale, steeply plunging, east-northeast–trending antiform known as the Embury Lake fold (Figure 52), causing rotation of lithological units and pre-existing shear zones on its northern limb into an east-west orientation. This large D_4 fold is of an equivalent generation to other regional-scale D_4 folds that resulted from late to postcollisional convergence between the Superior, Hearne, and Sask cratons and collectively form a broad northeast-plunging anticlinorium across the Reindeer Zone (*e.g.,* Lewry *et al.*, 1990; Ashton *et al.*, 2005; Figure 21).

According to Fedorowich *et al.* (1991, 1995), formation of the Embury Lake fold due to north-south shortening caused flexure and reactivation of pre-existing (originally ?D_3) shears and, consequently, the development of conjugate sets of brittle-ductile, predominantly strike-slip (D_4) shears between about 1790 and 1760 Ma. Auriferous hydrothermal fluids infiltrated the D_4 shears during this event and resulted in the formation of five distinct vein sets, the third and fourth generation (V_{iii} and V_{iv}) comprising the gold-bearing sets (Fedorowich *et al.*, 1991). At the Tartan Lake deposit, the intersection of the V_{iii} and V_{iv} vein sets is parallel to the intermediate compressive stress axis ($_2$) and is nearly parallel to the plunge of the orebody (*op. cit.*). The mineralized D_4 shears are offset by late brittle D_5 faults, such as the north-northwest–trending, sinistral-reverse Ross Lake fault, which was probably contemporaneous with late brittle displacement along the regional north-trending Tabbernor fault (Figure 21) to the west.

The maximum age of epigenetic gold mineralization in low-grade rocks of the Flin Flon Domain is constrained by the fact that its deposition postdates D_3 deformation and concomitant peak metamorphism, the timing of which is bracketed between 1820 and 1790 Ma (Figure 21). Minimum age constraints on the mineralization are lacking, and the timing of D_4 deformation in the Flin Flon Domain (and D_4 deformation regionally) are relatively poorly constrained. Direct dating of the mineralizing event itself is limited to a 1791 ±4 Ma $^{40}Ar/^{39}Ar$ age for vein-hosted muscovite from Tartan Lake (Fedorowich *et al.*, 1991) and a 1760 ±9 Ma Rb-Sr isochron age for tourmaline and muscovite from the Rio deposit (Ansdell and Kyser, 1991). Based on current knowledge of the timing of thermotectonic events in the Reindeer Zone, combined with the interpretation that the deposits were associated with metamorphic fluids, the 1791 Ma date is considered here to be the most accurate approximation of the timing of main-stage gold mineralization in the Flin Flon area.

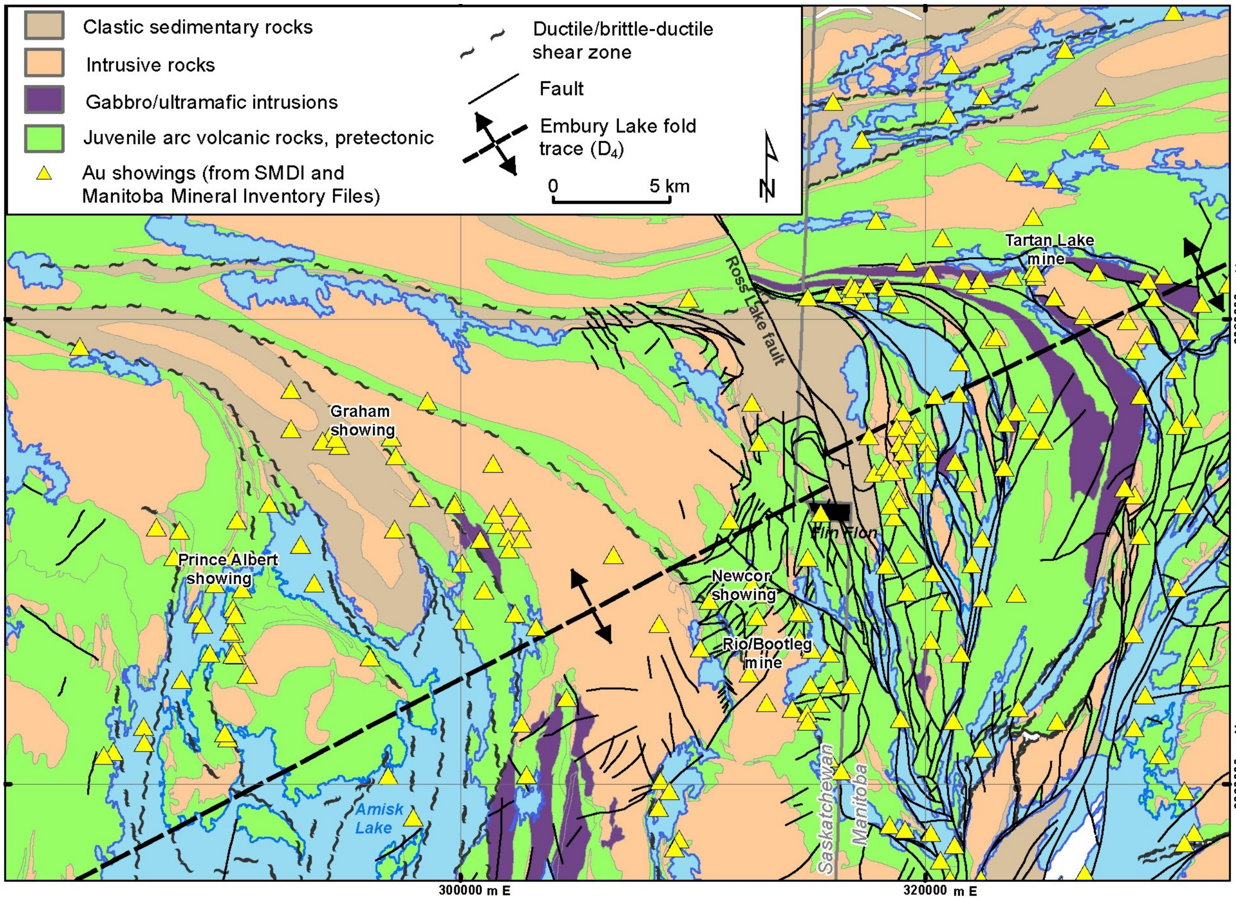

Figure 52 – Geological setting of the Amisk Lake–Flin Flon area, showing location of known gold showings in Saskatchewan and Manitoba in relation to the D_4 Embury Lake fold (modified after Slimmon, 2011).

Evolution of Epigenetic Gold Mineralization in the Reindeer Zone

The above discussion on characteristics of epigenetic gold deposits of the La Ronge, Glennie, and Flin Flon domains highlights several common elements, regardless of their location within the Reindeer Zone. The deposits have a near-ubiquitous association with shear zones, commonly of brittle-ductile character and typically subsidiary to major regional shear zones. Many of these shears have a displacement history that predates the gold mineralizing event (?early D_2, or prior) and were reactivated around the time of mineralization. The mineralized shears are in or marginal to greenstone belts and, due to competency contrasts, are localized at or near lithological or compositional contacts, particularly between plutons and volcanic rocks or dykes, or between volcanic rock and unconformably overlying sedimentary rock sequences. Gold mineralization is typically focussed in or adjacent to quartz (±carbonate) veins that filled jogs, bifurcations, or other irregularities along the shears that produced dilatant zones. Pyrite, arsenopyrite, and/or tourmaline commonly accompany the gold. Isotopic and fluid inclusion studies indicate that the majority of deposits formed from metamorphically derived, aqueous-carbonic, low- to moderate-salinity fluids at temperatures of 300° to 450°C.

Notwithstanding these similarities, compilation of timing constraints for main-stage gold emplacement and deformation/metamorphism indicates that the mineralizing event might have been slightly diachronous across the Reindeer Zone, apparently occurring progressively later from west to east (Figure 21). Whereas gold was emplaced synchronously with regional D_2 deformation in rocks of the La Ronge Domain, it apparently coincided with latest D_2 or the onset of D_3 deformation in Glennie Domain rocks and was synchronous with D_4 deformation in rocks of the Flin Flon Domain. A similar relationship is reflected in the relative, albeit loosely constrained, timing between gold mineralization and peak metamorphism, with a proposed syn–peak metamorphic timing for gold in the La Ronge Domain, syn– to slightly post–peak metamorphic timing in the Glennie Domain, and post–peak metamorphic timing in the Flin Flon Domain.

Existing data indicate, however, that amalgamation of Reindeer Zone rocks was well underway by the time of the first influx of epigenetic gold mineralization and that, at this time, tectonic processes affecting rocks of the La Ronge Domain were not disparate from those of the Glennie and Flin Flon domains (*e.g.,* Saskatchewan Geological Survey, 2003; Maxeiner *et al.*, 2005). This suggests that similar crustal-scale thermotectonic processes were ultimately responsible for the generation of gold deposits across the Reindeer Zone, albeit at different times and, possibly, crustal levels, and that one (or more) of these processes might have triggered the transport and deposition of mineralizing fluids in the individual areas. One possibility is that this was achieved mainly during a transition from a dominantly shortening deformational regime during tectonic convergence (early D_2) to one dominated by transpression or transcurrent deformation during late- to postcollisional intracontinental deformation (?late D_2, D_3, and/or D_4), which progressively served to open fluid pathways from lower to higher crustal levels. This interpretation is also consistent with the observed presence of both dip-slip and strike-slip deformational fabrics in host shear zones of many gold deposits in the Reindeer Zone and, if valid, might imply that this transition from collisional to postcollisional deformation occurred earlier in the western part of the orogen than in the central or eastern parts. This proposed model will be proven or disproven by additional detailed studies of the major gold deposits in all three domains (*i.e.,* La Ronge, Glennie, and Flin Flon), particularly those that provide direct and unambiguous constraints on the timing of the mineralizing event(s).

Exploration Guidelines for Gold in the Reindeer Zone

The information presented in this chapter reveals some relationships that can help target gold exploration in rocks of the Reindeer Zone. For syngenetic gold in VMS deposits, exploration should focus generally on identification of volcanic rocks emplaced in extensional geodynamic settings, and use of techniques that facilitate detection of massive sulphide lenses and related hydrothermal alteration zones (*e.g.*, Galley *et al.*, 2007a). Likewise, identification of disseminated sediment-hosted gold-sulphide mineralization should initially involve recognition of favourable clastic sedimentary horizons and detection of locally prevalent, predeformational disseminated sulphide mineralization. For the more widespread epigenetic gold mineralization, consideration should be given (but not limited) to:

- its localization within metamorphosed hostrocks, almost exclusively in greenstone belts, of upper greenschist to lower amphibolite facies and, less commonly, of higher metamorphic grade (middle–?upper amphibolite facies).
- distribution of deposits proximal to regional ‘tectonic zones’, commonly localized near an unconformity between temporally distinct supracrustal assemblages.
- a spatial relationship of mineralization with structures (shear zones, faults, and/or fractures) that are subsidiary to the regional tectonic zones. These are most commonly localized at the margins of and/or along heterogeneities (phase transitions, crosscutting dykes, supracrustal enclaves) within plutons of variable size, composition, and age within the greenstone belts. Volcanic rocks, iron formation, and clastic sedimentary rocks are less common hosts.
- mineralized structures most commonly being steeply dipping, brittle-ductile, anastomosing shear zones that are parallel or slightly oblique to the main regional foliation.
- mineralized shear zones that dominantly originated early during regional D_2 deformation and, now commonly exhibiting coexisting down-dip and subhorizontal stretching lineations, were the focus of either ongoing transpressional or transcurrent reactivation at the time of mineralization.
- possibly, a progressive timing for the mineralization event from the western (late D_2) to the central (late D_2 to D_3) to the eastern (D_4) parts of the Reindeer Zone.
- the occurrence of potassic alteration, silicification, carbonatization, chloritization, and/or sulphidization (±chloritization) within and adjacent to mineralized shear zones, as well as the presence of tourmaline in some instances.
- typical localization of gold mineralization in or adjacent to single or composite, shear-associated quartz (-carbonate) veins. These range from wide, shear-parallel (fault-fill) veins with wallrock laminations to narrower oblique veins to less common subhorizontal extensional veins. Mineralized veins are themselves commonly deformed, usually indicating emplacement during active deformation within the shear zone.
- localization of highest gold grades along margins of intersecting quartz veins, in veins at intersections of shear zone segments, at sites of kinks and other irregularities in shear zones, and in other dilatant zones. Gold mineralization can also be present away from veins in sulphidized, iron-rich wallrock.
- gold present in native form in the veins, but most commonly associated with pyrite, pyrrhotite, arsenopyrite, and/or other sulphide minerals in the veins and/or in sulphidized wallrock.

Chapter 7 – Concluding Remarks

Since the earliest efforts at the start of the 20th century, mineral exploration in Saskatchewan has uncovered more than 500 individual gold showings (Appendix 1). With examples in almost every geological region in the province (*i.e.*, the Phanerozoic basin, Rae Province, Hearne Province, and Reindeer Zone; Figure 1), these showings collectively reflect a variety of mineralization styles emplaced over a wide range of geological time. The majority of known gold showings throughout the northern Precambrian shield were emplaced during the Paleoproterozoic, between about 1900 and 1750 Ma, although rare Archean examples might also exist (*e.g.*, ?Ithingo Lake deposit, Mudjatik Domain).

The most widespread mineralization style, represented by that present at the Seabee mine in the Glennie Domain (~1 million oz. Au produced since 1991), the Roy Lloyd mine in the La Ronge Domain, and the Box deposit in the Beaverlodge Domain, is structurally controlled, 'orogenic'-style, quartz-carbonate vein-associated mineralization. Though less common, gold-bearing volcanogenic massive sulphide (VMS) deposits represent another important gold resource in the shield rocks, with Saskatchewan's largest-ever gold producer falling within this deposit class (historical Flin Flon mine; ~112 t (3.6 million oz.) of gold produced in Saskatchewan; Table 1). The Laurel Lake (Amisk Gold) deposit on northern Amisk Lake, containing an Indicated and Inferred Mineral Resource of >46.7 t (1.5 million oz.) of gold (and silver as gold equivalent; Table 2), likewise shares affinities with VMS-style mineralization. A small number of other gold showings in the Precambrian rocks (*e.g.*, Greywacke) are 'atypical' of either orogenic or VMS mineralization styles (see Robert *et al.*, 2007); although further study is required, these might represent manifestations of a distinct hydrothermal mineralization process(es). In the southern part of the province, which is underlain by undeformed and unmetamorphosed Phanerozoic strata, several small placer and paleoplacer gold showings are known; most of these were distally sourced and none are currently known to be economic.

Compilation of historical gold mining/production figures (Table 1) and existing Mineral Reserve/Resource estimates (Table 2) clearly indicate that gold-bearing VMS deposits, although less common, have been the most economically important source of gold in Saskatchewan, accounting for 122.5 t (3.94 million oz.) of produced gold and ~55 t (1.78 million oz.) of gold Reserves/Resources. This is due mainly to gold contributions from two large deposits, the Flin Flon mine and the Laurel Lake/Amisk Gold deposit, to which no other VMS deposits currently known in Saskatchewan are comparable. Further addition to this total therefore requires the discovery of other large, gold-bearing VMS deposits. Although this is entirely possible considering the favourable geological character, it seems most likely that the province's greatest gold potential currently lies in the widespread deposits of orogenic (and 'atypical') style, including both new discoveries and expansion of known deposits. To date, there has been roughly 51 t (1.63 million oz.) of gold produced from non–VMS-style gold deposits in Saskatchewan (Table 1), with at least an additional 96 t (3.1 million oz.) of existing Reserves and Resources (Table 2).[1]

Historically, gold exploration in Saskatchewan's Precambrian shield has involved mainly prospecting, glacial drift prospecting, bedrock and lake-sediment geochemical sampling, and/or traditional airborne/ground geophysical methods (*e.g.*, electromagnetic, electrical/IP, magnetic, *etc.*). These techniques, particularly when integrated, have been successful in identifying gold mineralization of various styles. Exploration for VMS deposits has traditionally focussed on geophysical techniques, whereas prospecting and glacial till sampling have led to discovery of many of the non–VMS-style deposits.

Although gold exploration has not been as widespread in Saskatchewan as in some other jurisdictions, additional deposits are nevertheless becoming increasingly difficult to find. Several innovative exploration strategies, as outlined by Robert *et al.* (2007), could prove to be productive in this regard. Specifically emphasized in their review is the importance of a comprehensive geological understanding at both the regional and deposit scales, as well as specialized knowledge of the characteristics of specific gold deposit types and of favourable geological settings for these deposits. Petrophysical analysis of known deposits has resulted in a better understanding of the physical properties of rocks in gold-mineralized systems and has allowed for refinements in acquisition and analysis of geophysical data, including improved airborne gravity systems and three-dimensional (3-D) inversion of potential field and electrical data. Geochemical methods remain an important exploration tool, both through refinements of existing techniques (*e.g.*, stream- and lake-sediment, soil, till, and rock sampling) and application of new techniques (*e.g.*, redox potential and microbial populations in soils, soil gas analysis, partial leach techniques, halogen

[1] Estimate includes all Proven and Probable Reserves, and Measured, Indicated and Inferred Resources for Saskatchewan deposits, except for the Measured + Indicated Resource for the Box and Athona deposits; see Table 2 for details.

concentrations, selective isotopic analyses, *etc.*). The latter are particularly important for so-called ‘far-field’ exploration programs, such as those focussing on basement rocks beneath younger sedimentary cover. Technological advances in a variety of remote sensing techniques have transformed these into powerful exploration tools. A range of multi- and hyperspectral imaging systems has been developed, including airborne, satellite-based, field portable, and lab-based varieties, and allow for enhanced mapping of lithology, structure, and particularly alteration at a range of scales. Equally important to acquisition of these diverse data is the ability to visualize and analyze them. To this end, the use of specialized GIS and 3-D modelling software should be integrated into any exploration program.

Along with innovative exploration techniques, further study of the regional and local controls on gold mineralization in Saskatchewan is required. Although some excellent research on this topic has been completed during the past 25 years, there remain some significant gaps in our knowledge that inhibit accurate interpretation of the overall mineralizing systems. Some of the key outstanding questions include the following:

- What are the characteristics of favourable host units for gold-bearing VMS deposits, and what is the distribution of these units?
- What processes cause concentration of gold in only some VMS deposits, and what exploration techniques are best suited for identification of the gold-bearing variety?
- What were the salient tectonic events resulting in deposition of orogenic gold deposits in the various camps in Saskatchewan?
- What was the absolute timing of these mineralizing events?
- Were multiple/overprinting mineralizing events involved in the formation of some deposits and, if so, did this result in larger and/or higher grade deposits?
- What is the extent of (lower grade?) gold mineralization in sulphidized wallrock at the orogenic-style deposits, and does this style of mineralization have potential to add to the Resource base at some existing deposits?
- Do hostrocks of higher metamorphic grade (*i.e.*, deeper present erosional level) have a decreased prospectivity for orogenic-style gold mineralization, or does this simply represent a historical exploration bias?
- Do the different potential mineralization styles (*e.g.*, variably sulphidized zones) in these high metamorphic grade terranes require a different exploration approach, and have these terranes been somewhat overlooked for their gold potential?
- What are the important regional structural controls on orogenic gold mineralization, and why do some greenstone belts appear more prospective than others?
- What processes resulted in the formation of so-called ‘atypical’ greenstone-hosted gold deposits in Saskatchewan?
- Is there unrecognized or additional potential for other non-orogenic and non-VMS gold-bearing deposit types in greenstone and other terranes?
- What is the true genesis of banded iron formation–hosted deposits (*e.g.*, Nirdac Creek, Twin zones, and Sulphide Lake / Studer zones)?

Research into these and many other questions will inevitably lead to a better understanding of these systems and, consequently, to improved exploration targeting.

Despite an incomplete understanding of mineralizing processes, gold is becoming a commodity of ever-increasing importance in Saskatchewan. Clearly, no gold district in the province appears to have the economic potential of the most prolific gold districts globally, such as the Abitibi belt in eastern Canada (>170 million oz. gold produced), the Norseman-Wiluna belt in Australia (>90 million oz.), or the Paleozoic Tien Shan belt in central Asia (>50 million oz.). Nevertheless, with cumulative gold resources in excess of 5.5 million oz. and potential for significant addition to these resources with ongoing exploration efforts, the future of Saskatchewan’s gold industry appears promising.

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Appendix 1 – Known Gold Showings in Saskatchewan

(from the Saskatchewan Mineral Deposits Index (SMDI);
URL <http://www.er.gov.sk.ca/SMDI>)

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
Rae Province			
Beaverlodge Domain			
1210a	Box Au mine	6595762	300285
1210b	Gauthier Au occurrence / Shaft or Apex Au showing, Rose Au showing	6595662	299838
1211	Frontier Adit Au showing or Frontier Trust Adit Au occurrence or Earl Au showing (West subzones 1 to 4 and East subzones 1 and 2)	6596845	300343
1212	Greenlee Au showing/adit, Anderson Au showing, Anderson North Au showing	6593682	300949
1255	Hazel Claims Au showing (four veins: Center, South, Galena, and Contact Au zones), Vein No. 1 Au showing, Vein No. 10 Au showing	6594309	309189
1256	Melma Au showing	6594456	301558
1257	Athona Au mine or Athona Main zone and Athona East zone	6594944	302278
1258	Bearcat Au showing or Bearcat No. 1, No. 2, and No. 3 (A and B) zones	6599646	306007
1259	Murmac Lake Au showing	6597662	303651
1260	Northwest Minerals Au showing	6594652	309774
1261	Yah Au showing (Shirley Au zone, Crush Au zone)	6595801	308491
1264*	Nicholson Bay uranium mine (Nicholson zones 1 to 6)	6596047	305491
2077	MY Au-Cu showing, France Au-Cu showing, Magnetite Mt-Au-Cu zone	6600909	299660
2194	GIL Claims Au-U veins 1 to 3	6595756	297508
2307	JKS Au-As-Cu-Zn showing	6590449	292513
2308	Adrianne Au zones (zones 1 to 3) or On Golden Pond Au showing, Jane showing (Adrianne Trench 5 showing), Suzanne showing (Adrianne Trench 4 showing), Dubnick Vein 1 to Vein 3 Pb showing	6597471	301970
2319	Quartzite Ridge Au-Pt-Pd occurrence	6598142	293519
2378	MISSY Au showings or MISSY #1 Au showing and MISSY #2 Au showing	6600300	300038
2379	Drill hole LB-88-3	6595162	301075
2689	Pebble Island Au occurrence	6595069	298165
Tantato Domain			
1574	ELA Au showing or ELA prospect shaft or ANDY Au prospect	6575435	410802
1575	Algold Bay Au showing or MEL-CEC Au showing/zone, Algold Creek Au showing, Occurrence No. 3 Au showing	6574448	408074
1576	Thompson Island Au showing or Thompson Island Au zones 1 to 9	6571721	406946
1581	PIT Claim adit or Occurrence No. 6 Au showing (veins 1 to 5) and Occurrence No. 8 Au showing	6574030	415391
1683	Day Lake Au-Cu showing, Tent Au-Cu showing	6598056	451273
2174	Occurrence No. 5 Au showing and exploration shaft	6575053	411221
2175	Occurrence No. 9 Au showing (Occurrence 9 Main vein, Rob Au showing and AC Au vein)	6574945	406709

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2176	Occurrence No. 10 Au showing, Northeast Norite Bay Au showing, Old Cabin quartz vein, Ridge Au zone, North Pond Au zone	6572257	414401
2177	King Au showing (King North or Main Au showing/zone, King South Au showing/vein), Lad Au showing, Cole Lake and Cole South Au showing	6571725	414674
2178	Occurrence No. 11 Au showing, Occurrence No. 25 Au showing	6575445	409063
2182	Stoll Island Au showings	6572921	409793
2183	North Norite Bay Au showing	6572314	410618
2184	RN-15-13 Au showing, RN-15-4 Au showing	6571892	408819
2185	RN-15-22 Au showing	6572939	409035
2186	Stoll Point Au showing	6571403	408570
2187	Dardier Island Area Au-As occurrence	6570370	407785
2188	Occurrence No. 26 Au showing, Occurrence No. 27 Au showing	6571119	411414
2328	Drill hole G-5, and Dog Creek C Zone Au anomaly or dispersion train	6584672	411430
2329	Drill holes G-1 to G-3	6578495	410953
2612	Pine Channel Anomaly JJ Au showing	6574055	444080
Zemlak Domain			
1281	Neeley Lake Au prospect/shaft or SMDC AU-1 showing	6619001	303323

Hearne Province

SMDI #	Name	UTM Northing	UTM Easting
Mudjatik Domain			
1042	Centipede Lake trenches	6240662	360740
1043	Rex Silver Mines A Grid Au showing or Sunlite trench	6244171	371153
2074	Ithingo Main Au zone (includes Money Pit, Muskeg Pit, Hilltop Pit, and Pit 106 Au zones), Buller Au zone, Riverside Au showing, McMatt Pit	6298936	345557
2353	Nirdac Creek Au showing, Nirdac Creek boulder train	6649717	580325
2354	Nirdac A Grid Au showing, A Grid boulder train	6647134	578193
2355	McLintock auriferous felsenmeer	6650859	589589
2356	Lac Au-Pb-Zn showing and Trench DDT	6650313	583445
2357	Grab sample EN40-0099	6647264	589396
2358	Roumap Lake Au occurrence	6646937	589917
2360	Boulder sample EN5B-0880	6650227	587774
2462	Grab sample NR-10	6291716	347484
2463	Christopher Lake Au showing	6255836	322333
2464	Rex Silver Mines B Grid Au showing or JD trench	6245119	371508
2479	Sterny Au zone, North Sterny Au zone	6301704	345184
2525	Nigel's Au showing, New Gold Au showing	6258905	366922
Virgin River Domain			
1111	VIR Claims Au showing	6346344	326412
2686	Grab samples 5031, 34079, and 713325	6349568	325575
2687	Grab sample 32122	6356743	327219
Wollaston Domain			
0616	Moss Berry (Parker) Island Au-Cu occurrence	6455150	587033
0937	Beaverdam Au prospect	6236086	461720
0995	Art Cu-Au showing	6313386	486859
1875	Drill hole ZAB-2-80	6148758	387219

SMDI #	Name	UTM Zone 13, NAD 83[1] UTM Northing	UTM Easting
Reindeer Zone			
Rottenstone Domain			
0811	Drill holes KIE-8, -12, and -13	6169939	500384
0888	Como Lake Au-Ag showing (veins 1 and 5), Slocan quartz vein (Py)	6203408	538572
0961	Kerr Addison drill holes D-2 to D-4	6248789	559438
2300	Cook Au-Pb showing	6194894	507122
2301	PA Au-Mo showing	6195265	507260
2322	CBS 8910 Au occurrence	6201616	535119
2623	Thriller Mo zone, Native Au-Mo zones	6154050	499790
2624	Sample RB-10-04-02	6153061	498948
La Ronge Domain			
0422	VG Au showing or TAI Au showing, Skipper Au showing	6225770	576147
0423a	Weedy Lake Au deposit A zone or Kewatin A zone	6230949	575228
0423b	Weedy Lake Au deposit B zone (Main and Northeast subzones) or Kewatin B zone	6230949	575228
0423c	Weedy Lake Au deposit C zone or Kewatin C zone	6230949	575228
0423d	Golden Heart Au zone (high-grade portion of Weedy Lake Au deposit B and C zones)	6230949	575228
0423e	Weedy Lake Au deposit D zone or Kewatin D zone	6230949	575228
0424	Discovery Point Au showing	6232450	568880
0425a	Komis Au deposit (A to E zones) or Komis Au mine	6229812	568234
0425b	EP Au zone or Eric Partridge Au zone, and the Riddle till	6230002	568523
0426	Pipe Au showing or McKenzie Au showing, DY Au showing, No Dirt Au showing, 25 showing, 26 zone showing	6222250	572877
0427a	Oven Lake Au showing or Augustus Au showings	6225839	565347
0427b	Earl Lake Au showing or Augustus Au showings	6223614	567384
0427c	Clear Lake Au showing or Augustus Au showings	6225386	564009
0427d	Corner Lake Au showing or Augustus Au showings	6225769	566780
0452	Greenhill Lake Au showing (A to E veins) and Trench No. 13 Au showing	6238369	567702
0453	Wedge Lake Au deposit, Trench 12 zone (Wenzel showing, A zone), T-6 Au zone (Trench 6 Au zone, No. 6 Au vein, B zone), Trench 20 zone (C zone)	6234350	571552
0476a	Augustus A zone Au showing or Henry Lake Au showing, Fisher Ag-Au showing, Buller Au showing	6252905	596614
0476b	Henry Lake (south end) Pb-Ag-Au occurrence	6245397	596956
0501	Discovery Au showing, North zone Au showing, South zone Au showing	6273786	624945
0513	Jenny Point Au-Ag showing	6264202	608380
0619	Contact Lake Au mine or Bakos Au deposit or BK-1, BK-2, BK-3 zones	6141414	507983
0619a	B-1 Au showing	6141414	507983
0619b	Keya Au zone	6141414	507983
0755	East Eureka Au-Cu zone or Main Eureka zone or Hanson A showing, West Eureka Au-Cu zone or Hanson B showing, Hanson Cu showing	6146143	507307
0765	Upises Au showing or Upiesaw Au showing	6143171	504482
0766	Socko-Tyon Au showing	6144269	512793
0767	Teneycke Lake area trench No. 4 or Teneycke North showing; Highway Au zone	6143543	505185
0768	Ramsland North Au occurrence	6145901	510013

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
0769	Ramsland Centre Au showing, Point Area Au showings (84-1 to 84-7)	6145654	510101
0770	Ramsland East Au occurrence	6145531	510716
0771	Ramsland South Au showing or Point 84-7 Au showing or Hill 300 Au showing, Area A Au showing, Area B Au showing	6144881	510103
0887	Star vein No. 2	6203513	543165
0889a	Fork Lake Au deposit (portion of), Kahn #18 Au vein, Kahn #28 Au vein	6204583	544974
0889b	Star Lake Au mine (Starrex 21 Au zone, Starrex 29 Au zone)	6204583	544974
0890	Star Lake Au mine A or Main, B, and C zones or Rush Au zone or Pie Au zone, Star Lake D zone or Ducksnest Au zone, Squarepit Au zone	6205785	544667
0891	Tamar Au showing or Vein 23	6203061	544296
0901	Mallard Lake Decade Au deposit East or Main Vein, Mallard Lake deposit Lake Au vein/zone; Decade decline, Argyle decline, New Decade decline	6207337	545205
0902	Jojay Au deposit (Red or Main zone or CMS-C zone, Blue, Orange, Purple, and Footwall zones)	6212047	546194
0903a	Tower Lake East Au deposit (West zone lenses 1 and 2, South lens, Upper East lens, Lower East lens, 22 zone, Rusty zone, Limy zone)	6226972	558139
0903b	Tower Lake East Au deposit (PAT Au zone and PAT A and B zones)	6226972	558139
0903c	Tower Lake West Au deposit or Trenches 2 to 5 zones, Byers mineralized zone - Fortuna Au showing	6226972	558139
0904	PUS Au showing (possible extension of JoJay deposit)	6216394	547876
0905	Allen Au veins (zones) 1, 3, 4, and 5 or Breyenton Lake showings 1 and 3 to 5	6211397	551566
0906	Kaslo Au showing, K-3 Au occurrence	6226516	554006
0907a	Lake Au showing	6206719	548070
0907b	Island Lake drilled Py-Po-Gf conductors	6207340	542503
0909	Exit Lake Au showing or Ahole Lake Au showing (extension of Jojay deposit)	6219343	548879
0910	Hayes Lake Au showing	6218733	549612
0911	Augustus Withdrawal Au showing, Little Lake Au-Cu showing, HT Au showing, PR Au showing	6220449	550939
0912	Allen Au vein (zone) No. 2 or Breyenton Lake showing No. 2	6212120	552509
0913a	Centre Lake Au showing, part of Centre Lake Au occurrence	6226955	552017
0913b	West Lake Au showing, part of Centre Lake Au occurrence	6226918	551466
0914	Drill holes Nos. 1 to 13 (Tower Lake area Trench No. 3 zone)	6226977	556173
1785	‘A Wall Of Sulphides Outcrop’ Cu-Au showing	6264083	608588
1877a	Rod Main Au zone or Rod C Au zone (portion of Jolu Au mine)	6206622	544866
1877b	Rod South Au zone or Jolu Au mine	6206622	544866
2065	Twin Au zones or Twin North Au zone and Twin South Au zone	6234492	568933
2066	Joyce Au zone or Transom South Au deposit	6197651	541314
2073	Fork Lake Au mine or Jasper Au mine or Jasper's Pond South Au showing or Transom North zone (Jasper's Pond showing, James showing, and Muskeg zone are also known as the J1, J2, and M1 ore shoots)	6199951	545543
2073a	James Au zone or Transom Lake North Au deposit (portion of Fork Lake Au mine)	6199765	545458
2137	Bog Side Au occurrences	6204826	544590
2267	Road Zone Au showing	6182875	525587

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2268	Campbell Au showing, Brainy Au showing, Poppa Au showing, Hailstone Au showing	6182409	525084
2269	D.J. Au showing, Joe's Au showing	6181600	524165
2270	Yates Au showing	6181745	527806
2271	Wilson Lake E-E' and F-F' anomalous Au areas	6192453	533664
2272	Wilson Lake G-G' and H-H' anomalous Au areas	6192664	532985
2273	Wilson Lake A-A' anomalous Au area, B-B' anomalous Au area, C-C' anomalous Au area, D-D' anomalous Au area	6193901	533062
2277	North Contact Au zone (part of), Zak Au-Cu showing	6143953	510123
2278	Turtle Lake Au showing or Quartz Vein Au showing (Quartz Vein No. 1, Quartz Vein No. 2)	6138878	507390
2279	Shear No. 1 Au showing, Shear No. 2 Au showing, Turtle Lake auriferous condemnation structure	6139496	507230
2285	JB Au-Cu showing	6177235	516219
2286	BD1 Au showing, BD2 Au showing, MH-2 Au showing	6177070	521034
2287	Dickens Island A Zone Au showing, Dickens Island B Zone Au showing, MH-1 Au showing	6177690	521536
2290	Rainbow Lake Au showing, MZ Au showing	6177374	520021
2291	Ewan Au showing, Davidson Au showing or Cogema Kwiatkoski Lake Au showing	6166520	510176
2292	Blackstone Au showing	6165592	510090
2293	‘West zone’ geochemical Au anomaly or drill holes LR86-01 and -02	6177054	517476
2294	Vidgy Lake Au showing	6160575	504377
2295	Beranek North Au showing or Hood Lake Au showing	6157669	504029
2296	Bartlett Lake (north end) Au geochemical anomaly	6154238	503857
2297	Shandy Lake Au showing	6178897	527197
2302	Aud Lakes Narrows Au showing	6192736	525372
2303	Texas Grid Au showing	6183730	523596
2310	Kidney Lake Au showing, Kidney Lake North samples and dispersion train	6223544	570749
2310a	Komis Road showing	6223528	571647
2311	Toadstool Grid Au showing	6223468	549971
2312	Blindman Lake Au showings (BML #1 quartz vein (Main zone) and BML #2 to BML #4 quartz veins)	6205698	545222
2313	Transon West Au showing/zone	6200087	543789
2314	W B Lake Au showing (northeast extension of Blindman Au showing)	6205917	545411
2315a	B Zone Au showing, Dyke Hill Au showing, C Zone Au showing	6205084	545575
2315b	Box Canyon Au showing	6205084	545575
2317	Kenwood Au showing	6233799	564141
2320	Weedy Lake Extension Au showing (extension of Weedy C zone)	6230185	575741
2321	Vein Zone Au-Cu-Mo showing	6200472	547932
2323	Nibs Au showing (East and West zones)	6204515	552654
2324	Drill holes M-1 to M-4 and M-9	6203540	551244
2330	Gina Lake Au showing	6196002	540132
2332	B-18 Au showing	6205547	551029
2333	North Shore Au showing, Drew Au showing, Ingot Au showing	6206816	548502
2334	Samples 16712, 16735, and 16736	6205445	550285
2340	Charlie's Chance Au showing or Cogema Kwiatkoski Lake Au showing	6166676	510735
2341	Granite Hill Au showing	6167294	510873
2342	Sol Hill Au showing	6151056	505808

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2343	S-97953 Au-Mo veins 1 to 4	6196915	541859
2345	Contact Lake (southeast of) Au occurrence	6203521	543980
2346	Samples FO60-1012 and FO60-1022	6202108	547723
2347	Area E Au showing	6205231	550427
2348	Area A Au showing or Duncan Au showing, Area B Au showing or L-36 Au showing, Area C Au showing, Area D Au showing	6206888	549368
2349	Discovery Au zone (or Cameco Area A Au showing, Cameco Area B Au showing, Cameco Area C Au showing or Asbell Bay A, B, and C Au showings), Bornite Cu zone, North Cu zone	6188256	534619
2350	Ross Au zone/showing	6199457	545635
2351	Slushy Au showing/zone	6199787	544677
2352	John Au showing/zone	6199023	545501
2363	Duck Au showing, sample 1906-ML #2	6148583	505916
2367	Kiwi Lake Au showing	6168342	509437
2368	Onipoowuk Lake (southeast shore) Au occurrence	6164779	504897
2369	Beranek South Au showing, Beaver Pond Au showing	6155474	503909
2370	Bartlett Lake Au showing	6154391	501560
2377	0102 Au showing	6221208	552346
2391	Roxy Au zone or Jasper's Pond North Au showing	6200539	545554
2392	Jasper North Au showing	6200199	545627
2393	CP Au showing	6203164	545353
2397	Drill holes BB87-02, -04, 05-07, 09-11, -15, and -16	6225752	569626
2398	Camp Au zone	6228901	569299
2399	Drill hole OV-87-4	6226235	564927
2400	Weedy Northeast Au showing	6232383	575874
2401	Hattie Au showing	6233807	575935
2403	Grab Samples G-1, -3, -4, and -5	6240678	567149
2404	Grab samples 5068 and 5073	6245597	590581
2405	Daiwan's Han Au zone	6251979	595315
2406	Daiwan's Shepherd Au zone	6249366	593246
2409	FC-9 Au occurrence, A-1 Au occurrence or AL Au showing	6223677	559133
2410	Boulder sample R-83-6	6224118	557453
2411	Hump-Kirk lakes trenches, DP Au showing, Muskeg Au showing	6229935	559994
2413	Mushroom Lake Au showing, HR-27 Au showing, Wally's Au showing, Memorial Au showing	6227921	555023
2414	Sheba Au showing, HR-7 Au showing, Soloman Au showing, Bob's Vein Au showing, Line 35 Vein Au showing	6229211	556730
2415	North Narrows Au showing, Blob Lake Au showing	6227680	553095
2416	Rosetta Lake Au showing, MR-15 Vein Au showing	6227539	554217
2419	Samantha Au showing or Mag Lake Au showing	6180875	521643
2421	Joey Au showing	6183960	526033
2422	Harmony Au occurrence	6183282	526455
2423	Digger Au occurrence	6183749	526940
2424	Smurfette Au occurrence	6184060	527199
2425	Happy Au occurrence	6183037	526805
2426	Blue Au occurrence	6183628	527324
2427	ML Au showing, MLX Au showing (extension of ML showing)	6205215	546285
2428	6 East Au showing (northeast extension of the Star Lake structure)	6205843	547179
2430	CBS 5969 Boulder Au showing or samples H-3-2 and H-3-4	6225132	554575
2431	Paramecium Au occurrence, Boot Lake Au occurrence	6225399	553710
2432	RMC-29 Quartz Vein Au showing or RMC-29 Vein	6230490	559883
2434	OWL I Au showing, OWL II Au showing, OWL III Au showing	6142061	506540

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2435a	Macdonald 1 Au showing	6215538	545932
2435b	Macdonald 2 Au showing	6215255	545468
2436a	B.C. 1 Au showing	6210659	546451
2436b	B.C. 2 Au showing	6209955	547186
2437	Grab samples 102578 and 102579	6225779	556741
2438	BR-20 Au showing, 700 Au showing	6233361	559481
2439	BC-1 Au showing	6232476	560338
2440	SH-19 Au showing, Rain Zone Au showing	6233763	559476
2441	Jenzaia Au showing (No. 1 or North-South vein, No. 2 or East-West vein)	6216095	545926
2443a	PAM Au zone and North Tensional Vein Au showing	6206755	545731
2443b	Blindman Au zone	6206944	546075
2443c	East Au zone	6207100	546160
2443d	18+50E Au zone	6207226	546419
2443e	22+00E Au zone	6207509	546849
2445	Walter Au showing	6145338	506887
2446	222 Vein Au showing	6233113	561637
2447	Boot Vein Au showing	6230993	560462
2448	22 Vein Au showing	6228211	558277
2449	Zone 1AV Au showing, zone 2AV Au showing, zone 3AV Au showing	6229264	560607
2450	K-5 Au occurrence or drill hole K88-5	6226750	552934
2451	New Kaslo Au occurrence or NIKO Au deposit	6226633	553435
2452	DJ Structure Au anomalies	6218945	561254
2453a	Grizz Au showing	6223706	551798
2453b	Norvis Au showing, A.P. Au showing, 273 Au showing	6223426	551663
2492a	Aligar Au showing, Big Buddy Au showing, Little Buddy Au showing, Luvy showing, Professor showing, Cranberry showing, Goldpan showing	6225156	576348
2492b	Ginger Au showing, Mufferaw Au showing, No Name Au showing, James Bond Au showing	6225156	576348
2492c	Coconut 1 Au showing, Coconut 2 Au showing, Thurston Au showing, Mary-Ann Au showing, 302 Au showing	6225156	576348
2493	MelMac Au showing	6229113	563039
2494	Bar Au showing	6227580	563872
2496	Lily Au showing	6143898	512653
2497	Drill hole HAY89-1	6172897	513600
2498	Schwartz Au showing	6181279	521954
2499	Grab sample DK90-859	6174578	516752
2500	Grab samples DK90-1044 and DK90-1069	6173896	516354
2501	Firepit Au showing, Thunder Hills Au zone, Creek Au showing, 418 Au showing, Zero Au zone, Blue Au zone, sample DK90-890	6172225	515906
2502	Transom Central Grid Au showing and drill holes TC-1 to TC-4	6197936	542005
2503	WM Area Au showing (northeast extension of the Star structure)	6205653	546800
2504	Pointy Lake Au showing (Pointy Lake Structure zone), Thin Structure Au zone	6204814	546358
2505	Kamp Au zone	6203378	545073
2506	Brinsdon Lake Au occurrence	6221461	555244
2507	Grab sample 956	6216595	554356
2508	Grab samples 41212 and 41217	6145430	506324
2513	Randy Au showing	6145526	508099
2514	Teacher's Point Au showing	6182888	527572

SMDI #	Name	UTM Zone 13, NAD 83[1] UTM Northing	UTM Easting
2515	V.G. Au showing	6183384	527918
2516	Sulphide Island Au showing	6183141	528511
2517	P.R. Au showing	6184347	528503
2518	Boulder Au showing	6201055	544716
2519	Ross Au Zone extension (DMZ Au showing, DMZ.W Au showing, DMZ.X Au showing)	6199556	546224
2520	Fly Au zone	6226439	564131
2521	Curry Au showing, Curry II Au showing, Ericks Au showing, Rain Au showing, Hail Au showing	6142059	505556
2523	TBO Au showing	6222522	551001
2527	Compass Lake Au showing	6237456	587244
2528	Broken Hammer Au showing, Broken Hammer North showing, Broken Hammer North Extension showing, Mo Vein showing, Rusty Hammer Au showing, Quad Au showing, Bears Cave erratic	6235060	584986
2537	Dog Creek Stock 4 Au showing and the Dog Creek B Zone dispersion train	6231724	567928
2538	Gold-Smith Vein Au showing	6230724	567272
2545	Benoir Au showing	6185395	515753
2554	That Au showing, Hatt Lineament Au showing, Some Creek Au showing	6142463	506452
2555	Birch Hills geochemical Au zone, Roland Au showing	6181038	516431
2556	McLeod Au zone (Main or East zone, West zone)	6201159	548566
2571	MacKay Lake (west of) Au occurrence	6145210	502020
2572	Muskeg Lineament Au showing (includes Area B-3 Au showing, Area 15-4 Au showing), True North Au showing, Mark Au showing	6141939	507736
2587	Henry Lake trench 91-1 Au-Pb-Ni showing	6256461	601862
2588	MacKay Lake (southwest end) Au occurrence	6144406	502109
2589	Grab samples 2101 and 2104	6205271	548520
2598	Trench samples 56908, 56911, and 56913	6262241	610330
2601	Grab samples RS-10-10-2 and SM-9-25-1	6187176	526101
2602	Grab sample DM-10-8-3	6186116	524628
2603	Sample MM-10-10-3	6186688	527148
2604	Sample KA10-8023	6206021	551856
2605	Visitation Au showing	6216373	556312
2606	Rosie Au showing	6217770	556726
2607	Samples 4351-D-1647, 4351-D-1915, 4351-D-1930	6170191	517468
2617	Bay Au zone (East Trench zone, CLL 1 Trench zone, 40-A Trench zone, Shear Trench zone)	6180850	515735
2619	Fleming Lake Grid Au-in-till anomaly	6235036	586846
2622	Cabin Au zone	6148239	502405
2625	Devil Au-Cu showing, Little Devil Au-Cu showing	6171917	516256
2626	Arseno Au showing, West Arseno showing, Silver Au showing	6172602	517441
2627	Roy Lloyd mine; Bingo structure (Bingo North, Bingo South and Bingo East Au showings)	6172939	516759
2628	JKL Au showing, Grunge Au-Cu showing, BMS Au showing	6173035	517404
2629	183 Au showing	6173347	518084
2630	Gabbro Au showing	6173934	518064
2631	Lonely Au-Cu showing, Pond Au showing	6173311	517037
2633	Contact B Structure Au showing or drill hole FO92-68	6203008	548060
2650	Gull Au occurrence or Gull North vein, Gull South Au occurrence or Gull South vein, Ben Au occurrence	6237417	586866
2659	Grab sample R-16039	6193544	525993

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2660	88 Gold showing	6176656	518349
2661	GB Gold showing	6188655	530145
2662	This Au occurrence, 733 Gold-Copper zone	6142770	505274
2663	New Pit Au-Cu showing, Pitmaster Shear Au showing; 14 North Cu-Au showing	6143480	504394
2666	Drill holes LD94-1 and LD94-2	6141624	503306
2669	Italy Lake Au showing or Partridge Contracting Au showing, Claim Line North showing, 1712 showing	6192052	533928
2678	Lakeshore Shearzone Au showing; Gold Anomaly CC 557	6232884	579620
2682	Trench 750N Au showing	6143262	502249
2683	Grab sample WS95R-105	6144313	503163
2684	Grab sample FF95R-106	6143788	503954
2691	Linda Lake Au showing	6143613	510194
2700	Byers Au mineralized zone or Phantom Au-in-till anomaly area or Phantom Au showing	6226574	558438
2701	Drill holes HL-1 to HL-14; Muskwa Au showing	6233083	559554
2715	Vulture Au showing	6139371	506052
Glennie Domain			
0247	Knox Syndicate KAY Claim No. 3 drill hole No. 3	6093497	580029
0248	Brownell Lake Pluton As occurrences	6092289	584925
0249a	S-103612 Au-As occurrence	6092563	581398
0249b	Point Au showing, Point 2 Au showing, Island Au showing	6092591	581202
0269	CBS 2180 drill holes DES-78, DES-79, and DES-111	6068000	599493
0341	SAD Au zone	6117090	592839
0382	Seabee Au mine, Seabee No. 2 zone/vein, Seabee No. 5 zone/vein, 161 zone, Currie Rose Option 10 Vein West Extension	6171924	587199
0418	Sucker Lake (east of) Au occurrence	6232870	595486
0488b	Deep Bay–East Gladman Lake Cu trend, West Gladman Lake beryl occurrence	6236917	630393
0674	Wapa No. 13 Au showing	6087823	559054
0732*	Anglo-Rouyn mine (open pit orebody A, orebodies B and C) or Moose Point Cu-Zn showing or Rio Algom mine, and Anglo Rouyn mine Tailings Recovery Project	6127496	499735
0754	Preview North Au zone/adit, Preview South Au zone/adit or PAP C zone	6140773	511783
0756	Lucky Strike Au showing	6135600	506515
0757	Galena Au-Pb showing or Bee zone Au showing, Island zones As-Au showing or BEE 9 As-Au showing	6134333	506904
0758	PAP A zone or PAP North Au showing or Caldwell Au showing, PAP B zone or PAP South Au showing	6139780	510167
0759	South Camp Au showing, Discovery Au showing, Studer S+O Au or Studer Main Au or DEE-2 Au or Dee South Au showing	6136127	507570
0760	Joe Au showing	6142413	512376
0761	GEM Au showing	6132659	502467
0762	Main Camp Au showing or DEE-2 North Au showing, North Camp As-Au showing, Pyrrhotite showing	6136684	507921
0763	Sulphide Lake or Studer showing (A, B, C, D, E, and F zones), Camp Au zone, 4088 Au zone, Chalcopyrite Cu-Au zone	6133928	504509
0764	Clearwater A Au showing or Availl Au showing, Clearwater B Au showing or Vern Au showing	6139470	509588
0886	Garskie Au vein, Coffyne Au vein	6204576	544281
1147	PAP (Preview) SW Au deposit or PAP K and L zones	6139780	510167

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
1148	Anglo American Corporation drill hole 13-32-65-21W2	6057831	491759
1728	AMP Au showing	6094263	584657
1729	M-10 Au showing	6091459	569038
1730	Alex Au showing	6097900	565617
1731	Duck Lake Au showing (Main and Lake zones)	6154948	573702
1732	Irving Lake Au showing, Irving Lake South Au showing	6155577	562436
1869	Wood Lake Au showing or Kirkland Au showing S-5 or Cliff zone	6124268	615387
1876	Drill holes 75-LC-1 and -2, MEP-73-2 and -3, and SYD-84-1 (extension of GEM Au showing)	6131546	501128
1878	Grab sample RR10-1514	6157436	611067
1879	Grab sample RR10-1512	6158087	611121
1880	Grab sample RR10-1536	6155229	610615
2217a	Olson Au showing	6093494	579852
2217b	Spartan Au showing	6093712	579955
2218	Tuscan Au showing	6092725	581769
2219a	Carina Au showings - Abaco Au showing/ zone	6092335	580744
2219b	Carina Au showings - Talco Au showing/ zone	6092365	580690
2219c	Carina Au showings - Emco Au showing	6092426	580636
2219d	Carina Au showings - Dosco Au showing/ zone	6092619	581077
2219e	Carina Au showings - Kaldo Au showing/ zone	6093194	580391
2219f	Carina Au showings - Siskin Au showing, 2 Vein Au showing	6092460	580813
2220	Juba Au showing	6094708	582017
2221	Jena Au showing	6095025	582456
2222	Kalix Au showing	6091682	585541
2228	Boundary Au zones or East Boundary zone, Bruno VG Au showing	6172799	587654
2229	Pine Lake Joint Venture Au showing	6172977	588803
2230	Currie Rose Vein Au showing or Dan's Au vein, Doug Au vein	6172848	586989
2231	Laonil Northwest Au showing or Pigeon Southwest Au showing	6172208	584364
2232	Laonil Island Vein Au showing; Daves Vein or Seabee Vein 2d Structure	6171032	585872
2233	Santoy Lake A, B, and C Au showings (veins 1 to 8) or Santoy Lake Gold showing zones 1 to 8	6172188	595353
2234	Porky Lake PL-1 Au showing or Porky Lake West Au zone; Porky Lake Main Au zone	6175098	585076
2235	Porky Lake PL-2 Au showing or Zimmerman 1984 Au showing or Porky Lake East zone, Porky Lake South Shore Au showing	6174726	586602
2236	Pigeon Lake P-1 Au showing or Pigeon Lake East Au showing	6177574	588290
2237	Pigeon Lake P-2 Au showing	6178253	588189
2238	Pigeon Lake P-3 Au showing	6177908	587969
2239	Pigeon Lake P-4 Au showing or Pigeon Lake West Au showing	6176969	587395
2240	Munro Lake Au showing or M-7 Trench Au showing; Nugget Au showing; Wire Au showing	6172260	591508
2241	CAR-1 Au showing or CARR Au showing	6175249	599475
2244	DD Au showing	6165247	598933
2245	Georges Lake Au occurrences or Jay Lake Au occurrence (10 sites), Nigel's Au show, VG Au show, Shoreline Vein Au show, Camp Vein Au show	6158351	600246
2247	Western Zone Swarm Au showing (Western Zone showing (includes Nigel and Ed's Au showings), Quartz Swarm showing, Royex Quartz Swarm showing)	6137381	611751

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2248	Main Quartz Swarm Au showing or Main Zone Au showing or Jill Au showing and Chico Au showing (part of Western Zone Swarm Au showing)	6138151	612824
2249	Royex Quartz Swarm Au showing or Royex Au showing, Roland Au showing	6137334	612316
2254	Robinson Lake Au showing	6154876	581840
2255	Truscott Lake Au showing No. 2 or Island Au showing	6183761	586858
2258	Versary Au zone	6118714	617035
2265	C-1 Au showing, C-2 Au showing, D-1 Au showing, or Triangle Lake Au showings	6172393	590457
2266	F-1 Au showing	6172617	589352
2274	Jahala lakes (west of) Au occurrence	6116876	545230
2275	Few Lake Au showing	6122726	545912
2276	Boundary Au showing (Boundary North Au showing or E showing, Boundary South Au showing or D showing), Trench 165-23	6136090	500986
2281	Cameco Grid 86-2 Au showing	6146201	517248
2282	Freestone Lake Au showing or Grid 86-1 Au showing	6146419	517493
2284	Quartz Vein 87-1 Au showing, Quartz Vein 87-2 Au showing, Tourmaline Au showing	6142911	513359
2289	South Smith Bay (north of) Au occurrence	6149803	520797
2339	Grab samples PE80-208, 209, 235, 239, and 607	6147255	517823
2364	Lynx Lake (southwest of) Au geochemical anomaly	6132164	499471
2365	Rio Tinto R-1, R-1A, R-1B, R-2, and R-2A, R-6 to R-11 trenches	6130965	507544
2366	Trenches of Anglo Rouyn mine horizon	6129354	505131
2375	Sample 11112	6091211	574769
2388	Simon Lake Au showing	6154602	563414
2389	North Axe Lake Au showing	6159990	570044
2390	Leland Lake South Au showing or Dock Au showing, NW Point Gold occurrence	6155371	565297
2495	Grab sample MR-33b or A-1 structure/zone	6136462	502957
2530	Studer B Au showing, Studer C Au showing	6139521	500123
2536	Julie Au showing	6136097	612312
2542	MAC'S Au-Cu zone/showing	6160757	603975
2543	Uskik Lake Grid Au zone/showings or BR-106 Au showing, SR-10 Au showing, CR-80 Au showing, Footprint Shear Au showings No. 1, No. 2, and No. 3	6156696	604878
2564	Grab samples 50212 and 50213	6114291	614673
2565	Grab samples 36968 and 37158	6113888	615834
2566	Grab sample 50412	6109844	613724
2567	Grab sample 50509	6109190	614733
2568	Eureka Au occurrence (or grab sample 50498)	6110126	617421
2576	Tourma Au zone veins (or grab samples A12961, A12969, A12985, and A12990), A12751 Au showing (or grab sample A12751), Meech Au vein	6112687	616025
2577	Carb Au zone (grab samples A13201 and A13202), Ed Au vein, Tahoe Au zone (or sample A12770)	6112271	615469
2578	Second Lake (south end) grab sample A13149	6106270	615429
2634	CJR100 Au showing	6174216	594750
2642	D-Day Au showing	6110559	615070
2643	Second Lake (northeast end) grab samples 34181 and 34182 or Second Lake Au showing	6108059	616447
2644	Trenches TR92-1, TR92-2, TR92-3, and TR92-4; Terra Au zone or Three-Way zone	6108757	615932

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2645	Tim's Au showing, South Lariviere Au showing	6109074	616225
2646	Orchid Au zone or Homestake trench TR92-6	6110066	616324
2647	Till Au zone	6110908	616585
2676	Drill hole S-501	6170291	584377
2688	DAWN Claims drill holes Nos. 95-01 to 95-04	6133220	507310
2698	Drill hole CSP-3	6119015	479376
Flin Flon Domain			
0005	Newcor Au mine	6068680	698617
0007	Dodo Au showing	6068242	697096
0008	Angelski Patmore Au showing	6067070	695032
0009	Phantom Lake Au mine	6063928	701032
0010	McMillan Au mine, McMillan Au veins 1 to 4	6065010	701719
0011	Bootleg Au mine or Rio Au deposit (includes WC zone, AJ zone, Phantom Lake Granite Dyke zone, and B zone)	6067745	699178
0012	Phantom Lake (west of) Au showing	6068048	701135
0013	Unity Au-Cu showing	6068717	699458
0014	Cor Au prospect	6069124	698848
0016	IMC-A showing	6063771	701703
0017	IMC-B Au showing, Barber-Bell Au showing, MK Shear Au showing, Bell Shear Au showing	6064064	699914
0018	IMC-C Au showing or IMC Phantom Lake Au showing	6066524	701652
0019	Yellow Jacket Au showing	6063433	701736
0020	Dee Au showing	6064228	702203
0021	Wekatch Lake Gold Mines adit, Wekatch vein No. 2	6066159	696864
0023*	Coronation Cu-Zn mine	6052730	694105
0062	AL Claim No. 6 drill hole (barren); Beaver Claim No. 8 showing	6076895	698185
0063	Beaver Claim No. 32 Au-Cu-Zn showing	6075211	698616
0071*	Flin Flon mine	6072214	700842
0072*	Callinan deposit, Callinan North deposit, Callinan South deposit, Callinan East zone	6075222	700261
0086	Prince Albert Au mine or Monarch Au mine or Pamon shaft	6067041	675746
0087	Mosher South Au showing, Mosher East Au showing	6062285	689498
0088	Derby Au showing or Hoodo Au showing	6064576	682769
0089	Kent Au showing or Lode Au showing	6069960	676555
0090	Victory Exploration adit and shafts or Amisk Gold Syndicate (AGS) Au showing or Amisk Gold mine	6065792	675177
0091	Duplex No. 1 Au showing; Martin Au showing; Duplex Southwest Claude Au showing; Dave's Point Au showing	6068413	676526
0092	Fox Claim No. 2 drill hole	6057866	685195
0094	Sonora Au showing	6060770	673326
0095	Bud Au showing	6059579	672116
0096	SYE or Sunset Exploration shaft or SYE Au showing	6067860	687383
0097	Hannay Island showings	6062929	674768
0098	Beaver Au showing and shaft	6064149	675886
0099	Flash Au-Cu showing	6063568	691309
0100	Royal Au showing	6069144	679362
0101	Mitchell Au showings	6068931	686354
0102	Grand Lode Au showing or SMDC C zone, Lucky Strike Au showing or SMDC B zone, SMDC A zone	6059580	683958
0103	Drill holes SR-8 and SR-9	6065371	675480
0104	Sunrise Exploration adits or Amisk Gold Syndicate (AGS) Au showing	6066498	686633
0105	TCA Au showing, Glory Hill Au showing, Clamshell Reef Au showing, Crayfish Reef Au showing, Dowada Island Au showing	6067040	677027

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
0106	Dyke Claims trench	6066474	689771
0107	Mosher North Au showing	6066991	688817
0108	MISSI Claim No. 8 trenches	6064162	677032
0109	Laurel Lake B deposit or SMDC B showing or Baker zone	6064531	676964
0111a	Laurel Lake D deposit or SMDC E showing or part of Electrum zone (Laurel D and E deposits)	6065083	676835
0111b	Laurel Lake E deposit or SMDC E showing or part of Electrum zone (Laurel D and E deposits)	6065083	676835
0111c	SMDC V Au showing	6065083	676835
0113*	Birch Lake mine	6061124	691341
0117*	Flexar mine or Birch Lake North zone	6062866	691554
0209*	Western Nuclear or Hanson Lake Cu-Zn-Pb mine or Parrex Syndicate Trust showing 3	6060751	638667
0296	Graham Au mine or Graham deposits No. 1 and No. 2 (zones 1A, 1B, 1C, 2A, and 2B), Frank Au showing	6073528	680673
0297	Golden Cross Au showing	6070785	677865
0298	Robinson Creek Au showings (Vein zone, Bleiler zone, and Quartz zone), Jack Au showing, Wasp Au showing, Wasy Au showing	6071571	685833
0299a	Graham Au mine or Graham deposit No. 3	6073943	680227
0299b	Graham Au mine or Graham deposit No. 4	6073943	680227
1783	Drill hole SAM78-8	6057917	696666
1784	Drill hole SAM78-7	6057508	696504
1859	Drill hole WAG-17	6061932	702790
1870	Drill hole SAM-37-79	6071415	685804
1882	Drill hole SAM-101-81	6070720	687712
2133	Laurel Lake deposit, Amisk Gold deposit, Laurel Lake North zone (Pyrite, Tetrahedrite, Chalcopyrite, and Sphalerite-Galena subzones) or Laurel Lake decline; Portal zone	6066079	676787
2169*	McIlvenna Bay deposit	6055315	640951
2197	Carol Au showing	6069310	674127
2198	Raine-Walker South Au showing, Raine-Walker North Au showing, Don Au showing	6068159	673974
2199	D.R. Davis trenches A and B	6059378	671711
2201	MIC Claim showing or Laurel SMDC W Au showing	6063378	677547
2202	Laurel SMDC A Au showing or Able Au showing	6064187	676870
2204	Wolverine Lake East Au showing	6070215	688217
2205	Konuto Lake North Au showing	6060104	689895
2206	Laurel West Au zone (part of Laurel Lake Au zone)	6066162	676721
2207	Laurel Lake (or Laurel East) Au zone (part of Laurel Lake Main zone); 203 zone	6065888	676839
2209	Samples DB5T-62 and DB5T-63	6069725	688327
2226	Wolverine North Au showing or Grid 83-3 Au anomalies showing, Wolverine West Au showing	6071601	684293
2227	Drill holes WV4-1 to WV4-3	6073286	683132
2280	Man-1 Grid Cu-Au zone or drill holes MBO-1 to MBO-46	6105362	674154
2304	Grab samples MK70-6305, -6306, and 6309	6051154	684516
2305	Grab Samples MK7A-6356 and MK70-6358	6048762	685063
2306	Fuzz Au showing	6070139	683350
2325	Drill holes PN7D-06 and PN7D-07	6065113	702612
2336	Grab sample PN7A-256	6065264	699055
2337	Claude Gold Shear Zone Au showing or Buller Shear Au showing, G-3 Au showing	6074062	678540
2338	Samples G-2872 and G-2873	6075757	678384

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2361	Drill holes AL5-15 to AL5-17	6060570	676958
2362	Drill hole AL5-14	6060781	676824
2383	87-1 Au showing to 87-7 Au showing (87-1, 87-2a, 87-3, 87-4a, 87-4b, 87-5, 87-6, 87-7), Bruce Au showing	6073653	679934
2433	Possible extension of Tartan Lake Au horizon	6081124	695085
2474	Wacker Shear Zone Au showing, PN7D-12 Fault Au showing	6066435	702427
2475	North Shear Au showing, North Shear 2 Au showing	6066964	701095
2476	Drill hole SR-89-7	6000270	629689
2483	K Au showing, Al Au showing, Ken Au showing	6073830	680499
2484	JP Au showing	6074080	682850
2489	Black Diamond Au showings (Fat Au vein, Anomaly Au vein, ML Au vein, and Franks Au vein), Blake Au showing	6069364	673122
2490	Plot Lake Au zone	6076826	669190
2510	Q 1146 auriferous grab sample	6072400	701533
2511	Samples 16505 and 22166	6085423	656239
2512	SD Au showing, Mark Au showing, K.W. Au showing	6074080	682850
2524	Lunch Stop zone Au showing (vein 1, vein 2, vein 3)	6066964	701095
2552	Drill hole CF-20	6050558	690313
2553	Drill hole CF-23	6059173	695660
2558	Golden Bear Shear Zone Au showing or Dingo-Dingue Vein Au showing	6070012	687043
2559	Don Au showing, DB Au showing, JH Au showing	6069851	692799
2560	Dob 7 Au showing	6070209	688808
2561	Conley Au showing, Doken Au showing	6071146	687533
2562	Swanny Au showing	6070917	688725
2563	Lana Au showing, KC Au showing	6075747	684284
2570	Rye Option Au-Cu showing	6071765	697676
2573	Getz Au showing	6060349	695646
2574	Boys Au showing	6059934	696075
2575	Drill hole AL91-4	6067532	680089
2579	Drill hole WC-1	6060092	673406
2596	Samples MC10-3013, MC10-3298, and MC10-218	6071515	688216
2597	KC-4 (1991) Au showing	6073335	687317
2668	Drill hole FFS-6	6070463	701153
2671*	Konuto Lake mine or Amisk Lake Cu-Zn deposit or Denare Beach base metal deposit; Hoffman Option mineralized zone	6060104	689895
2673	HBED Grid FFS-3 trenched Au showing	6068070	700937
2693	Drill holes NER-149 and NER-149A	6052221	688660
2708	East Site North of IMC-B Au showing, West Site North of IMC-B Au showing, Cain Ridge A Au showing, Cain Ridge B Au showing, McBean Structural Zone Au showing	6064064	699914
2726	Drill hole NER-155	6033950	700069
Kisseynew Domain			
0332	Drill hole DOT 1-69 or S-99217 Au showing	6121569	620849
0411	Dolly Au-Cu-Mo showing or Eccles Lake Au-Cu-Mo showing	6108397	694434
0810	Utie Island Au showing	6157933	526452
0908	KETA Au showing zone, No. 1 vein or No. 3 vein or B zone, No. 2 vein or A zone	6208273	554028
1862	Drill hole NAW-73	6156736	620854
2081	North Lake Au showing	6149794	509442
2257	Fish Dot Gold zone	6121374	618238
2259	Grab sample 4528	6120088	618714
2331	B-13 Au showing	6209039	553464

SMDI #	Name	UTM Zone 13, NAD 83[1]	
		UTM Northing	UTM Easting
2335	Contact Au showing	6209260	553791
2395	Street Lake Au showing	6237143	592912
2396	Kamuchawie Au showing	6238372	685567
2412	Grab sample 541RR-57 or zone C	6207604	557224
2418	Manitou Island samples	6168453	515658
2420	Greywacke Au deposit (North, Central, and South zones)	6177542	527990
2444	Scriver Lake Au showings (North and South zones)	6204701	552721
2491	Yak Au showing	6123839	617889
2522	Sako Pond Au showing or PIT Au zone	6171123	518739
2526	Cliff Au showing	6243546	591587
2539	Closure Lake Au showing	6176704	527594
2544	Hoover Au showing	6179850	531008
2550	Lyons Au zone, Area B Au showing, Nick's Lake Au showing	6176487	527386
2569	Wasp Lake Au showing	6181099	532759
2582	Naza Au-Cu showing	6095581	684914
2600	Cameco's Auriferous Quartz Vein showing	6186469	535434
2620	Stauffer Lake Au showing	6173095	533169
2621	Soil sample SR1G-9163	6177202	532475
2641	Aga Au-As showing	6092787	684709
2649	BC Au showing	6173079	526290
2692	Grab sample number 94-4-R or Asbell Bay Au-Cu showing or CRZ.1 Au zone, Crocodile Au zone	6187795	535110
Athabasca Basin (or sub-Athabasca Basin)			
1150a*	Cluff Lake D uranium deposit	6477941	235850
1693	Shasko Au showing, ’63 Au prospect (drill hole 63-1)	6569030	397306
1937	Harrison Island E-12 auriferous boulder	6464317	581670

[1] UTM co-ordinates are approximate.

* Denotes a showing that contains appreciable gold, but for which gold is not the primary commodity.

Appendix 2 – Mineral Deposit Category Definitions

Mineral Deposit Category	Definition
Producing mine	Commodities are currently extracted for sale. Total of the produced ore plus the published, defined Reserves/Resources must meet or exceed the minimum grade-tonnage standard[1].
Past-producing mine with Reserves/Resources[2]	Commodities were in the past extracted for sale. Past production must have met or exceeded the minimum grade-tonnage standard. Reserves/Resources of unmined material must also meet or exceed the minimum standard.
Past-producing mine without Resources[2]	Commodities were in the past extracted for sale. Production must have met or exceeded the minimum grade-tonnage standard. No Resources remain or the existing Reserves/Resources do not meet the minimum standard.
Developed prospect with Reserves/Resources[2]	Mineralization is present in three dimensions, as defined by a delineation drill/exploration program. Mineralization is present for a significant distance along strike and down-dip, with numerous intersections that meet or exceed the minimum grade-width standard. Published Reserves/Resources meet or exceed the minimum grade-tonnage standard.
Developed prospect without Resources[2]	Mineralization is present in three dimensions, as defined by a delineation drill/exploration program. Mineralization is present for a significant distance along strike and down-dip, with numerous intersections that meet or exceed the minimum grade-width standard. Reserve/Resource figures have not been published or the published Reserves/Resources do not meet the minimum grade-tonnage standard.
Prospect	Mineralization is present in three dimensions, as indicated by drill hole intersections, excavations, and/or surface rock sampling. Mineralization extends for a significant distance along strike and down-dip, with a minimum of three intersections that meet or exceed the minimum grade-width standard.
Occurrence	Mineralization is present in two dimensions, as indicated by surface rock sampling and/or isolated drill hole intersection(s). At least one sample must meet or exceed the minimum grade standard.
Bedrock geochemical anomaly	Mineralization is present in two dimensions, as indicated by surface rock sampling and/or isolated drill hole intersection(s). At least one sample must equal or exceed one-half of the minimum grade standard for an occurrence.
Mineral location	A mineral is present that may be of economic interest or is commonly associated with a mineral of economic interest. If reported, the analytical value would be below the minimum for a bedrock geochemical anomaly.

[1] Standards are defined in Rogers and Hart (1995).

[2] 'Reserves' or 'Resources', when capitalized, are NI 43-101 compliant for the purposes of this report.

Note: For polymetallic mineralization, combined individual values must meet or exceed the equivalent minimum value standard.