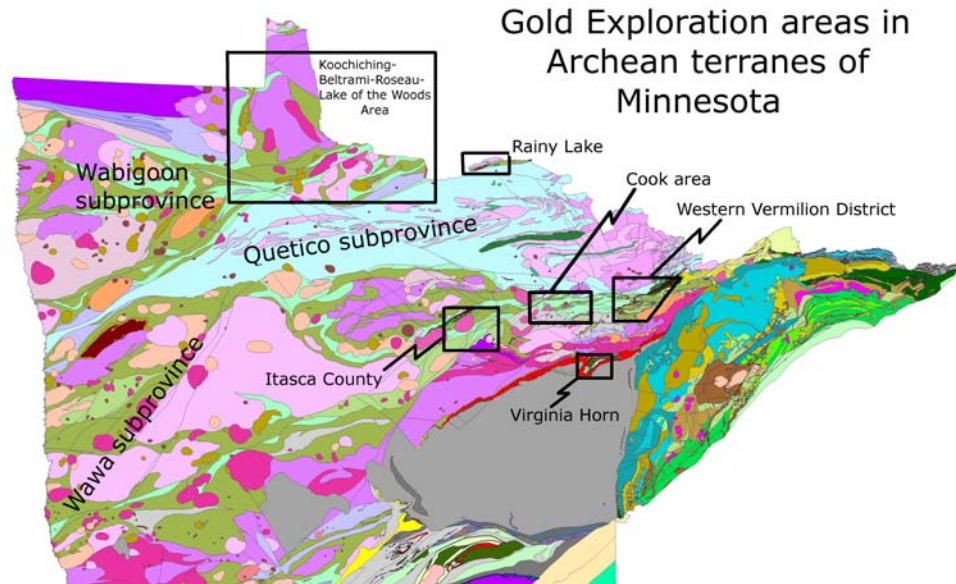


THE HISTORY OF GOLD EXPLORATION IN MINNESOTA

By

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Cover Photo Caption

Precambrian geologic map of the northern half of Minnesota showing areas where intense exploration activities took place in search of orogenic gold during the 1980s and 1990s. Geology from Jirsa et al., 2011.

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ABSTRACT

This report is more or less an *atlas* with regard to gold exploration in the Archean rocks of northern Minnesota. The main objective of this study is to compile all available information (maps, assays, reports, etc.) from the historical records to produce a “Guidebook” that describes “who did what, where, and how, and what did they find” regarding the gold exploration history of northeastern Minnesota. In essence, detailed “due diligence” checks have been performed in this report, and the results are described for 62 orogenic gold prospects as follows: western Vermilion District with 29 gold prospects; Cook area with nine gold prospects; northeastern Itasca County area with nine gold prospects; Rainy Lake area with four gold prospects; Virginia Horn area with ten prospects; and the Koochiching-Beltrami-Roseau-Lake of the Woods counties area (no significant prospects).

Out of 23 gold prospects that were extensively drilled and/or trenched in the western Vermilion District, the best prospects that returned the highest gold values, and collectively the most mineralized zones, are located in the area bordered by the Vermilion Fault and Mud Creek Shear zone. Most of these prospects are associated with subsidiary shear zones and/or rheological contacts on the edges of iron-formation lenses. Shear zone-hosted gold was also explored for in some detail elsewhere in the western Vermilion District at Spaulding Bay, Murray, and Eagles Nest Shear zones. Exploration for gold took place the most extensively, and for the longest period, at the Shagawa Lake stock. There are very few conclusions that can be drawn from the data that are available for the Cook area. The data suggest that the best gold potential is present at the Linden Grove area, where several faults converge and structural preparation would be increased.

A review of the gold prospects in Itasca County suggests that significant gold shows are associated with an iron-formation trend in the Wilson Lake sequence. In almost all cases, the high gold values are associated with iron-formation, especially structurally-prepared and sulfide-replaced zones. Glacial overburden sampling campaigns have reiterated this gold-to-iron-formation connection.

A review of the exploration activities conducted at the gold prospects in the Rainy Lake area suggests that significant gold anomalies are present within both the “iron-formation” unit of Day (1990) and the Rainy Lake-Seine River Fault Zone. However, the gold values obtained during drilling generally occur as isolated values in a select number of drill holes. Exploration to the west of Rainy Lake in the Koochiching-Beltrami-Roseau-Lake of the Woods area is confined to scattered drill holes that targeted geophysical anomalies.

Exploration in the Virginia Horn has to date identified a “small but low-grade” gold deposit associated with a hypabyssal quartzofeldspathic intrusion informally known as the Viking porphyry. Visible gold, often with associated arsenopyrite, is present in quartz veins in the porphyry. However, gold shows are also present in the surrounding rocks, and more drilling is needed to fully assess the potential of the Virginia Horn.

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INTRODUCTION

Overall, the history of gold exploration in Minnesota may be summarized as very brief periods of activity that resulted in the: Vermilion Gold Rush of 1865-1867; Rainy Lake Gold Rush of 1893-1895; Raspberry Prospect explorations (west of Ely) circa 1900; and, more recently, a brief intense campaign in the 1980s and 1990s following the discovery of the Hemlo gold deposit in Ontario. Exploration in Minnesota during this latter period (Fig. 1) took place in the:

- Archean Wawa greenstone belt and includes such areas as the Virginia Horn, Itasca County, Cook Area, and Western Vermilion District (Raspberry Prospect,

Mud Creek Shear Zone/Vermillion Fault area, Murray Shear, and Eagles Nest Shear to name a few); and

- Archean Wabigoon greenstone belt in the Rainy Lake/International Falls area and in Koochiching-Beltrami-Roseau-Lake of the Woods Counties.

Orogenic gold deposits were the type of ore deposits that were sought during the 1980s-1990s. This type of deposit has been called a variety of names that include: Archean lode-gold; greenstone gold; shear-hosted gold; low-sulfide-gold veins; mesothermal gold-quartz veins; and iron-formation-hosted gold. An excellent review of the various types of Archean lode-gold deposits is presented in Peterson (2001).

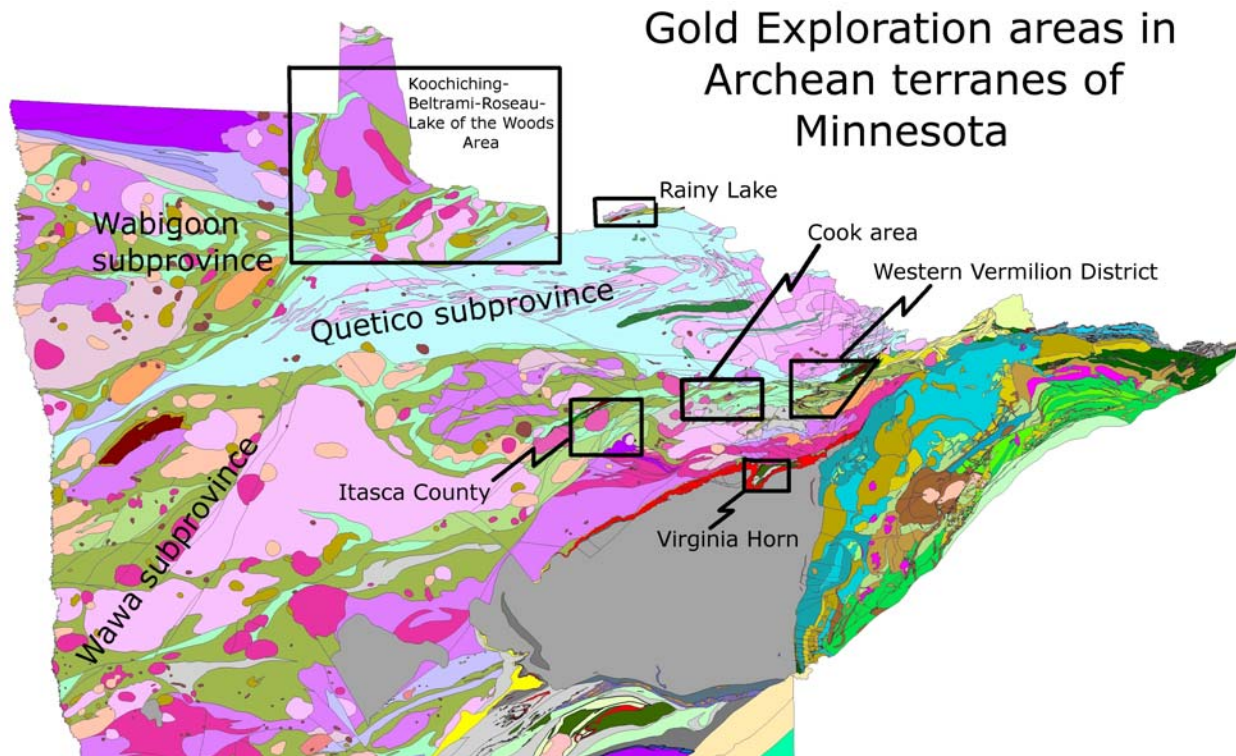


Figure 1. Precambrian geologic map of the northern half of Minnesota showing areas where intense exploration activities took place in search of orogenic gold during the 1980s and 1990s. Geology from Jirsa et al. (2011).

The main objective of this study is to compile all available information (maps, assays, reports, etc.) from the historical records to produce a “Guidebook” that describes “who did what, where, and how, and what did they find” regarding the gold exploration history of northeastern Minnesota. This guidebook can be used by minerals exploration companies to quickly assess what types of information relative to gold assays were found through surface sampling (rock and soil) and drilling. Scans of specific exploration-related materials were collected mainly from the Minnesota Department of Natural Resources (MDNR) minerals archive website (<http://minarchive.dnr.state.mn.us/>) and are included with this report. In many instances, certain materials were not available at the website, and in these cases, scans of the original paper copies were made at the Natural Resources Research Institute (NRRI); these scans are also included with this report. While geophysical surveys were conducted in almost all of the gold exploration areas, scans of this type of material are not included in this report, nor are there any discussions of the geophysical interpretations.

It was not one of the goals of this project to revise the detailed geology or structural interpretations of areas where intense gold exploration has taken place. These areas have been mapped in detail, and those maps, listed below, are used in the figures of this report to illustrate the overall geologic settings for the various gold prospects in the following areas:

1. Western Vermilion District:
 - a) Sims and Southwick, 1985 – Geologic map of the Western Vermilion District;
 - b) Jirsa et al., 1991 – Geologic map of the area between the Western Vermilion District and Itasca County (Cook-Side Lake area);
 - c) Jirsa et al., 2001 – Geologic map of the Eagles Nest Quadrangle;
 - d) Peterson and Jirsa, 1999a – Map showing the bedrock geology and mineral exploration areas of the Western Vermilion District;
 - e) Peterson, 2001 – Ph.D. dissertation on Archean lode-gold and massive sulfide potential in several areas of Minnesota using Canadian mining camps as analogs; and
 - f) Peterson and Patelke, 2004a – NRRI map (available online) displaying the bedrock geology and gold prospects in the area between the Mud Creek Shear and Vermilion Fault [**Note:** This GIS-related map (and associated databases) is the **single most important tool** to understanding the geology and rock/drill core geochemical results of the Mud Creek area.];
2. Northeastern Itasca County:
 - a) Jirsa, 1988 – Geologic Map of the Sherry Lake Quadrangle, Itasca County, Minnesota; and
 - b) Jirsa, 1990 – Bedrock Geologic Map of Northeastern Itasca County;
3. Rainy Lake/International Falls area:
 - a) Hemstad et al., 2000 and 2001 – Two 7.5-minute quadrangle maps showing the geology of the Rainy Lake area and the geology of the various gold prospects in Minnesota along the international border; and
 - b) Day, 1990 – Geologic map of the Rainy Lake area; and
4. Virginia Horn area:
 - a) Jirsa, 1998 – Geologic map of the Midway area of the Virginia Horn; and
 - b) Jirsa et al., 1998 – Geologic map of the Virginia Horn area.

It should be noted that there are very few corporate summary reports in the MDNR files that describe: 1. why a particular exploration company picked up specific parcels of land for exploration; 2. what mineralization

model(s) they used to conduct their exploration campaigns; 3. why they drilled holes in specific locations; and 4. why they abandoned the property. The exploration materials turned in at the demise of their efforts range from detailed reports, to poorly-drafted maps with meager information, to data that are obviously missing. Thus, in the absence of such summary reports, certain judgments cannot be avoided in writing this report regarding the reasoning and sequencing in each of an exploration company's campaigns.

It was also noticed while collecting the data that some drill hole locations were incorrect with regard to specified UTM (Nad 83) coordinates. In these cases, the holes were re-plotted on maps and new UTM coordinates were obtained. Extreme cases that stand out wherein the locations for a large group of holes were corrected include the Raspberry gold prospect and overburden holes in the Wilson Lake area of Itasca County. Coordinates for all of the known holes in specific gold exploration areas are included in Appendix A (on the CD in the back pocket of this report) for the following areas:

- Western Vermilion District = Vermilion_District_drillholes_trenches_list.xls;
- Itasca County explorations = Itasca_County_drill_holes.xls;
- Rainy Lake Area = Rainy_Lake_drill_holes.xls; and
- Virginia Horn Area = Virginia_Horn_drill_holes.xls.

Acknowledgments

The author of this project owes a huge debt of gratitude to the exploration geologists who participated in the search for gold deposits, and other ore deposit types, in Minnesota during the late 1900s. While no economic gold deposits were ever found, their persistence to continually explore in areas

with little to no outcrop, and their efforts to convince their management to fund or joint venture these efforts (if only for short periods of time), was meritorious to say the least. Their efforts have shown that zones with gold enrichment do indeed occur throughout the state and that the final prize of discovering a potential gold mine in Minnesota still awaits a company, or individual, with the fortitude to doggedly pursue such a venture. The MDNR should also be applauded for their foresight to establish a central point in Hibbing, MN, where exploration-related records and drill core are preserved. Special thanks are extended to the following geologists who took the time to write corporate summary reports (as listed below) that are on file at the MDNR or NRRI: Richard Buchheit (Meridian), Torrie Chartier (Normin), Peter Giangrande (American Shield), Peter Jongewaard (Noranda), Roger Kuhns (BHP-Utah International), Steve Mornis (ACNC), Arthur Norton (Normin), William Ulland (American Shield), and the author of this report (USS and Santa Fe Pacific). Furthermore, discussions with Robert Roe and Alan Coyner (formerly with Kerr McGee), Dan England (formerly with Rhude and Fryberger), Tom Gardner (Rendrag Inc.), Peter Giangrande (formerly with St. Joe and BHP), and Ernest Lehmann and William Rowell (Vermilion Gold) has helped to fill in some of the exploration gaps that are not included in the MDNR files. If more time were available, the author could have used these sources to even more fully substantiate the exploration records.

Finally, the largest debt of gratitude is extended to the geologists who, through their iterative mapping efforts, led us to a greater understanding of the geology of the Archean greenstone belts of Minnesota. It is on their collective backs that we now stand, and the following persons deserve special mention: Terrence Boerboom, George Hudak, Mark Jirsa, Richard Patelke, Dean Peterson, David Southwick, and Paul Sims.

This report is dedicated to the late, great Richard Patelke who had the vision to suggest that this project be completed. As he so eloquently put forth in previous times:

“The devil is in the details.”

HISTORICAL INTRODUCTION – MINNESOTA’S GOLD RUSHES IN THE 19TH CENTURY

There were three historical gold rushes, albeit very short gold rushes, that took place in Minnesota during the 19th century. The first gold rush, often overlooked in history annals, took place in 1858 and involved placer gold from the Zumbro River near the town of Orinoco in Olmsted County. Only eight years later the cry of gold once again echoed through the woods, but this time the rush occurred in northeastern Minnesota in what is now called the western Vermilion District. This gold rush was also short lived (1866-1867) and was associated with quartz veins in Archean rocks on the shores and islands of Lake Vermilion. No gold deposits were ever found during the Vermilion gold rush, but this particular gold rush was highly instrumental in the discovery and development of the iron mining industry in Minnesota. The last gold rush took place in 1893 along the international border with Canada in the Rainy Lake area where the gold was associated with quartz veins in variably deformed rocks in a broad shear zone. A small amount of gold was actually produced from the Little American Mine, but production costs were high, and the mine closed in 1895.

Zumbro River Gold Rush

Holden Whipple, a local prospector, was entranced by placer gold strikes in California and spent time panning the gravel deposits of the Zumbro River near the town of Orinoco.

In 1858 he reportedly found a gold nugget, and the rush was on. The Orinoco Mining Company was formed, sluice boxes were constructed, and the river gravels were processed for gold with disappointing results. The spring floods of 1859 ruined the sluices of the Orinoco Company, and the boxes were rebuilt. Still no gold was found. Another flood in July destroyed the sluice boxes again and ultimately brought the Zumbro River gold rush to a final end.

Vermilion Gold Rush

The mineral wealth of the eastern Vermilion District was first noted by J.G. Norwood (1852), who observed ferruginous rocks of the Paleoproterozoic Gunflint Iron Formation on Gunflint Lake in 1850. This find had nothing to do with the Vermilion Lake Gold Rush, but caused several successive territorial and state governors to urge for further geologic investigations in northeastern Minnesota (Lass, 1998). In 1864, the state legislature funded the position of state geologist, and A.H. Hanchett was appointed (Schwartz, 1964). Evidently his work was not satisfactory (Schwartz, 1964), and in 1865 Governor Stephen H. Miller appointed Henry H. Eames to the position of state geologist. Eames, along with his brother Richard M. Eames (assistant state geologist), conducted a reconnaissance effort in the western Vermilion District. Samples collected by Eames reportedly contained \$25/ton of gold (Lakso et al., 1979). By the end of their summer field work, the Eames brothers leaked rumors about the presence of gold in the rocks of the Lake Vermilion area. These rumors were first made public in newspapers (summarized in Walker, 1974), and Minnesota’s second gold rush occurred. The rumors were officially confirmed in an 1866 report wherein Eames (1866a) reported the presence of hematite iron ore in the slates of Lake Vermilion, but his mention of gold-bearing

quartz veins received the most interest. In a latter report that same year, Eames again mentioned immense bodies of “magnetitic and hematitic iron ore,” as well as primitive schistose rocks with quartz veins carrying gold and silver (Eames, 1866b). A map showing the outline of the rock formations surrounding Lake Vermilion, and the locations of the quartz veins, was supposedly prepared and submitted by Richard Eames, but no such map ever accompanied the published report (Clements, 1903).

When the first news of the Eames finds was made public in the newspapers, the Vermilion Lake Gold Rush took place during 1865-1866. It is estimated that more than 2,000 prospectors came to the region, and 15 companies were formed in attempts to extract the gold from various prospects along the shores and islands of Lake Vermilion (<http://miningartifacts.homestead.com/IndexMinnesotaMiningHistory.html>). Even the Governor of Minnesota, Stephen Miller, formed a gold mining company after he received samples from the Eames brothers that were assayed by the Philadelphia Mint and found to contain \$25/ton of gold. The mining town of Winston City was formed on the south shore of Pike Bay and several “mines” became established at: 1. the falls of Pike River on Lake Vermilion; 2. “Minnesota Point,” said to be nine miles west of Winston City; 3. Ely Island; 4. Pine Island; 5. Foss Island; 6. Walker’s Island; and 7. Dertz’s Island (Fortune Bay Casino handout by MGL and Associates (1996), acquired by the author in 1999). Gold was found at a few of these sites, but in such low concentrations, e.g., \$25/ton in 1866, that it was not economical to mine the hard rock and process it, especially by small groups of prospectors. In summary, no significant gold deposits were ever found during this gold rush, and by 1867 most of the prospectors had abandoned the area – the spot where the Eames brothers found gold was never determined. However, this gold rush activity impacted the area by establishing a

road, the Vermilion Trail, from the newly-founded town of Duluth to Lake Vermilion and, more importantly, by introducing prospectors, e.g., George Stuntz, to the area and calling attention to the iron ore deposits.

In 1869, George R. Stuntz was appointed by the Secretary of War to make improvements to the Vermilion Trail and extend it to the Nett Lake Reservation (Walker, 1974). During this endeavor, Stuntz became determined to develop the iron ore deposits that he had seen earlier during his prospecting days on Lake Vermilion. Stuntz, along with George C. Stone, enlisted the financial aid of Charlemagne Tower, who was interested in funding their efforts. However, before doing so, Tower commissioned Professor Albert Chester of Hamilton College, New York, to conduct a private geological investigation of the western Vermilion District in 1875 and 1880 (Lass, 1998). After a favorable report on the iron ore deposits (Chester, 1884), Tower, along with Stuntz and Stone, organized the Minnesota Iron Company. On August 1, 1884 the Duluth and Iron Range railroad was completed from Two Harbors to Tower, and 62,122 tons of ore were shipped from what was to become the Soudan mine on Lake Vermilion. Meanwhile, iron ore was found in the Ely area by Mr. H.R. Harvey in 1883, and these showings eventually lead to the development of the Chandler, Pioneer, Zenith, Sibley, and Savoy mines. Numerous smaller iron-ore prospects were established in the Western Vermilion District during the 1890s and were worked intermittently until the 1920s. Many of these iron prospects were also looked at for their gold potential at the end of the 20th century and will be discussed later in this report.

While the Vermilion Gold Rush ended in 1867 and later prospecting was aimed mostly at locating iron ore deposits during the latter portion of the 19th century, the lure of finding gold could not be fully extinguished. One example is the Raspberry Gold Prospect to the west of Ely, MN, where prospectors found

low grade concentrations of gold associated with a quartz vein in 1889. This prospect, to be discussed later, was explored intermittently by several companies for the next 100 years. Several other iron ore prospects, to also be discussed later, were further explored for gold in the later part of the 20th century.

Rainy Lake

As early as 1865, prospectors began looking for gold along the international border near Rainy Lake. In the summer of 1893, George W. Davis, en route to exploration in Canada, discovered gold associated with a two-meter-wide composite quartz vein on what is now called Little American Island in Rainy Lake (Gordon, 1983; Hemstad and Jirsa, 2010). In the spring of 1894, the Little America Mine was developed and the town of Rainy Lake City was founded, with a peak population of about 500 persons. Prospecting activity grew in the area, and several more mines were started on various islands of Rainy Lake including: Big American Mine (Big American Island), Lyle and Soldier mines (Dryweed Island), and Bushyhead Mine (Bushyhead Island).

During the first year, the Little American Mine produced \$4,635 worth of gold (Hemstad and Jirsa, 2010). Through a series of calamitous events, the mine eventually reached a depth of 210 feet, and by closure in 1895 the mine had produced a total of \$45,000 worth of gold at today's prices (Hemstad and Jirsa, 2010). Several attempts to reopen the mine were made until the county seized the property in 1898. The Bushyhead Mine operated for two years, but the amount of gold produced, if any, is not recorded. Eventually, low production from the mines and the high costs of transportation to the remote Rainy Lake area ended the rush, and by 1901 Rainy Lake City was abandoned.

Miscellaneous Gold Prospects

Several other gold plays took place in Minnesota wherever quartz veins were exposed in Precambrian bedrock or supposed color was seen in gravel beds. While it would be impossible to document all of these prospects, a few of the better known ones are as follows (most are described by Grout, 1937 and/or are listed in Martin, 1985):

- “Gruner showing,” with visible gold in the greenstone belt beneath the Mesabi Iron Range in an area called the Virginia Horn near Gilbert, MN (to be discussed later);
- Quartz veins, with silver and lesser gold, cutting the Rove Formation at McFarland Lake (sec. 6, T.64N., R.3E.) and at the Spalding Mine on the eastern end of Spalding (Miranda) Lake (Sec. 5, T.64N., R.2E.);
- Prospect pits for Cu-Ni in the Rove Formation with some associated gold (Secs. 35 and 36, T.64N., R.5E.);
- The prospect of Dr. Allison near Kelliher, Beltrami County (Sec. 31, T.152N., R.30W.);
- Gold prospect associated with disseminated sulfides in the greenstone belt near Indus (Sec. 4, T.159N., R.25W.) that was later explored for both its VMS and gold potential;
- Fluorite-bearing granitic pegmatite, with gold, on Gold Island in Saganaga Lake (in the Saganaga batholith, Sec. 14, T.66N., R.5W.);
- Vermilion River Mines (Sec. 36, T.67N., R.18W.) was first explored by the Eureka Corporation in 1924, who sunk a 54-foot deep exploration shaft (Jaksa and Johnson, 1970). The reported occurrence of gold was associated with veins along a contact zone between granitic rocks and quartz-biotite schist (both associated with the Vermilion Granitic Complex). The

property was transferred to the Vermilion River Mines, Inc. in 1928. They sunk another exploration shaft (shaft #2) along the contact to a depth of 113 feet. A third shaft (shaft #3) was sunk in 1931-1932 to a depth of 200 feet with a 265 foot-long drift (positioned at both sides of the shaft) at the 100-foot level, and a 525-foot drift (positioned to the south of the drift) at the 200-foot level. A mill was constructed in 1934 for testing the commercial possibilities of the mined material. By 1935, investors began to lose interest in the mine, and by 1938 the shaft was sealed. Grout (1937) reported that the highest gold assay was 0.9 opt gold in a 6-foot-thick zone. There are several copies of assays and check assays in the files at the MDNR. These assays show conflicting results between various labs – with the highest, and questionable, assay at 13.23 oz/ton gold. Furthermore, Jaksa and Johnson (1970) suggest that the Vermilion River Mine was a fraudulent stock venture as expressed by the following statements “... Sampling results of the underground workings by the operators and the State engineers were not in complete accord ... At least four diamond drill holes with gold of questionable amounts were also part of the exploration ... Logs are incomplete and assays are of dubious value.”

- The Hanson Brothers lease (Sec. 33, T.66N., R.17W) consisted of two shafts that followed quartz veins in the Vermilion Granitic Complex. The first shaft was 34 feet deep (sunk in 1937), and an assay of 0.18 oz/ton gold was reported in 1938. The second shaft, located ten feet east of the first shaft and sunk in 1938, was inclined to the north and encountered quartz veins and “... a series of caves probably formed by the leaching of the original rock by descending carbonated waters ... if no commercial gold deposit is found, at least some concentration in iron,

manganese, and probably zinc, will result” (1938 Annual Report, Lands and Minerals (MDNR), p. 216-218). There are no reported gold analytical results for this prospect. These workings were visited by the author in 1983, and the inclined shaft was found to be filled with water with thin-gauge rails leading downward at the mouth of the shaft;

- Unnamed prospect in the Vermilion Granitic Complex (Sec. 3, T.66N., R.15W.) consists of a shaft (reported to be 90 feet deep) and four holes that were drilled in 1921 (Martin, 1985, p. 198);
- Quartz veins in the Thomson Formation near Thomson Dam in Carlton County;
- Quartz vein near the mouth of Silver Creek (Sec. 16, T.46N., R.20W.; Carlton County) that was explored in a 30-foot-deep shaft prior to 1850 (Harder and Johnston, 1918);
- The Arrowhead Mine in Carlton County (Sec. 32, T.48N., R.18W.) consists of several small workings in black carbonaceous slate (Paleoproterozoic rocks of the Thomson Formation) that are heavily fractured, brecciated, and impregnated with quartz and pyrite (Ojakangas, 1976; Morey and Davidson, 1979; Severson et al., 2003). The carbonaceous slate was primarily mined to be used as coal and at one time may have been mined for gold;
- The Glen Township deposits in Aitkin County (Secs. 14, 15, 18, 19, and 30, T.46N., R.25W.) consist of over 90 preserved core holes that were drilled to intersect sulfide-rich carbonaceous argillite and iron-formation. Some of the holes that intersected the iron-formation were sampled and reported to contain up to 1.41 ppm gold (EldougDoug, 1984). A comparison was drawn to Homestake-type iron-formation-hosted gold deposits, and a flurry of gold sampling campaigns followed with unsuccessful results (Severson et al., 2003);

- Quartz vein near Granite Falls in the Minnesota River Valley (sec. 4, T.115N., R.39W.);
- Quartz vein near Delhi in the Minnesota River Valley (Sec. 4, T.113N., R.36W.; Renville County);
- Steeply-dipping quartz vein in Benton County (Sec. 27, T.37N., R.30W.) that was worked in a ten-foot-deep test pit by Major Newson in 1870 (Winchell, 1888) and;
- Supposed gold-bearing gravels in Fillmore County at Jordan (sec. 31, T.104N., R.12W.; Winchell, 1884) and Spring Valley (Sec. 26, T.103N., R.13W.; Winchell, 1884).

HISTORICAL REVIEW OF SOME OF THE IRON ORE PROSPECTS IN THE WESTERN VERMILION DISTRICT

The successes of finding iron ore at Soudan and Ely further encouraged iron ore prospecting in the western Vermilion District, and any earlier mention of gold was soon forgotten. In retrospect, exploration for both base and precious metals in the Vermilion District was hindered for over 85 years by iron ore companies that obtained great land holdings and turned all of their efforts to locating more iron ore properties (Peterson, 1999). Test shafts and trenches were made by these companies wherever iron-formations were exposed. Ironically, many of the gold prospects in the western Vermilion District that were looked at in the latter part of the 20th century were associated with lean iron-formations (Ulland, 1999). Because of this iron-formation/gold association, the historical developments at some of these earlier iron-ore prospect sites, excluding the Soudan Mine and Chandler-Pioneer-Zenith-Sibley-Savoy Mines, are briefly discussed below. The regional locations of the iron-ore prospects and mines are depicted in Figures 2 and 3. A detailed account of the developmental history

for most of these mines has been well summarized by Stenlund (1988), and the reader is referred to this publication that is available at the Soudan State Park and Ely-Winton Historical Society. Most of this section of this report is gleaned from Stenlund (1988). According to Stenlund (1988) many of the typical iron prospects in the Vermilion District went through extended periods of exploration wherein a company would test the prospect and give up the option if results were not satisfactory, only to be succeeded by another company that believed they could find ore where others had failed. This protracted type of development is obvious in almost all of the following iron ore prospect historical descriptions.

LaRue Mine (also called Armstrong Bay Mine)

Records as early as 1882 indicate that this mine site (Sections 7 and 8, T.62N., R.14W.) showed conflicting claims by both Nicholas Lonstorf and Peter Armstrong. Armstrong later sold his interest to George C. Stone and the Minnesota Iron Company (Stenlund, 1988). In 1891, W.G. LaRue of Duluth leased the property and began a drilling campaign (results are unknown). By 1916, LaRue had established an adit, and by 1917 about 4,000 tons of ore (65-68% Fe) were stockpiled. In 1920, the Chippewa Iron Mining Company took an option on the property, renamed it the Armstrong Bay Mine, sunk a shaft 500 feet deep to intersect with the adit, and began hoisting ore in January, 1922. By August, 1922 there were 1,200 feet of underground workings, and a reported 10,000 tons of ore were stockpiled. No activities took place during the winter of 1922-1923. In the spring of 1924, the St. Louis County mine inspector reported that all activities had ceased at the mine. A total of 4,748 tons of ore were reportedly shipped from this mine (Skillings Mining Review directory).

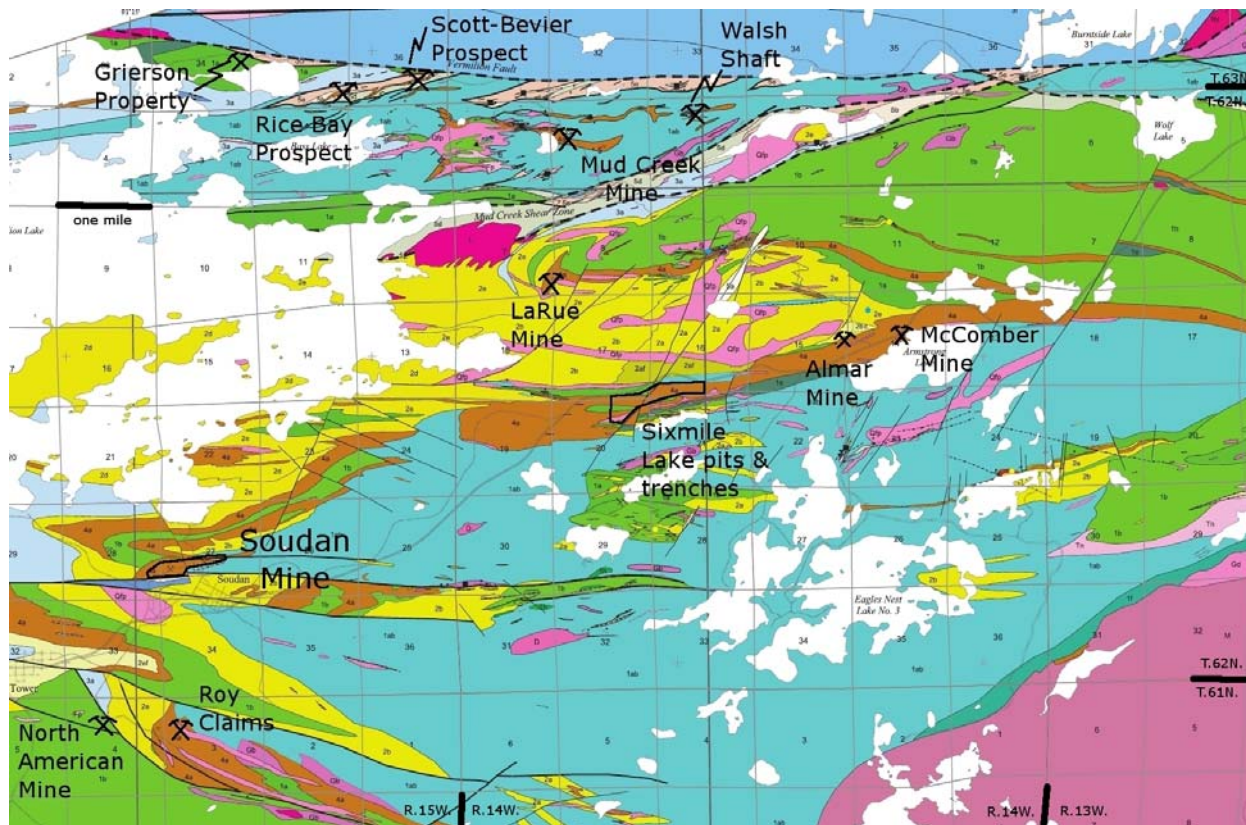


Figure 2. Iron-ore prospects in the Western Vermilion District in the vicinity of Soudan, MN. Iron-formation trends are shown in the brown color – geology from Peterson and Jirsa (1999a).

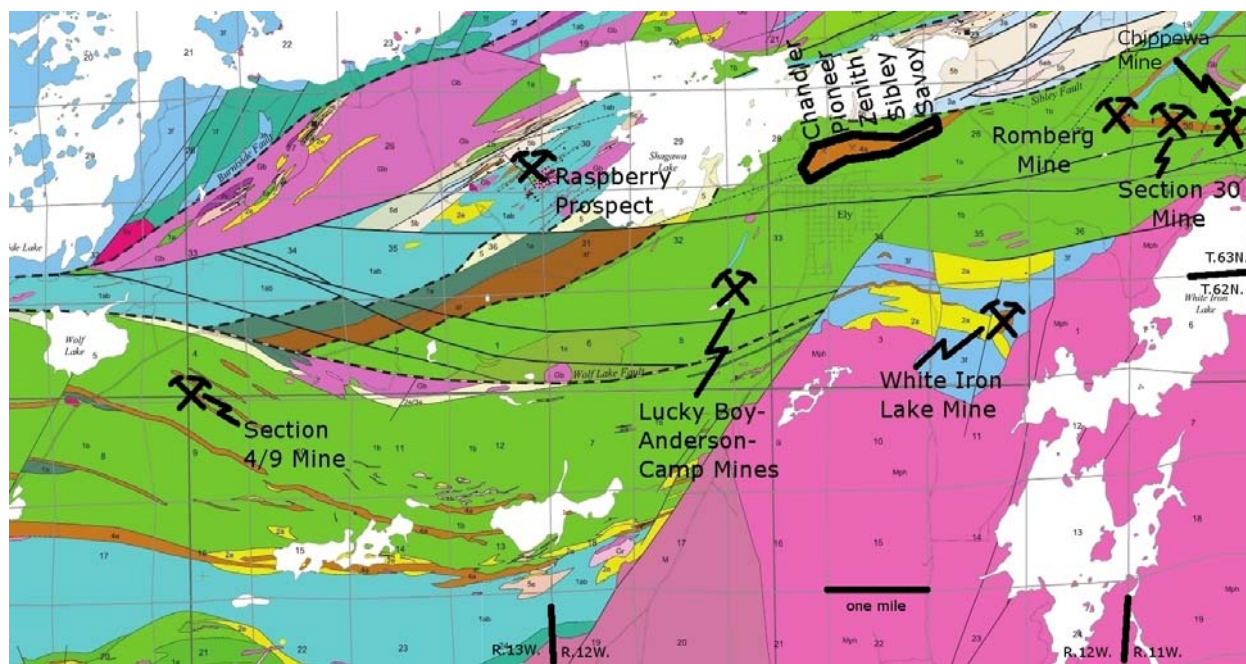


Figure 3. Iron-ore prospects in the Western Vermilion District in the vicinity of Ely, MN. Iron-formation trends are shown in the light brown color – geology from Peterson and Jirsa (1999a).

The only indications of a mine at the LaRue site that were present in the early 1980s are shown in Figure 4 and consisted of: an extremely long east-trending adit/tunnel (#2) that was structurally sound and contained no timbers until a mined-out room was reached at the end of the tunnel; a deep shaft (120 feet deep?) extending up from this tunnel to the surface; and a short west-trending tunnel (Adit #1) on the opposite site of the hill that lead into another mined-out room. Stenlund (1988) reported the presence of an overgrown stockpile that was never shipped and the cement foundation of the boiler house. Adit #2 was often filled with ice and was traversed by the author in the winter of 1980. This ice often lasted well into June, and the mouth of the tunnel served as a party site. By

1987, the entrances to both of the tunnels were bulldozed closed by United States Steel Corporation (USS).

Sixmile Lake area

While there is no historical mention of a mine in the Sixmile Lake area, numerous test pits, trenches, and shallow shafts have been found throughout the area to the north and west of Sixmile Lake in Sections 16, 20, and 21, T.62N., R.14W. (Severson and Heine, 2010). A few channel samples across the iron-formation trend were collected in order to evaluate the taconite potential of this area in the early 1950s by W.S. Moore Company (W.S. Moore collection at the NRRI).

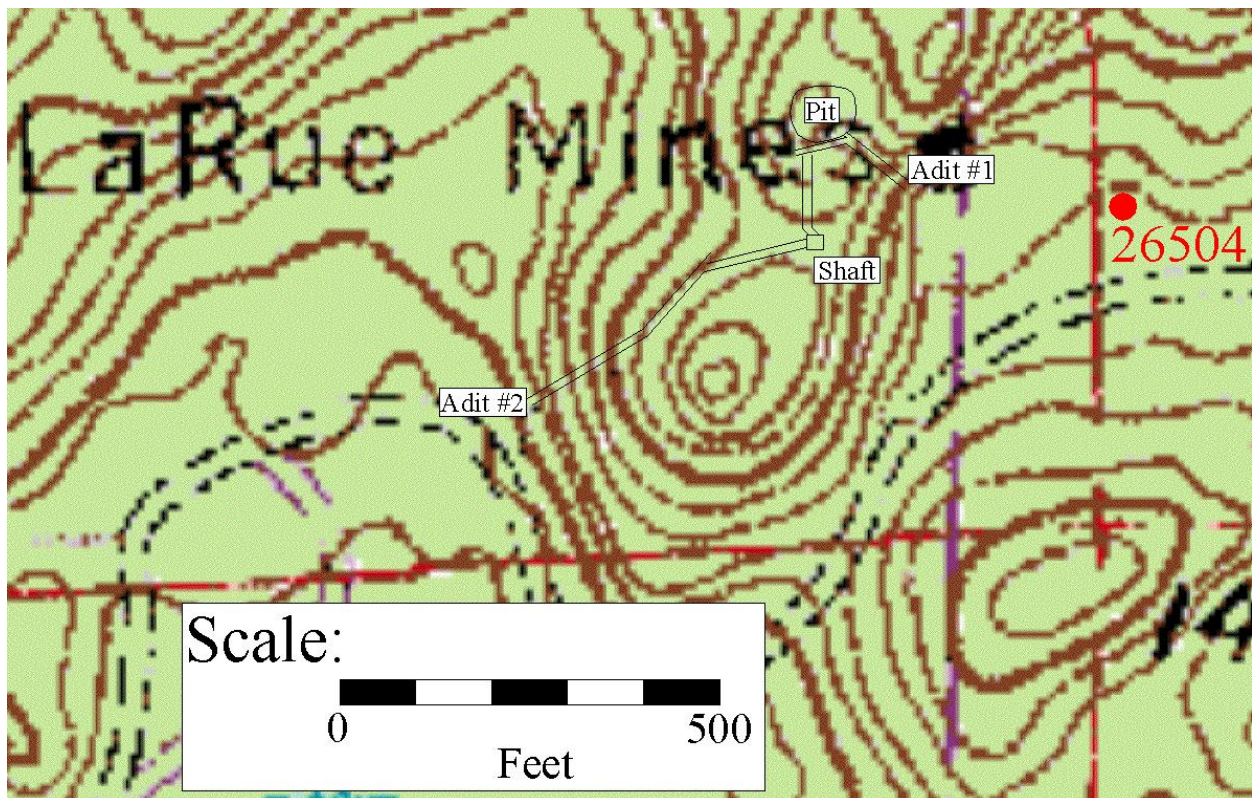


Figure 4. Map showing the configuration of the underground workings at the LaRue Mine as determined from historical records and the author's memory. Hole 26504 was drilled by U.S.Steel in the 1970s, presumably for VMS exploration(?).

Almar Mine

Serious exploration work began on this property (Section 16, T.62N., R.14W. – Fig. 5a) in 1909 with the sinking of 21 test pits and a 20-foot-deep shaft into ore (57% Fe at 17 feet and 60% Fe at 20 feet). By 1911, the “Big Hope” shaft (one of the earlier test pits) was down at least 128 feet, along with a cross-cut, into soap rock, paint rock, and mixed ore. The ore grades must have been too lean, as the mining crew was moved to the nearby McComber Mine in 1911. The Cuyuna-Saltana Iron Company conducted some drilling on the property in 1914, but there was no follow-up activity. No ore was ever shipped from this mine, and all that remains today are the vestiges of the shaft, a waste pile, and small test pits (Stenlund, 1988). The Hanna Mining Company drilled a core hole (V-1) to the west of the Almar Mine in the 1960s in search of a VMS deposit.

McComber Mine – History of Exploration

According to Stenlund (1988), the McComber Mine (Sections 13 and 14, T.62N., R.14W.) is a classic example of an iron-ore prospect that switched owners on numerous occasions throughout its lifetime. The first extensive work on this property was conducted in 1888-1891, when Captain McComber sunk two shafts, with cross-cuts and drifts, and stockpiled 1,000 tons of ore. After McComber’s death in 1893, the mine languished until it was reopened by the following companies:

- 1902-1903 by Captain M.L. Fay of the Mahoning Mining Company;
- 1910 by George A. St. Clair and the Stewart Mining Company;
- 1913-1919 by the Mutual Iron Mining Company;

- 1919-1921 by the National Mining Company;
- 1923 by Captain George Kelly; and
- In 1925, a reduction plant was being considered to remove the sulfur from the high-sulfur ore in the vicinity of the #2 shaft by the fee owner (Stewart Mining Company).

In total, 8,386 tons of iron ore were shipped from the McComber Mine (Stenlund, 1988). Shaft #1 was reportedly the deepest, with levels at 54 feet, 114 feet, 200 feet, 300 feet, and 400 feet (W.S. Moore collection at NRRI). Several ore bodies were delineated on the 54th through 200th levels that ran 0.137 % S, 0.357% S, and 1.25% S (W.S. Moore collection at NRRI). Lesser information is available on Shaft #2, which reportedly was sunk to 200 feet with levels at 50 feet, 100 feet, and 200 feet. The ore and rock associated with Shaft #2 was also described as being high-sulfur ore (W.S. Moore collection at NRRI).

The property was evaluated for its taconite potential in 1954-1957 by W.S. Moore Company (W.S. Moore collection at NRRI). In 1954, W.S. Moore geologists (Jack Everett and Roger Chapman) visited the property along with Dr. G.M. Schwartz of the MGS and Fred Klinger of the Oliver Iron Mining Company. During their visit, massive magnetite-rich ore, with unspecified amounts of calcite and pyrite, was found on the stockpile near the #2 shaft. Dr. Schwartz believed this ore was formed by replacement of the originally thin-bedded iron-formation by either late magnetite or by hematite that was later metamorphosed to magnetite by nearby granitic stocks (actually quartz feldspar porphyry bodies). Schwartz’s theory was based on the observation that some of the magnetite-rich material showed ghosts of original bedding that had been brecciated and recemented by pure magnetite. A search of the literature by W.S. Moore found an article by

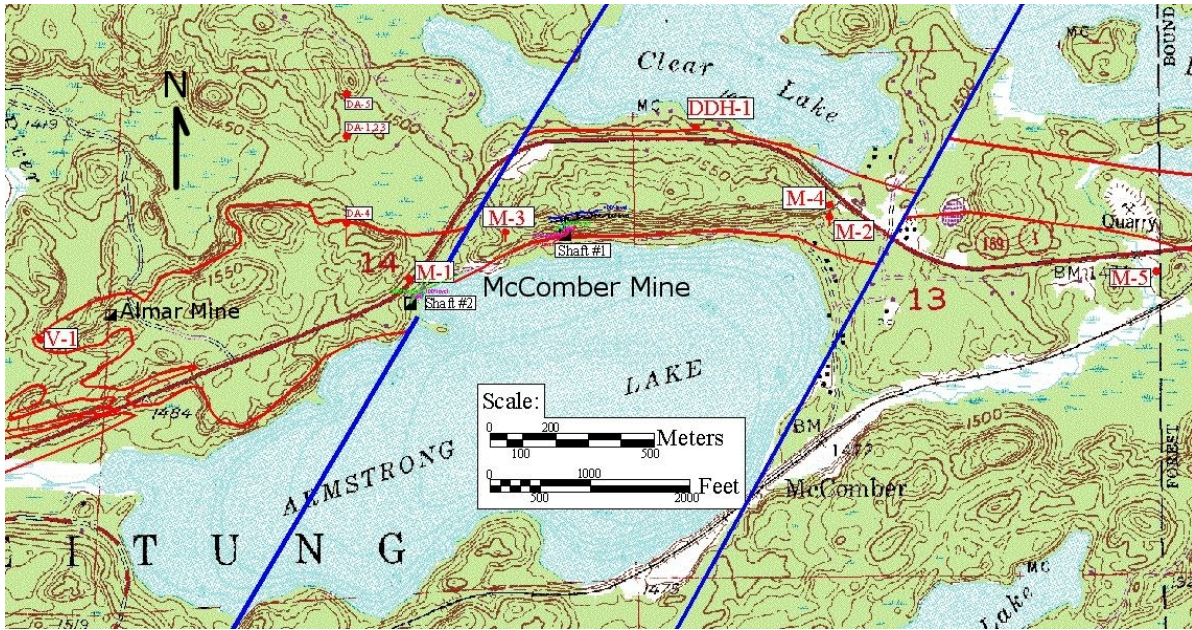


Figure 5a. Geology of the McComber Mine area, modified from Jirsa et al. (2001) showing distribution of shafts and drill holes. The shaft locations that are shown are approximate with an error of around 50 feet. The M-series holes were drilled by W.S. Moore in 1954; DDH-1 was presumably drilled by W.S. Moore at a later date. The DA-series holes were drilled by d' Autrimont Exploration in the early 1900s. Trend of the Soudan Iron-formation is shown in red lines. Faults are shown in blue lines.

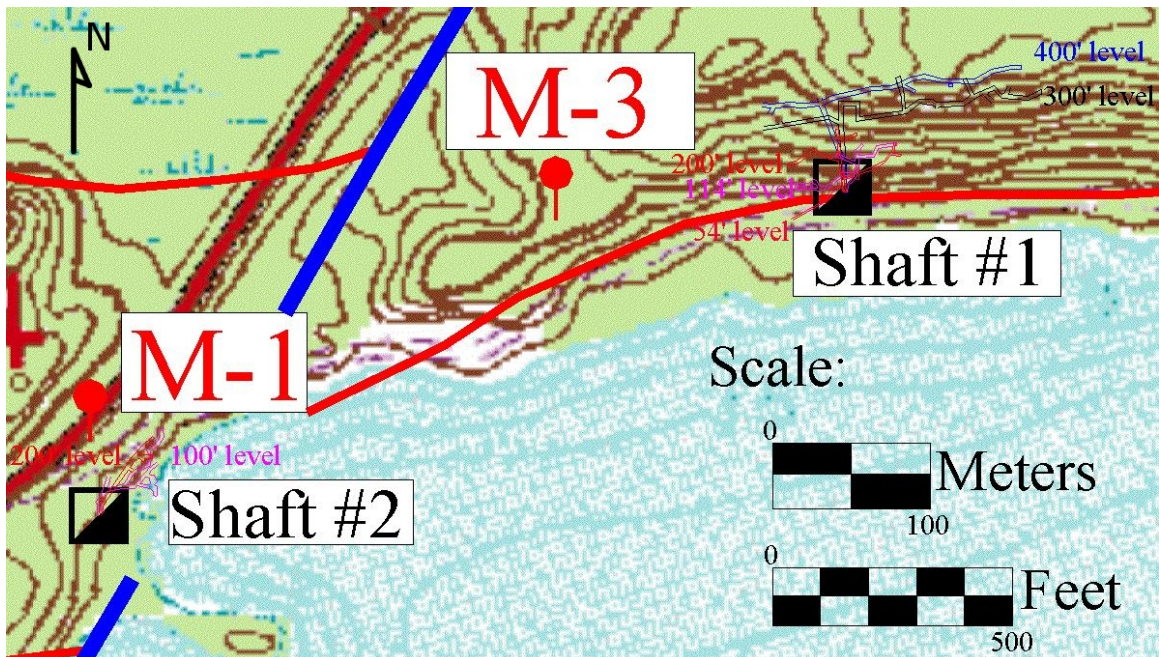


Figure 5b. Close-up of a portion of Figure 5a showing the projected distribution of the various levels associated with Shafts #1 and #2 at the McComber Mine. Note that the shaft locations are approximate but lie somewhere within the portrayed squares. The various level maps that are shown are based solely on spatial references to the shafts on old maps at the MDNR (scans supplied by Dale Cartwright, November, 2011).

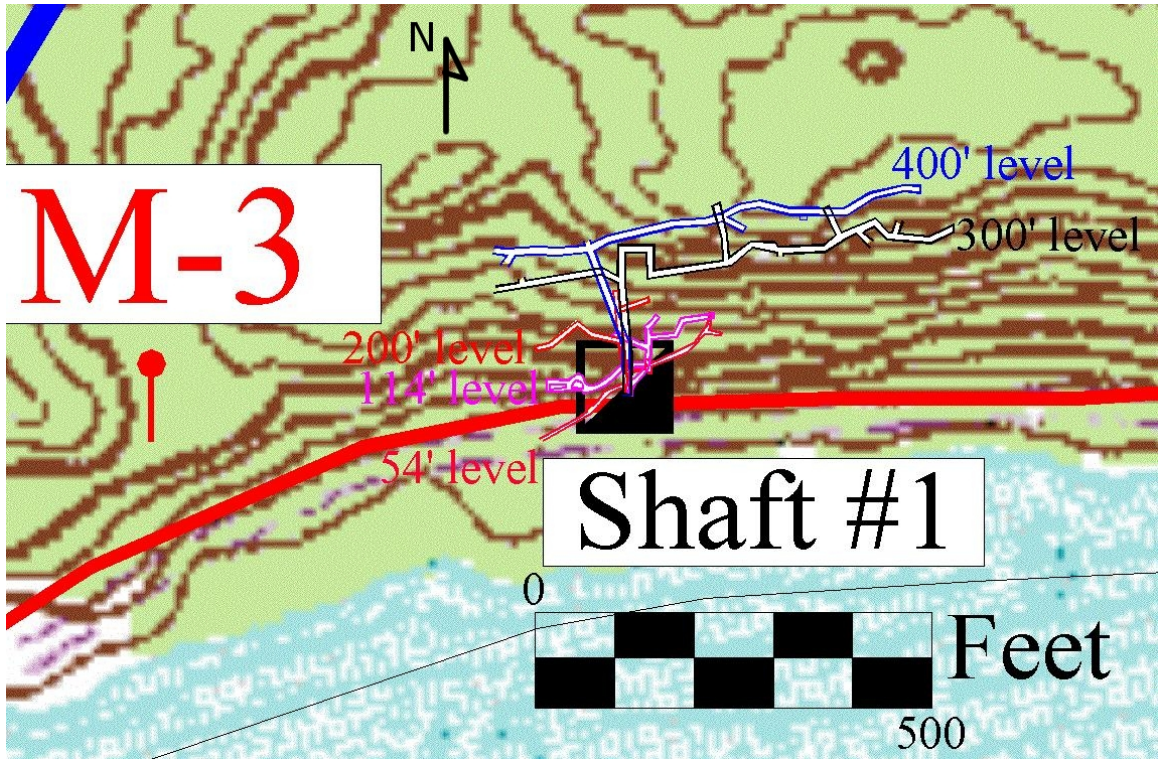


Figure 5c. Close-up of the McComber Mine area/Shaft #1 with projected distributions of the various levels.

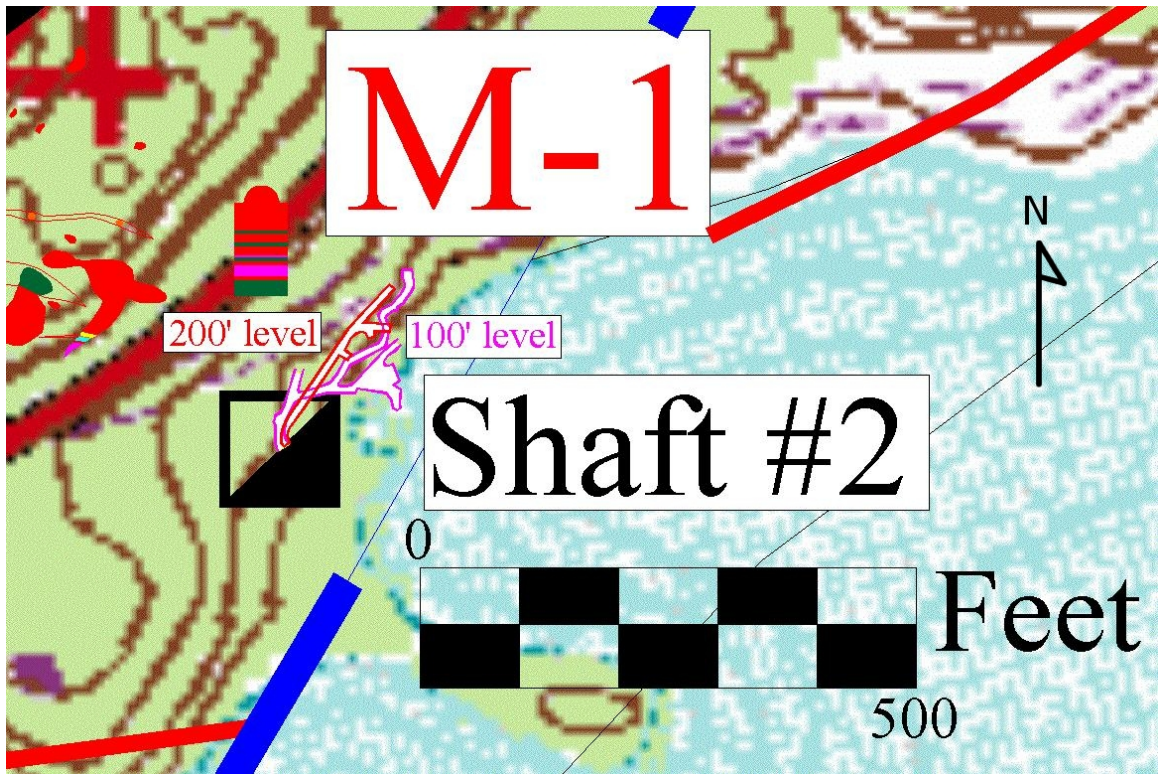


Figure 5d. Close-up of the McComber Mine area/Shaft #2 with projected distributions of the various levels (the level at 50 feet has a very small footprint and is not shown).

Dr. Gruner (1926 – Economic Geology, v. 21, p. 629-644) that also mentioned magnetite-replacement ore, with pyrite, at the McComber Mine. Spurred by mention of magnetite-rich ore, W.S. Moore conducted a gravity survey to try and locate similar magnetite-rich zones on the property. Several gravity highs were found, and W.S. Moore drilled five holes in 1954 (holes M-1 through M-5; Fig. 5). Another hole was drilled shortly afterward on a gravity high in the vicinity of Clear Lake (hole DDH-1 in Fig. 5) – presumably by W.S. Moore (?) – but the hole was logged by Drs. Gruner and Goldich. Complete drill core is only preserved for DDH-1 at the MDNR, whereas only skeletonized core, consisting of short core pieces with rare reference to their depth in the hole, is available for the M-series holes (from the Jack Everett collection – now at the NRRI).

Records for holes M-1, M-2, and M-4 indicate that typical magnetic iron-formation was intersected in these three holes. Skeletonized core pieces show that pyrite is common to portions of holes M-1 and M-4 (chalcopyrite is also present in M-4). The log for hole M-3 indicates that this hole was unique in that it intersected mostly non-magnetic iron-formation that was locally oxidized and enriched in hematite (consisting of steely blue hematite with some red and yellow staining as well as softer material in fractures and cavities). At a depth of about 140 feet, this hole began to encounter thicker beds of high-grade hematite ore. The skeletonized core for M-3 at the NRRI confirms these observations, as most of the core pieces consist of non- to weakly-magnetic iron-formation that contains steel-blue hematite. There is very little information available for hole M-5 except a location description and statement that the hole was drilled to 200 feet in “greenstone.” Skeletonized core (two pieces) for M-5 consists of two pieces of “greenstone” and calcite-veined/brecciated “greenstone.” Drill

hole DDH-1 intersected mainly “greenstone” with intervals of banded iron-formation and quartz-feldspar porphyry. Considerable pyrite is present in the iron-formation lenses near the top of DDH-1.

Grierson Property

The Chicago-Vermilion Iron Company began work on this property (Sections 34 and 35, T.63N., R.15W.) in September, 1910, and by June, 1911 all work ceased. Work completed by the company included the sinking of five test pits and a 30-foot-deep shaft. Interestingly, no iron-formation horizons have ever been mapped at this property, e.g., Peterson and Jirsa (1999a).

Rice Bay Iron Company

There is little information about this property (Section 35, T.63N., R.15W.) in Stenlund (1988) except that a 100-foot-deep shaft was sunk in 1910, and drilling activities took place in 1911.

Scott-Bevier Mine

D.V. Scott and A.M. Bevier began prospecting on this property (Section 36, T.63N., R.15W.) in 1905. A shaft was started in 1906, and by 1911 the shaft was reportedly 90 feet deep (Fig. 6). The Oliver Iron Mining Company (OIMC – a division of United States Steel Corporation) took interest in the property in 1911 and drilled at least eight holes. Drilling by other parties continued intermittently at this site until 1915. No ore appears to have ever been shipped from this mine. During the 1930s, a Civilian Conservation Corps camp was located at this site (Stenlund, 1988). Exploration for gold took place at this mine site during the 1980s, and it was colloquially known as the “*Dead*

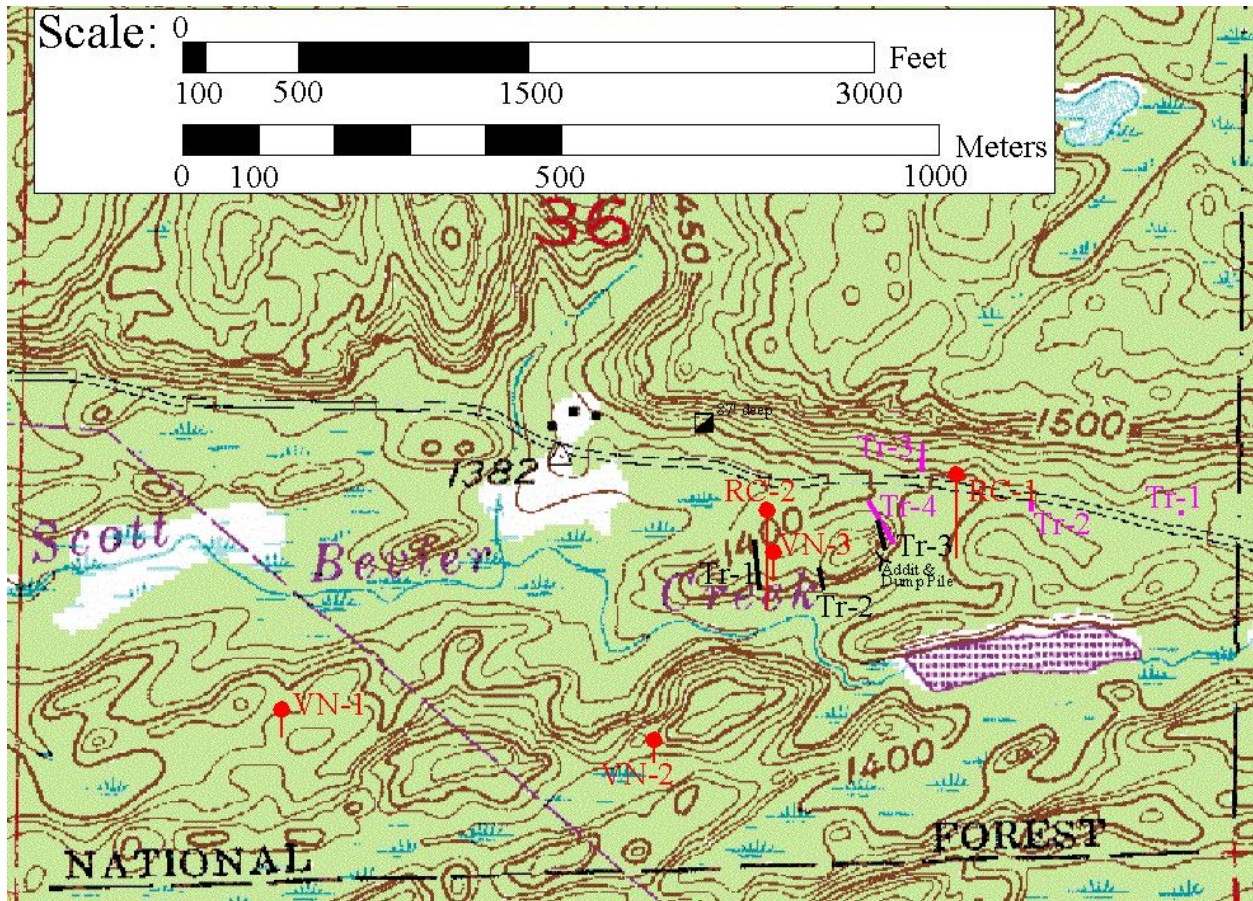


Figure 6. Location map of shafts and adits of the Scott-Bevier Mine. Gold exploration took place at this site, renamed the Dead Canary prospect, in the latter part of the 20th century, and the core holes that are shown were drilled by Chevron Resources (RC-series) and Cominco American (VN-series). Two campaigns of trenching to sample for gold also took place at the site during this period by Cyprus (Tr-1 through Tr-4 in magenta) and by Chevron (Tr-1 through Tr-3 in black).

Canary” prospect in reference to its close proximity to the Boundary Waters Canoe Area (see later discussions). A north-trending adit and associated waste piles are also present at the site, and both have returned anomalous gold assays.

Mud Creek Mine (also called Consolidated Vermilion and Extension property)

James Sheridan is credited with homesteading and originally discovering this iron ore prospect (Section 5, T.62N., R.14W.) in 1883. According to a map stored at the

MDNR, Sheridan established an exploration shaft/pit into outcroppings of iron-formation on the western end of the property (see Fig. 7 for the location). In 1887, the Consolidated Vermilion Iron and Land Company was incorporated, and a diamond drill was moved onto the property. By 1888, a planned 100-foot-deep shaft was started. During the fall of 1898, the Oliver Iron Mining Company (OIMC) secured an option on the lease, drilled a few holes, but gave up the lease when United States Steel Corporation (USS) was organized. The OIMC returned to the property in 1905-1906 and drilled three core holes in Section 5 near Lawler Lake. The holes must have showed disappointing results, and the

leases were dropped. [Interestingly, the drill core from these three OIMC holes were found at USS's Minntac Mine in the 1980s, and portions were assayed for gold by USS (see later discussions).] In 1909, drilling was conducted in Section 5 by the Vermilion Steel and Iron Company with Thomas J. Walsh as president. Also in 1909, adjoining property to the east was held by the Extension of the Vermilion Steel and Iron Company. In September of 1911, both of these companies merged to form the Consolidated Vermilion and Extension Mining Company—again with Walsh as president (Stenlund, 1988). In total, two shafts were sunk at the Mud Creek Mine—the Vermilion Shaft to the east (presumably Shaft#1 in Fig. 7; 300 feet deep) and the Extension Shaft (presumably Shaft #2

in Fig. 7; 400 feet deep). Ore was reportedly mined from several drifts at both shafts as they were continually deepened; most of the ore was probably taken from Shaft #2. The ore was stockpiled while a proposed rail spur, from the Tower-Ely track, was surveyed and constructed. In 1915, the ore from three levels at the Vermilion Shaft (Shaft #1) was found to contain high manganese contents (Stenlund, 1988).

In July of 1916 the rail spur was completed, and the first shipment of ore was sent from the Mud Creek Mine. Several tragedies struck the mine in 1916 and 1918. The latter was a cave in (the caved area shown in Fig. 7, which is now occupied by a pond) that took the lives of four miners. In lieu of these tragedies and other financial problems,

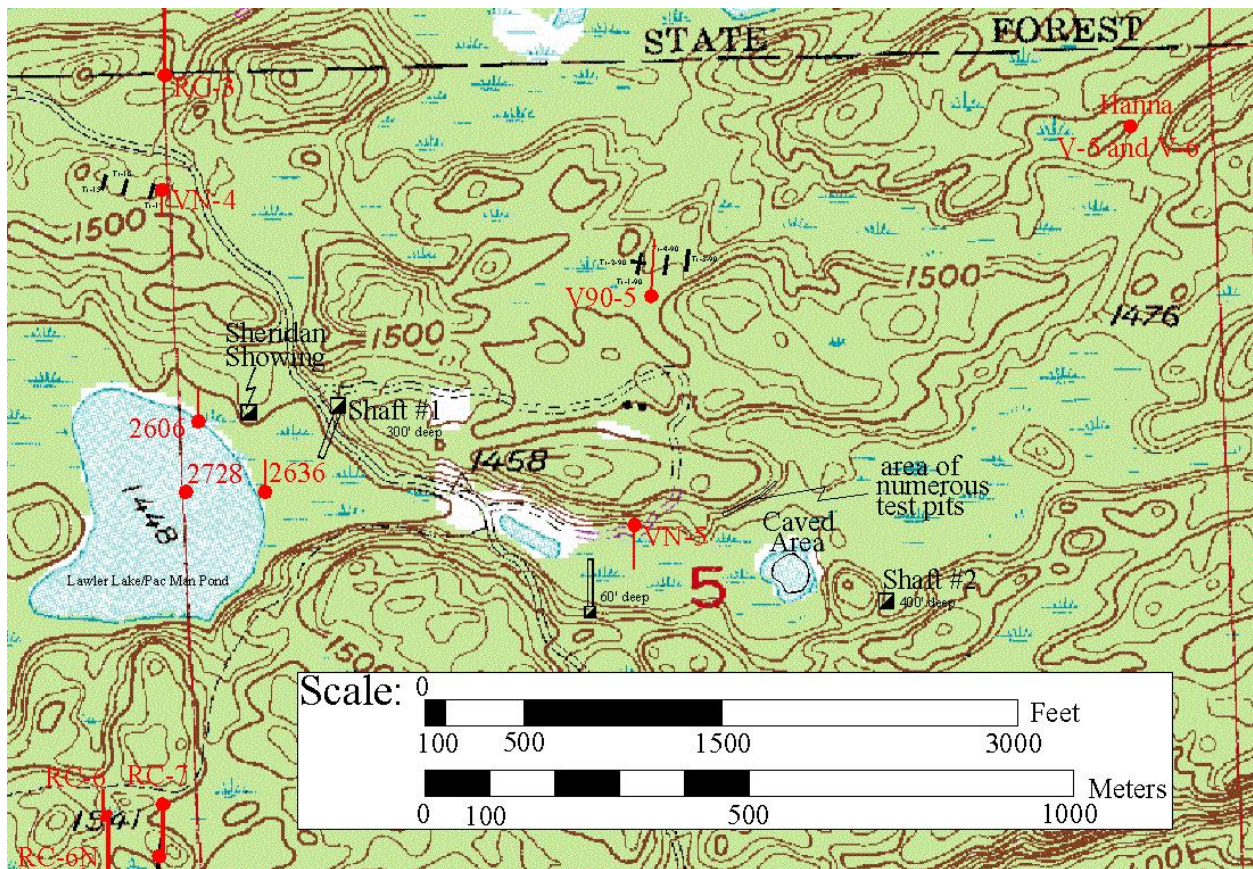


Figure 7. Location of mine workings associated with the Mud Creek Mine (also called the Consolidated Vermilion and Extension Property; and later the Phoenix Mine). Most of the drill holes shown on this map were drilled during gold exploration efforts in the latter part of the 21st century by: Chevron Resources (RC-series holes); Noranda Mining (V90-5); and Cominco American (VN-series). The holes around/in Lawler Lake were drilled by USS/OIMC in 1905-1906.

including the cost of the rail spur, the Phoenix Iron Company took the mine over in 1919. The mine was dewatered and by the end of 1919 was once again producing ore. However, in October of 1920 the Phoenix Mining Company announced that it would be closing the mine, and by March, 1924 the mine was apparently abandoned (Stenlund, 1988).

A map produced by Phoenix is one of the few surviving records that shows where the shafts, caved area, and mine buildings were situated – there are no known maps showing the configurations of the various mine levels. In total, the mine shipped 22,893 tons of ore after almost four decades of exploration and development (Stenlund, 1988).

Walsh Shaft

Workings near and including the Walsh Shaft (Section 4, T.62N., R.14W.) may have been included with the Mud Creek Mine, but, as this site is somewhat removed geographically, it is herein described separately. Apparently, Thomas J. Walsh was also instrumental in developments at this site in the early 1900s. Records from the Whiteside collection at the MDNR (in Hibbing, MN) and the RGGGS office (in Virginia, MN) indicate that two shafts are present on the property (Fig. 8). The northernmost shaft was at least 125 feet deep, with an 88-foot-long drift to the north, in 1901. The southernmost shaft, named

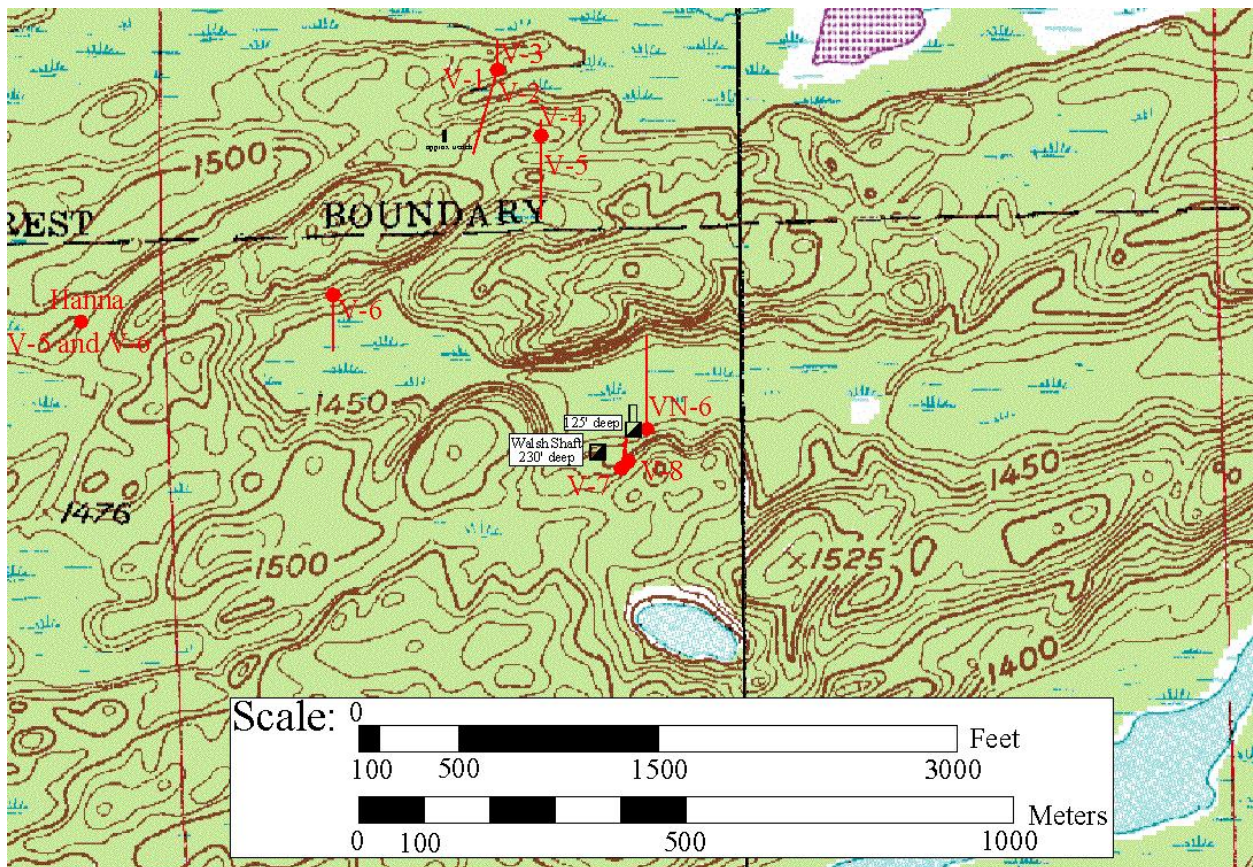


Figure 8. Map portraying the locations of the Walsh Shaft and a nearby unnamed shaft. Gold exploration took place at this site with holes drilled by Cyprus (V-series) and Cominco American (VN-series). The area in the upper central portion of this figure (site of drill holes V-1 through V-5) was called the Railroad Cut gold prospect.

the Walsh Shaft, was reported to be at least 230 feet deep, with a possible drift to the north into “magnetite ore.” However, no ore was apparently ever shipped from this mine. This area was drilled for iron-formation by several companies that included the Oliver Iron Mining Company, Sheridan Iron Company, and lastly, the Bergland Lumber Company (circa 1941).

North American Mine

Exceedingly little is known about the North American Mine (Fig. 9; Section 4, T.61N., R.15W.) that Hansen Evesmith described in 1932 as “... one of the most

extensive and costly developments on the Vermilion Range” (Aguar, 1971). Five holes were drilled on the property in 1900-1901, as deduced from records at RGGs office, but none of these holes intersected iron-formation – in fact, only one hole encountered a short interval of “paintrock.” George A. Fay reported in 1910 that a 25-foot-deep concrete shaft had been sunk (but was filling with water), and six out of eight holes drilled at the property had supposedly intersected iron ore (Fay, 1911-1915). This initial exploration work was conducted by the Lachance Iron Land Company and later on by the White Iron Lake Iron Company (Aguar, 1971). The shaft was called the Walsh Shaft, which was named for Thomas J. Walsh (also a player at the Mud

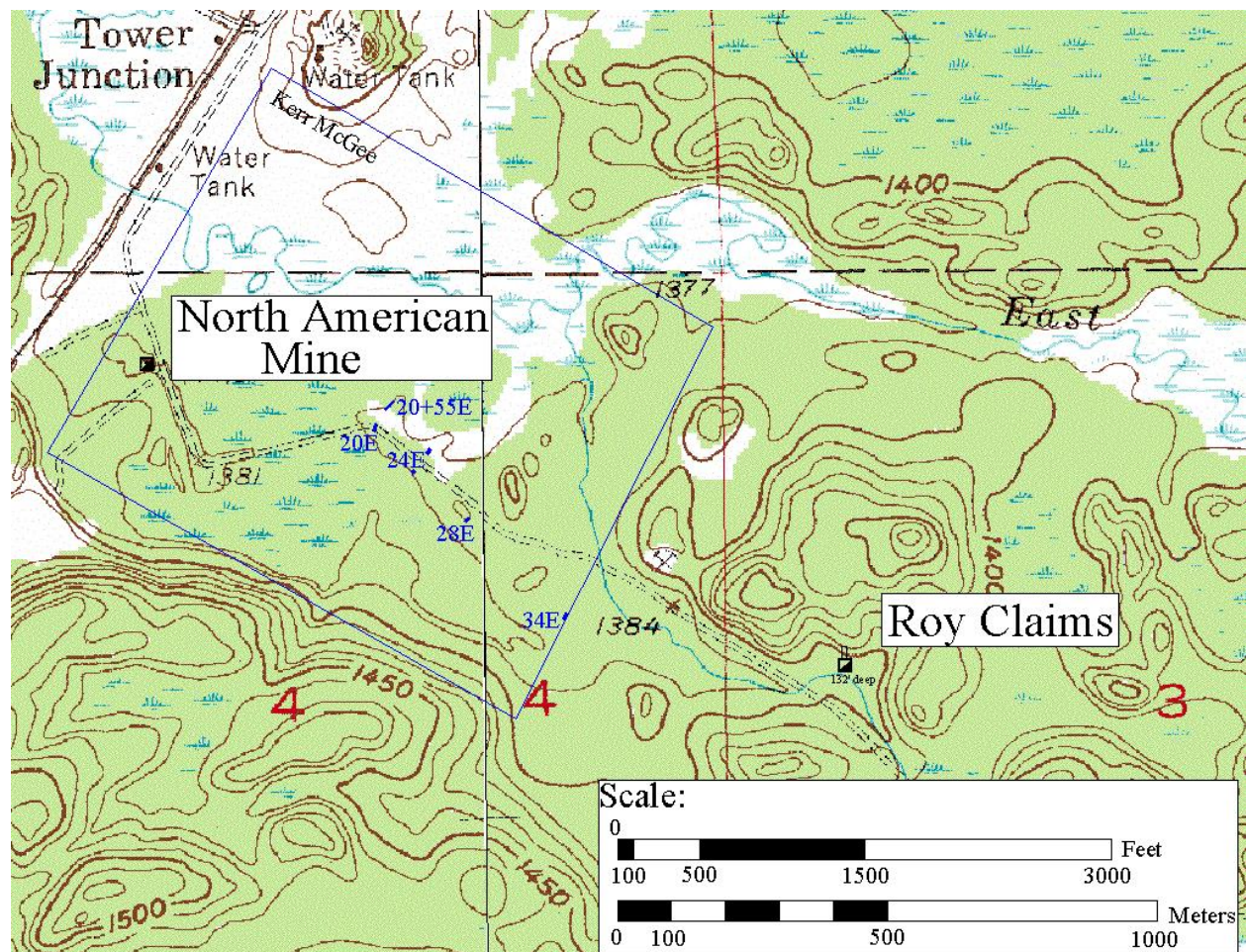


Figure 9. Map portraying the locations of workings at the North American Mine and nearby Roy Claims. Gold exploration, to be discussed later, took place at this site, and several trenches (blue numbered areas) were dug by Kerr McGee in order to expose and sample the bedrock.

Creek Mine). Interestingly, no outcrops of iron-formation have ever been seen on the property or in the dump piles adjacent to the mine shaft. Rather, the dump piles consist mainly of quartz feldspar porphyry and include some vein material of quartz, pyrite, and carbonate (Grout, 1937). This same prospect was also considered to be a gold mine by 1910, and in 1912 a gold assay of \$210/ton was reported (Aguar, 1971). The North American Mine was evaluated for its gold potential in the 1980s by the Kerr McGee Corporation (see later discussions).

Roy Claims

Records at the Minnesota Department of Natural Resources indicate that drilling took place on this property (Section 3, T.61N., R.15W.) as early as 1900 by the Roy Iron

Company. In 1903, the Sharon Ore Company drilled a 618-foot hole into greenstone with minor iron ore. The records also indicate that a 132-foot-deep shaft was established at the site with 75 feet of drifting to the north at the 116-foot level (Fig. 9).

Section 4/9 Mine

There is no formal name for this prospect (Sections 4 and 9, T.62N., R.13W.). Fay (1911-1915) mentions that E.C. Kennedy was drilling and sinking a shaft at this site in 1910 (Kennedy was also working at the nearby Lucky Boy-Anderson prospect at this time). Records at the RGGGS office in Virginia, MN, indicate that a shaft was sunk (initial date unknown and depth of shaft unknown) and that four holes were cored in 1906 (Fig. 10). The core from these same four holes was

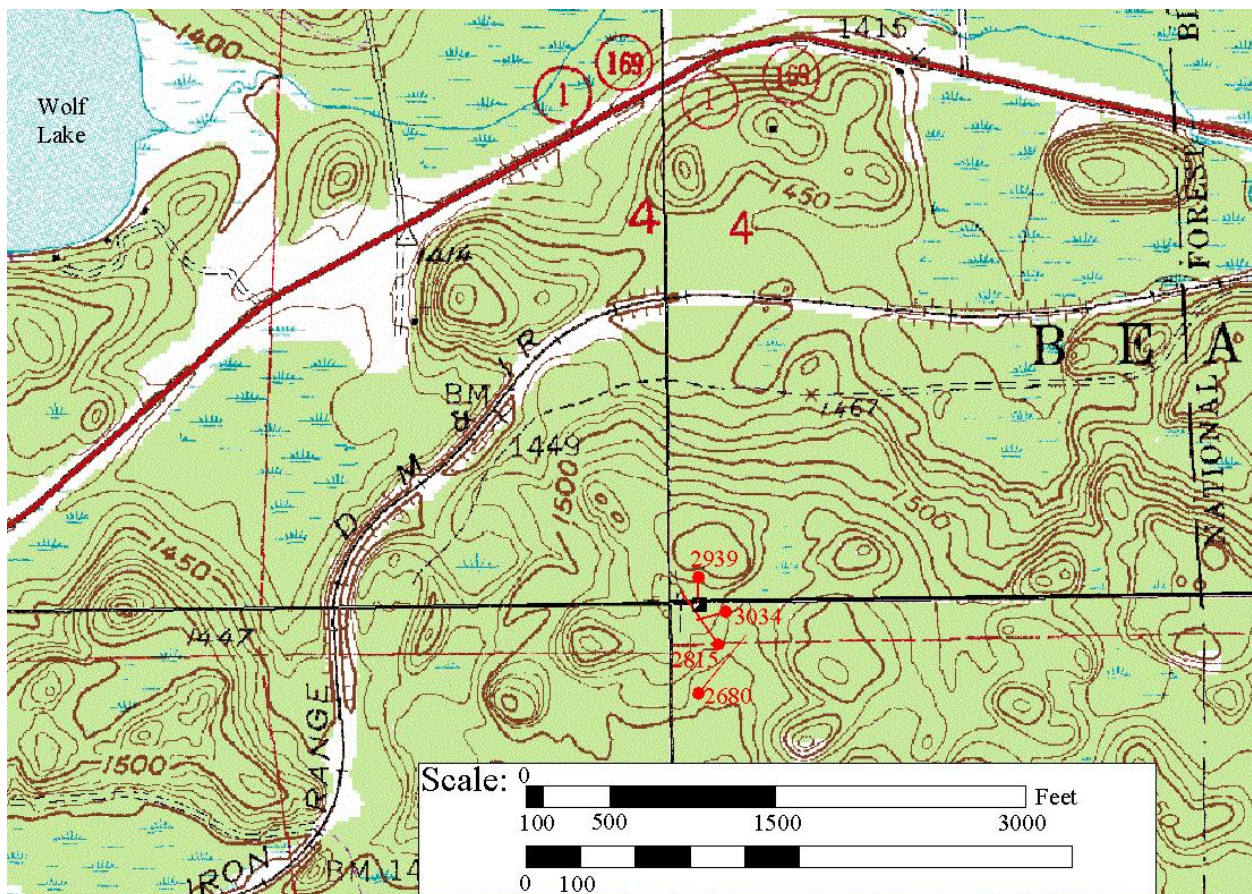


Figure 10. Location of shaft and four preserved core holes from the “Section 4/9 Mine.”

discovered at USS/Minntac in the 1980s. Severson logged the four holes and collected some samples for gold analyses in 1982 while employed by USS (see later discussions). He also briefly visited the site and confirmed the presence of a large water-filled shaft. Records at the NRRI indicate that this property was evaluated for its taconite potential in 1953 by W.S. Moore. The company collected a bulk/channel sample to the northwest of the shaft.

Lucky Boy-Anderson-Camp Mines

The Lucky Boy-Anderson and Camp properties (Sections 4 and 5, T.62N., R.12W.; and Section 33, T. 63N., R.12W.) both started out as individual prospects, with exploration occurring first on the Camp prospect in 1887 by the Duluth Development Company. The Anderson Iron Company began its explorations on the adjoining Anderson property in 1890 by digging several trenches, test pits, and a 70-foot-deep shaft. In 1891, another shaft was dug on the Lucky Boy-Anderson property that reportedly hit ore at 20 feet. The Depression of 1893 eventually halted exploration on both properties until 1910, when D.E. Woodbridge obtained an option on the Lucky Boy-Anderson prospect. The Vermilion and Mesaba Company, with E.C. Kennedy in charge, dewatered the shaft, conducted some drilling, and began sinking another shaft. Renewed interest and sinking of a new shaft at the Camp property took place in 1911. By 1913, E.C. Kennedy reported that work was continuing on both prospects and that there were three shafts at the Lucky-Boy Anderson prospect and two shafts at the Camp prospect (Fig. 11). Work continued slowly over the next three years, some water problems were encountered, and in 1916 the Old Range Iron Company took over. However, water continued to be a problem into 1917. By 1925, a St. Louis county Mine Inspector report indicated that all of the shafts

were abandoned (Stenlund, 1988). There are no records of any ore ever being shipped from this group of mines. Interestingly, the geologic maps of Sims and Mudrey (1978) and Peterson and Jirsa (1999a) do not show any iron-formation as being present at the surface at this site. Records at the RGGGS office indicate that none of the drill holes (vintage 1913?) intersected iron-formation, but “paintrock” was locally encountered in “diorite” and greenstone.

Raspberry Prospect

Several shallow shafts into iron-formation exposures in Section 25 (T.63N., R.13W.) attest to iron ore explorations. This site also received several phases of gold exploration activities and will be discussed later in this report.

White Iron Lake Mine

The White Iron Lake Company began drilling of favorable iron-formation occurrences in Section 2 (T.62N., R.12W.) in 1903. Ore was reportedly found by early 1904. An exploratory shaft was sunk in 1905 (Fig. 12) and eventually reached a depth of 175 feet by the end of 1907. Water problems were encountered and little work was done on the property until 1910, when the initial shaft was dewatered. A second shaft was sunk in 1911-1913 to a depth of 67 feet. In 1916, the company sent “ore” material to Duluth for testing and found it to be exceedingly lean – only 21.6% Fe (Stenlund, 1988) – and all further activities were discontinued. Both the Jones and Laughlin Steel Corporation (J&L) and W.S. Moore Company briefly evaluated this site for its taconite potential in the 1950s (W.S. Moore collection at the NRRI). Nearby iron-formation exposures situated between White Iron Lake and Farm Lake, and at Garden Lake, were also evaluated for their

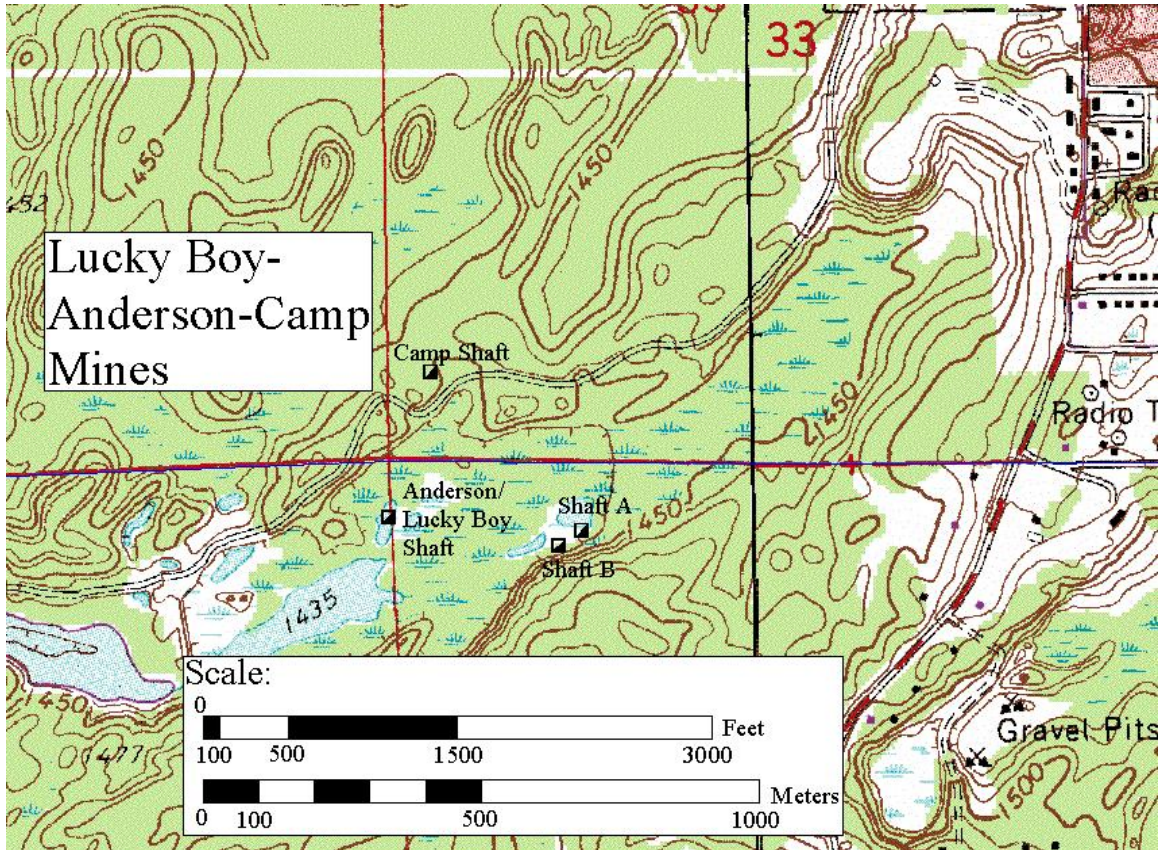


Figure 11. Distribution of shafts at the Lucky Boy-Anderson-Camp mines as determined from historical records at the MDNR. Note that Shaft A and Shaft B may actually be located under the nearby ponds.

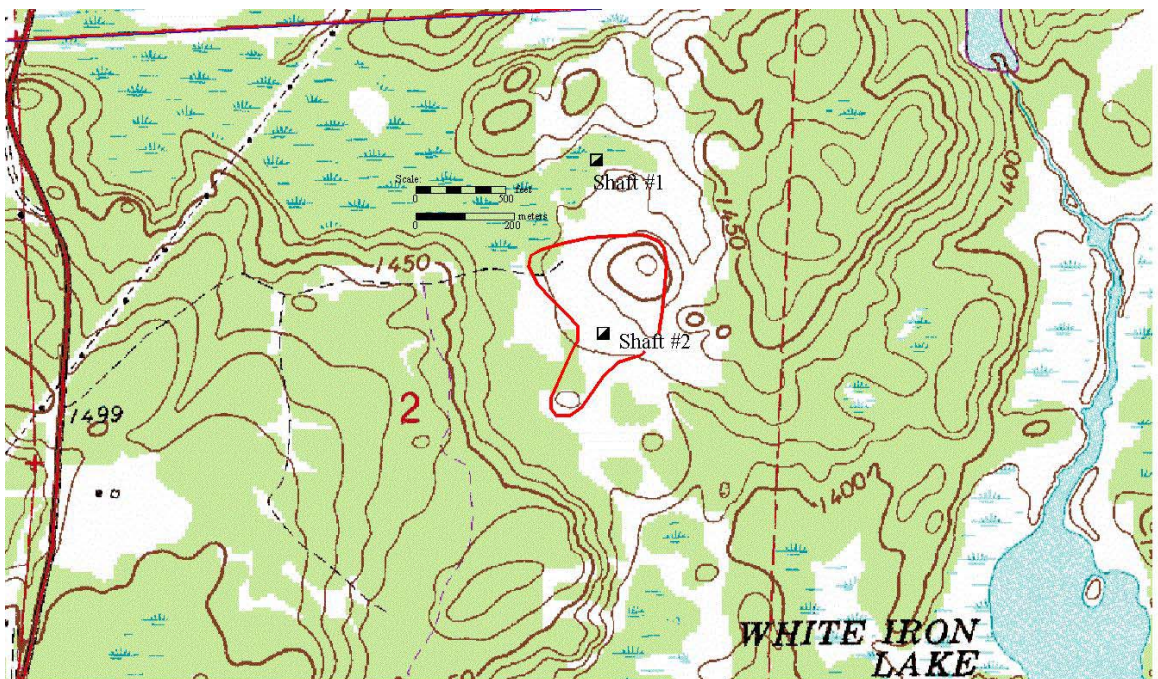


Figure 12. Distribution of shafts associated with the White Iron Lake Mine as determined from historical records. Red line outlines area mapped as iron-formation by Green and Schulz (1982).

taconite potential by J&L in the early 1950s. Seven samples from iron-formation exposures in Sections 32 and 33 (T.63N., R.11W) were collected for gold assays by the NRRI at the request of land owners and were found to contain no gold (Englebert and Hauck, 1991).

Romberg Mine

This property, shown in Figure 13, was originally established by Lazarus Silverman in Section 25 (T.63N., R.12W.) in 1895. Further exploration work continued intermittently in 1902 by the Mahoning Ore and Steel Company and in 1911-1912 by Mr. Fargo of the Wells-Fargo Express Company. By 1912, a 252-foot-deep shaft and three drifts were reported to be present at the site. Around 1921, Mr. George St. Clair had taken an option on the property to look for ore extensions from the adjacent Section 30 Mine (also owned by St. Clair). There are no records of any more work conducted, and in 1932 mining engineer Hansen Eve-Smith reported that no ore was ever shipped from the Romberg Mine (Stenlund, 1988).

Section 30 Mine

In opposition to the adjacent Romberg Mine, which produced no ore, the Section 30 mine (Section 30 T.63N., R.11W.), which was discovered in 1885, reportedly shipped almost 1.5 million tons of ore by 1923 (Stenlund, 1988). This mine, shown in Figure 13, started life in controversy in that there were numerous conflicting claims to its ore bodies. Litigation on the conflicting claims began in 1886 and lasted until 1902 when Frank Eaton, the Merritt family (famous for their part in discovering the Mesabi Iron Range), and George St. Clair gained title to most of the property (Lakso et al., 1979). Alfred Merritt and St. Clair organized the Section 30 Mining Company in 1909, and ore was mined from

two open pits (Section 30 and Bishop orebodies) as well as by underground methods (down to the 535-foot level). High shipping rates forced the mine to close in 1923. At least 52 surface core holes, and an additional 68 underground core holes, were drilled on the property in search of ore. Pickands, Mather and Company acted as sales agents during the mining period. Records of correspondence, by Hugh Roberts and stored at the MDNR, indicate that activities to find more ore at the Section 30 Mine were still being considered in 1929. In the 1950s, the Jones and Laughlin Steel Corporation evaluated this mine for its taconite potential and drilled 14 holes (1954-1956). Prospecting for gold took place at the Section 30 mine in the 1980s, and some of this core was sampled and assayed for gold by American Shield (see later discussions).

Chippewa Mine

Records at the RGGGS office indicate that several holes were drilled on the property (Sections 29 and 30, T.63N., R.11W.) in 1902 and 1907 by Hyde's Exploration and the Chippewa Iron Company, respectively. A 345-foot-deep shaft (Fig. 13) was sunk in 1917 by the Chippewa Iron Company and served workings that were eventually developed on the 100-foot level (276 feet long), 200-foot level, and 300-foot level. Ore was reportedly stockpiled, but there are no records that any ore was ever shipped, and by 1920 the mine was shut down and the surface equipment was moved to the La Rue Mine (Stenlund, 1988).

Garden Lake Area

There is very little information on the Garden Lake area (Sections 22 and 23, T.63N., R.11W.). The geologic maps of Green et al. (1966) and Green and Schulz (1982) show several thin iron-formation horizons in

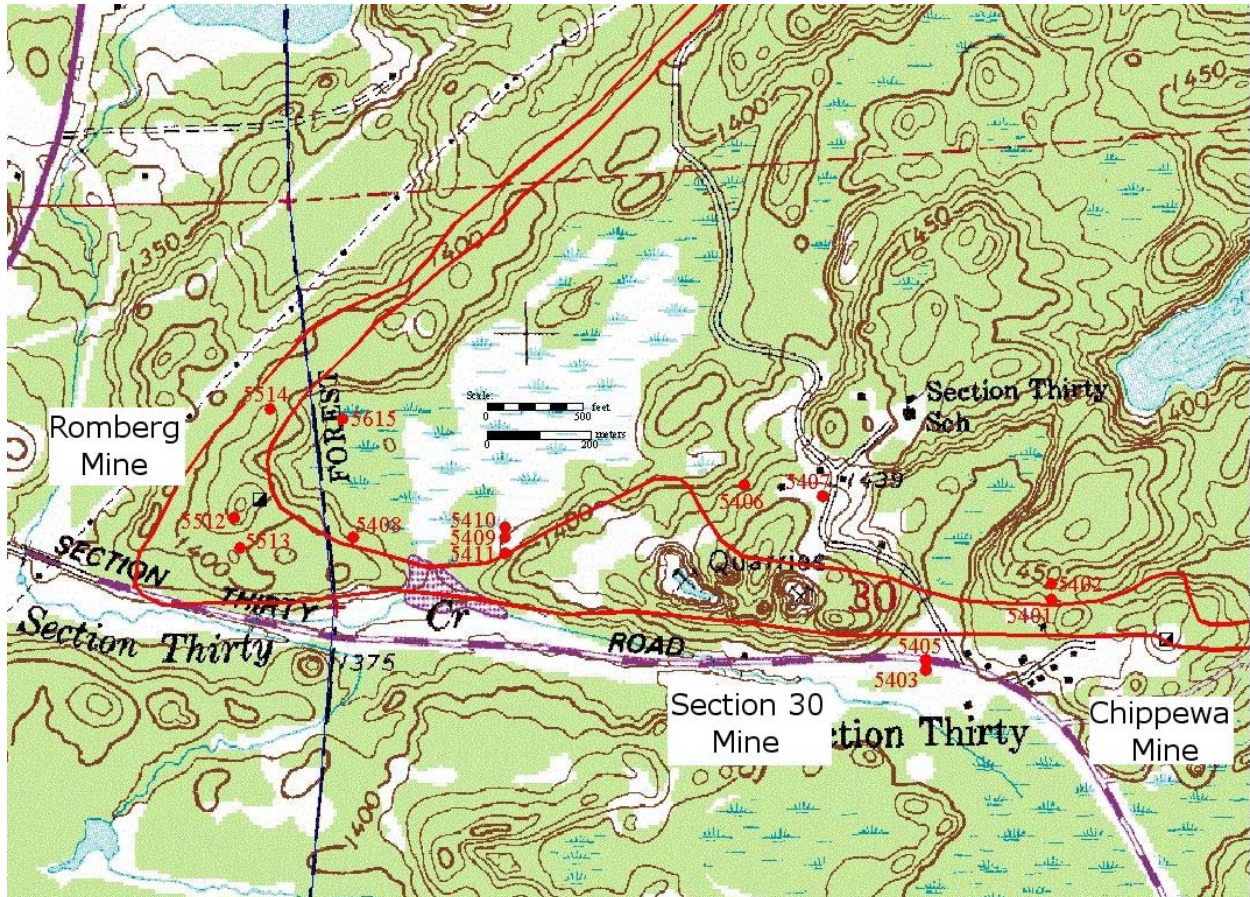


Figure 13. Distribution of shafts and open pits associated with the Romberg Mine, Section 30 Mine, and Chippewa Mine. Red lines outline areas mapped as iron-formation by Green and Schulz (1982). Core for the drill holes (red dots) are preserved at the MDNR.

the vicinity. The Garden Lake Iron Company drilled 14 holes at this site around 1958 (drill core is preserved at the MDNR). The timing of their drilling would suggest that they were evaluating some of the iron-formation horizons for their taconite potential. This site received some gold exploration in the 1980s by American Shield and Chevron. The Jones and Laughlin Corporation also evaluated iron-formations in the Garden Lake area, as well as iron-formations situated between White Iron Lake and Farm Lake (Fortier Property), for their taconite potential in the early 1950s.

GOLD EXPLORATIONS IN MINNESOTA IN THE 20TH CENTURY

Introduction

The first explorations for metals other than iron-formation in the greenstone belts of Minnesota did not occur until after Texas Gulf announced the discovery of the giant Kidd Creek volcanic-hosted massive sulfide (VMS) deposit to the north of Timmins, Ontario in 1964. Following this announcement, several companies began to seriously look for VMS

deposits in the poorly-exposed greenstone belts of the western Vermilion District, Itasca County, and the International Falls area (portions of Beltrami, Koochiching, Lake of the Woods, and Roseau Counties). Airborne surveys were flown in these greenstone belts by several companies, including: Texas Gulf, Bear Creek Mining, Hanna Mining, United States Steel, and Humble Oil/Exxon Corporation. These surveys indicated the presence of several conductors that were tested by drilling with generally unsuccessful results.

The 1980s and early 1990s brought renewed interest in these same greenstone belts of Minnesota, but this time the exploration was for gold. It is important to put into historical context the gold models that were in vogue at that time. One of the earliest catalysts that sparked some initial interest in Minnesota was a lengthy summary of Canadian gold camp deposits by Boyle (1979), wherein he divided the camps into four categories:

- granitization model – whereby gold was expelled during granitization events to ultimately be deposited in structural traps;
- metamorphic segregation model – whereby gold was concentrated into favorable traps during a thermal mobilization event;
- secretions from carbonated zones – whereby gold was concentrated in structural zones from carbonate-altered zones that were related to either shearing or hydrothermal activity near vent areas; and
- secretions from iron-formations – whereby low grade syngenetic gold disseminations in iron-formations were re-concentrated in structurally favorable sites owing to the brittle nature of the iron-formation.

At this same general time, there was a flurry of articles that called attention to the

ability of iron-formations to serve as potential gold repositories (Barnett et al., 1978, 1982; Fripp, 1976; Fyon et al., 1983; Hutchinson et al., 1971; Karvinen, 1978, 1980; Kerswill et al., 1983; Macdonald, 1983; Ridler, 1976a, 1976b; Rye and Rye, 1974; and Sawkins and Rye, 1974, to name a few). Many of these articles envisioned the gold to have been syngenetically deposited in iron-formation horizons, often associated with particular facies changes in the iron-formation, followed by later remobilization and concentration of the gold in structural traps. Carbonate facies iron-formation horizons (actually carbonate-altered rock thought to represent carbonate facies iron-formation in some instances) were common auriferous targets cited in these articles.

Using the above models, some companies began programs of evaluating the gold potential of the western Vermilion District in the early 1980s. United States Steel Corporation was one of the first, as they began to evaluate the potential of their own corporate mineral rights in 1980-1981. Also, at this time the price of gold reached new highs of above \$500 per ounce (U.S.), further stimulating exploration interest and financing. Other exploration companies were probably active during this time, but there are no records of their efforts until 1982, when companies began to bid on State lands during a minerals leasing sale.

Furthermore, the most overriding catalyst that sparked interest for gold exploration in Minnesota was the discovery of the Hemlo gold deposit in Ontario in 1981. When first discovered, the Hemlo gold deposit was touted as unique in that: 1. the gold was reportedly not associated with a typical quartz-vein system; 2. the gold grade was fairly consistent (80 million tons at an average grade of 7.7 grams/ton gold – Harris, 1989); and, more importantly 3. the gold mineralization seemed to be stratabound and remarkably continuous over a significant strike-length (3.7 km). In fact, the average gold grades at

each of the three mines that constitute the Hemlo ore body range from 5.9-11.53 grams/ton (Patterson, 1987). At first, the positioning of the ore body along a contact between metasedimentary and volcanic rocks suggested a stratabound nature, and early workers favored a syngenetic exhalative model in which the mineralization was penecontemporaneous with volcanism (Muir et al., 1995). It was not until around 1984 that the syngenetic model was fervently debated and a structural/hydrothermal model was invoked (Goldie, 1984). Other models proposed to explain the Hemlo deposit included a porphyry deposit model and a skarn model (see Muir et al., 1995 and references therein). The most recent model supports ore deposition by hydrothermal fluids within or near a ductile shear zone; however, no single genetic model adequately explains all of the complexities of the Hemlo deposit (Muir et al., 1995).

The initial news of the Hemlo discovery jarred mining companies into action on the Canadian Shield. The fact that this area had been explored for over 110 years before discovering Hemlo (Muir et al., 1995) led to the uniqueness of the deposit. Certain features that are associated with the deposit that fueled the ensuing exploration blitz elsewhere in the Canadian Shield included:

- The Hemlo gold deposit was overlooked for over 30 years of fairly extensive exploration effort – probably due to the fact that the area did not fit any classic gold deposit models that were in vogue at the time (Muir et al., 1995);
- The deposit straddles the Trans-Canada Highway and was even exposed in low roadcuts that were rumored to have never been looked at or sampled over the years leading up to the initial discovery;
- The “Barren Sulfide Zone” of the Hemlo area, also referred to as the “Sucker Zone,” was exposed in nearby roadcuts along the Trans-Canada Highway – this

obvious sulfide-stained zone on the highway was sampled continually by numerous geologists with generally low gold assay results;

- Some of the earlier exploration drill holes were terminated within <30 meters of the ore body;
- Alteration associated with the ore body is unique (Muir et al., 1995) and is present in various degrees of microclinization, sericitization, biotitization, silicification, carbonatization, albitization, pyritization, and tourmalinization with significant amounts of barite, molybdenite, and bright green vanadium muscovite that was first referred to as fuchsite;
- Collectively the ores are enriched in Au, Mo, Sb, Hg, As, Tl, V, and Ba (Muir et al., 1995); and
- According to Patterson (1987), the deposit is reflected in geochemical surveys of humic gold surveys (up to 430 ppb Au with a background of <14 ppb Au) and “B” soil horizon surveys (up to 10 ppm Au with associated Mo anomalies).

All of these features compelled mineral and oil companies to conduct gold exploration campaigns and re-examine the rocks of both the Wawa and Wabigoon subprovinces in Minnesota (Fig. 1). Companies that emerged to conduct exploration included: American Copper and Nickel Company (ACNC), American Shield Company, Amoco, BHP-Utah International Inc., Chevron Resources, CoCa Mines Inc., Cyprus Minerals Company (an affiliate of Amoco), FMC Minerals, Gold Fields Mining Corporation, Homestake Mining Company, Kerr McGee Corporation, Lehmann Exploration Management Inc., Mapco, Meridian Lands and Minerals Company, Nicor Mineral Ventures Inc., Noranda Exploration Inc., Normin Mining Company (Boise Cascade), Newmont Exploration Limited, Resource Exploration Inc., Rhude and Fryberger Inc., Santa Fe Pacific Gold, St. Joe American Corporation, and Texas Gulf

Oil. Some of these listed companies conducted joint venture exploration campaigns with other listed companies (and unknown companies); however, the details of these joint ventures are mostly unknown.

Most of the exploration companies were drawn to Minnesota based on geologic similarities, as accounted for in published geologic maps and reports pertaining to Minnesota, to known gold mining camps elsewhere in the Canadian Shield. After extensive geologic literature researches, the exploration company's efforts probably began as reconnaissance mapping of specific areas coupled with sampling of interesting-looking and variably-mineralized outcrops. Available geologists with some work experience in the area were contacted for their opinions and knowledge of potentially mineralized zones. Airborne geophysical surveys were flown in some areas, whereas pre-existing airborne surveys (1960s- and 1970s-vintages) were obtained/purchased in other areas. Unfortunately, there is very little in the preserved records at the MDNR from this early phase of exploration. Pre-existing drill holes, stored at the MDNR and in private collections, were also extensively sampled during this phase. The next phase was to secure land packages by bidding on, and being awarded, State mineral rights during publically-held State lease sales, and/or obtaining privately-held mineral rights held by individuals and local companies (most often iron-mining companies, paper companies, and Fee Offices representing individual and family interests). Once the land packages were secured, grid lines were established that were then utilized for:

- detailed geologic mapping;
- detailed outcrop sampling and geochemistry;
- sampling of various soil media;
- biogeochemical sampling (in some cases); and

- geophysical surveys (magnetics, electromagnetic, induced potential, etc).

Generally, there are considerable amounts of data in the preserved files from this second phase, and these data are summarized wherever possible for each of the explored areas in this report. The last phase of exploration for the companies was to choose favorable areas on the basis of the above criteria for follow-up work that often included successive campaigns of drilling and/or trenching. These data are also summarized in this report wherever possible. Scans of the drill logs and accompanying assay results are presented in the appendices of this report.

Gold Exploration in the Western Vermilion District

Geologic Setting

The geologic setting of the western Vermilion District is recently well summarized by Southwick et al. (1998), Peterson (2001), Jirsa and Boerboom, (2003a), Peterson and Patelke (2004a, 2004b), and Hudak et al. (2002). Supracrustal rocks in the district consist of volcanic-dominated stratigraphic sequences of the Neoproterozoic Wawa subprovince. These rocks are subdivided on the basis of stratigraphic and structural setting into: 1. the Soudan belt to the south; and 2. the Newton belt to the north (Jirsa et al., 1992; Southwick et al., 1998). The Soudan belt is characterized by arcuate folds and curvilinear structural trends involving calc-alkalic and tholeiitic volcanic strata that are overlain by, and interdigitated with, turbiditic rocks. In contrast, the Newton belt is interpreted to consist of a deck of fault-bounded, homoclinal, dominantly north-facing stratigraphic packets of volcanic and volcanoclastic sequences. The boundary between these contrasting structural panels can be traced geophysically across Minnesota and has been informally designated the Leech

Lake structural discontinuity (Jirsa et al., 1992).

Lithostratigraphic units in the western Vermilion District, as shown in Figure 14, include: 1. Lower member (Ael), Soudan Iron-formation member (Aes), and Upper member (Aeu) of the Ely Greenstone, the Lake Vermilion Formation (Alv – including the informally recognized Gafvert Lake felsic complex), and Knife Lake Group (Akl) of the Soudan belt; 2. the Bass Lake sequence (Abl) and Newton Lake Formation (Anl) of the Newton belt; and 3. syn- to post-tectonic granitoid intrusions of the Giants Range batholith (Agr) and a suite of smaller post-tectonic alkalic stocks and plutons (not shown).

In any discussion pertaining to the gold potential of the western Vermilion district, it is important to understand the basic structural components that are present. Numerous structural studies have been conducted, and the most current interpretations (Hudleston, 1976; Bauer, 1985; Hudleston et al., 1988; Jirsa et al., 1992; Peterson and Patelke,

2004b) suggest that the Western Vermilion District underwent at least three periods of deformation as outlined below:

1. *D₁ Deformation.* The earliest deformation event produced broad, locally recumbent folds (F₁) such as the Tower-Soudan Anticline, which is a steeply west-plunging fold that closes to the west and is overturned in the southwest limb. These types of folds are inferred mostly on reversals in facing directions. Axial planar cleavage associated with this event is generally lacking, and a soft sediment origin has been invoked. The D₁ event seems to have had a large component of nearly bedding parallel shearing that locally produced sheath folds during soft sediment folding, e.g., conical folds that exhibit dome-and-basin interference structures.
2. *D₂ Deformation.* The second deformation event accompanied regional metamorphism to greenschist to amphibolite facies and produced widespread foliation,

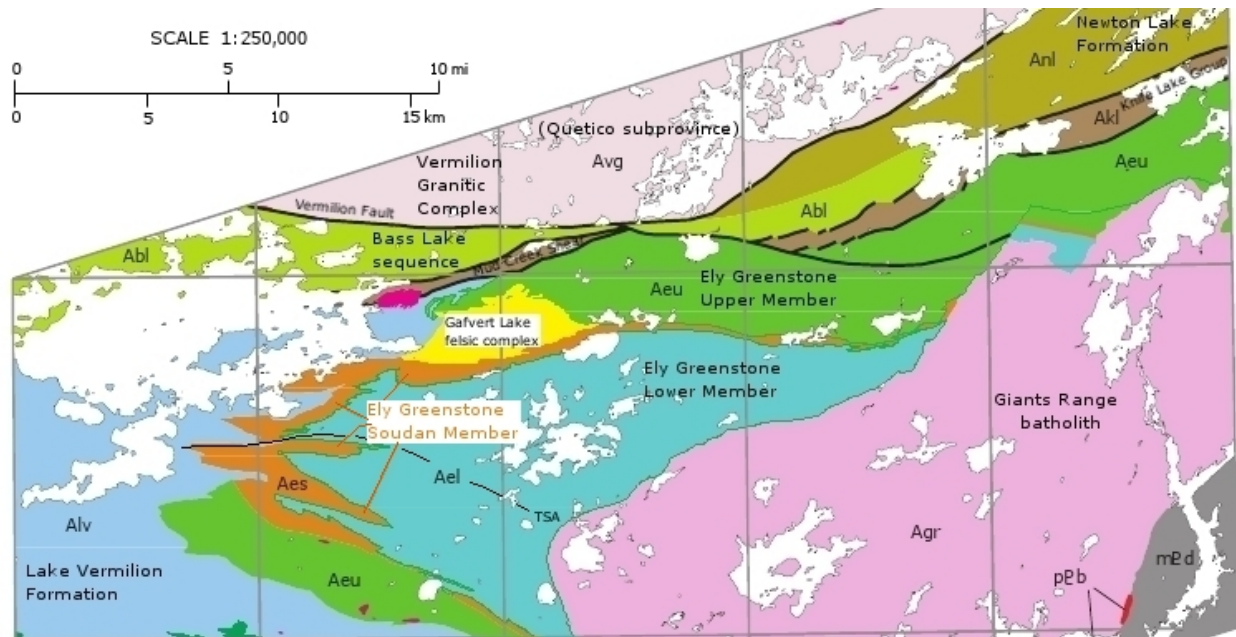


Figure 14. Simplified geologic map of the western Vermilion District (modified from Peterson and Jirsa, 1999a) showing lithostratigraphic units in the Soudan belt (units Ael, Aes, Aeu, Alv, and Akl) and Newton belt (units Abl and Anl). TSA denotes the axis of the Tower-Soudan anticline.

lineation and localized folding as well as strike-slip faulting – all the result of northwest-southeast directed transpression. Folds (F_2) of this event are upright, vary from isoclinal to open, and are marked by an axial planar metamorphic cleavage and schistosity (C_2) that trends east-northeast and is steeply dipping. D_2 deformation is bracketed at about 2,674-2,685 Ma (Boerboom and Zartman, 1993) and included emplacement of most of the intrusions of the Giants Range batholith to the south of the district. Major shearing, related to dextral transpression, took place relatively late in the D_2 event and produced features such as the Mud Creek Shear Zone, Murray Shear Zone, Longstorff Bay Shear Zone, and Shagawa Lake Fault.

3. D_3 Deformation. Structural elements generated after D_2 metamorphism are assigned to D_3 . The timing of these features is syn- to post-emplacement of late, small, granitic and alkalic plutons. In the Vermilion district, the F_3 folds are small and involve both bedding and the earlier-formed C_2 metamorphic cleavage – north-trending kink bands are also locally present. Large structures related to the third deformation event include both NE- and NW-trending faults that include the Vermilion, Burntside Lake, Haley, Bear River, Deer Creek, Waasa, Camp Rivard, and Wolf Lake faults.

Most of the aforementioned authors invoke a model of subduction-driven accreted terrains to explain the deformation. However, more recent studies (Erickson, 2008; Goodman, 2008; Karberg, 2009) believe that density-driven sagduction was also important.

Gold Exploration Activities

As mentioned earlier, the first phase of explorations for base metals in the western Vermilion District took place in the 1960s and 1970s. Several conductors were tested by drilling, with generally unsuccessful results. Figure 15 displays areas where some form of drilling (one or more drill holes/area) for VMS deposits took place. Many of these holes were sampled during the ensuing gold exploration phase in the 1980s.

In regard to gold exploration in the western Vermilion District, there were at least 24 major gold exploration areas, shown in Figures 16 and 17, which were explored by a multitude of companies from 1981 through 1995. These companies drilled 182 holes and dug 60 trenches at 23 of the prospects. The prospects that were explored at the beginning of this exploration phase were evaluated for stratabound zones associated with facies changes in iron-formation. However, as exploration progressed it became obvious that most of the gold prospects in the western Vermilion District were associated with a host of rock types in close proximity to major shear zones such as: Mud Creek Shear zone; Murray Shear zone, Shagawa Lake Shear zone, Burntside Lake fault, and Vermilion fault. Iron-formations were still envisioned to be important in some of these structurally-prepared areas due to their brittle nature and ability to form gold traps, but this criteria became less important with time. Peterson and Patelke (2004a, 2004b) categorize the gold prospects as:

1. auriferous quartz-carbonate-pyrite veins and sulfidized zones in iron-formation;

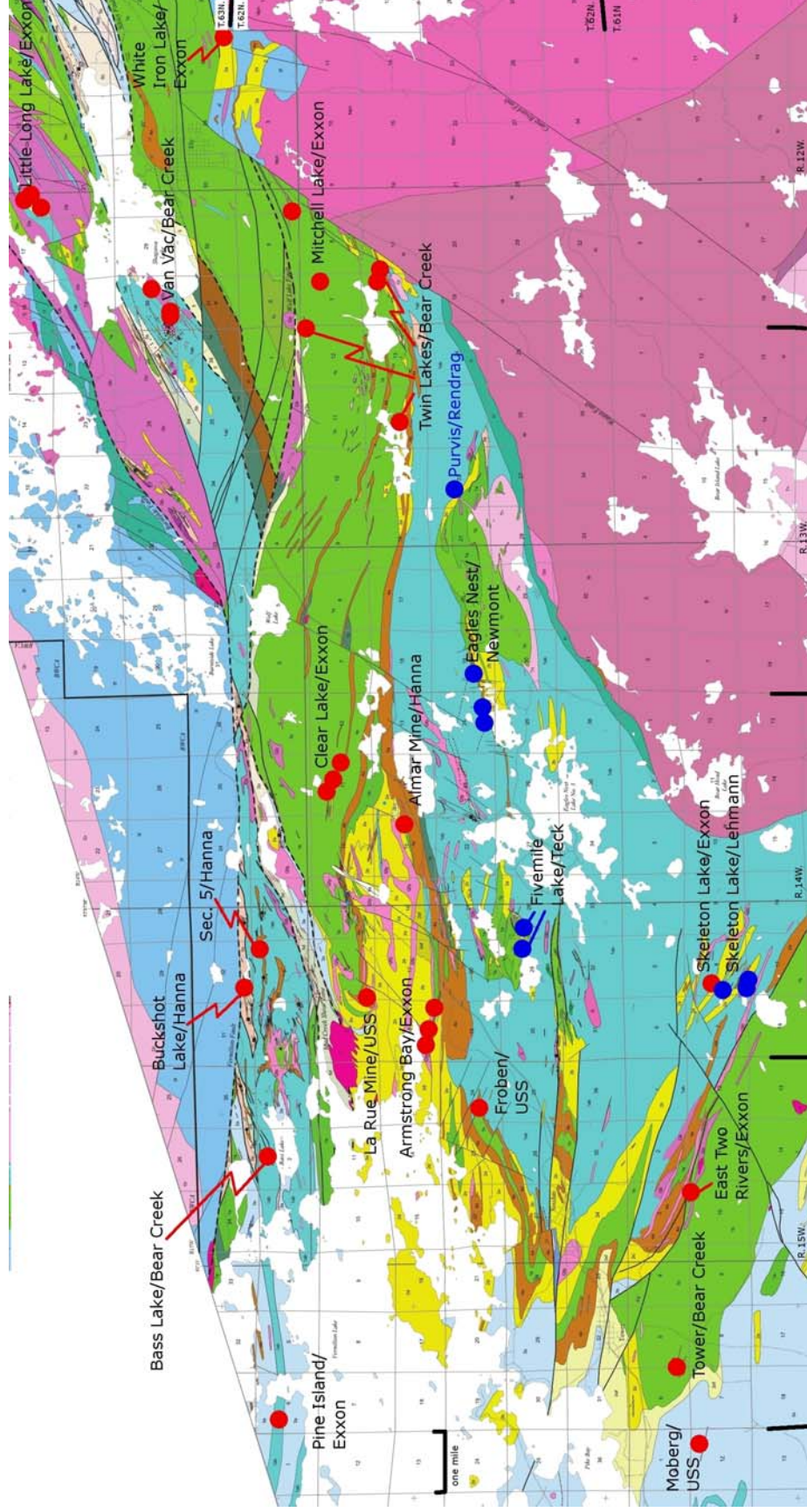


Figure 15. Geologic map of the western Vermilion District (modified from Peterson and Jirsa, 1999a) showing areas where drilling for VMS deposits took place in 1969-1975 (red dots) and 1983-1999 (blue dots). The respective companies that conducted the drilling at each site are listed. A listing of the holes at each site is presented in the Vermilion_District_drillholes_list.xls in Appendix A.

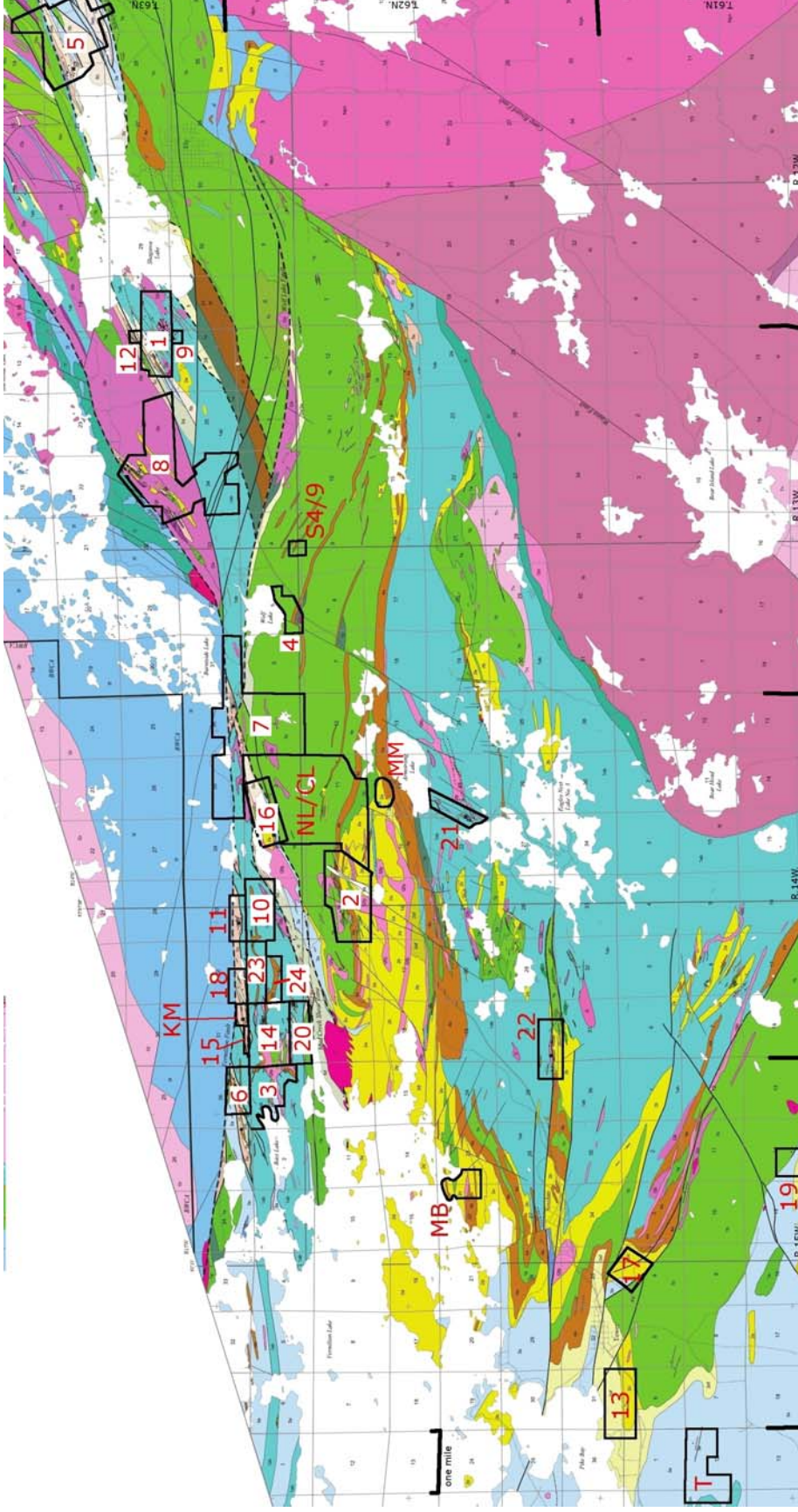


Figure 16. Gold exploration properties of the western Vermilion District that were explored in the latter part of the 20th century. Prospects are numbered in the order in which they were first drilled or trenched as follows: 1. Raspberry; 2. Section 9; 3. Bass Lake; 4. Wolf Lake; 5. Spaulding Bay; 6. Dead Canary; 7. Foss Lake; 8. Burntside River; 9. Quartz Hill; 10. Walsh Shaft; 11. Railroad Cut; 12. Raspberry North; 13. Pike Bay; 14. Section 6/Pac Man Pond; 15. Clearcut; 16. Mud Lake; 17. North American Mine; 18. Buckshot Lake; 19. West Two Rivers; 20. West Mud Creek; 21. Eagles Nest Shear; 22. Murray Shear; 23. Section 5; and 24. Mud Creek Mine. Areas where extensive mapping and sampling took place but received no drilling or trenching activities are: 1. KM=Kerr McGee Showing; 2. S4/9=Section 4/9 Mine; 3. NL/CL=Nicholson Lake/Clear Lake; 4. MM=McComber Mine; 5. MB=Mattson Bay; and 6. T=Tower. In this same category, but not shown, are: 1. Garden Lake; 2. Section 30 Mine; 3. Mud Creek-USS; and 4. Mud Creek-Tamarack. See Figure 16 for more detail of gold prospects in the Mud Creek Road area. Geology from Peterson and Jirsa (1999a).

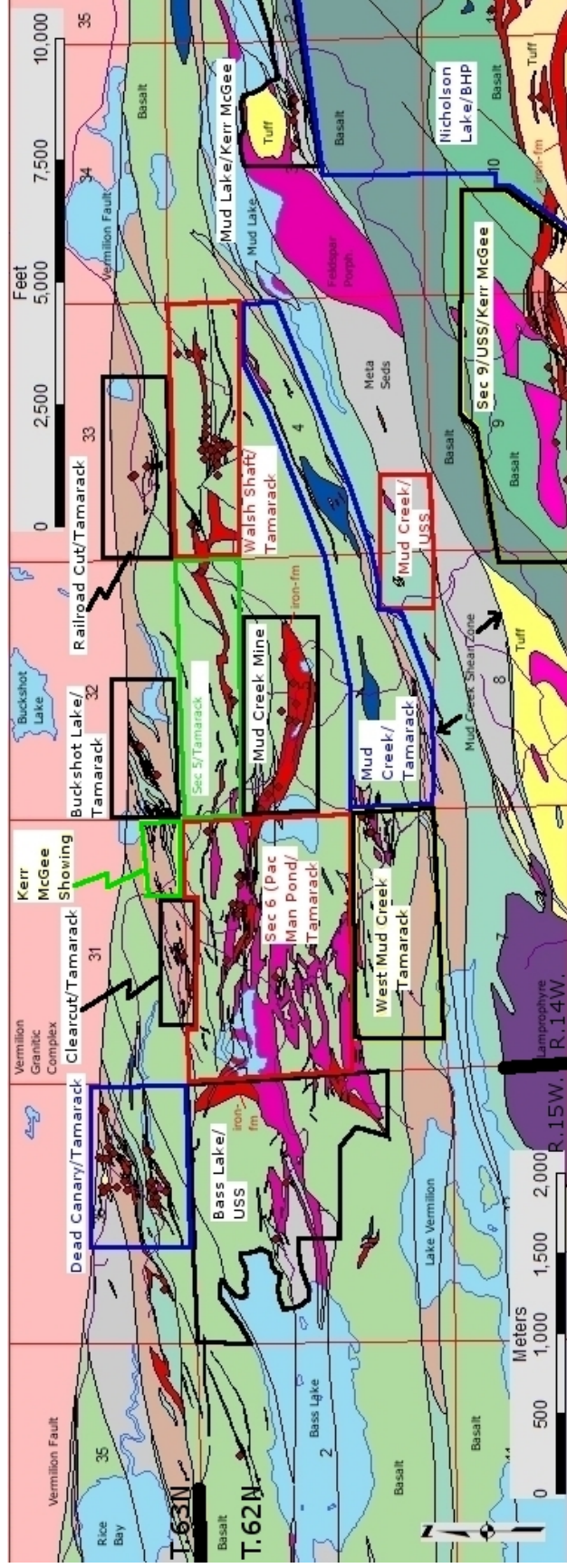


Figure 17. Gold exploration properties in the Mud Creek Road area (also referred to as the Rice Creek Block by Tamarack). Note that most of these properties are also displayed in Figure 16. Most of these prospects received some drilling and/or trenching. The properties listed under Tamarack were joint ventured on several occasions by different companies and will be discussed in more detail. Geology from Peterson and Patelke (2004a).

2. well-foliated auriferous quartz-sericite-ankerite-pyrite schists in major shear zones; and
3. felsic intrusive-hosted auriferous quartz veins and stockworks, e.g., Raspberry.

Peterson and Patelke (2004b) further note that all of the prospects are found within areas of moderate to strong iron-carbonate alteration, with the best mineralization associated with attendant sericite alteration.

The available records show that many of the gold properties in the vicinity of the Mud Creek Road (Fig. 17) were joint ventures between various exploration companies and the Tamarack Company of Duluth. Tamarack appears to have been a local group of investors/land holders, with William Ulland of American Shield as a partner, which obtained private and State mineral leases and assembled large land packages. These land packages were then promoted to various companies as joint venture projects. As will be seen in this report, many of the Tamarack-controlled lands in Figure 16 (referred to as the Rice Creek Block by Tamarack) were joint ventured numerous times to several different exploration companies. Available records show that William Ulland felt that the properties located in the Rice Creek Block were good prospects for the following reasons:

1. All of the properties are situated in a broad deformation zone that is located between the Vermilion Fault to the north (with numerous splays) and the Mud Creek Shear zone to the south.
2. Rocks in the deformation zone are typified by numerous highly sheared zones ranging from <1 foot thick to over 100 feet wide.
3. Rocks in the shear zones are characterized by phyllonitic to mylonitic textures that are superimposed on volcanic and clastic sedimentary rocks and by brittle fractures and breccia zones within iron-formation

horizons. Furthermore, the shear zones and breccia zones commonly occur along lithologic contacts of high competency contrast.

4. Common alteration assemblages in the shears include: quartz-carbonate(ankerite, ferroan dolomite, and calcite)-sericite-chlorite-green mica (fuchsite?)±tourmaline alteration in the volcanic rocks and intrusive porphyries, and quartz-carbonate(calcite, ankerite, and siderite)-pyrite-hematite-iron chlorite in the iron-formations. Quartz veining is common to all rock types.

For the remainder of this chapter, each of the gold prospects in the western Vermilion District will be described in their rough chronological exploration order (from the first drilled gold prospect to the last drilled gold prospect). Many of the maps for the individual prospects have been modified from an NRRI map by Peterson and Patelke (2004a). These two individuals did a remarkable job of compiling all assay data (rock, drill core, and soil samples) and even conducted more detailed mapping and sampling in order to produce the final GIS-referenced map and data bases. The author of this report noted on numerous occasions, while conducting “due diligence” checks on available assay data, that Peterson and Patelke (2004a) did an exceptionally thorough job – in some areas, their databases contain assay values, or locations of trenches, that are no longer preserved in the records at the MNDNR.

Raspberry Prospect

The Raspberry Prospect (sec. 25, T.63N., R.13W., and sec. 30, T.63N., R.12W.) represents a gold property that was explored the most extensively, and for the longest period, than any other gold property in the entire state. Most of the information on the Raspberry Prospect that is presented in this

report is taken from an unpublished corporate report by Roger J. Kuhns for BHP-Utah International Inc. (on file at the NRRI) and from a M.S. thesis by Bruce Yeomans (1984). The Raspberry Prospect was first discovered in 1889 by C.C. Prindle, A.W. Dutton, B.E. Wells, and E. McIntosh when it was initially called the “Raspberry Patch Claims.” These prospectors first sank several test pits in the area in 1894 and located sporadic low-grade gold concentrations. In 1935, the property owners sank several test shafts into a shallow, flat-lying quartz vein in a granodiorite/quartz monzonite stock (the Raspberry stock - Figs. 18, 19, and 20). Evidence for only one of these shafts is present on the property today, and it has been described as being 15 feet deep with a 20-foot-long adit extending

northwesterly at the bottom of the shaft (Yeomans, 1984). The following is a chronological listing of more recent exploration activities for the Raspberry Prospect:

- R.V. Whiteside drilled nine holes (WS-series) into and around the Raspberry stock in 1962-1963 and intersected 2.8 feet of 0.47 ounces/ton (opt) of gold in hole WS-1, which was drilled in the immediate vicinity of the shaft;
- Bear Creek Mining Company explored the property, referred to as the Van Vac property, for VMS deposits by conducting geologic mapping and drilled three holes (S-series) to test geophysical conductors in 1969;

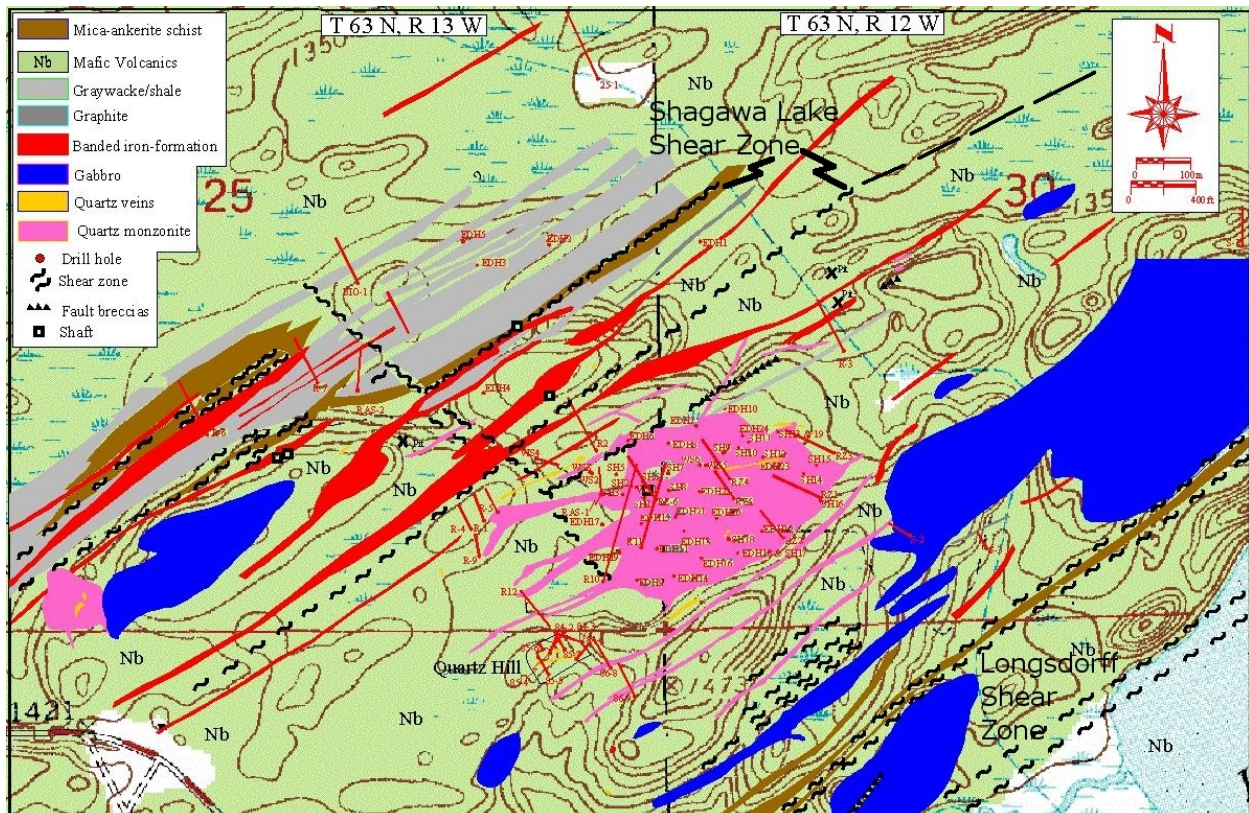


Figure 18. Geology of the Raspberry prospect (modified from unpublished Kuhns report at the NRRI, which was modified from Yeomans, 1984) and distribution of drill holes showing projected traces of inclined holes (note that most holes were vertical). Rock units are tentatively included in the Bass Lake sequence. See Figure 19 for a close-up portrayal of the holes in the Raspberry stock. Note location of the Quartz Hill prospect, explored by St. Joe Minerals, to the south of Raspberry in Section 36.

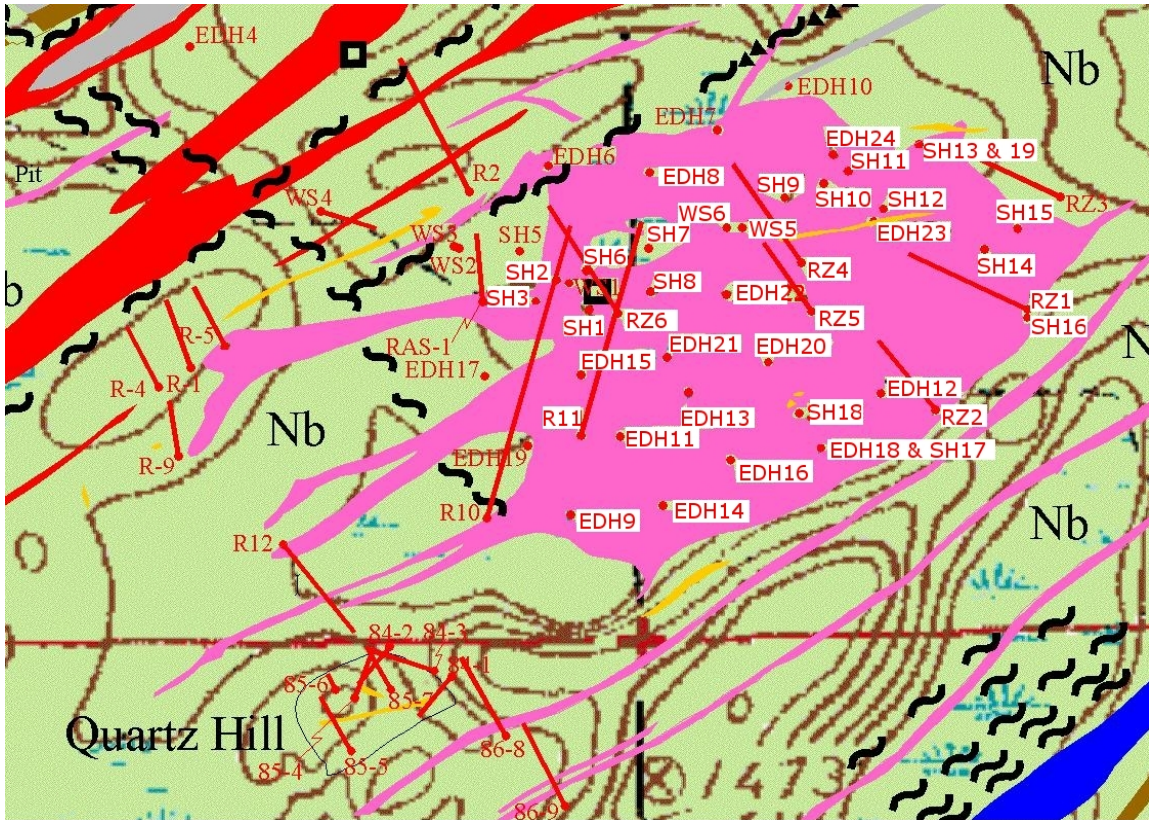


Figure 19. Enlarged area, from Figure 18, showing distribution of drill holes within the Raspberry stock. Note that the shaft location, in the stock, obscures the text denoting drill hole WS-1.

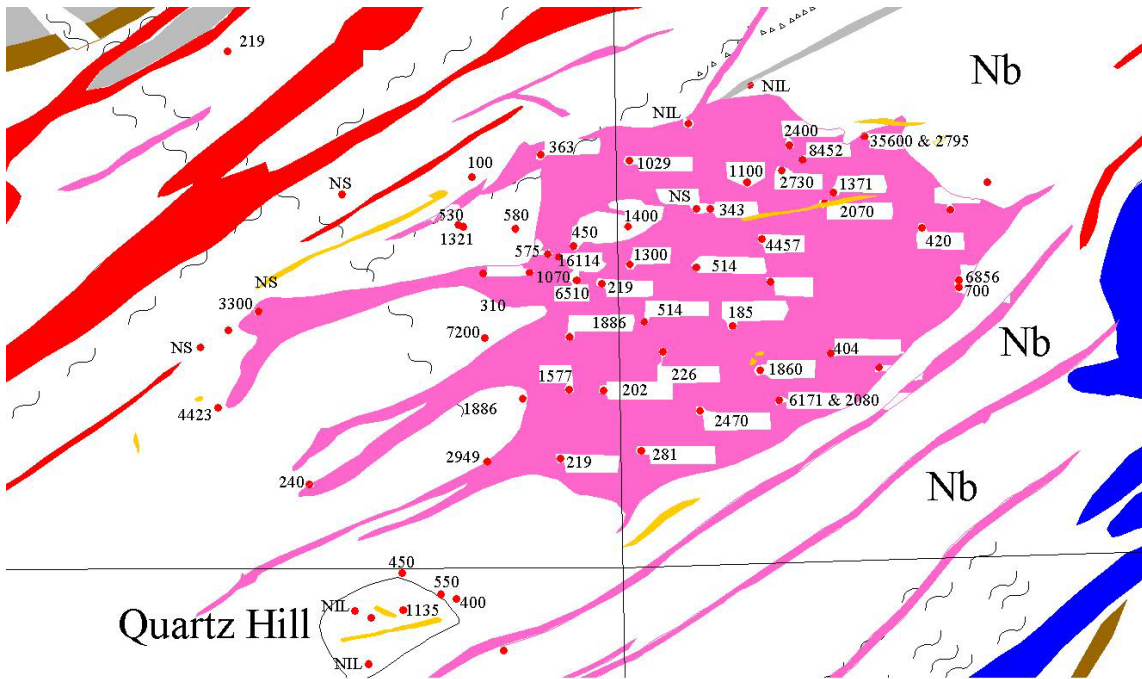


Figure 20. Maximum gold values (listed in ppb Au; with a threshold >100 ppb Au) for each drill hole in and surrounding the immediate area of the Raspberry stock. NS is an abbreviation for “not sampled.”

- W.S. Moore Company, with William Ulland as vice president, acquired a lease on the property from Whiteside in 1972 and hired Thomas C. Keefer to evaluate the prospect in 1973. Keefer's report, apparently no longer preserved, described the original prospect as a two-foot-thick, flat-lying quartz vein yielding 0.25-0.36 oz/ton gold;
- Several Duluth businessmen formed the Tamarack Company in the early 1970s and consolidated the various land holdings at Raspberry into a single land package. All future activities at the Raspberry prospect were managed by American Shield Company, with William Ulland as president, and Tamarack subsequently subleased the Raspberry prospect as part of several successive joint ventures as described below;
- North Central Minerals Ventures (NCMV) along with American Shield – explored the property for gold in 1974 and drilled six holes (RZ-series) near a then newly-discovered mineralized quartz vein;
- New Jersey Zinc – geophysically evaluated the property for VMS potential in 1976, but never drilled any holes;
- Gold Fields Mining Corporation – explored in 1979-1980 by conducting detailed geologic mapping (Yeomans, 1984) and drilled 24 holes (EDH-series rotary holes). Gold Fields dropped the property after they concluded that a one-million-plus-ounce gold deposit was not present;
- Nicor (Northern Illinois Corporation) – drilled five holes on the property in 1982 (R-1 through R-5) and dropped it in 1983 after a tumultuous relationship with Tamarack;
- Amoco – leased the property during 1984-1986 and drilled seven core holes (R-6 through R-12);
- Kerr McGee Corporation drilled a hole (BL-25-1) in 1985 to the north of the Raspberry property at what is informally portrayed as the Raspberry North prospect in Figure 12;
- CoCa Mines Inc. – optioned the property from Tamarack Company/American Shield in 1987-1989 and drilled 19 holes (SH-series rotary holes) that they felt delineated **150,000 tons of ore grading 0.10 opt gold** within 100 feet of the surface. CoCa believed that the mineralization was controlled by flat-lying quartz veins in the stock;
- BHP-Utah International – explored the property in 1989-1990, drilled two core holes on the property (RAS-1 and RAS-2), and another on Shagawa Lake (SP-90-1), in the winter of 1990. BHP reached a similar conclusion as to gold mineralization as did CoCa Mines;
- NRRI – conducted a grid-based biogeochemistry survey in 1990 that defined several gold anomalies in sampled plant and twig media (Zanko et al., 1991; in prep.);
- One of these biogeochemistry anomalies was drilled by American Shield in 1991. The site for this hole (BIO-1) was chosen because the biogeochemistry anomaly also corresponded with several auriferous soil anomalies as well as geophysical conductors (Fig. 21). This hole was an academic success in that the top portion of the hole intersected five anomalous gold zones (>100 ppb Au, with a maximum of 776 ppb Au) as predicted by the soil and biogeochemical surveys; and
- The MNDNR conducted a re-evaluation of the core from Raspberry in 2008-2009 (Frey and Hanson, 2009) and through the use of a hand-held, semi-quantitative XRF found up to 116 ppm gold in spot analyses of select core and cuttings. The gold is mainly found in quartz veins where it is associated with galena, molybdenite, rutile, and other polymetallic sulfides (Frey and Hanson, 2009). Overall, they

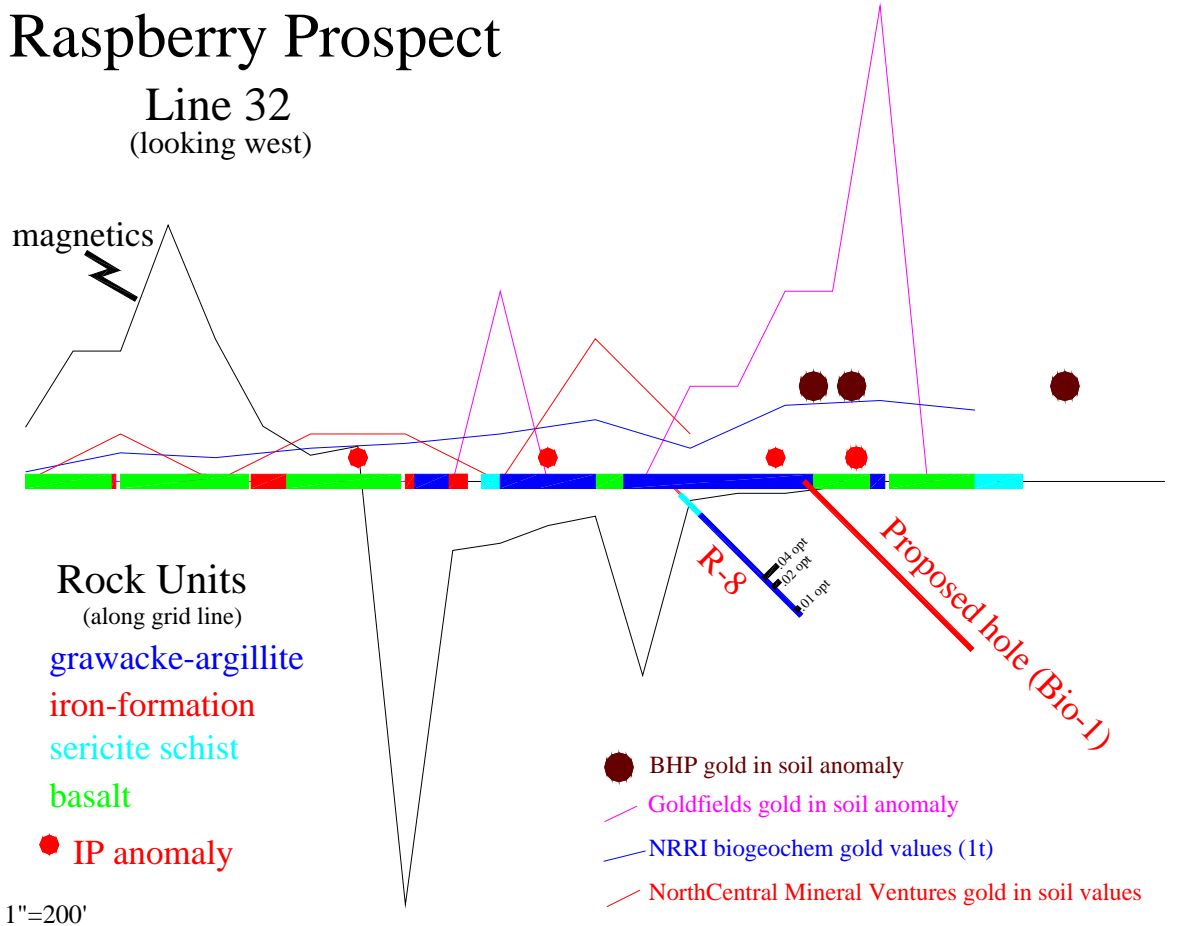


Figure 21. Geologic, geochemical and geophysical profiles along Line 32W at the Raspberry prospect showing the corresponding anomalous features that led to drilling of the BIO-1 core hole by American Shield. Diagram modified from a drawing supplied by Bill Ulland to the NRRI in 1990.

found several new gold occurrences in holes R-9 and R-11, and verified anomalous gold in previously known auriferous intervals in holes SH-1, SH-11, and SH-19. Most of Frey and Hanson’s work was on hole R-11, wherein they found a maximum of 116 ppm XRF gold at 80.4-81.3 feet. Frey and Hanson (2009) believe that the gold may be associated with late, hairline fractures/veins that are positioned within (and possibly cross-cutting) earlier, thicker quartz veins.

In total, at least 61 holes were drilled on the property for gold and VMS exploration – their distribution is shown on Figures 18 and

19. For the most part, the highest gold values (shown for specific holes in Fig. 20) were associated with quartz veins in the quartz monzonite intrusive body referred to as the Raspberry stock. Drill hole SH-1, which was drilled near the shaft, is the best mineralized as it has numerous consecutive intervals with >200 ppb gold in the top 20 feet with a maximum of 6,240 ppb Au. The highest gold assay for the entire property is present in drill hole SH-19 with 35,600 ppb Au at 112-114 feet. For the most part, the gold occurs within zones of sericite and iron-carbonate alteration associated with the quartz veins in the Raspberry stock.

According to Kuhns's report (on file at NRRI), the most important structural events at the Raspberry Prospect, in terms of gold mineralization, were: 1. formation of extensive mylonitic shear zones, such as the Shagawa Lake fault and Longsdorff shear zone (Fig. 18); and, most importantly 2. emplacement of the syn-kinematic Raspberry stock during D₂ deformation (rock in the stock is slightly deformed). Both shear zones trend in a 045-065° direction, both are comprised of bifurcating and anastomosing smaller-scale shear zones, and both host carbonate-sericite alteration. The Longsdorff shear is estimated to be up to 1,500 feet wide and does not appear to contain any known gold mineralization, whereas the Shagawa Lake Fault zone is weakly mineralized with respect to gold, but is only 100-600 feet wide.

Kuhns reports that the Raspberry stock seems to be the focus for gold mineralization. Quartz veins in the stock probably developed during D₂ and exhibit two domains:

1. Domain #1 = veins associated with the Raspberry stock that can be grouped into three subsets:
 - a. N73°E, 41°SE;
 - b. N48°E, 74°NW;
 - c. N76°E, 73°NW; and
2. Domain #2 = veins associated with Quartz Hill to the south of the Raspberry Prospect that can be grouped into three subsets:
 - d. N77°W, 53°SW;
 - e. N52°W, 55°SW; and
 - f. N80°E, 57°SE.

These vein trends suggest that the Raspberry stock had a dominating influence on the development of quartz veins of the entire first domain and portions of the second domain (2-f; above). The veins probably formed in response to NW-SE directed transpression. Local vein deviations away from the stock (subsets 2-d and 2-e; above) occur along tensional cracks that developed

during the late phases of the transpressive event. The gold is mainly associated with northeast-trending quartz veins that exhibit various dips from large, low-angle veins to small, irregular, high-angle veins. These veins contain low percentages (usually <1% sulfides) of pyrite, argentiferous tetrahedrite-tennantite, galena, chalcopyrite, molybdenite, and sphalerite – no free gold was ever observed. Kuhns compared the Raspberry prospect to the Sigma gold mine (Robert and Brown, 1986) and found that the Raspberry prospect (at only 0.15 mt @ 0.10 opt Au) showed striking similarities to the Sigma Mine (19+mt @ 0.17 opt Au). However, he believed that it was unlikely that a large gold deposit was present at Raspberry due to: 1. the small size of the Raspberry stock; 2. the lack of free gold (which would likely increase the grade requirement for development); and 3. the low periodicity of quartz veins in the stock (which translates into a absence of “uniform” grade at Raspberry).

Kuhns felt that gold mineralization was possibly associated with the two major shear zones, especially the Shagawa Lake Shear Zone. A portion of a Shagawa Lake Shear Zone was tested by the drilling of RAS-2 at a “five-metal anomaly” (Cu, Zn, Pb, Hg, Ag) that was found through both soil geochemistry and biochemistry, the latter conducted by the NRRI (Zanko et al., 1991; in prep.). While drill hole RAS-2 yielded gold anomalies (up to 1 ppm Au), it was felt that this portion of the shear had little potential of hosting a large-tonnage, near-surface, gold deposit. Another drill hole (not shown in any of the figures) tested a northern splay of the Shagawa Lake Shear Zone, but this hole was found to be only weakly mineralized (580 ppb in SP-90-1).

Scanned materials included with this report:

- Whiteside_Raspberry File containing the following:

- Whiteside_Rasp_1935_gold_assays.pdf = gold assay results, in opt, for samples collected from the shaft area in 1935;
- Whiteside_Rasp_WS-[#]-log.pdf = geologic logs, with posted gold assay results, for the appropriately-numbered Whiteside drill holes (WS-1 through WS-6);
- Whiteside_Rasp_WS_[#]_and_WS_[#]_logs.pdf = crude geologic logs, with no known assay results, for the appropriately-numbered Whiteside drill holes (WS-7 through WS-9);
- Whiteside_Rasp_WS_Series_assays.pdf = gold assay results for select samples collected from holes WS-1, WS-2, WS-3, and WS-5;
- Whiteside_Rasp_WS_3_ASSAYS.pdf = gold assay results for two samples collected from drill hole WS-3; and
- WHITESIDE_RASP_WS_4_ASSAYS.pdf = gold assay results for a series of continuous intervals collected from drill hole WS-4;
- Bear_Creek_Raspberry File containing the following:
 - Bear_Creek_S-[#]-log.pdf = geologic logs, with posted assay results, for the appropriately-numbered Bear Creek drill holes (S-1 through S-3); and
 - S_holes_assay-by-am-shield.pdf = assay results for select intervals collected by American Shield from the Bear Creek drill holes;
- Nicor_Raspberry File containing geologic logs, with posted gold assay results, for the appropriately-numbered Nicor drill holes (R-1 through R-6);
- Amoco_Raspberry File containing geologic logs, with posted gold assay results, for the appropriately-numbered Amoco drill holes (R-7 through R-12);
- North_Central_Mineral_Raspberry File containing the following:
 - NCM_RASP_RZ_[#]_LOG.pdf = geologic logs, with posted assay results, for the appropriately-numbered North Central Mineral Ventures holes (RZ-1 through RZ-6); and
 - NCM_Rasp_RZ_holes_assays.xls = excel spreadsheet listing the assay results for select samples collected from the RZ-series holes (from Englebert and Hauck, 1991);
- Gold_Fields_Raspberry File containing the following:
 - GoldFields_EDH-[#]-assays.pdf = gold assay results, and crude geologic log, for the appropriately-numbered Gold Fields rotary holes (EDM-1 through EDM-24);
 - GoldFields_EDH-series-assays.pdf = complete listing of gold assay results for all of the EM-series rotary holes; and
 - Newmont_fire-assay-report.pdf = gold assay results for select intervals collected by Newmont (timing unknown) from the EM-series rotary holes;
- CoCa_Raspberry File containing the following:
 - CoCa_SH-[#]-log.pdf = geologic log for the appropriately-numbered CoCa rotary holes (SH-1 through SH-19); and
 - CoCa_assays-SH-holes.pdf = gold assay results for all of the SH-series rotary holes;
- BHP_Raspberry File containing the following:
 - BHP_RAS_1_LOG.pdf = abandonment report for BHP-Utah International drill holes RAS-1 (no detailed geologic log or assay results were ever turned into the MDNR);
 - BHP_RAS_2_LOG.pdf = geologic log for BHP-Utah International drill hole RAS-2;
 - BHP_RAS-2-assays.pdf = gold assay results for select intervals from drill hole RAS-2;
 - BHP_SP_90_1_LOG.pdf = geologic log for BHP-Utah International hole

SP-90-1, and corresponding Au assays, that was drilled on Shagawa Lake in the winter to intersect the northern splay of the Shagawa Lake Shear Zone. [Note: as an interesting sideline, the drilling of this hole encountered some public discontent by some citizens of Ely, MN, and a local Native American (Heart Warrior Chosa) had a vision that drilling would allow water to enter the Vermilion Fault, which would “lubricate” and re-activate the fault, causing it to move at “super-sonic” speeds.];

- BHP_Rasp_soil-sample-results.pdf = BHP-Utah International soil sample results (190 ppb Au maximum); and
- NRRI_biogeochem_Raspberry.pdf = biogeochemical sampling results conducted by the NRRI (Zanko et al., in prep);
- Kerr_McGee_Raspberry File containing the geologic log and assays results for Kerr McGee hole (BL-25-1) that was drilled to the north of the Raspberry prospect (also on the Shagawa Lake fault?); and
- American_Shield_Raspberry File containing the following:
 - BIO_1_LOG.pdf = geologic log for American Shield/NRRI-related drill hole (BIO-1); and
 - AmShield_NRRI_BIO_1_ASSAYS.pdf = gold assay results for select intervals collected from hole BIO-1.

Section 9

USS became interested in exploring their own fee lands in this area, originally called the Section 9/10 area (T.62N., R.14W.), due to the reported presence of carbonate iron-formation in early 1900s-vintage drill hole records. The spatial position of these old holes in a magnetic “dead zone” along an iron-

formation trend further indicated that a facies change in the iron-formation was present in Section 9. In addition, this area coincided with airborne EM conductors, suggesting the presence of sulfide-rich zones. These three features suggested that the area presented some potential of hosting a stratabound auriferous iron-formation using gold models that were in vogue at the time. A grid was established in 1981, and detailed geologic mapping (Fig. 22) revealed the presence of a possible vent area in the Gafvert Lake felsic sequence that was capped by sulfide + carbonate iron-formation. Two holes, based solely on geophysical criteria, were drilled in Sections 9 and 10 (holes 27013 and 27014; respectively) in 1981. The first hole (27013) was drilled to determine the nature of a well-defined EM conductor that was coincident with an iron-formation facies change as indicated by a decrease in magnetic intensity. The hole encountered two massive sulfide horizons, with chert interbeds, that overlie felsic volcanics of the Gafvert Lake felsic sequence. The northernmost sulfide horizon (87 feet thick in drill hole) assayed at 70-820 ppb Au, whereas the southernmost sulfide horizon (113 feet in drill hole) assayed at only 10-275 ppb Au (Severson and Heine, 2007). Later resampling of the same intervals in the northernmost sulfide horizon failed to confirm the anomalous gold values (Severson and Heine, 2007). The second hole (27014) was drilled in adjacent Section 10 to target an EM conductor associated with faulted iron-formation. The original objective of the hole was to locate a mineralized fault zone cutting pyritic iron-formation in the hope of finding remobilized gold in structurally-prepared zones. Drilling confirmed the fault zone, which contained a variety of faulted and altered rock types, but with only a maximum of 450 ppb Au (Severson and Heine, 2007).

USS drilled another hole (28017) in the Section 9 area in 1983 to further test the throat of the inferred vent zone and various iron-formation facies that were postulated to have

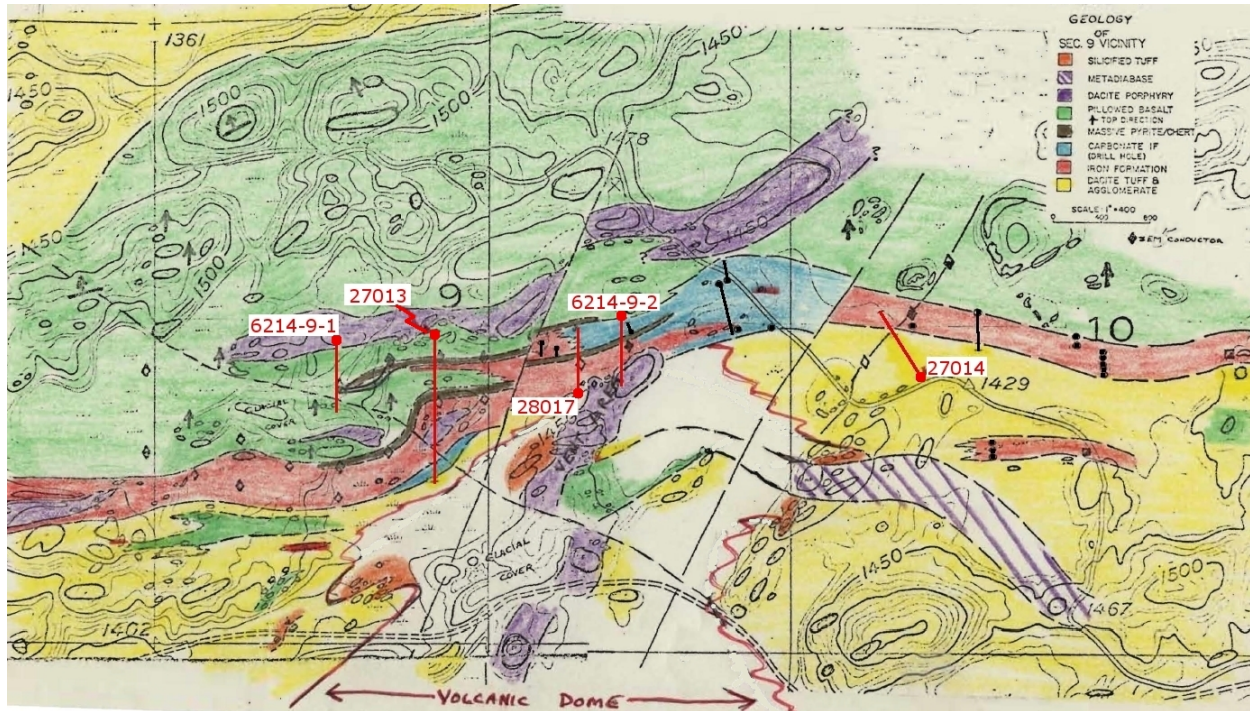


Figure 22. Simplified geology of the Section 9/10 area showing holes drilled by USS and Kerr McGee (in red) as well as early-1900s vintage holes (in black) drilled in search of iron ore. This figure is modified from a figure in Severson and Heine (2007), which was originally scanned from a 1982 USS report by Severson on file at the RGGS office in Virginia, MN. A geologic map by USS for the Section 9/10 area (1 inch=200 feet) is available at the MDNR.

formed a cap to ascending hydrothermal solutions during deposition. The hole intersected mostly cherty iron-formation, with sedimentary and tuffaceous interbeds, and minor dacite porphyry (QFP). Only a maximum of 90 ppb Au was assayed from select sample intervals, and these discouraging results lead to discontinued activities by USS in this area.

The data at this point becomes somewhat sketchy, but Kerr McGee eventually leased the property from USS and drilled two more holes in 1987 (holes 6214-9-1 and 6214-9-2 in Fig. 22). According to the Kerr McGee logs, the first hole intersected sulfide iron-formation and basalt, whereas the second hole intersected various facies of iron-formation interbedded with sediments, QFP, basalt, and felsic volcanics (similar to USS hole 28017), but gold values were low (maximum 180 ppb Au in 6214-9-1 and 130 ppb Au in 6214-9-2).

Interestingly, the massive sulfide/chert body intersected in the top of hole 6214-9-2 contains unusually high nickel values with a maximum of 2,606 ppm Ni, which Peterson (2001) ascribes to have originated via metal fixing in a reducing environment associated with organic material.

Still later, Kerr McGee entered into a joint venture with BHP, and several soil sampling surveys were conducted (Severson and Heine, 2007). Several anomalous gold values (up to 300 ppb Au) were found in A-zone soil samples to the immediate west of Kerr McGee's 6214-9-1 hole. All of these anomalies occur entirely within a swamp, which BHP interpreted to be a biogeochemical up-grade with the gold being sourced from the slightly elevated gold values in the adjacent bedrock iron-formation. Overall, the gold values in the iron-formation, while being slightly elevated, were not high

enough to warrant further exploration in BHP's opinion.

Scanned materials included with this report:

- Geologic drill logs and associated assay results for the USS drill holes (27013, 27014, and 28017); and
- Geologic drill logs and associated assay results for Kerr McGee drill holes (6214-9-1 and 6214-9-2).

Bass Lake

As recounted in Severson and Heine (2007), USS began investigations on their fee lands in the Bass Lake area (Fig. 23; Section 1, T.62N., R.15W.) based on: 1. the presence of airborne EM conductors in a 1960s-vintage USS survey; and 2. the presence of anomalous arsenic in lake samples collected in nearby Lake Vermilion (Meineke et al., 1976). Mapping took place in 1981 and indicated that the major rock types present on the property consisted of: 1. pillow basalts (now tentatively assigned to the Bass Lake sequence by Peterson and Jirsa, 1999a); 2. two thick iron-formations at the northeast and southeast corners of the property; and 3. a late-stage, quartz-poor feldspar porphyry (called an andesitic porphyry by USS) that showed evidence of stoping into the country rocks. During the course of mapping, several aphanitic, sericitic, shear zones were found within the porphyry (labeled "ser schist" in Fig. 23). These shear zones were inferred to be potential repositories for gold using the Boyle model, whereby gold was "sweated out" of the iron-formation and concentrated in available structures near the porphyry contacts. Reconnaissance mapping to the immediate east in Section 6 (see later discussion pertaining to the Section 6/Pac Man Pond area) confirmed the presence of ~1 ppm Au peripheral to the same porphyry body, which seemed to lend credence to the

model. Two holes were drilled in 1983 to target the sericitic shear zones in the porphyry. Several zones of sheared sericitic rocks were intersected in both holes (28019 and 28020). While these sheared rocks looked impressive in drill hole, only a maximum of 210 ppb Au was found to be associated with them.

Kerr McGee leased this property from USS but conducted no explorations. The property was later re-evaluated by BHP during a joint venture with Kerr McGee (Severson and Heine, 2007). BHP conducted an IP survey around 1989, but only weak and short-length IP anomalies were identified in the area. Due to a lack of any sizeable alteration or traceable gold anomalies, exploration in this area was discontinued in 1990.

Noranda conducted a reconnaissance mapping and sampling program to the south of the Bass Lake area in 1990. They collected grab samples from a brecciated, quartz-veined, and sulfide-bearing iron-formation that ran 1,072 and 656 ppb Au (Fig. 23). While these initial results were encouraging, Noranda did not conduct any follow-up work, as they felt the mineralization was restricted to a small area that was hard to access and the area was situated too close to cultural developments on nearby Lake Vermilion.

Scanned materials included with this report: Geologic drill logs and associated assay values for USS drill holes (28019 and 28020).

Wolf Lake

As recounted in Severson and Heine (2007), USS became interested in exploring their fee lands in the Wolf Lake area (Fig. 24; Section 5, T.62N., R.13W.) in the early 1980s due to the inferred presence of faulted, pyritic iron-formation as indicated in their 1960s-vintage airborne survey. Mapping encountered a north-facing sequence of basal

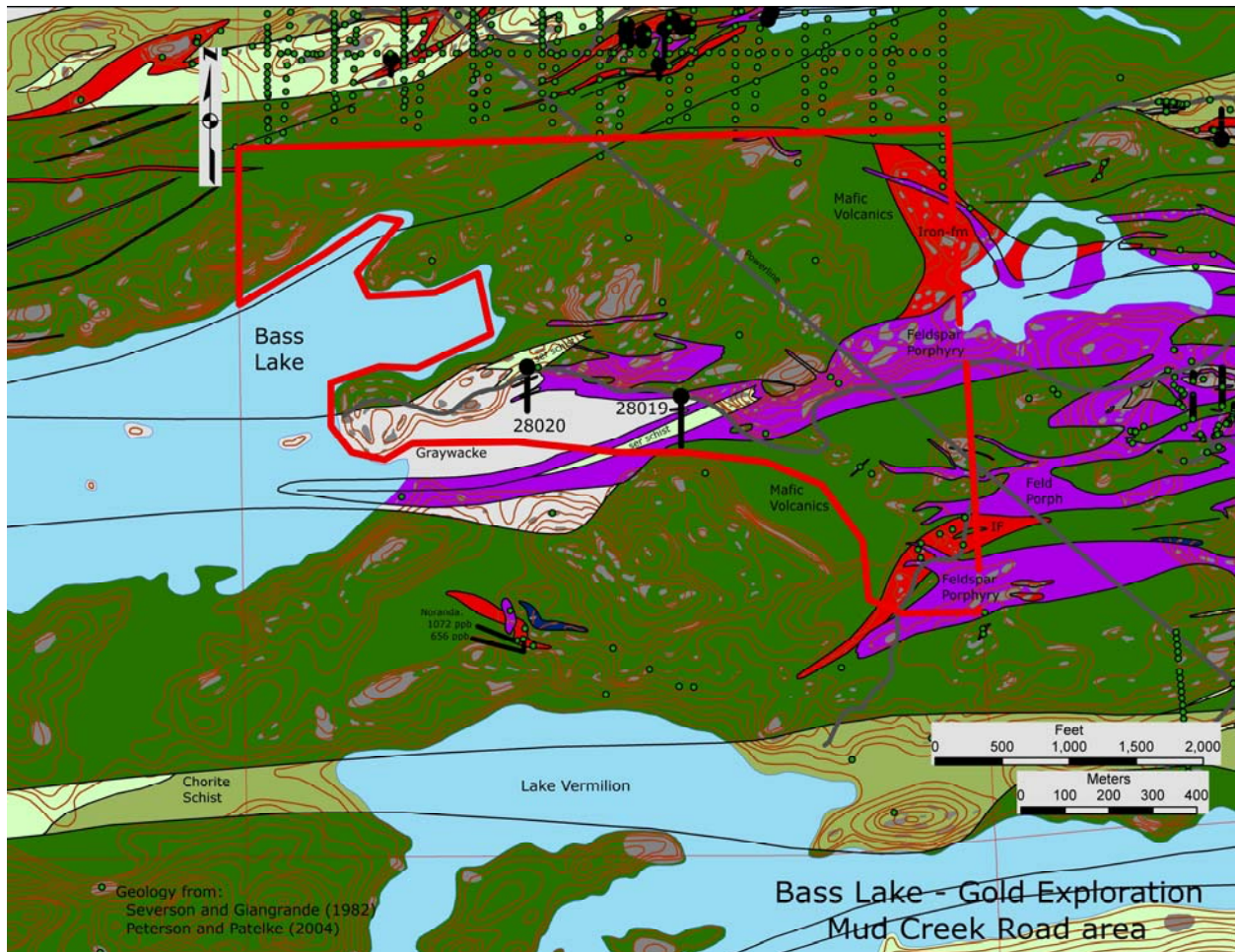


Figure 23. Geology of the Bass Lake area showing locations of the two USS holes drilled in 1983. Area outlined in red was mapped by USS in 1981, and the data were incorporated in Peterson and Patelke (2004a). Portions of the Dead Canary and Section6/Pac Man Pond gold prospects are located at the top and right side of the figure respectively.

mafic volcanics (Upper Ely Member) overlain successively by hydrothermally altered crystal tuffs with intercalated iron-formation lenses, a main iron-formation with localized altered mafic tuffs, and a thick sequence of pillowed mafic flows (also Upper Ely Member). Ground geophysical surveys confirmed the presence of a conductive horizon overlying the main iron-formation on the west side of a northeast-trending fault (Fig. 24) with 800 feet of left-lateral displacement. Geochemical soil sampling showed two anomalous zones: an anomalous copper zone positioned over the EM conductor; and an anomalous arsenic

zone located at the intersection of the conductor and the northeast-trending fault. Two holes were drilled in 1983 into both of these soil sample anomalies (28018 and 28021, respectively). Analytical results from select samples from both holes were discouraging (maximum of 50 ppb Au), and no further activities were conducted at Wolf Lake by USS.

Scanned materials included with this report: Geologic drill logs and associated assay values for USS drill holes (28018 and 28021).

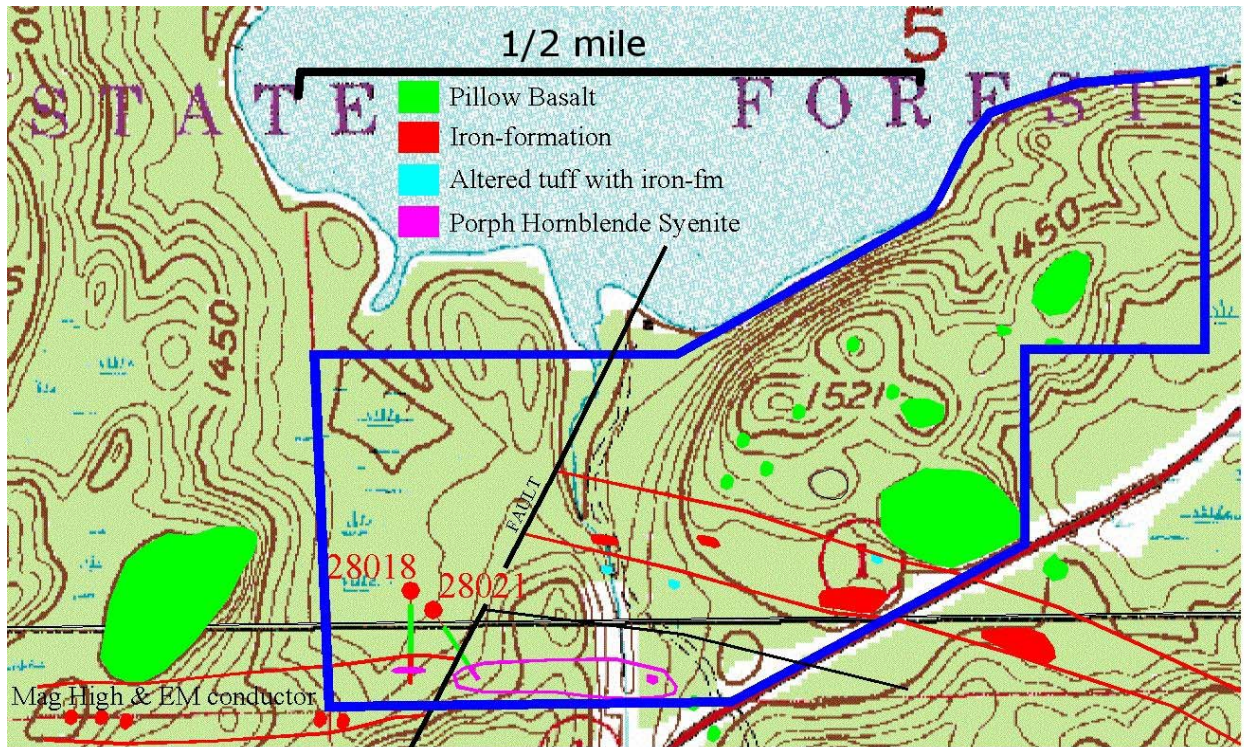


Figure 24. Simplified geologic map of the Wolf Lake area showing trend of iron-formation (in red) and holes drilled by USS in 1983.

Section 4/9 Mine

As recounted in Severson and Heine (2007), interest in this area (T-62N., R.13W. – Fig. 10) by USS was incidental and related wholly to the discovery of preserved core from four old Oliver Iron Mining Company (OIMC) holes that were drilled in 1906 at this small iron ore prospect. The core was relogged, and six samples from all of the holes were sent in for assays. A brief visit was also made to the prospect site, which included several test pits and a caved shaft. Three outcrop samples were collected for assay. The geochemical results from both the drill core and outcrop samples were uninspiring (<30 ppb Au), and interest in this area quickly diminished.

Scanned materials pertaining to the Section 4/9 mine that are included with this report are:

- OIMC_[#####]_LOG.pdf = geologic logs for the appropriately-numbered OIMC drill holes from the Section 4/9 Mine (2680, 2815, 2939, and 3034); and
- USS_SEC4+9_62_13_ASSAYS.pdf = assay results for samples from the above OIMC drill hole (select intervals) and outcrop samples.

Mattson Bay

As recounted in Severson and Heine (2007), the Mattson Bay area was chosen to be explored for gold by USS in 1981 due to the presence of iron-formation associated with the Gafvert Lake felsic complex on USS lands. Geologic mapping (at 1 inch = 200 feet; map on file at the MDNR) indicated the presence of several east-west-trending iron-formation lenses, offset by a northeast-

trending fault, in dacitic volcanics with local quartz-feldspar porphyry. Overall, there appeared to be nothing of great significance at this location, and USS turned their attention elsewhere. There are no scanned materials associated with this prospect in this report.

Spaulding Bay

There are very few records regarding the Spaulding Bay prospect (Fig. 25; Section 23, T.63N., R.12W.) that was explored by Kerr McGee during 1983-1989 (called the Spaulding prospect by Kerr McGee). Kerr McGee probably became interested in this property as the result of a regional sampling campaign that found highly anomalous gold contents in a nearby road cut (Chevron sampled this same road cut in 1987 and found 5.67 ppm Au – Fig. 25). Rocks of the prospect consist of highly-sheared and altered (quartz-sericite-iron carbonate-pyrite) schistose rocks of the Knife Lake Group. Nine holes were drilled into these intensely sheared rocks during 1983-1984 (holes 23-1 through 23-9; Fig. 25) with limited follow-up drilling in 1985 (holes 23-10 and 23-11). The logs for all of these holes are available, but large portions of six of the logs, including assay results, were purposefully omitted when the logs were turned in to the MDNR. These meager records, and discussions with Robert Roe (pers. comm., October, 2011), indicate that hole 23-1 encountered the most anomalous gold values, which are posted in Table 1. Gold assay values for each of the holes, where available, are presented in Figure 26. Kerr McGee spent considerable effort trying to extend the mineralization intersected in 23-1 to the east without success. Their efforts also included an IP survey with an electrode lowered down hole 23-1 to the mineralized zone. Kerr McGee and BHP entered into a joint venture to explore still further to the west and east of the Spaulding property several years later. Hole SP-24-1 was drilled to the

east in 1989 and intersected an eight-foot-thick zone, at 992-1,000 feet, that assayed at 395-1,040 ppb Au (Fig. 25). Hole SP-90-1 was drilled to the west in 1990 on Shagawa Lake during the winter and received much publicity (see Raspberry Prospect discussions and related scanned materials).

The MNDNR conducted a re-evaluation of some of the core from Spaulding Bay in 2008-2009 (Frey and Hanson, 2009). Through the use of a hand-held, semi-quantitative XRF, they found gold in spot analyses of select core from holes SP-23-2 and SP-23-9A. An interval from SP-23-9A (30-32 feet) was subsequently sampled and sent in for assay with a returned result of 693 ppb Au (as compared to a 560 ppb Au assayed by Kerr McGee).

Scanned materials on the Spaulding Bay prospect that are included with this report:

- Scanned lithologic logs and associated assays for Kerr McGee holes 6312-23-2, 6312-23-3, 6312-23-5, 6312-23-7, 6312-23-8, and 6312-23-9A;
- Scanned lithologic logs and associated assays for portions of Kerr McGee holes 6312-23-1, 6312-23-4, 6312-23-6, 6312-23-9, 6312-23-10, and 6312-23-11; and
- Scanned lithologic log and associated assays for BHP/Kerr McGee hole SP-24-1.

Dead Canary

The old Scott-Bevier iron prospect (Fig. 6) was picked up by the Tamarack Company in 1982 after American Shield collected brecciated iron-formation samples from an old collapsed adit/trench and dump pile that assayed at 0.04-0.065 opt gold. The property was renamed the Dead Canary prospect (Section 36, T.63N., R.15W.) at that time in reference to its close proximity to the Boundary Waters Canoe Area Wilderness.

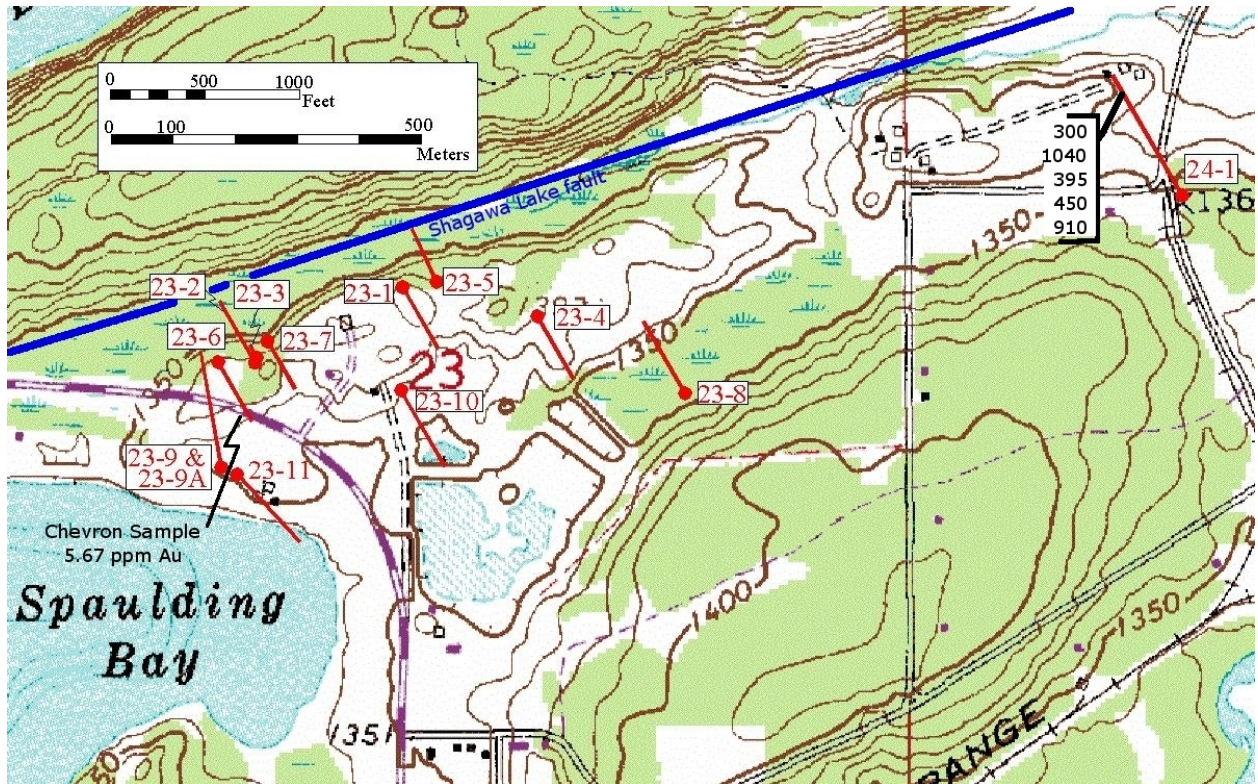


Figure 25. Distribution of exploration holes in the Spaulding Bay prospect (Note that all holes are preceded by 6312, e.g., 6312-23-1). Gold values (all in ppb Au) are shown for the mineralized zone in hole 24-1. See Figure 26 for detail of gold values obtained in other Spaulding Bay holes.

Table 1. Select gold assays from drill hole 6312-23-1 of the Spaulding Bay prospect (from Peterson and Jirsa, 1999b). Note that these data are obscured on the original Kerr McGee results for this hole.

From (feet)	To (feet)	Au (ppb)
29	31	2,220
31	33	2,960
33	35	1,355
35	37	1,660
45	47	2,380
310	311	5,400
311	312	10,000
312	313	6,540
313	314	6,400

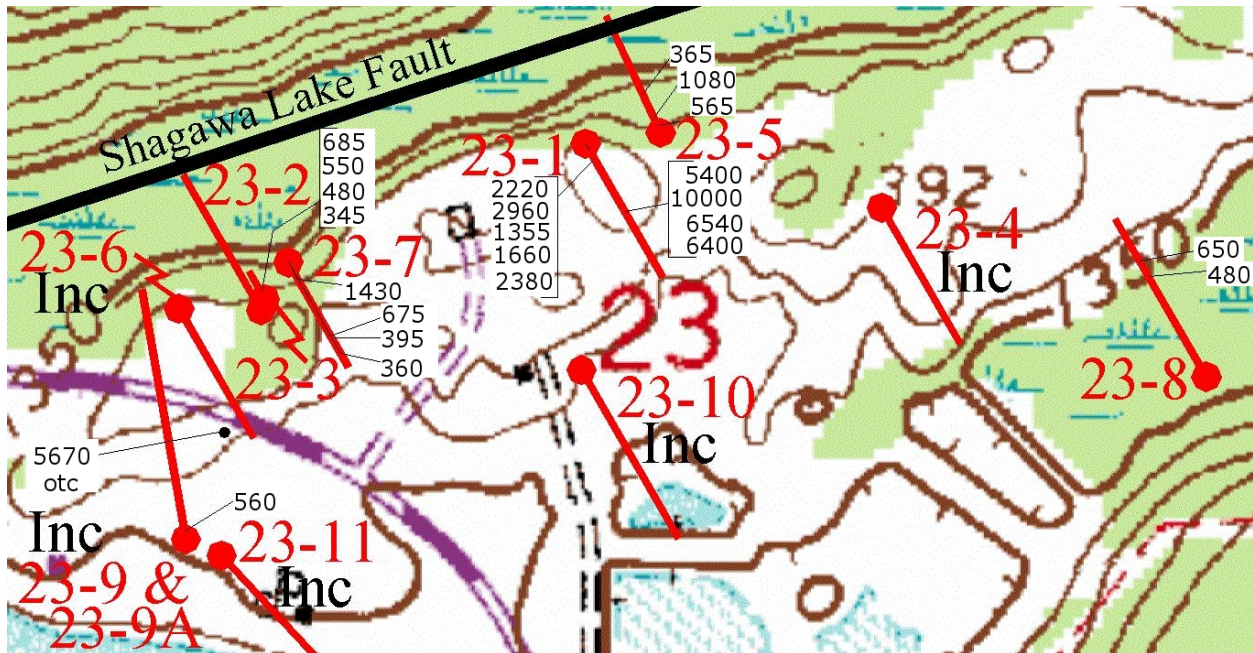


Figure 26. Detailed distribution of gold values (using a >300 ppb Au threshold) in drill holes in the western part of the Spaulding Bay prospect. All posted gold values in ppb. The notation “Inc” by specific holes indicates that not all of the assay data for a particular hole was turned over to the MDNR and is therefore “incomplete.”

The property was first joint ventured by Cyprus and Tamarack Company in 1983. After confirming the presence of gold in the dump material (up to 1.44 ppm Au), Cyprus tried to cut four trenches across the iron-formation trend (Figs. 6 and 27). Trenches #1 and #2 did not reach bedrock, and assays from Trench #3 were not even mildly interesting. However, the southern end of Trench #4 contained four pieces of float of iron-formation with boxwork pyrite and tourmaline that assayed over 1 ppm Au (maximum of 2,190 ppb Au – Fig. 27). While these values were impressive, the rock exposed in the trench showed only a maximum of 388 ppb Au, and Cyprus discontinued activities in this area by 1986.

This property was subsequently picked up by Chevron around 1987 and was renamed the Rice Creek prospect. Chevron cut an additional three trenches across the iron-formation trend (Figs. 6 and 26) with discouraging assay results. However, several outcrop samples

with >278 ppb gold (maximum of 1,170 ppb Au) were found during the course of mapping and sampling the property. Overall, the results from previous trenches, dump samples, and outcrop samples suggested that the high gold values were hosted by sheared contacts along a series of east-west-trending iron-formation lenses (Fig. 27). In other words, the gold was thought to be associated with the rheological contrasts between the iron-formation and the adjacent, less competent rocks, all part of the Bass Lake sequence. In addition to the anomalous rock samples, Chevron also found a strong gold anomaly in the soil with a maximum of 719 ppb Au (Fig. 27). Both the soil anomaly and the iron-formation contacts were tested by drilling two holes (RC-1 and RC-2) in 1987. While both holes intersected zones with gold mineralization (up to 1,710 ppb Au and up to 719 ppb Au in holes RC-1 and RC-2, respectively), the values were too sporadic to elicit more work by Chevron. William Ulland with American Shield

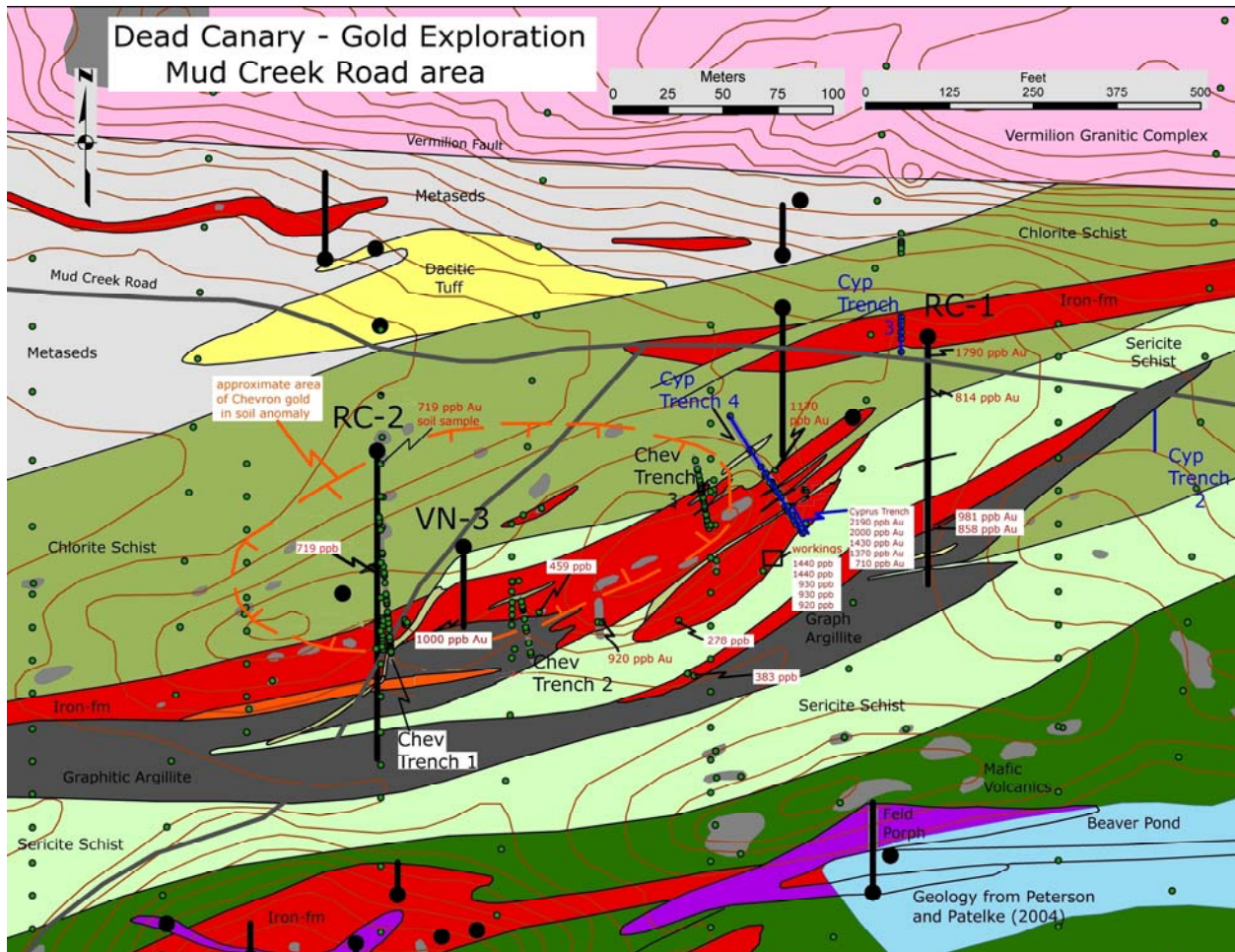


Figure 27. Geology of the Dead Canary prospect showing distribution of old drill holes (unnumbered black dots), recent gold exploration drill holes (RC-1, RC-2, and VN-3), anomalous gold values (all in ppb), the location of the Chevron’s gold in soil anomaly, and trenches dug by both Cyprus (blue) and Chevron. Geology from Peterson and Patelke (2004a).

believed that the holes did not adequately target the soil anomaly nor intersect intended fault splay targets.

According to the data presented in Peterson and Patelke (2004a), Chevron apparently dug a fourth trench on the property in about the same location as Cyprus Trench 4 in Figure 27 (except their location correlates with the longer blue line in the figure). There are no records of such a trench at the MDNR.

The assay results regarding this supposed Chevron Trench #4 are similar to the results obtained in Cyprus Trench #4 – the Chevron Trench #4 assays are also included in this

report (as an excerpt from Peterson and Patelke, 2004a) for comparison.

Noranda picked the property up in 1989-1991, but conducted no exploration activities themselves, as they determined that the previous work on the property had adequately tested the mineralized zone and showed it to be limited to a small area. Cominco was the last company to explore on the property when they drilled hole VN-3 (Fig. 6) in 1995. The hole was drilled across the same iron-formation trend, but only intersected a single anomalous zone that assayed at 1,000 ppb Au. Peterson and Patelke (2004a) collected a few

samples from the area and confirmed the presence of gold in the iron-formation (920 ppb Au in Fig. 6).

The most recent round of activity in the western Vermilion District, and consequently near the Dead Canary prospect, consisted of two separate till sampling campaigns by the NRRI. Larson (2004) conducted a basal till sampling campaign in the western Vermilion District. His highest gold sample (sample 007 with 940 ppb Au @ 558,551E; 5,304,834N) was obtained about 1.5 miles west of the Dead Canary prospect near the public landing on Rice Bay of Lake Vermilion. Hauck et al. (in prep.) also collected a basal till sample at this same vicinity (sample A-1807 @ 558,530E; 5,304,823N) and found 294 normalized gold grains (273 raw gold grains), of which 208 grains were pristine – this sample contains the second highest amount of gold grains in the Vermilion District. Taken collectively, both of these sampling campaigns suggest that rocks to the immediate south of the Vermilion Fault, if not very close to the fault itself, may be the source of the gold in these two till anomalies.

Scanned materials on the Dead Canary prospect that are included with this report:

- Cyprus_Dead_Canary_otc_assays.pdf = map and listing of outcrop samples collected by Cyprus at Dead Canary;
- CanaryCyprus_Dead_Canary_Trench_Assays.pdf = listing of assay results (hand-written) for two of the trenches dug by Cyprus at Dead;
- Cyprus_Dead_Canary_trenches_map.pdf = map showing the location of all four of the trenches dug by Cyprus at Dead Canary;
- Chevron_Dead_Canary_map_with_grid_geol_trenches.pdf = geologic map showing the location of the grid, three trenches, and two drill holes established by Chevron at the Dead Canary prospect;
- Chevron_Dead_Canary_trench_descriptions.pdf = short write-up by Chevron describing the geology of their three trenches;

- Chevron_Dead_Canary_Trenches2and3.pdf = Maps of Chevron Trenches 1 and 2;
- Chevron_Dead_Canary_trench_otc_assays.pdf = assay results from the three Chevron trenches and geology on a geophysical line by line basis;
- Chevron_Dead_Canary_soil_results.pdf = listing of soil sample results;
- Chevron_Dead_Canary-gold-in-soil-map.pdf = map of soil sample results map showing Chevron's gold anomaly;
- Chevron_Dead_Canary-As-in-soil-map.pdf = map of soil sample results map showing Chevron's arsenic anomaly;
- Geologic logs with associated assays results for Chevron holes RC-1 and RC-2;
- Chevron_assays_Dead_Canary_Trench_4_from_P&P.xls = excerpted database, from Peterson and Patelke (2004a), of assay results from the unknown Chevron Trench #4; and
- Geologic log with associated assays results for Cominco's hole VN-3.

Foss Lake

Kerr McGee became interested in the Foss Lake prospect (Section 36, T.63N., R.14W.) in the early 1980s after a reconnaissance sampling campaign revealed the presence of anomalous gold in several outcrops in an area situated to the south of Tamarack Bay of Burntside Lake (Fig. 28). Rocks in this area consist of highly sheared/foliated schists positioned between the Vermilion and Wolf Lake faults. Two holes (6314-36-1 and 6314-36-2) were drilled in 1984. Hole 36-2 was drilled first, on the basis of the auriferous outcrops (Fig. 28), and encountered several anomalous gold zones with a maximum of 3,110 ppb Au in highly sheared mafic volcanic rocks correlated with the Bass Lake sequence. The second hole (36-1) was drilled to the south, also in the Bass Lake sequence, on the basis of geophysics into a conductive zone. Contrary to the foliated rocks inter-

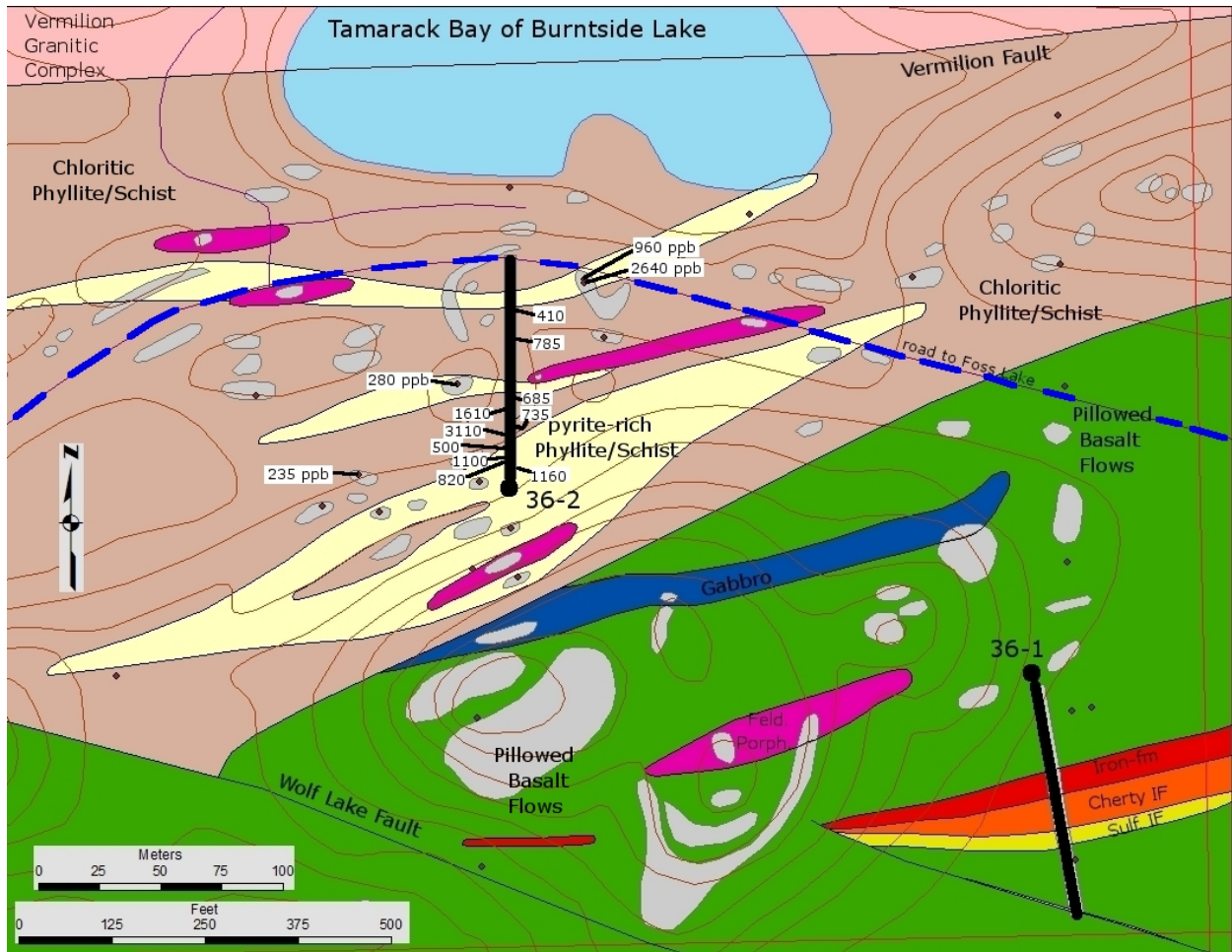


Figure 28. Geology of the Foss Lake prospect, modified from Peterson and Patelke (2004a), showing distribution of drill holes and anomalous gold values in outcrop (>200 ppb Au) and drill hole (>400 ppb Au).

sected in the first hole, hole 36-1 intersected relatively undeformed rocks consisting of pillow basalt and iron-formation (Fig. 28). A graphitic-pyritic iron-formation was the only unit sampled in this hole, and it was found to be barren of gold. In spite of the good gold values obtained in hole 36-2, Kerr McGee did not conduct any follow-up work.

The MNDNR conducted a re-evaluation of the core from the two Foss Lake holes in 2008-2009 (Frey and Hanson, 2009). Through the use of a hand-held, semi-quantitative XRF they confirmed the presence of gold in three of the zones in hole 6314-36-2 that were originally found by Kerr McGee. They also

found a new gold zone associated with the iron-formation in hole 6314-36-1, at 312-314.1 feet, with 28 ppm XRF gold.

Scanned materials on the Foss Lake prospect that are included with this report:

- Kerr_McGee_Foss_Lake_rock-assays.pdf = listing of assay results for outcrops at the prospect;
- Kerr_McGee_Foss_L_Au-soil-grid-map.pdf = map showing the results of a soil survey for gold; and
- Geologic logs, and associated assay results, for the two holes drilled by Kerr McGee (6314-36-1 and 6314-36-2).

Burntside River

The Burntside River area (Section 27, T.63N., R.13W. – Fig. 29) was considered to have gold potential by USS when a unique “siliceous marble” horizon was noted in the then-newly-published Shagawa Lake Quadrangle Geologic map (Sims and Mudrey, 1978). During a reconnaissance trip to the area in 1981 to confirm said rock, USS geologists noticed incredible ladder veins that were similar to structures described in Canadian gold camps (as recounted in Severson and Heine, 2007). Several samples were collected at the site and were found to contain anomalous arsenic values (up to 800 ppm), but the assay results were disappointing in regard to gold (10-50 ppb).

Eventually Kerr McGee, acting on this USS-gained knowledge, leased the property

and conducted an exploration program. They surmised that the “siliceous marble” was an altered ultramafic of the Newton Lake Formation, were equally impressed with the anomalous arsenic values, and drilled four holes in the vicinity in 1984-1985 (Fig. 29).

An internal BHP company report (as recounted in Severson and Heine, 2007) summarizes their joint venture activities with Kerr McGee in the area as follows. The area occurs within strongly sheared pillow basalts of the Newton Lake Formation with syn-kinematic serpentinitized peridotite and post-kinematic gabbro intrusions. Kerr-McGee recognized three transitional carbonate-mica alteration zones in the holes they drilled: 1. an upper chlorite-ankerite zone; 2. an irregular chlorite-talc-ankerite zone; and 3. a lower chlorite-ankerite zone. This alteration zone was thought to potentially develop with depth

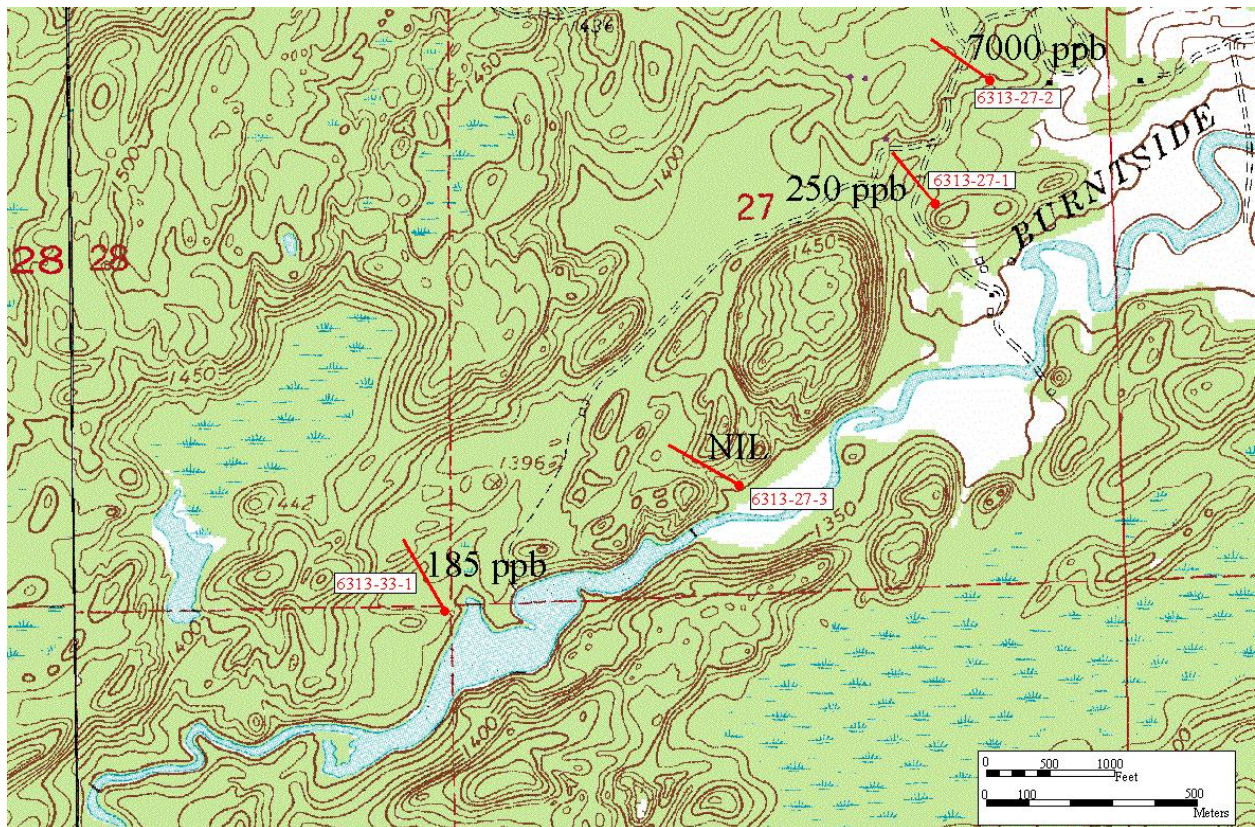


Figure 29. Distribution of holes drilled by Kerr McGee at the Burntside River prospect. The maximum amount of gold, in ppb, encountered in each drill hole is shown.

into a quartz-magnetite-gold or gold-quartz-sulfide alteration and mineralization. However, according to BHP, surface and cored intervals did not support this concept. Relogging of holes by BHP indicated that the gold mineralization event followed the major carbonate-mica alteration event, which in turn was followed by a late/post-kinematic quartz-calcite veining event that contains anomalous, but low, values of gold. At best, a few isolated intervals with values barely >100 ppb Au were found in the drill holes; however, a maximum of 7,000 ppb Au was encountered in hole 27-2. Due to a lack of alteration, mineralization, and troubles with local land owners, no further exploration work was conducted by either Kerr McGee or BHP in this area.

Scanned materials on the Burntside River prospect that are included with this report:

- Kerr_McGee_assays_Burntside_River_etc.pdf = assay results from outcrops (locations unknown) at the Burntside River prospect; and
- Geologic logs and associated assay results for four holes drilled by Kerr McGee (6313-27-1, 6313-27-2, 6313-27-3, and 6313-33-1).

Quartz Hill

St. Joe Minerals became interested in the Raspberry prospect (Section 25, T.63N., R.13W. – Fig. 19) as early as 1982 and began joint venture negotiations with both Nicor and American Shield/Tamarack. St. Joe Minerals made offers to acquire the land on several occasions, but their terms were refused by Tamarack. Assuming that a deal would eventually be worked out (but actually never happened), St. Joe Minerals picked up the property to the immediate south in Section 36 (Fig. 19) during a State lease sale in 1982. In the course of conducting the initial mapping campaign on the property, Peter Giangrande

first discovered and sampled what later became known as the Quartz Hill prospect. According to Peterson and Jirsa (1999a), the prospect consists of non-magnetic basalts of the Bass Lake Sequence that are cut by abundant white quartz veins and altered to various percentages of iron-carbonate, sericite, silica, and sulfides. Although nearly all quartz veins orientations are present, the most common are those that have shallow dips and those that trend east-northeast with steep dips. Giangrande (pers. comm., August, 2011) believed that the majority of the quartz veins at the property, and thus the gold mineralization, was subhorizontal in nature and was related to the same mineralizing event as at the nearby Raspberry prospect.

Most of the intense exploration of the Quartz Hill prospect by St. Joe took place during 1984-1986. Unfortunately, very little summary information regarding their explorations was ever turned in, and it is difficult to reconstruct all of the historical events. In fact, even the materials that were turned in are piecemeal, and considerable effort was spent summarizing their data in the figures of this report (including correcting the previously-determined UTM locations for the drill holes). Figures 30 and 31 display the distribution of anomalous gold samples collected from rock and panned till, and soil, respectively. As a result of obtaining these highly encouraging assay results in 1983, St. Joe dug seven shallow trenches and conducted detailed channel sampling in 1984 – the results of which are portrayed in Figure 32. Drilling soon ensued in 1984 when holes 84-1, 84-2, and 84-3 were cored. According to Giangrande (pers. comm., October, 2011), all of the holes drilled at this property did not take into account his theory that the mineralization was connected with subhorizontal quartz veining, and, as to be expected, all three of these holes encountered moderately encouraging gold results in only the top portions of the holes (Fig. 32). Follow-up drilling in 1985 and 1986 also ignored the

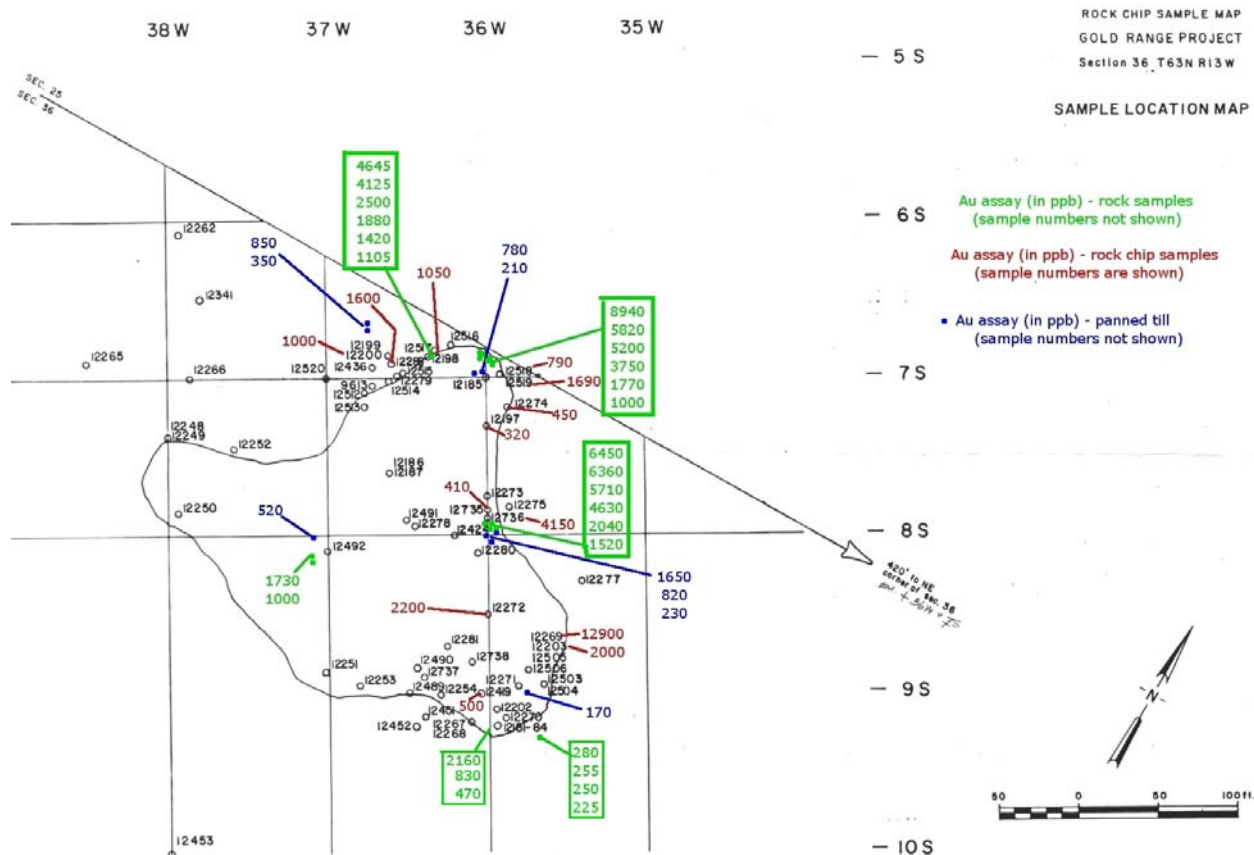


Figure 30. Distribution of anomalous gold values for rock samples (using a threshold of >200 ppb Au) and panned till samples (using a threshold of >150 ppb Au) collected at the Quartz Hill prospect.

subhorizontal concept, and once again, only one hole (85-7) intersected gold mineralization in the top of the hole (Fig. 32). In the end, drilling failed to intersect encouraging gold mineralization (maximum of 1,135 ppb Au in hole 85-7), and St. Joe discontinued activities at Quartz Hill.

Recent studies of the drill core by Hudak et al. (2002) delineated semi-massive to massive sulfide mineralization that occur as replacement deposits within felsic tuffs in holes 84-2, 84-3, and 85-4. They believed that the relative abundance of felsic tuffs, and associated synvolcanic hydrothermal alteration mineral assemblages, are indicative of either a shallow-water Archean “Mattabi-type” VMS system or a shallow subaqueous high-sulfidation epithermal system.

Scanned materials pertaining to the Quartz Hill prospect that are included with this report:

- St_Joe_Qtz_Hill_detail_geol_grid.pdf = map showing detail of the geology for the Quartz Hill prospect and relative grid coordinates;
- St_Joe_Qtz_Hill_profile_along_north_edge.pdf = drawing of the cliff face along the northern edge of the Quartz Hill outcrop;
- St_Joe_Qtz_Hill_DH_trench_loc-map.pdf = map showing drill hole locations and trenches, along with sample numbers, of the Quartz Hill area (note that the grid system is different in this map);

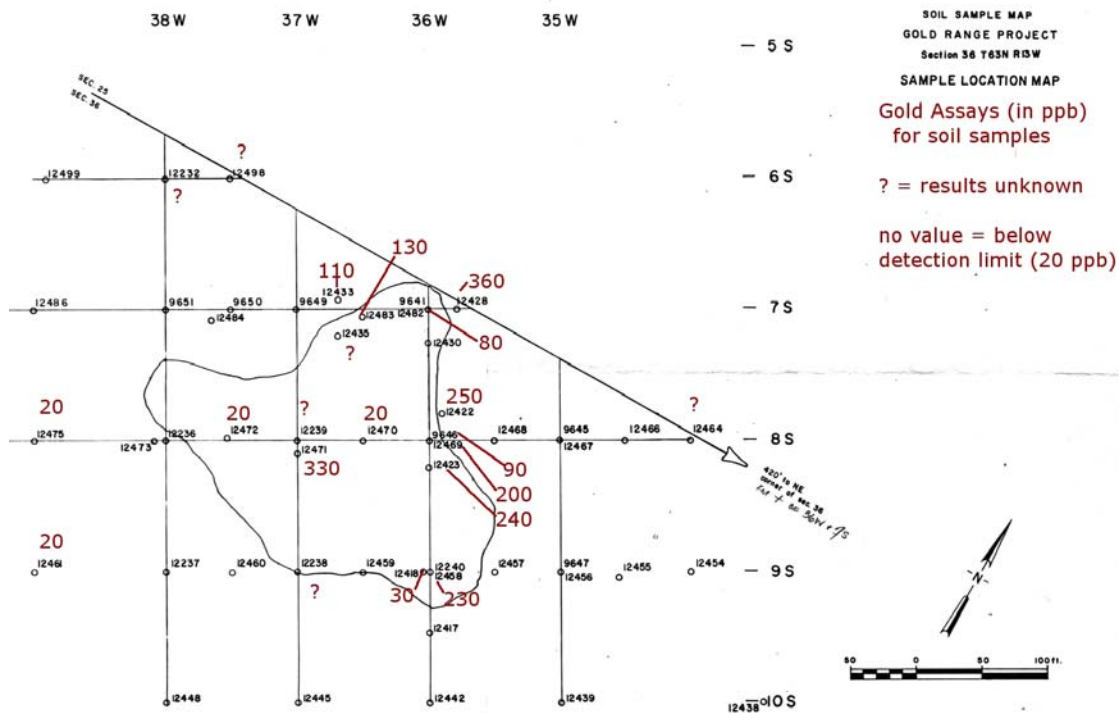


Figure 31. Distribution of anomalous gold values (all in ppb Au) for soil samples collected at the Quartz Hill prospect.

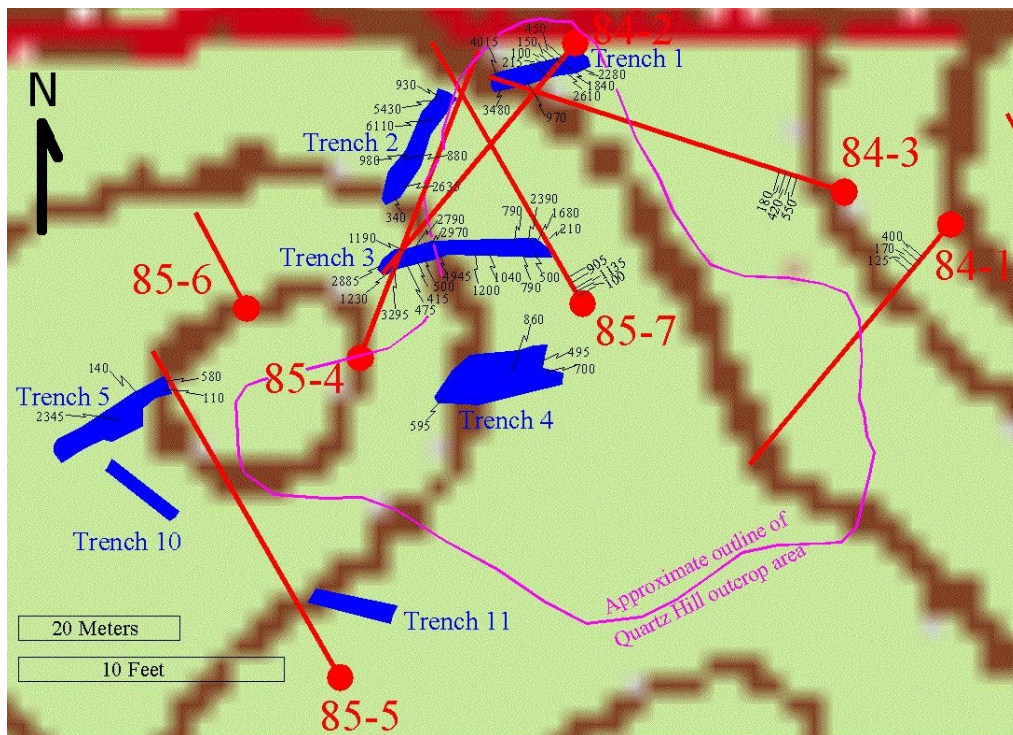


Figure 32. Distribution of anomalous gold values (all values are in ppb Au; using a threshold of >100 ppb Au) for rock samples collected from the trenches and in drill hole intervals at the Quartz Hill prospect. Drill holes 86-8 and 86-9 are located to the east and southeast of this figure. Note that the outline of the outcrop that defines Quartz Hill is approximated and is difficult to reconcile based on the maps (with two different grid coordinates) that were turned over to the MDNR.

- St_Joe_DH_assays_1_thru_7_&_Trench_11.pdf = assay results of the first seven drill holes (84-1 through 85-7);
- QTZ_HILL_TRENCH_AND_HOLES_8_9_ASSAYS.pdf = assay results for the St. Joe trench samples and for holes 86-8 and 86-9; and
- St_Joe_QH-84-[#]-log.pdf = geologic logs for all of the appropriately-numbered St. Joe drill holes (QH-84-1 through QH-86-9; hole QH86-8 never submitted to the MDNR).

Walsh Shaft

As noted previously, American Shield and Tamarack Company leased a substantial land package in the area between the Vermilion Fault and Mud Creek Shear zone in 1982. Furthermore, American Shield looked at areas to lease with known iron-formation lenses that could have provided structural traps for gold mineralization. According to a memorandum by William Ulland (7/7/1994 – on file at the MDNR), much of the iron-formation at the Walsh Shaft prospect (Section 4, T.62N., R.14W. – Fig. 33) was thought to occur in a topographic depression that Ulland believed to be related to the effects of shearing and carbonate alteration. This same memorandum mentions that dump rock of pyritic and calcite-veined magnetite breccia collected near the shaft was found to contain up to 650 ppb Au. Ulland also stated that old drill hole records indicated that hole W-2 intersected a 268-foot-thick interval of a quartz vein (orientation unknown), which was never assayed for gold in the iron exploration days. Furthermore, in the same memorandum, Ulland indicates that he sampled a 1941-circa drill hole from the area (hole B-3 – the exact location unknown, but presumably close to hole B-1 in Fig. 33) that was found to contain several intervals with >100 ppb Au with a maximum of 1,900 ppb gold.

The first non-iron-formation explorations in the Walsh Shaft area were conducted by Hanna Mining Company in 1971 when they drilled two very short holes (V-5 and V-6, Fig. 8) into an EM conductor and intersected graphite-bearing iron-formation.

Cyprus became interested and joint ventured the property with American Shield/Tamarack in the early 1980s. They drilled three holes in the area (V-6, V-7, and V-8) in search of gold in 1985. Cyprus conducted very limited sampling of these three holes, and no significant gold horizons were found (maximum of only 0.008 opt Au was found in V-6 – Note that the location of hole V-6 is shown in Fig. 8). In lieu of uninteresting rocks seen in these drill holes, and lack of encouraging assay results, Cyprus discontinued their activities at the Walsh Shaft prospect.

Noranda re-evaluated the information on this property in 1989-1991 and believed the prospect to have little potential of hosting a mineable gold prospect. Cominco drilled a single hole (VN-6) on the property in 1996, presumably to test the quartz vein that had been previously intersected in hole W-2. No quartz vein was encountered in VN-6, and only a maximum of 100 ppb Au was found in the drill hole.

Scanned materials pertaining to the Walsh Shaft prospect that are included with this report are:

- Hanna_V_5_&_6_logs.pdf = geologic logs of the Hanna drill holes (V-5 and V-6);
- Cyprus_V_[xx]_log.pdf = geologic logs, with assay results, for the appropriate Cyprus drill holes (V-6, V-7, and V-8);
- Cominco_VN_6_log.pdf = geologic log of the Cominco drill hole (VN-6);
- Cominco_VN_6_assays.pdf = assay results from hole VN-6; and
- Berg_3_assays.pdf = assay results from hole B-3.

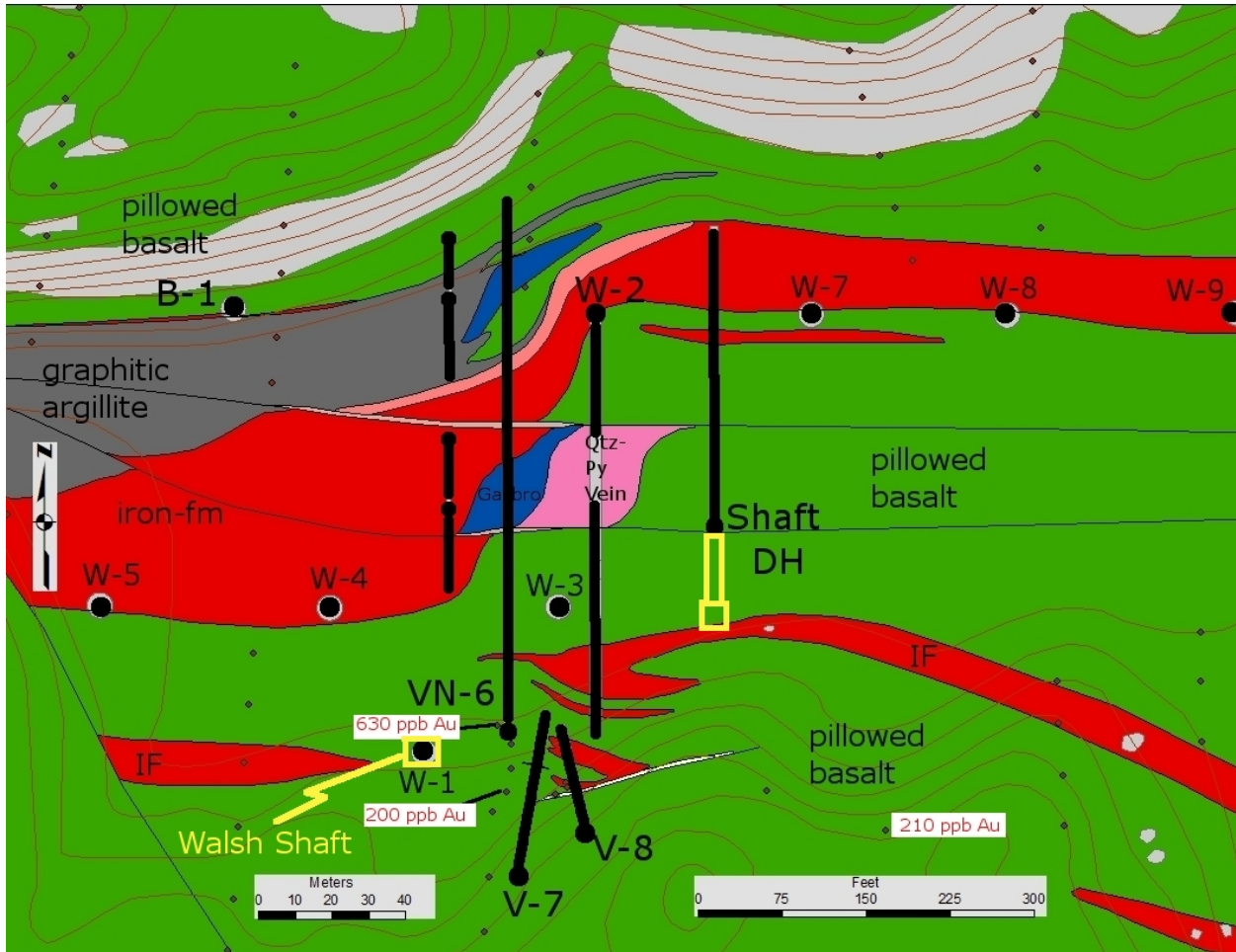


Figure 33. Geology of the Walsh Shaft prospect showing distribution of drill holes, old shafts, and anomalous auriferous surface samples (modified from Peterson and Patelke, 2004a). W-series holes were drilled by the Sheridan Iron Company and unnumbered holes were drilled by OIMC, both circa 1900-1911. V-series holes were drilled by Cyprus (V-6 is located to the west of this figure). Drill hole VN-6 was drilled by Cominco (note that the location of drill hole VN-6 in this figure shows some variation with the reported UTM location as is shown in Fig. 8).

Railroad Cut

The Railroad Cut prospect (Section 33, T.63N., R.14W. – Fig. 34) was picked up by American Shield/Tamarack after anomalous gold values (0.34 opt Au) were obtained from an old railroad cut on the site by Jim Hanttula, working for American Shield in 1983 (memorandum by William Ulland; 7/7/1994). This same memorandum also mentions that a high grade gold float (1.2 opt Au – location unknown) was found in tree roots. After these finds, a succession of companies explored the

site and, in the course of sampling the railroad cut and other exposures, found numerous anomalous gold values throughout the property (Fig. 34). Most recently, Peterson and Patelke (2004a) collected several samples that assayed high gold values that are also posted on Figure 34.

Cyprus was the first company to explore the property and drilled five holes on the property (Fig. 34) in 1985. All of the holes were logged as intersecting banded greenstone, which in reality consisted of chlorite schist with sericite and ankerite. One

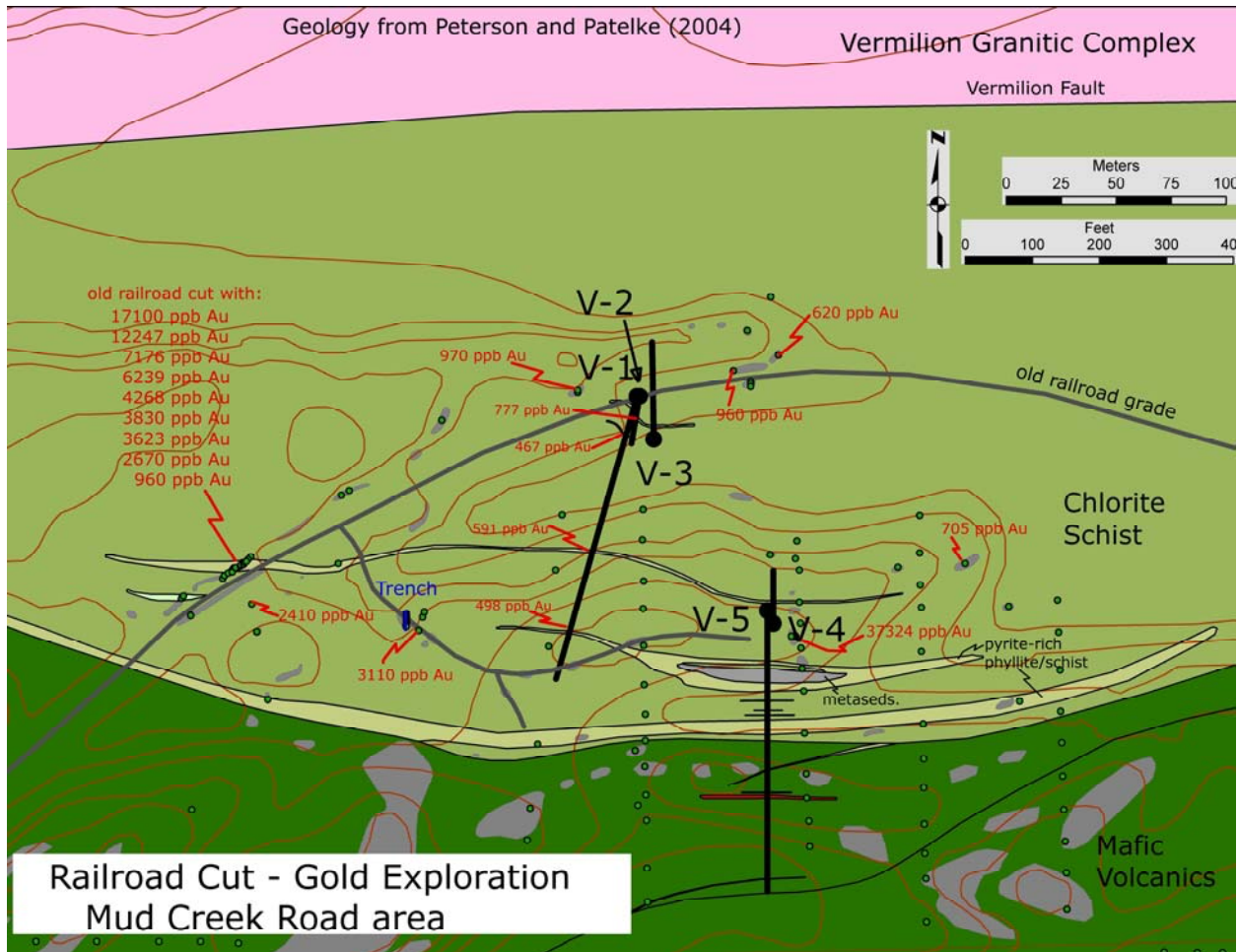


Figure 34. Geology of the Railroad Cut prospect, modified from Peterson and Patelke (2004a), showing drill holes and the distribution of anomalous gold values (>400 ppb Au threshold). Note that the sample with 37,324 ppb Au is from Peterson and Patelke (2004a) but could not be confirmed in the files at the MDNR.

of the holes reportedly intersected a shear/splay zone consisting of ankerite-sericite-pyrite-tourmaline-fuchsite (?) schist that assayed at 0.05 opt gold over five feet (a 6/30/1986 Cyprus review/report by E. Downs on file at the MDNR). However, the highest gold assay from the Cyprus drill holes on the property that could be confirmed with the data at hand for this investigation is 0.025 opt gold in hole V-2 (777 ppb Au in Fig. 34). In the same review, Downs also mentions that mineralized float was found about 600 feet south of the Vermilion Fault (exact location unknown) that ran 1.2 opt gold.

Chevron also evaluated the prospect in 1986-1987 and collected additional samples from the old railroad cut that assayed up to 17,100 ppb Au. Chevron re-sampled portions of two of the Cyprus holes (V-1 and V-5), but the gold values were low. In spite of the high gold values from the railroad cut, Chevron conducted no further work at the prospect.

Noranda evaluated the property in 1989-1991. They collected still more samples from the railroad cut and from a trench that they dug to the east (blue-labeled “Trench” in Fig. 34). Some of the samples from the railroad cut contained gold (maximum 2,670 ppb Au). The

trench samples were discouraging, and a grab sample located to the east of the trench assayed at 3,110 ppb Au. After review of all the data, Noranda felt that the gold mineralization was constrained to localized and thin (<1 m) discontinuous zones that were difficult to intersect in drill hole. Thus, Noranda recommended that no further work be conducted at the Railroad Cut prospect. In a later review of all the work conducted at this prospect, William Ulland noted that area to the north, near the Vermilion Fault, was still the most prospective and had yet to be drilled (undated memorandum on file at the MDNR).

The most recent work conducted at the Railroad Cut prospect was a district-wide basal till sampling campaign conducted by the MDNR (Dahl, 2005). In the course of collecting till samples, five bedrock samples were collected from the known mineralized railroad cut. Four out of five of the samples assayed at >1 ppm gold with a maximum of 12,247 ppb Au (the MDNR results are also incorporated in Fig. 34).

Scanned materials pertaining to the Railroad Cut prospect that are included with this report are:

- Geologic logs, with gold assays, for the Cyprus drill holes (V-1 through V-5);
- *Chevron_assays_V_1_&_5_holes.pdf* = Chevron's assay results for the re-sampling of V-1 and V-5;
- *Noranda_RRCut_sample_location_map.pdf* = Noranda's sample location and trench location map;
- *Noranda_RRCut_otc_assays.pdf* = Noranda's assay results for the above; and

- *Noranda_RRCut_trench1_assays.pdf* = Noranda's assay results for their trench.

Section 6/Pac Man Pond

USS was originally interested in the Section 6 area (T.62N., R.14W.) in 1981 after conducting a reconnaissance mapping and sampling effort to the east of their Bass Lake area. They found a three-foot wide quartz vein in mafic volcanics, and both the vein and the wall rock were sampled. The vein itself only contained 30 ppb Au, whereas two samples of the adjacent wall rock ran 940 ppb and 890 ppb Au. Further interest was stimulated when core from three 1900s-vintage holes from the Lawler Lake area were found at USS's Minntac facility in 1982. Several samples were collected from these holes. One sample, from hole 2606, consisted of a five-foot-thick, quartz-filled breccia in iron-formation (with 10% pyrite) that assayed at 960 ppm Au and 295 ppm As (Severson and Heine, 2007). All of these results seemed to confirm Boyle's iron-formation-hosted gold model, and USS planned to bid on the property in an upcoming State lease sale. However, USS never bid on these lands, and they were subsequently obtained by the Tamarack Company of Duluth. Several joint ventures between American Shield and other companies ensued. The exploration activities of these joint ventures took place within three subareas in the northern half of Section 6 (also called the Pac Man Pond area). These subareas, shown in Figure 35, are referred to in this report as: North Central area, West Central area, and NE Corner.

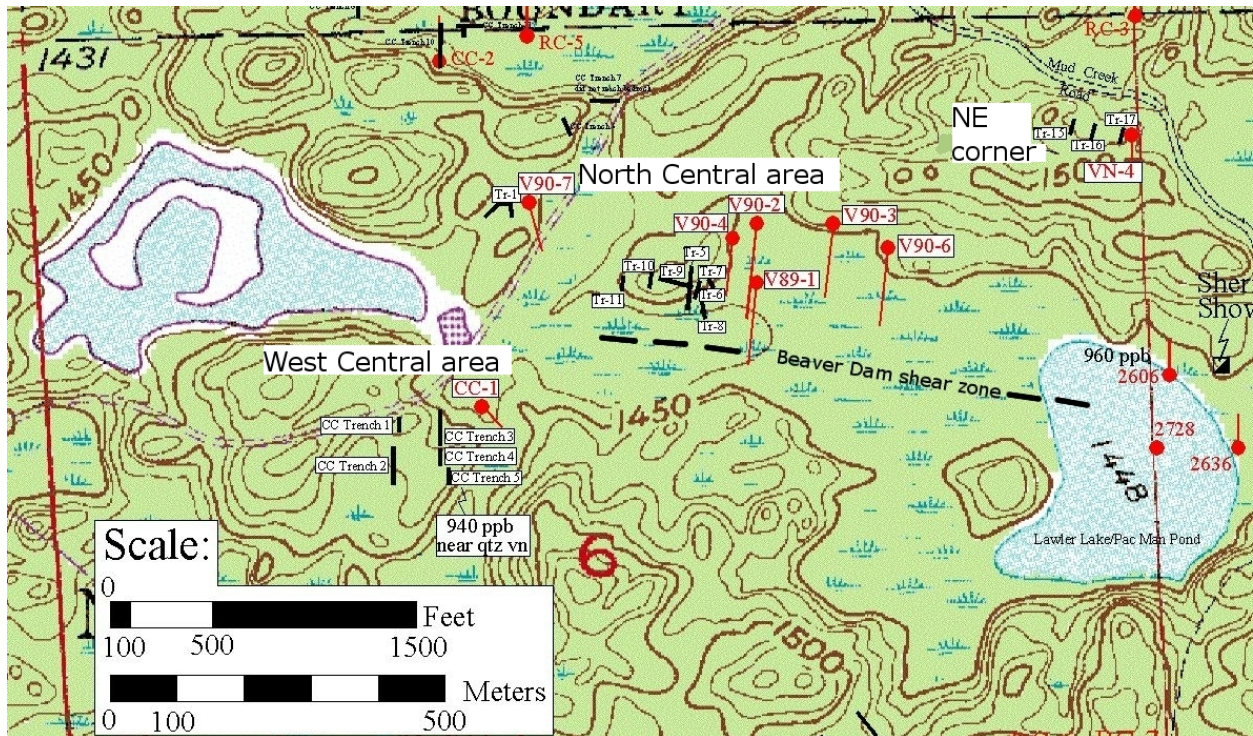


Figure 35. Map showing locations of drill holes and trenches in the Section 6/Pac Man Pond gold prospect. Cyprus drilled and trenched the CC-labeled items, Noranda drilled the V89/90-series holes and dug the Tr-labeled trenches, and Cominco drilled VN-4. The holes near Lawler Lake were drilled by OIMC in the early 1900s and were later sampled by USS for gold assays in 1982.

The following is a listing for the activities that took place in the North Central (Fig. 36) and West Central (Fig. 37) subareas of Section 6:

- Cyprus explored the property in 1986 and found sheared and carbonate-altered rock on the edge of a 300-foot-wide topographic depression. This depression was presumed to be an expression of a major EW-trending shear zone called the Beaver Dam shear. Outcrop and locally derived float (floatcrop), which assayed at 358 ppb and 670 ppb Au respectively, were found along the north margin of the depression (actual locations are unknown). In 1986, Cyprus dug five trenches (trenches CC-Tr-1 through CC-Tr-5) in the West Central area (Fig. 37) near the anomalous USS outcrop sample.

These trenches exposed several contacts between feldspar porphyry (FP), mafic volcanics, and sheared metasedimentary rock (called argillite by Cyprus). Samples from trench CC-Tr-2 were the most anomalous with 340 ppb and 280 ppb Au associated with a pyritic zone in the FP. Hole CC-1 was drilled in 1986. This hole intersected a thick package of well-foliated metasedimentary rock (called banded argillite) that assayed a maximum of only 19 ppb Au. In lieu of these disappointing results, Cyprus discontinued their efforts;

- Chevron conducted some reconnaissance exploration efforts on the property in 1987 in the form of outcrop and soil sampling as part of more extensive campaign that was conducted in adjacent properties, e.g., Clearcut and West Mud Creek areas.

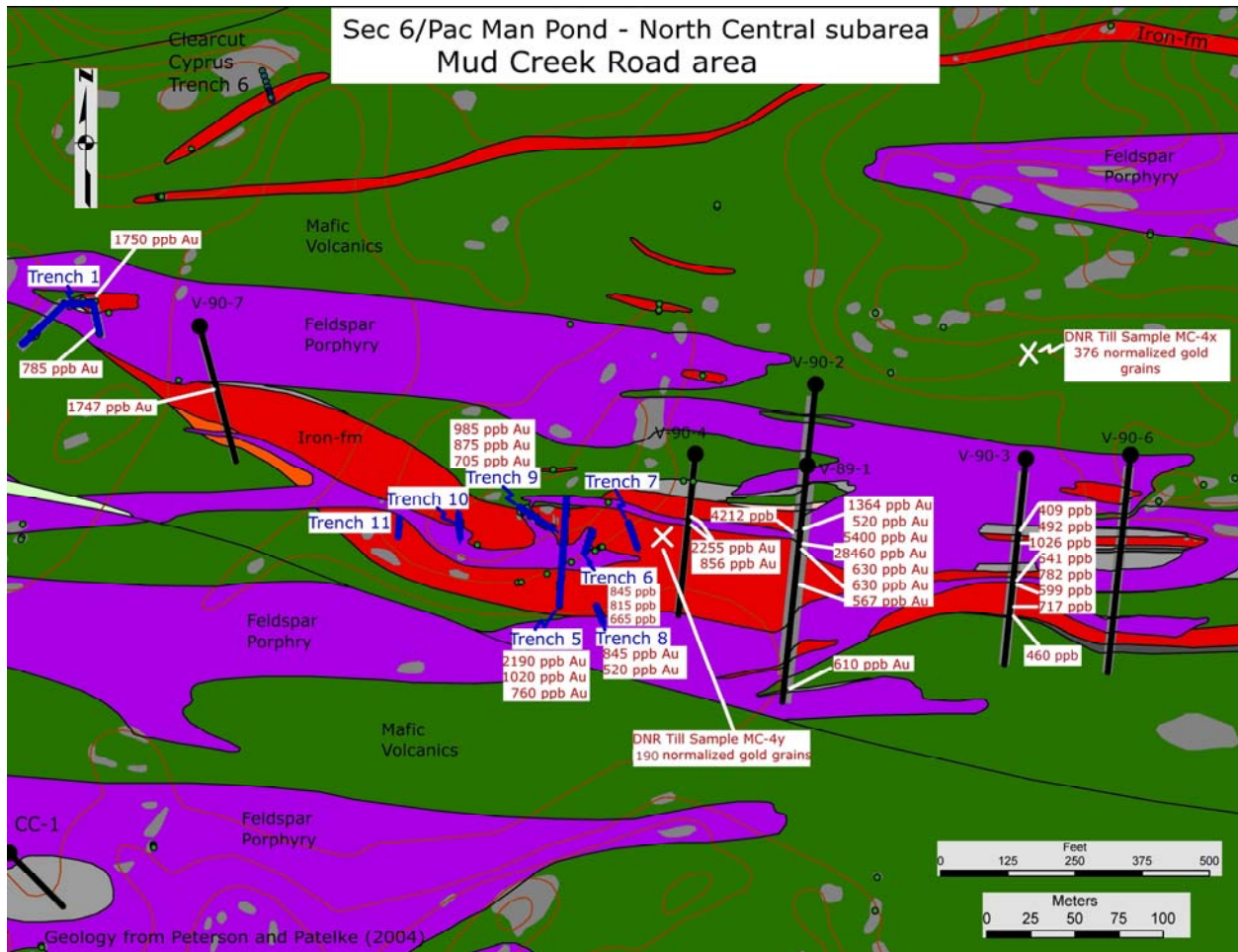


Figure 36. Geology of the North Central subarea of the Section 6/Pac Man Pond prospect (modified from Peterson and Patelke, 2004a) showing drill hole and trench locations. Also portrayed are anomalous gold values (>500 ppb Au) obtained from outcrops, drill holes, trenches, and basal till samples (normalized gold grain counts).

Assay results from their samples from the Section 6/Pac Man Pond area were low, and no further work was conducted;

- Noranda picked up the property in 1989 and conducted a grid-based rock and soil sampling campaign that encompassed all of Section 6. Significant gold values were found in the West Central (Fig. 37) and NE Corner (Fig. 38) areas of Section 6; however, no significant surface gold values were found in the North Central area. In spite of the lack of anomalous surface samples, Noranda drilled their first

hole (V89-1) in the North Central subarea in 1989 – most likely with the intention of testing the Beaver Dam shear zone. Hole V89-1 intersected alternating intervals of cherty iron-formation, FP, and mafic volcanics with widespread carbonate alteration and ubiquitous thin quartz-calcite veins. A brecciated iron-formation, in contact with a FP (to the north), was intersected in this hole at 218.8-233 feet that averaged 0.187 opt gold with a maximum of 0.831 opt gold (28,460 ppb Au);

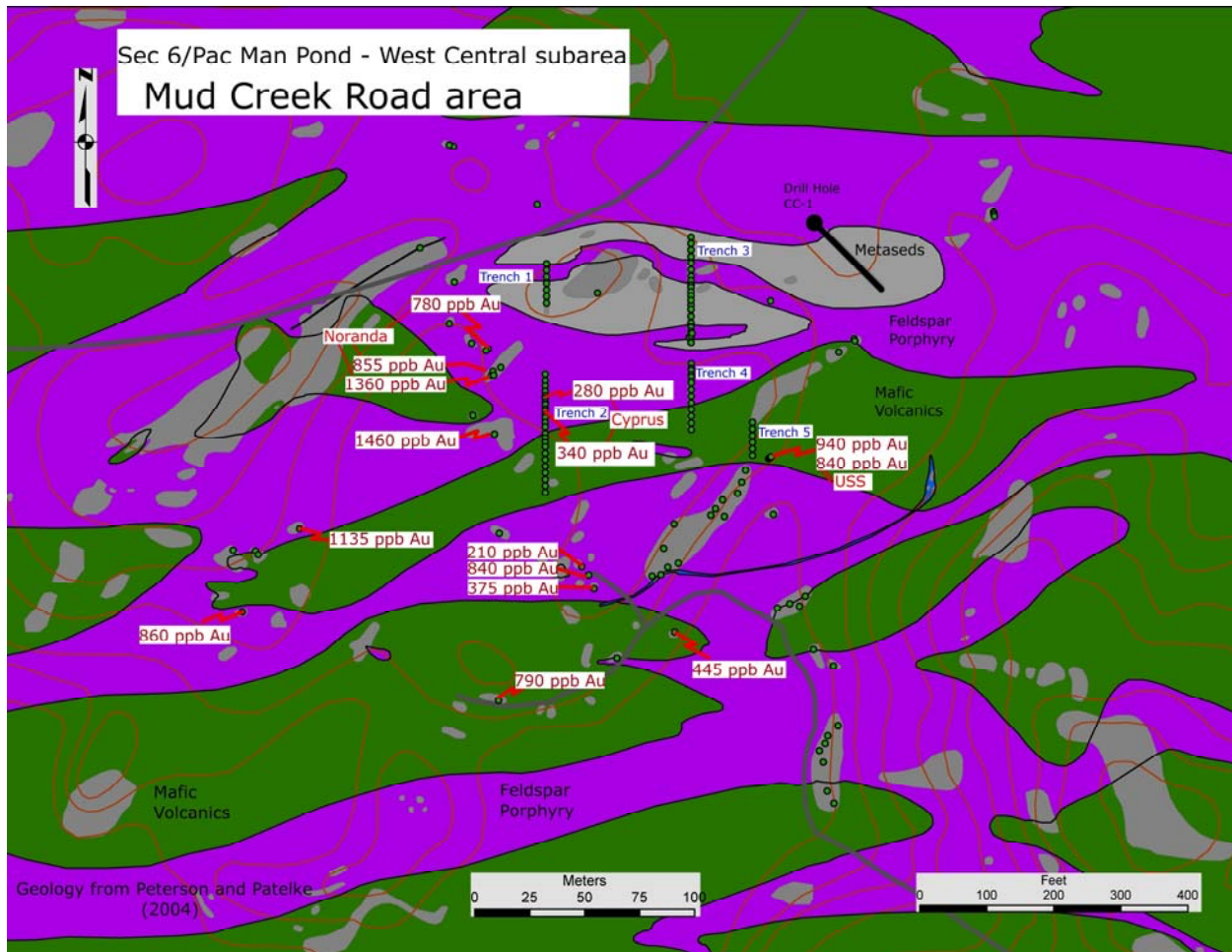


Figure 37. Geology of the West Central subarea of the Section 6/Pac Man Pond prospect (modified from Peterson and Patelke, 2004a) showing locations of trenches, a single drill hole, and anomalous gold values (>500 ppb Au threshold) obtained from outcrops and trenches. Anomalous samples collected by USS, Cyprus, and Noranda are so-indicated; the remainder of anomalous samples were collected by Peterson and Patelke (2004a).

- Following these encouraging results, Noranda dug eight trenches (Figs. 35 and 36) during the summer/fall of 1989 to expose the iron-formation/FP contact zone that was auriferous in hole V89-1. Several iron-formation/FP contacts were exposed in all of these trenches. Assay results received from trenches 1, 5, 6, 8, and 9 were the most anomalous with respect to gold (see posted values in Fig. 36). Arsenopyrite was observed in trench 8;
- Noranda drilled six holes (V90-1 through V90-4, V90-6, and V90-7) in 1990 as a follow-up to the encouraging trenching activities. Table 2 lists the results obtained in each of the holes;
- In 1991, Noranda determined that while their drilling and trenching results were indicative of several areas of low-grade gold potential, there were no continuous gold horizons, and thus, there was no potential to host a minable deposit;

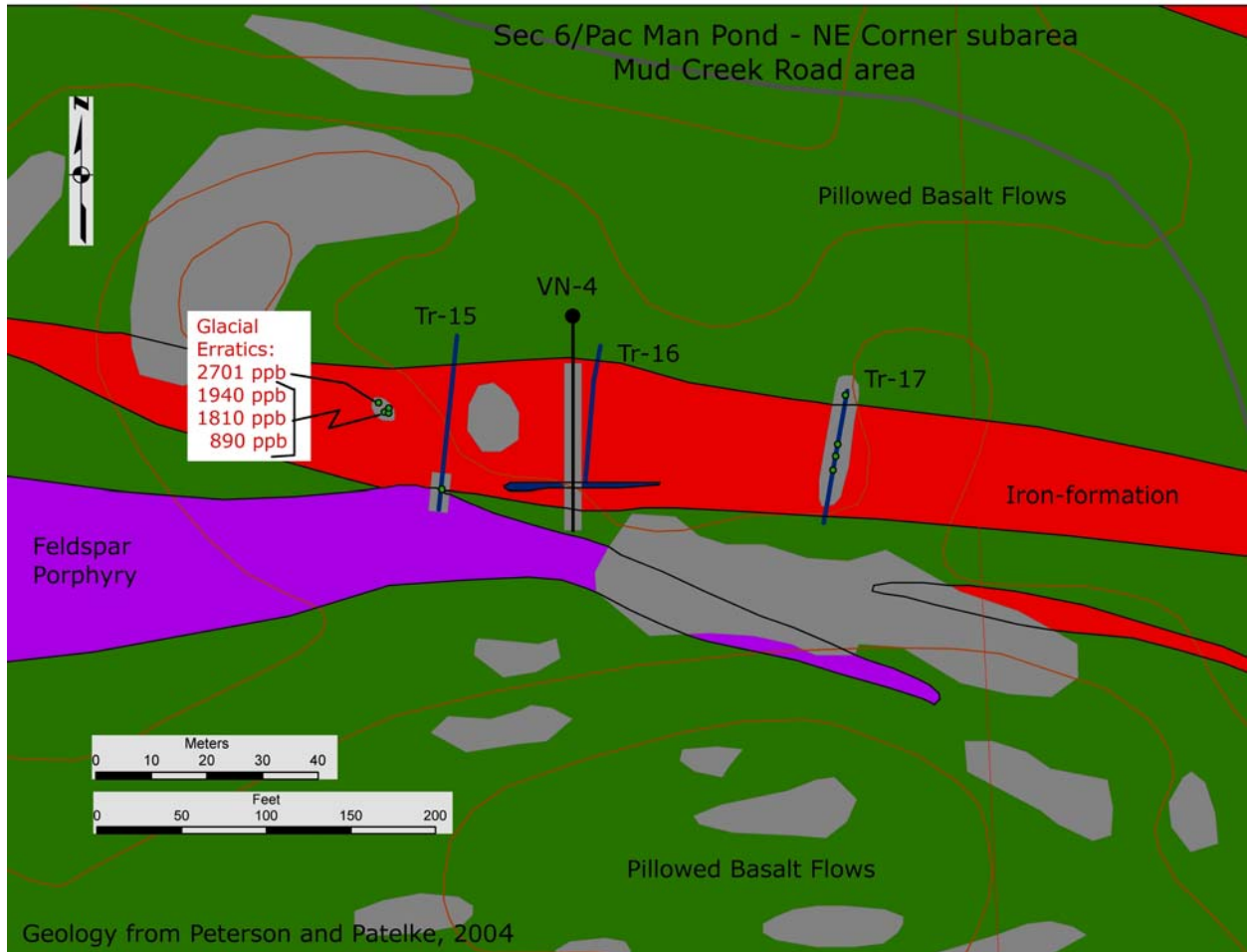


Figure 38. Geology of the NE subarea of the Section 6/Pac Man Pond prospect (modified from Peterson and Patelke, 2004a) showing locations of trenches, a single drill hole, and anomalous gold values (>500 ppb Au) obtained from float samples.

Table 2. Listing of reasons for the drilling of the Noranda holes at the Section 6/Pac Man Pond prospect and a short summary of the assay results. From an internal Noranda report by Peter Jongewaard (1991) on file at the MDNR.

Hole Number	Reasoning	Results
V90-2	Test down dip extension of V89-1 auriferous contact zone.	Brecciated iron-formation narrows to only 3.8 feet thick with 0.023 opt gold.
V90-3	Test eastern strike extension of V89-1 auriferous contact zone.	Several anomalous gold zones were intersected in the hole (see Fig. 36).
V90-4	Test western strike extension of V89-1 auriferous contact zone.	Brecciated iron-formation narrows to only five feet thick with 0.046 opt gold.
V90-6	Test gold mineralization to east of V90-3.	Disappointing results with only 200-300 ppb Au.
V90-7	Test contact zone between FP and iron-formation to the extreme west.	Disappointing results with only 0.51 opt (1,747 ppb) Au in a two foot zone.

- Peterson and Patelke (2004a) conducted detailed mapping and sampling in the area. In the course of completing their work, they identified numerous outcrops from the West Central subarea, especially in the feldspar porphyry, that were anomalous with respect to gold (see posted values in Fig. 37). Peterson and Patelke (2004b) reported thin quartz veining was seemingly everywhere within the porphyry and suggested that the mineralization is stockwork-style. Furthermore, they noted that the highest grades occur in areas of strong sulfide oxidation (sulfide burn) in the porphyry;
- A glacial till sampling orientation survey was recently conducted throughout the western Vermilion District by the MDNR (Dahl, 2005). Of the 32 basal till samples analyzed, 4 were highly anomalous with respect to gold, with counts of 88 to 1,282 gold grains per 10 kg of -2mm sample. The second highest sample collected by Dahl (2005) was from the Section 6 area (see Fig. 36 for location) wherein the sample (MC-4x) contained 376 normalized gold grains (143 raw gold grains), of which 303 grains were pristine. A second sample (MC-4y) was also collected in the same area (see Fig. 36) that contained 190 normalized gold grains (99 raw grains), of which only 90 gold grains were pristine. Overall, Dahl (2005) notes that the till samples yielding the highest gold grain counts in the survey display a significant component of shear zone clasts or iron-formation clasts; and
- Another basal glacial till sample (MC-34b) was collected by the NRRI in 2007 in the same site as the MDNR sample (Hauck et al., in prep.). The NRRI sample was found to contain 1,282 normalized gold grains (641 raw gold grains), of which 1,264 were pristine.

A slightly different exploration history is indicated for the NE Corner subarea of the

Section 6/Pac Man Pond prospect (the NE Corner subarea is portrayed in the upper right corner of Fig. 35). The following is a listing for the activities that took place in the NE Corner subarea:

- In 1989, Noranda sampled a large glacial erratic (10 x 10 feet) of highly altered, pyrite-bearing iron-formation that assayed at 890 ppb, 1,810 ppb and 1,940 ppb gold (Fig. 38);
- In an attempt to find the bedrock source for the glacial erratic, Noranda dug three trenches (Tr-15 through Tr-17 in Figs. 35 and 38) in 1989. While the three trenches encountered iron-formation in contact with mafic volcanics (in the southern portions of trenches 15 and 16), the iron-formation was sulfide poor. Assay results of samples collected from the trenches were discouraging, as the values ranged from 39-175 ppb Au. Thus, Noranda determined that the source of the erratic was not uncovered by the trenching activity and discontinued activities in this area. In hindsight, Noranda felt that the source was most likely located to the north, where another iron-formation/mafic volcanic contact was inferred based on outcrop mapping.
- Cominco American picked up the property in the mid-1990s. There is very little information that was turned in, but the data suggest that they sampled another glacial erratic in the area that returned an assay result of 2,701 ppb Au. Following this discovery, Cominco drilled a hole (VN-4) across the iron-formation trend. The hole intersected both contacts of the iron-formation, but the hole only showed a maximum 0.004 opt gold. In lieu of the discouraging results obtained from this hole, Cominco dropped the property.

Scanned materials pertaining to the Section 6/Pac Man Pond prospect that are included with this report are:

- OIMC_[###]_LOG.pdf = geologic logs for the appropriately-numbered Oliver Iron Mining Company holes (2602, 2636, and 2728) that were drilled at the nearby Mud Creek Mine in the early 1900s and later logged and sampled by USS;
- USS_SEC6_62_14_ASSAYS.pdf = assay results for reconnaissance samples collected by USS in the Section 6 area [and Kerr McGee showing area = 660 ppb Au];
- Cyprus_PacManPond_Clearcut_Trench_Assays.pdf = includes assay results for the five trenches (#1-#5) dug and sampled by Cyprus in the West Central subarea;
- Cyprus_CC_1_LOG.pdf = geologic log, with posted gold assays, for Cyprus hole CC-1 drilled in the West Central subarea;
- Cyprus_CC_1_2_ASSAYS.pdf = assay results for Cyprus holes CC-1 and CC-2;
- Noranda_Sec5_and_6_trench_assays.pdf = assay results for all of the trenches dug and sampled by Noranda in their Section 6 (Trenches 1 through 17, excluding Trench 16) and adjacent Section 5 (Trenches 90-1 through 90-4) prospect areas;
- Noranda_Section_6_otc_assays.pdf = assay results for outcrop samples, and float samples, collected by Noranda in their Section 6 prospect (grid-based locations);
- Noranda_Section_6_Humus_assays.pdf = assay results for humus samples (maximum of 6.4 ppb Au) collected by Noranda in their Section 6 prospect (grid-based locations);
- Noranda_V_90_[###]_log.pdf = geologic logs, with posted assay results, for the appropriately numbered Noranda holes from their Section 6 prospect (V-89-1, V90-2, V-90-3, V-90-4, V-90-6, and V-90-7);
- Cominco_VN_4_LOG.pdf = geologic log for Cominco hole VN-4; and
- Cominco_VN_4_ASSAYS.pdf = assay results for Cominco hole VN-4.

Section 5 area

The Section 5 prospect constitutes another Tamarack property (north half of the north half of Section 5, T.62N., R.14W. – Fig. 39) that Noranda was working on at the same time as at their adjacent Section 6/Pac Man Pond prospect. Noranda conducted mapping, sampling (rock, B-soil, and humus), and geophysical surveys in 1990 that identified an auriferous, sulfide-bearing, iron-formation in the area. The highest value they obtained was 978 ppb Au (>10,000 ppm As) in float from an old test pit (Fig. 39). Follow-up trenching by Noranda (Tr-1-90 through Tr-4-90 in Fig. 39) exposed locally disrupted and folded, sulfide-bearing (pyrite and arsenopyrite) iron-formation. The first two trenches returned the best values with respect to gold. Trench 90-2 was found to contain 0.041 opt Au in a three foot thick zone, and a subcrop piece of iron-formation with a high of >10,000 ppm Au was found in Trench 90-1 (Fig. 39). A small shear zone in Trench 90-2 was coincident with a local decrease in magnetic intensity. This magnetic low was drilled (V-90-5) by Noranda in late 1990. However, this hole failed to intersect any evidence of mineralization at depth (maximum of 45 ppb Au). The disappointing results of this hole downgraded the Section 5 prospect to a low priority, and Noranda eventually discontinued their activities.

A memorandum by William Ulland (undated – on file at the MDNR) mentions that a ten-by-ten-foot float boulder was found approximately 2,500 feet to the east on the same iron-formation trend. A sample from this boulder assayed at 1.8 ppm gold. In retrospect, Ulland felt that the iron-formation of the Section 5 prospect was never adequately tested for gold mineralization.

Scanned materials pertaining to the Section 5 prospect that are included with this report are:

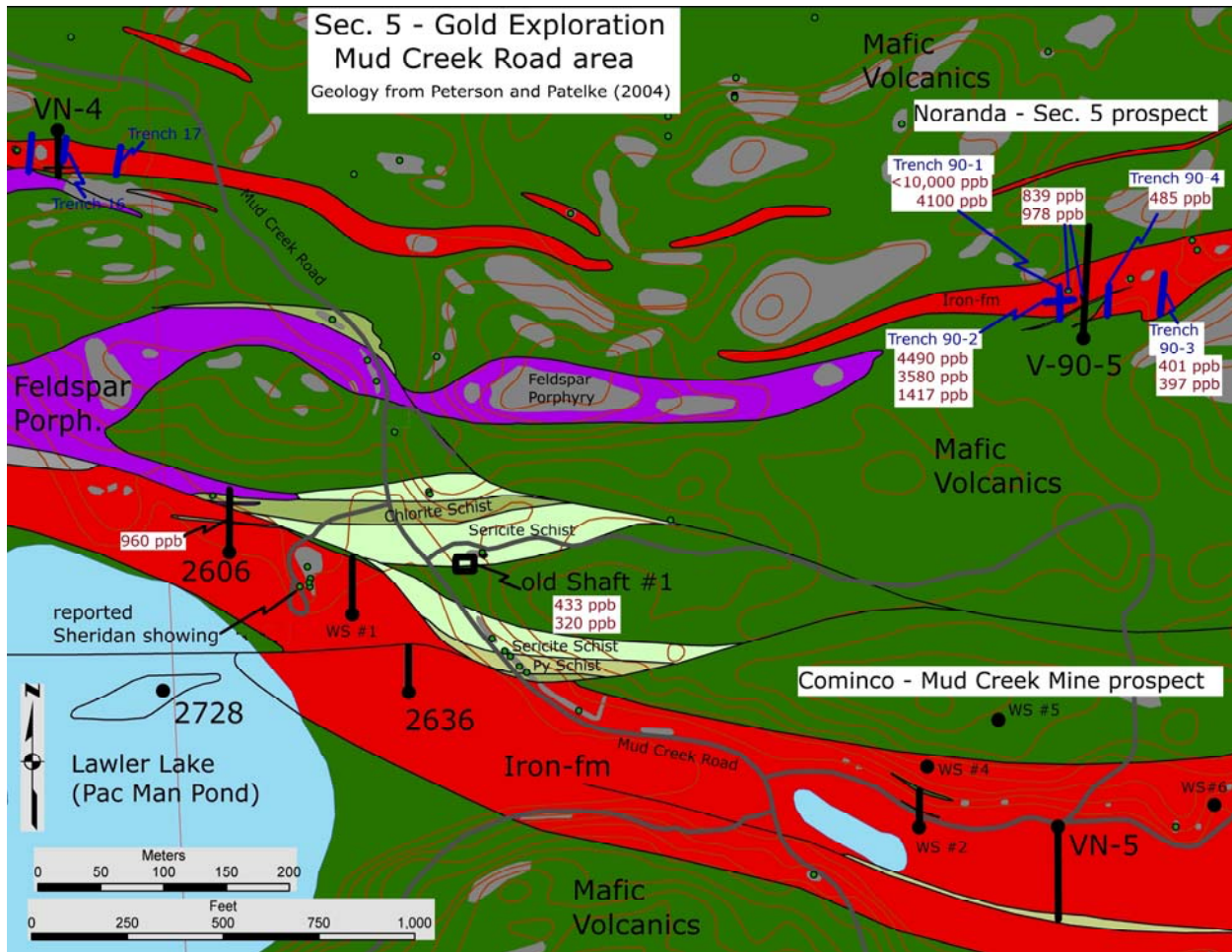


Figure 39. Geology of the Section 5 + Mud Creek Mine prospects (modified from Peterson and Patelke, 2004a) showing locations of trenches, drill holes, and anomalous gold values (>300 ppb Au) obtained from outcrops, and trenches. Hole V-90-5 was drilled by Noranda, and holes VN-4 and VN-5 were drilled by Cominco. All of these other holes were drilled in the early 1900s.

- Noranda_Section_4_5_assays.pdf = assay results for outcrop samples collected by Noranda in their Section 5 prospect (grid-based locations);
- Noranda_section_5_otc_assays.pdf = additional assay results for outcrop samples collected by Noranda in their Section 5 prospect (grid-based locations);
- Noranda_section_5_soil_assays.pdf = assay results for B-soil samples collected by Noranda in their Section 5 prospect (grid-based locations);
- Noranda_section_5_humus_assays.pdf = assay results for humus samples (maximum of 6.4 ppb Au) collected by

Noranda in their Section 5 prospect (grid-based locations); and

- Noranda_V_90_5_log.pdf = geologic logs, with posted assay results, for the Noranda hole from their Section 5 prospect (V-90-5).

Mud Creek Mine

The area immediately adjacent to Noranda's Section 6/Pac Man Pond and Section 5 prospects was probably looked at as well. However, there is very little in the MDNR records about exploration in this area

(Section 5, T.62N., R.14W. – Fig. 39). All that is known is that it was drilled by Cominco in 1995. Based on the track records of the adjacent areas, Cominco probably drilled their hole (VN-5; Fig. 39) into a topographic depression in the iron-formation trend with expectations of intersecting sheared rock and/or alteration. However, this hole did not intersect any gold mineralization (maximum of only 95 ppb Au), and no further work was conducted. Scanned material included in this report pertaining to this area is a geologic log, with posted assay results, for Cominco hole VN-5 (Appendix B).

Clearcut

The Clearcut area is a small Tamarack property (Fig. 40) that straddles the section line between Section 6 (T.62N., R.14W.) and Section 31 (T.63N., R.14W.). Cyprus was the first to joint venture this property with American Shield in 1984. In late 1985, Cyprus cut six trenches in various places within the prospect (Fig. 40 – Trenches 6 through 11). No gold mineralization was encountered in Trenches 6 and 8 (Trench 7 did not reach bedrock). Most of Trench 9 was poorly mineralized with respect to gold except for a

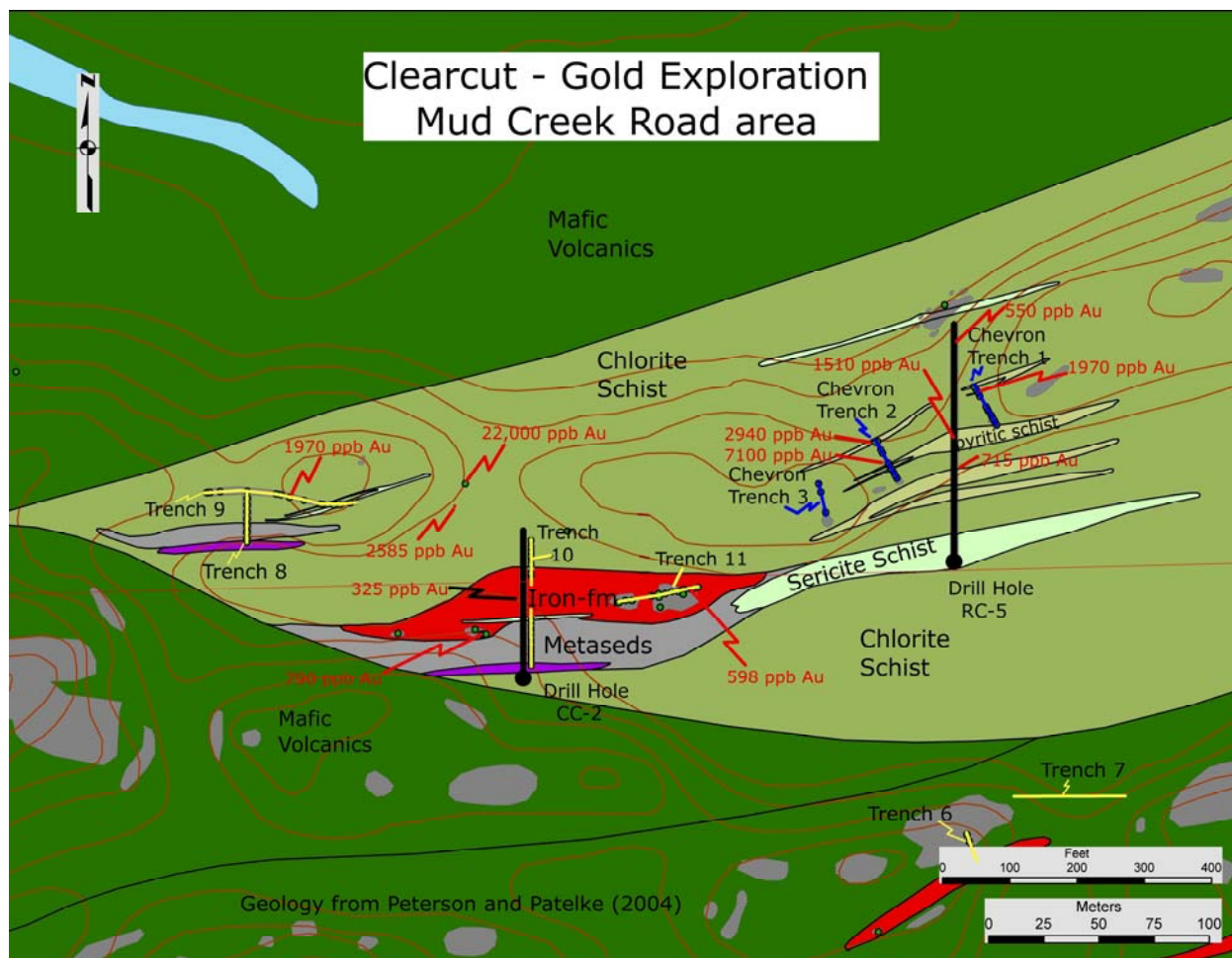


Figure 40. Geology of the Clearcut prospect (modified from Peterson and Patelke, 2004a) showing locations of trenches (yellow = Cyprus trenches; blue = Chevron trenches), drill holes, and anomalous gold values (>500 ppb Au) obtained from outcrops, and trenches.

four-inch-wide quartz ankerite vein that ran 1.97 ppm Au. Trench 10 was dug across an iron-formation trend and was the most mineralized. Five consecutive samples, over a 17-foot-wide zone across the northern contact of the iron-formation, assayed at >100 ppb Au with a maximum of 590 ppb Au. A high-graded, arsenopyrite-rich sample (>10,000 ppm As) from this same trench assayed at 402 ppb Au. Trench 11 contained several arsenopyrite-rich, ankeritic zones, but the corresponding samples assayed at only 33-88 ppb Au. However, a sample of a one-half-inch-wide quartz vein from Trench 11 assayed at 598 ppb Au. According to an undated memorandum by William Ulland at the MDNR, Cyprus also found float running 0.25 opt Au on the north edge of property in one of their trenches (this value could not be confirmed in the data at the MDNR).

Encouraged by the mineralization that was evident in Trenches 10 and 11, Cyprus drilled a single hole (CC-2) across the iron-formation trend in 1986. The hole intersected foliated ankerite-sericite rock and brecciated iron-formation. A 20-foot-thick zone in the brecciated iron-formation showed the best indication of gold mineralization, but with a maximum of only 325 ppb Au (Fig. 40).

Chevron picked up the property in 1987 and, through the course of mapping and sampling, found 8,010 ppb gold in an unknown outcrop (the assay result, but not the location, for sample CC-3 is preserved in the records). The records at the MDNR also indicate that Chevron collected a sample that assayed at 22,000 ppb Au (Fig. 40). Interestingly, there is no mention of this sample in any of the Ulland memorandums on file at the MDNR, nor was this area ever targeted by a drill hole (making the location of this sample suspect).

Chevron dug three trenches across the iron-formation trend in 1988. However, there are no preserved records at the MDNR that indicate where these trenches were dug. Fortunately, Peterson and Patelke (2004a)

captured the trench locations (shown in Fig. 40) before they were lost (or they were never turned in to the MDNR). Chevron's Trench 2 was the best mineralized in that it encountered a folded quartz-carbonate vein with 7,100 ppb Au and a quartz-sericite-pyrite schist with 2,940 ppb Au. Trench 1 found 1,970 ppb Au in a quartz-pyrite schist. As a follow-up to the trenching, Chevron drilled a single hole (RC-5) positioned between Trenches 1 and 2. Apparently, the auriferous horizon exposed in the trenches was intersected in this hole; however, the interval in the hole assayed at only 1,500 ppb Au. Due to the lack of a thick mineralized horizon in their single drill hole, Chevron discontinued their efforts at Clearcut.

Scanned materials pertaining to the Clearcut prospect that are included with this report are:

- Cyprus_PacManPond_Clearcut_Trench_Assays.pdf = includes assay results for the Cyprus trenches dug at the Clearcut prospect (Trenches 6, 8, 9, 10, and 11);
- Cyprus_CC_2_LOG.pdf = geologic log, with posted assay results, for the Cyprus drill hole (CC-2);
- Chevron_Clearcut_Buckshot_trench_assays.pdf = assay results for the Chevron trenches (T-1, T-2, and T-3) at the Clearcut prospect (also includes assays for trenches at the Buckshot Lake prospect);
- Chevron_RC-5-log.pdf = geologic log for the Chevron drill hole (RC-5); and
- Chevron_RC-5-thru-7-assays.pdf = assay results for Chevron drill hole RC-5 (and other RC holes).

Kerr McGee Showing

Even though this particular outcrop has historically been called the Kerr McGee Showing (SW ¼ of Section 31, T.63N., R.14W.), there are no Kerr McGee data pertaining to this prospect in the MDNR files. Kerr McGee referred to this prospect as the

“Mud Creek Road Showing” in reference to auriferous exposures along the road. They extended the exposures to the east with the use of hand tools, a portable pump, and a high-pressure hose (Robert Roe, pers. comm., October, 2011). While the sampling results of Kerr McGee are unknown, several other companies did collect highly auriferous samples from this area. Their assay results are collectively shown in Figure 41. Peterson and Patelke (2004b) state that the showing is hosted within an extensive zone of highly strained rocks interpreted to be subsidiary structures associated with the Mud Creek shear zone. Furthermore, they state that the

gold mineralization occurs within multiple thin (0.2-2.0 meter) zones of quartz-sericite-ankerite-pyrite±green mica±tourmaline schist hosted by essentially gold-barren chlorite-rich schist. The schist reportedly displays excellent C’ shear bands and S’₂ crenulations (Southwick et al., 1989). The rocks are correlative with the Bass Lake Sequence and contain localized thin iron-formation boudins.

A memorandum (8/14/1986) by William Ulland describes how he sampled a 25-foot-wide zone with multiple thin zones (<2 meters) of quartz-sericite-ankerite-pyrite-tourmaline schist wherein he obtained gold values of: 0.92 opt in a grab sample; 0.24 opt

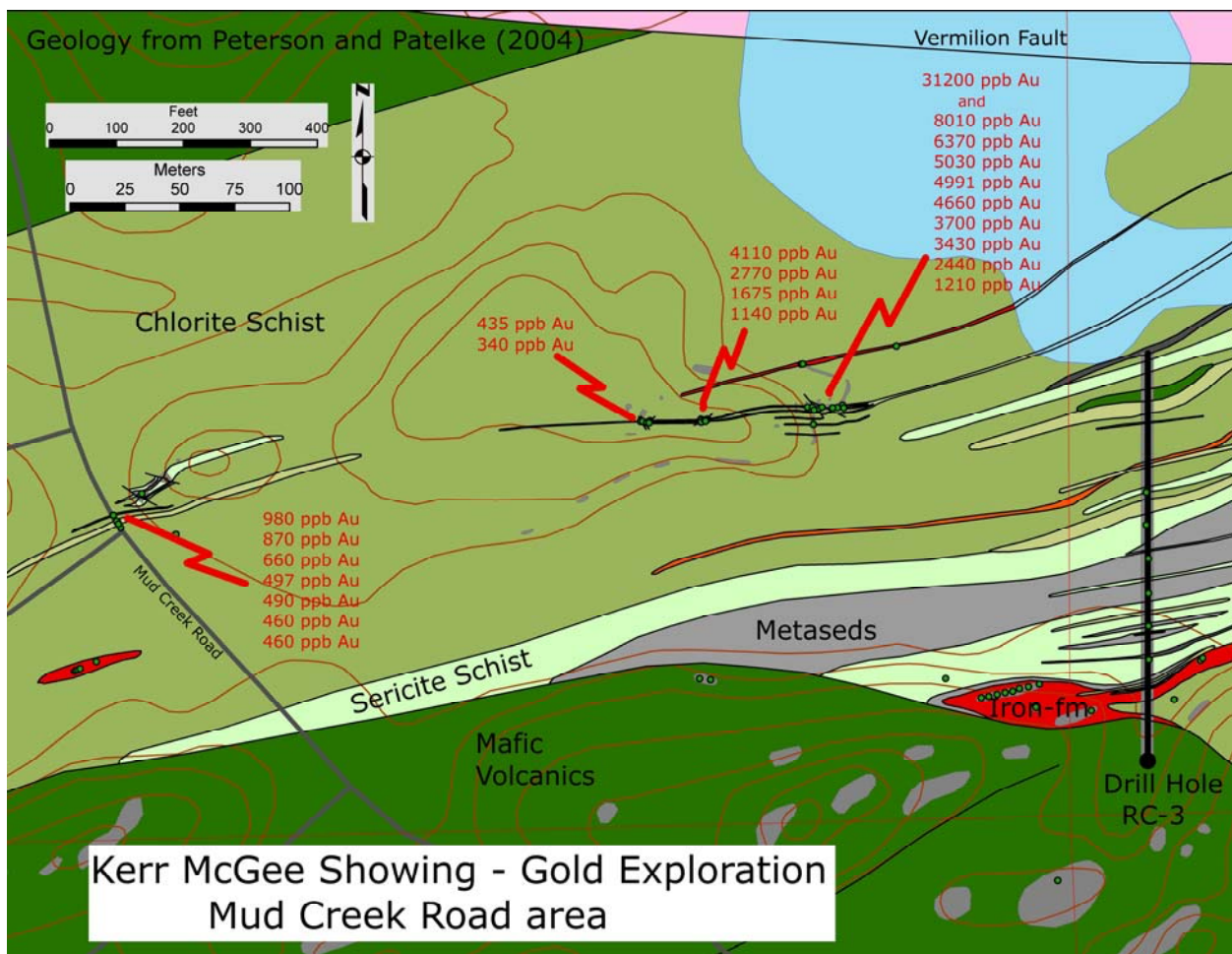


Figure 41. Geology of the Kerr McGee Showing, modified from Peterson and Patelke (2004a) showing the distribution of anomalous gold samples (>300 ppb Au). Drill hole RC-3 was drilled to the immediate east in Chevron’s Buckshot Lake prospect.

(8 ppm) over 10 inches; 0.26 opt over 15 inches; and 0.11 opt (3.6 ppm) over 9 inches. All in all, companies that collected samples from this particular outcrop include: Kerr McGee (results unknown), USS, American Shield, Chevron, Noranda, and Cominco, as well as Peterson and Patelke (2004a). In fact, most of the anomalous samples shown in Figure 42 were collected by Peterson and Patelke (2004a).

For unknown reasons, Kerr McGee chose not to drill this prospect. Robert Roe, formerly of Kerr McGee, recalls that while the gold numbers were impressive, the auriferous zones were too thin to justify core drilling

(pers. comm., October, 2011). Chevron, however, did control land to the immediate east, and they drilled along the trend of the Kerr McGee Showing in their Buckshot Lake prospect to be described next.

Buckshot Lake

The Buckshot Lake prospect (Section 32, T.63N., R.14W. – Fig. 42) was picked up by Tamarack around 1986, as it was positioned immediately adjacent to the Kerr McGee Showing (KMS). Chevron conducted exploration activities in 1987, and one of their first recorded actions was to drill a hole (RC-3)

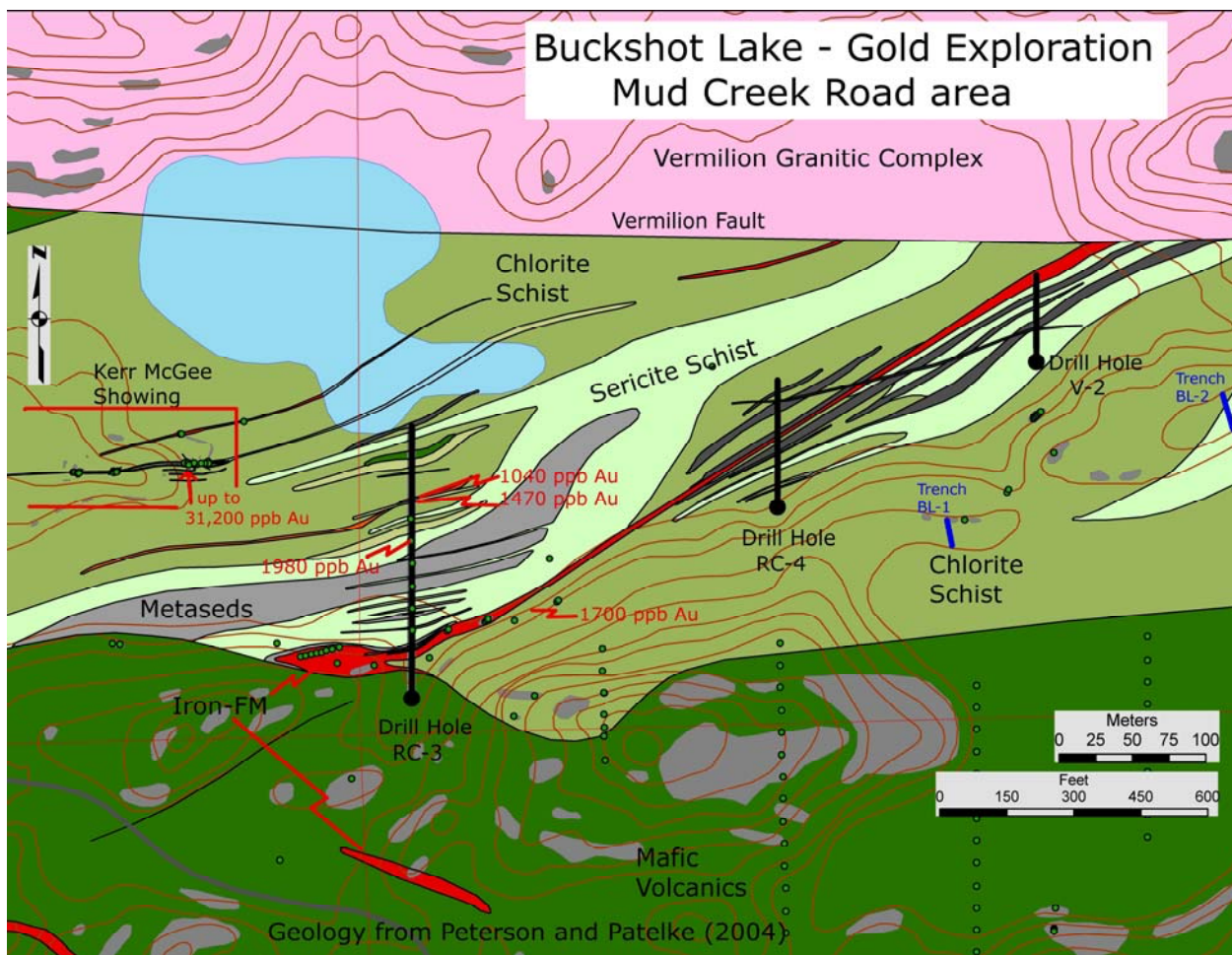


Figure 42. Geology of the Buckshot Lake, modified from Peterson and Patelke (2004a) showing the distribution of anomalous gold samples (>1,000 ppb Au). Drill hole V-2 was drilled by Hanna as part of their VMS exploration efforts in 1970. The dark gray bands intersected in both V-2 and RC-4 are graphitic argillite.

about 400 feet to the east of, and presumably on strike of, the KMS (Figs. 41 and 42). Rocks similar to the KMS were intersected in the hole, but sampled assays for gold were not similar. Overall, the hole intersected two zones with enriched gold contents. The thickest zone was 7.2 feet thick (595-602.5 feet) and averaged 0.035 opt gold (1,470 ppb and 1,040 ppb Au). Another zone was intersected higher in the hole (509-527 feet) that contained several assays in the range of 100-400 ppb Au with an isolated maximum of 1,980 ppb Au.

Chevron's next action was to dig two trenches in 1988. No gold mineralization was encountered in either trench. A second hole (RC-4) was drilled in 1988 about 1,000 feet east of RC-3 – probably based on geophysical-related expectations, as several graphitic argillite horizons were intersected in RC-4. Gold assay results for this hole were never written on the geologic log, and the available records at the MDNR do not indicate that the hole was ever sampled. This missing data is substantiated by an undated memorandum by William Ulland that also states that some of the hole was sampled by American Shield and that only a maximum of 222 ppb Au over two feet was found.

Based on foliation trends in the nearby KMS, Peterson and Patelke (2004b) have postulated that the Chevron holes were never drilled deep enough to intersect the gold mineralization and that the area has never been fully evaluated for its gold potential. Furthermore, they state that the style of mineralization at the KMS, and by analogy the Buckshot Lake prospect, is similar to both the Clearcut and Railroad Cut prospects, and that all of these prospects may collectively form a continuous zone of anomalous to ore-grade gold mineralization over a strike length of over 2.5 miles.

Scanned materials pertaining to gold exploration at the Buckshot Lake prospect that are included with this report are:

- *Hanna_V_2_log.pdf* = geologic log for the Hanna V-2 hole;
- *Chevron_Buckshot-Lake-Soil-Results.pdf* = assay results for the Chevron soil sample survey;
- *Chevron_Buckshot_ClearCut_trench_assays.pdf* = assay results for Chevron trenches BL-1 and BL-2 (mostly assays for Chevron's Clearcut prospect trenches);
- *Chevron_RC-3-log.pdf* = geologic log, with posted assay results, for Chevron drill hole RC-3; and
- *Chevron_RC-4-log.pdf* = geologic log (no assay results indicated) for Chevron drill hole RC-4.

West Mud Creek

The West Mud Creek prospect (SE corner of Section 6, T.62N., R.14W.), along with adjacent lands to the east (Sections 3 and 4 – Fig. 17), were acquired by Tamarack due to their proximity to the Mud Creek Shear Zone. The area in Sections 3 and 4 was initially explored by Chevron starting in 1987, and grid lines were eventually added to the west in what became known as the West Mud Creek grid (Fig. 43). Apparently, the West Mud Creek grid showed more promise, and further exploration efforts by Chevron were concentrated in this area. According to an undated memorandum by William Ulland, Chevron conducted a B horizon soil sampling survey (-100 mesh) that showed clusters of very strong gold anomalies with an isolated maximum of 1.5 ppm Au. The patterns of the anomalies apparently indicated bedrock control. In order to check the validity of the soil sample assays, one of the anomalous soil sample sites (unknown) was confirmed to be bedrock-related, as the site was hand dug a few inches to bedrock and a 2 ppm Au value was found in the underlying sheared bedrock. One area in particular, the "Porphyry Anomaly," showed several >100 ppb Au in soil anomalies with a maximum of 622 ppb Au.

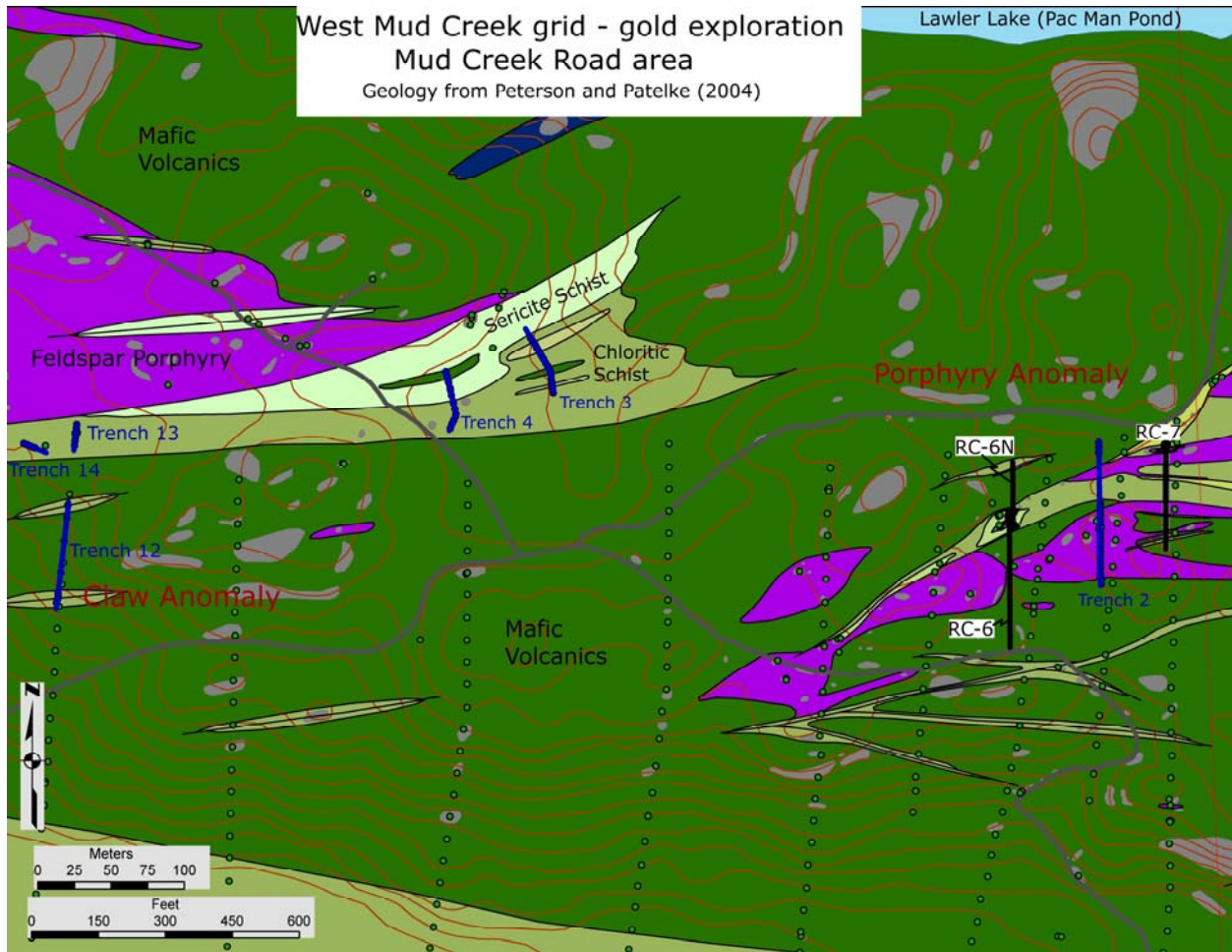


Figure 43. Geology of the West Mid Creek prospect, modified from Peterson and Patelke (2004a), showing trenches, drill holes, and general locations of soil anomaly areas. See Figure 44 for details of the “Porphyry Anomaly” area.

The “Porphyry Anomaly” is shown in Figure 44. This area received some drilling in 1988, as it was not only associated with a soil anomaly, but unique rocks consisting of quartz-veined/brecciated carbonate-altered porphyry and massive ankerite were discovered in nearby old test pits. Holes RC-6 and RC-6N encountered the carbonate-altered sheared rock with green mica, but only a maximum of 325 ppb Au was found in RC-6. Hole RC-7 was drilled nearby on a 622 ppb Au soil anomaly and intersected 437 ppb Au associated with a small vein in the porphyry.

Chevron also defined a gold soil anomaly further to the west that was called the “Claw Anomaly” (grid lines 60W-72W). This soil

anomaly area and similar soil anomalies defined elsewhere within the property were never drilled.

The West Mud Creek prospect was picked up by Noranda, and sampling of one outcrop returned values of 1,760 ppb and 2,400 ppb Au (Fig. 44). Six trenches were dug on the property in 1989 (Trenches 2, 3, 4, 12, 13, and 14 – Fig. 43). Trench 2 was dug in the “Porphyry Anomaly” (Fig. 44) and exposed an iron carbonate altered feldspar porphyry and its highly altered contact with mafic volcanics to the north and south (Jongewaard Suszek, 1991). Assays from 10-foot-long composited channel samples included 1,130 ppb Au and 1,380 ppb Au near the south end

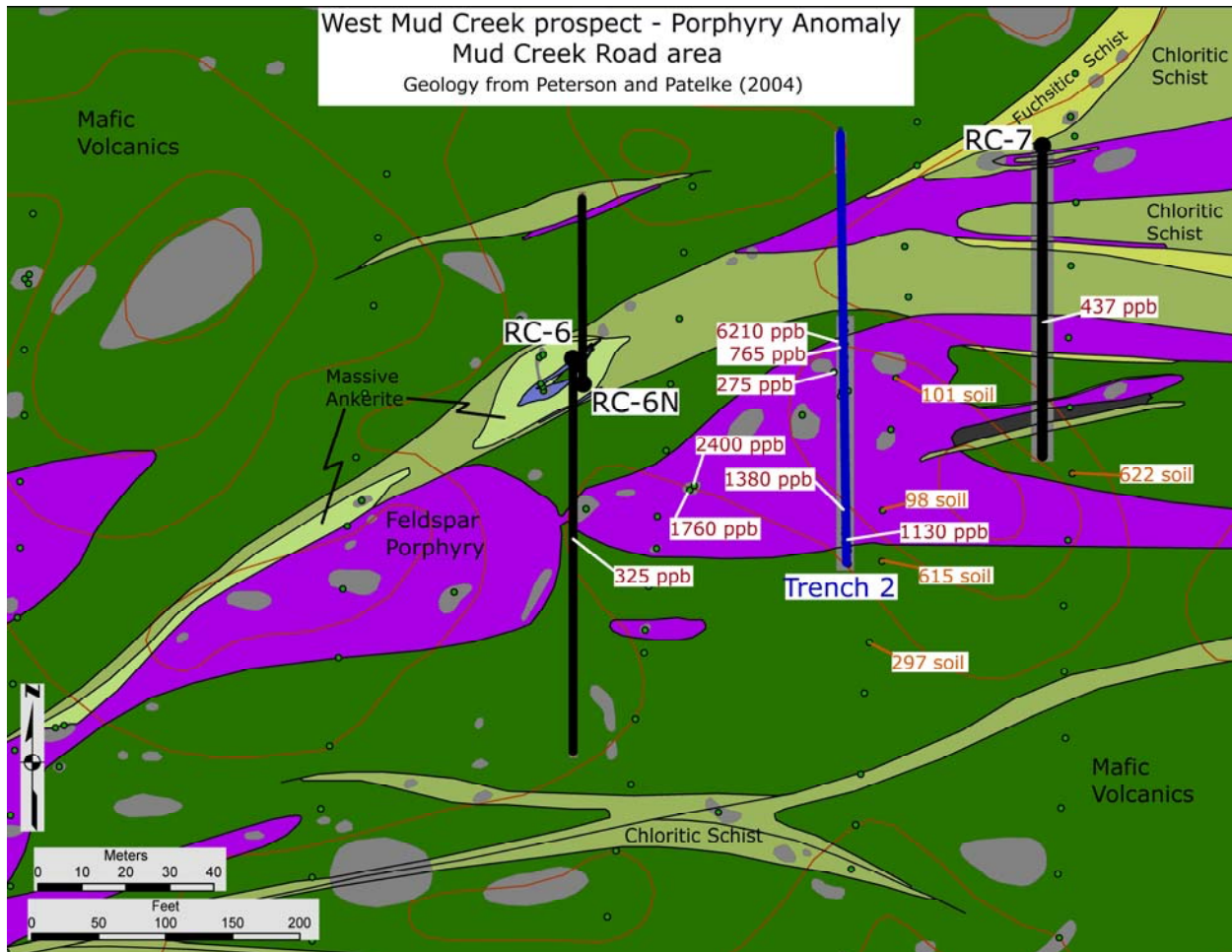


Figure 44. Geology of the “Porphyry Anomaly” in the West Mud Creek prospect, modified from Peterson and Patelke (2004a), showing locations of drill holes, trenches dug by Noranda, and anomalous gold anomalies (>300 ppb Au) in rock and drill core. Also shown, in orange, are >100 ppb Au in soil anomalies associated with the “Porphyry Anomaly.”

in altered porphyry, and 6210 ppb Au from quartz-carbonate-pyrite veins in the contact area near the north end (Fig. 44). Based on the structure seen in Trench 2, Noranda postulated that a definite correlation existed between high Au values and quartz-carbonate±pyrite veins in the feldspar porphyry, especially those with an EW orientation and in the centimeter-scale range.

According to Jongewaard and Suszek (above reference), Noranda’s Trenches 3 and 4 (Fig. 43) were dug along trends perpendicular to a major EW-trending shear zone and exhibited the most intense shearing at their northernmost ends. Alteration was

strongly evident; however, assay results were discouraging. Trenches 12 through 14 (Fig. 43) were dug as a followup to test Chevron’s 1988 “Claw anomaly.” All of the trenches encountered a thick sequence of mafic volcanics, with several thin feldspar porphyry dikes in Trench 12. The rocks in the trenches also exhibited local intense shearing and alteration, but were barren of sulfides and gold mineralization. No further work was conducted by Noranda.

Peterson and Patelke (2004b) noted that the gold mineralization in Noranda’s Trench 2 is generally confined to quartz-pyrite veins in iron-carbonate altered feldspar porphyry and

that the porphyries are generally located adjacent to linear zones of intense strain. Furthermore, they postulated that the porphyries were intruded along these structural breaks during D₂ deformation.

Scanned materials pertaining to gold exploration at the West Mud Creek prospect (WMC) that are included with this report are:

- Chevron_Mud-Creek-rock-assays.pdf = assay results for rock samples collected by Chevron at their WMC;
- Chevron_Mud-Creek-soil.pdf = assay results for soil samples collected by Chevron;
- Noranda_WMC_soil_assays.pdf = assay results for Noranda's soil samples from the West Mud Creek grid (and some from the Section 6/Pac Man prospect to the north);
- Chevron_RC-6-log.pdf = geologic log for Chevron's drill hole RC-6;
- Chevron_RC-6N-log.pdf = geologic log for Chevron's drill hole RC-6N;
- Chevron_RC-7-log.pdf = geologic log for Chevron's drill hole RC-7; and
- Chevron_RC-5-thru-7-assays.pdf = assay results for Chevron drill holes RC-6, RC-6N, and RC-7 (also for RC-5 at the Clearcut prospect).

Mud Lake

As recounted in Severson and Heine (2007), USS was drawn to this general area in 1981 by the fact that a large fault zone, later called the Mud Creek Shear Zone, crossed USS lands in the SE corner of Section 5 and SW corner of Section 4 (T.62N., R.14W.). Mapping and geophysical surveys were completed by USS in rapid fashion, and, as the area seemed uninteresting, the field crews moved on to other USS lands located elsewhere. At the time, the significance of the

shearing and green mica in an outcrop along the Mud Creek road was not recognized.

Around 1983, Kerr McGee picked up lands toward the east of the USS investigations along the fault scarp positioned on the southern edge of the Mud Creek Shear Zone. As this area (Sections 2 and 3, T.62N., R.14W.) encompasses Mud Lake, it was appropriately called the Mud Lake prospect (Fig. 45). An undated memorandum by William Ulland, on file at the MDNR, states that Kerr McGee found ankerite-sericite-silicification±fuchsite alteration along the fault scarp. After conducting geophysical surveys, Kerr McGee dug six shallow trenches (Fig. 45) along the fault scarp and collected composite and grab samples from the trenches in 1986. The results of this sampling were singularly dead with respect to gold. Kerr McGee drilled three holes in December of 1986 in order to test geophysical conductors. Sheared zones, often with graphite, were intersected in all three holes; fuchsite is reported in the log for a shear zone in hole 3-1. The highest assay was from a two-foot-thick zone in a porphyry (1,330 ppb Au) in hole 3-2. Outside of this spot anomaly, the assay results indicate that some consecutive intervals showed some weak gold mineralization, e.g., three consecutive intervals in the mid-500 ppb range in hole 3-2.

In 1987, Kerr McGee collected a series of outcrop samples on a grid-wide basis and found anomalous gold (240-640 ppb Au) from several outcrops in a spatially-restricted area near hole 3-2 (Fig. 45). Two more holes (3-3 and 3-4) were drilled in 1987 and more shear zones were intersected, as well as a seven-foot-thick breccia zone in hole 3-4 that showed some weak gold enrichment (up to 380 ppb Au). The highest gold assay from this second round of drilling was 550 ppb Au associated with a carbonate-sericite schist in hole 3-3. Overall, both drilling campaigns showed that localized gold enrichment took place in subsidiary shears and breccia zones

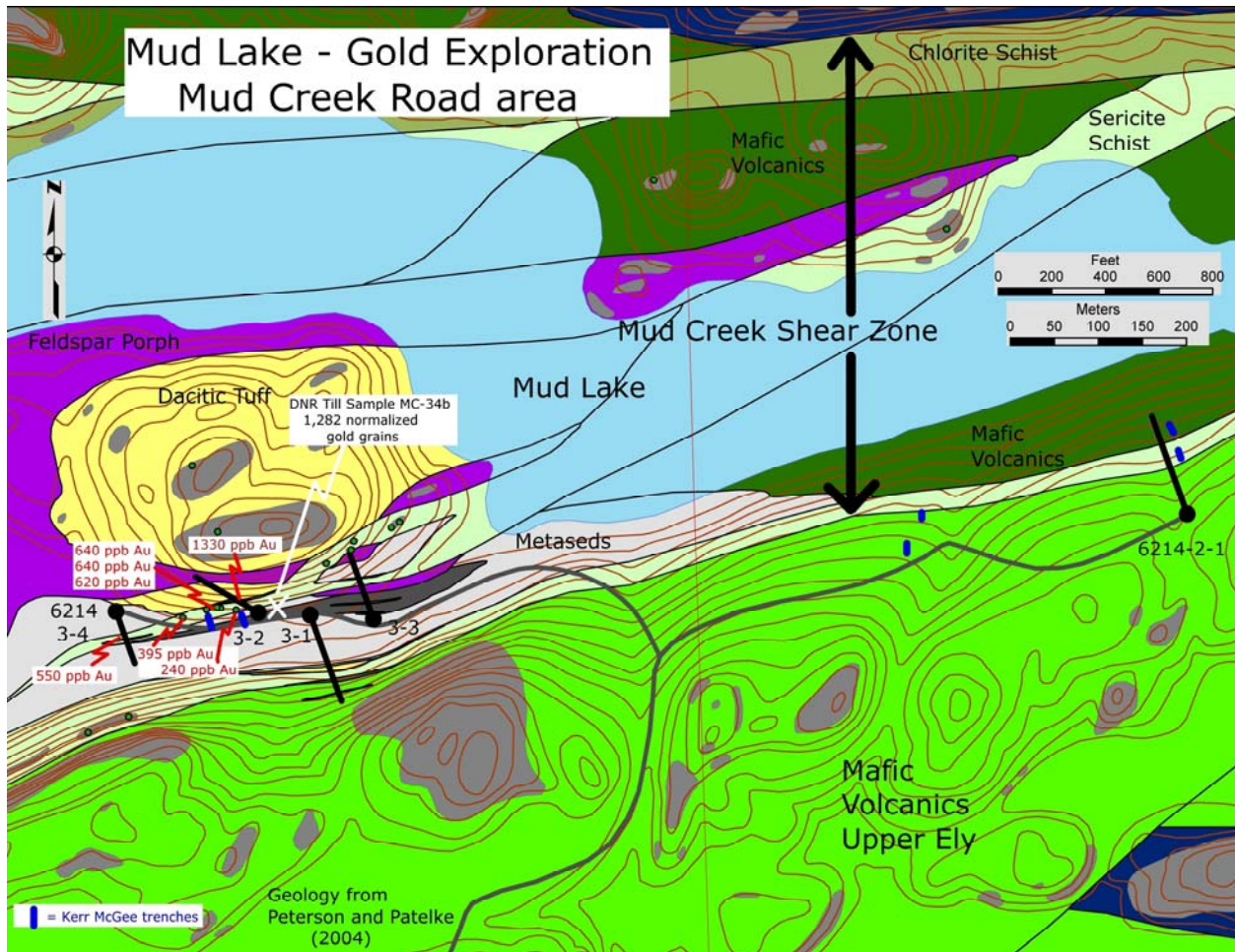


Figure 45. Geology of the Mud Lake prospect (modified from Peterson and Patelke, 2004a) showing locations of trenches (blue), drill holes, and anomalous gold values (>500 ppb Au in drill holes and >200 ppb in outcrops).

related to splays off the southern edge of the Mud Creek Shear Zone, but no economic concentrations of gold were intersected.

More recently, a basal till sample was collected from this site by the MDNR (Dahl, 2005). Of the 32 basal till samples analyzed in this orientation survey, the highest sample was from the Mud Lake area (see Fig. 45 for location) wherein the sample (MC-34b) contained 1,282 normalized gold grains (641 raw gold grains), of which 1,264 grains were pristine.

Scanned materials pertaining to the Mud Lake prospect that are included with this report are:

- [Kerr_McGee_MUD_LAKE_TRENCH_ASSAYS.pdf](#) = assay results for the six trenches that Kerr McGee dug at Mud Lake;
- [Kerr_McGee_MUD_LAKE_OTC_ASSAYS.pdf](#) = assay results for outcrop samples at Mud Lake; and
- [Kerr_McGee_6214_\[#\]_\[#\]_log.pdf](#) = geologic logs, with associated assay results, for Kerr McGee drill holes (6214-2-1, 6214-3-1, 6214-3-2, 6214-3-3, and 6214-3-4).

North American Mine

Kerr McGee conducted a cursory exploration survey of the North American Mine (Section 4, T.61N., R.15W.) in 1987. These activities were probably based on the historical context that this mine could have once been a possible gold “mine.” Kerr McGee established a grid and conducted geophysical surveys. They also dug and sampled rock from at least six shallow trenches (Fig. 46). Basal till samples were also collected from the trenches. In the end, one outcrop/float sample from one trench ran 200 ppb Au, and one basal till sample from

another trench ran 215 ppb Au (Fig. 46). No further work appears to have been conducted.

Scanned materials pertaining to gold exploration at the North American Mine that are included with this report are:

- Kerr_McGee_NORTH_AMERICAN_MINE_TRENCH_ASSAYS.pdf = assay results from outcrop and float samples collected from the six Kerr McGee trenches; and
- Kerr_McGee_NoAmerican_trench_assays_basal_till.pdf = assay results from basal till samples collected from the Kerr McGee trenches at the North American Mine.

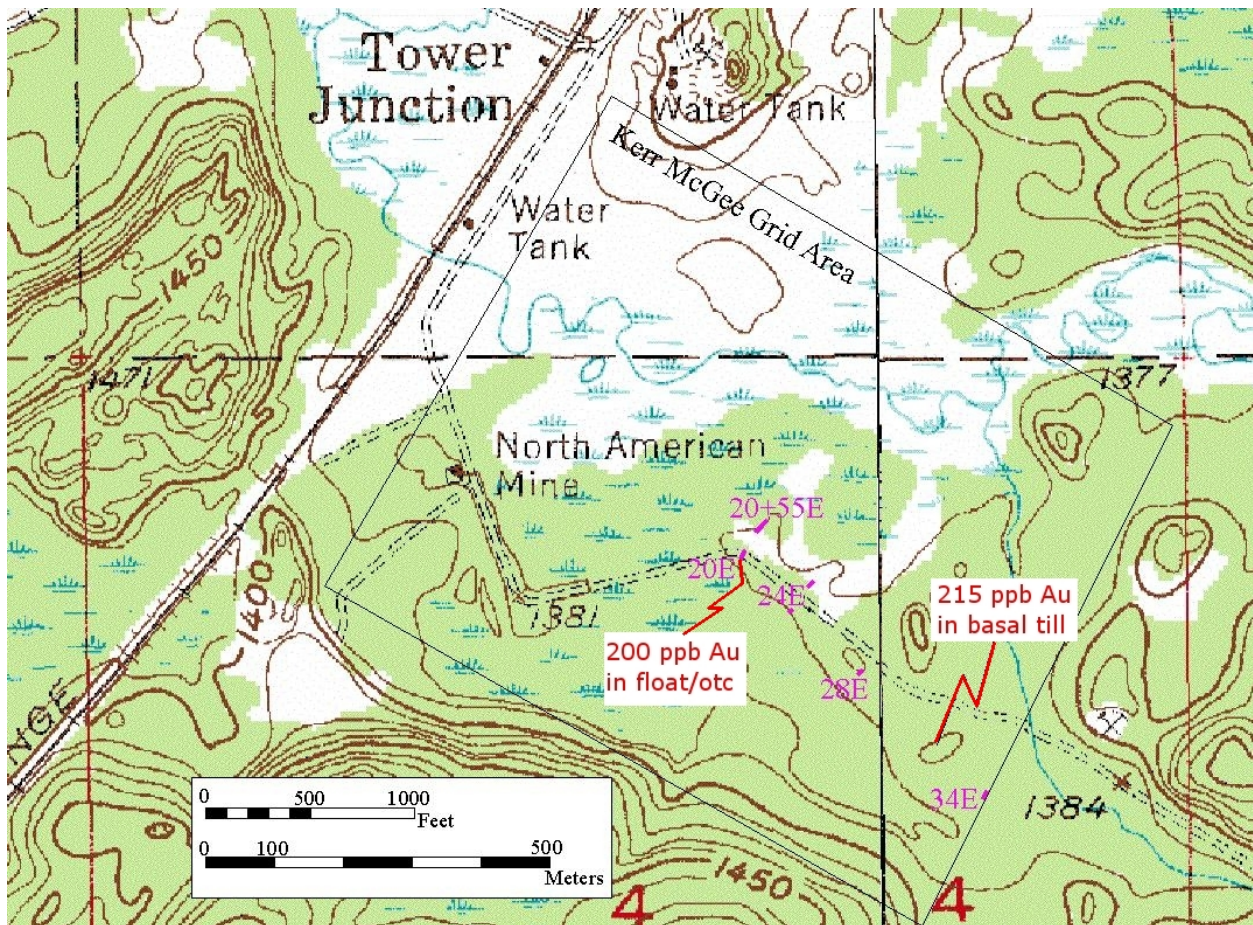


Figure 46. Map portraying the locations of workings at the North American Mine and 6 trenches (magenta numbered areas) that were dug by Kerr McGee. Anomalous gold sample sites are indicated accordingly.

McComber Mine

The McComber Mine (Section 14, T.62N., R.14W. – Fig. 47) was briefly examined for its gold potential by two companies during joint venture campaigns with Tamarack/American Shield. According to an undated memorandum by William Ulland (on file at the MDNR), Ulland found a large float piece of pyritic and veined iron-formation to the north of the old mine area that ran 0.38 opt gold – resampling of this piece did not return this assay value. This same memo mentions that the MDNR did some sampling of material from the old McComber dump piles on Armstrong Lake and reported anomalous gold values of up to 900 ppb (Vadis and Meineke, 1979).

A grid was established on the property by Nicor in 1982, and a geochemical soil survey

found a gold/base metal anomaly (Fig. 47) near the Ulland sample. In 1990, Noranda conducted a cursory examination of the Nicor data, collected two iron-formation samples with discouraging gold assay results, and subsequently dropped the property.

Scanned materials pertaining to gold exploration at the McComber Mine area that are included with this report are:

- Nicor_McComber_grid.pdf = crude map showing location of Nicor’s grid lines and location of their gold/base metal soil anomaly;
- Nicor_McComber_soil_results_map.pdf = detailed grid map showing soil sample analytical results for Au, Cu, Pb, and Zn;
- Noranda_McComber_sample_map.pdf = reconnaissance outcrop map and location of two samples collected by Noranda;



Figure 47. McComber Mine area showing locations of old drill holes (W.S. Moore and Pickands Mather) and locations of gold/base metal anomalies (green dots) found in the Nicor soil sampling survey.

- Noranda_McComber_assays.pdf = assay results for the two samples collected by Noranda at McComber; and
- M_[#]_log.pdf = geologic logs for holes drilled at the McComber Mine by W.S. Moore (M-1, M-2, M-3, and M-4).

Section 30 Mine

USS made a cursory examination of the Section 30 Mine (T.63N., R.11W.) after noting the presence of high tungsten values in soil that had been recently released in a report by Grimes and Alminas (1981). According to a memorandum by William Ulland (September, 1989), Ulland collected three samples of sulfide-rich iron-formation from a dump pile in 1982 that ran 100-300 ppb Au. Ulland also collected core samples from Jones and Laughlin drill holes (Fig. 13) that ran up to 1,000 ppb Au (assay results not confirmed in the files at the MDNR). These two actions lead to sampling of iron-formation at nearby Garden Lake that returned highly encouraging assay results, and future exploration efforts were shifted to Garden Lake.

Garden Lake Showing

According to 1986 report by Peter Giangrande for American Shield (on file at the MDNR), William Ulland sampled, in 1982, a 40-foot-long roadcut of iron-formation on the south side of the Fernberg Trail in the Garden Lake area (Section 20, T.63N., R.11W.). Four samples from this zone, referred to as the CS zone (Fig. 48), averaged >2,000 ppb Au, with a maximum of 5,180 ppb Au. Another area, located to the east along the trend of the informally-named Fernberg Trail fault (E anomaly in Section 22 – Fig. 48), also returned high gold values with a maximum of 4,112 ppb Au.

Giangrande (above reference) further mentions that he collected eight channel

samples from the CS anomaly (in 1986) that averaged over 1,000 ppb Au with a maximum of 2,320 ppb Au. Giangrande also collected nine samples from the E anomaly, three of which contained >200 ppb Au with a maximum of 460 ppb Au. Lastly, according to Giangrande, a list of mineralized showings in the area was obtained from a local prospector – Joe Pucel (also owner of the IGA grocery store and once mayor of Ely). Several of these showings were sampled and assayed with highly discouraging results.

Chevron picked up the property and conducted exploration activities in 1987. They re-sampled the CS anomaly and, out of 15 samples, 5 samples were found to contain gold in excess of 500 ppb Au with a maximum of 1,910 ppb Au (Ulland files at the NRRI). A grid was established (location unknown), and both soil and rock samples were collected for assay during 1987-88 (Ulland files at the NRRI). Furthermore, Chevron found iron-formation float with 2,760 ppb Au about “... 4,000 feet on strike with the CS outcrop” (Ulland files at the NRRI – exact location unknown). Chevron attempted to negotiate a state lease on the lands covering the CS and E anomalies. However, as this area lies within the BWCA watershed, their request was turned down by the MDNR, and no further activities were conducted (Ulland files at the NRRI).

The only scanned material pertaining to the Garden Lake showing that is included with this report is the 1986 report by Peter Giangrande. A detailed description of the CS anomaly roadcut is presented in Peterson and Jirsa (1999b).

Pike Bay

This property, located to the west of Tower (Section 6, T.61N., R.15W. – Fig. 16), was drilled by Kerr McGee, presumably for its VMS potential, in 1985. The hole intersected mostly dacitic volcanic rocks with

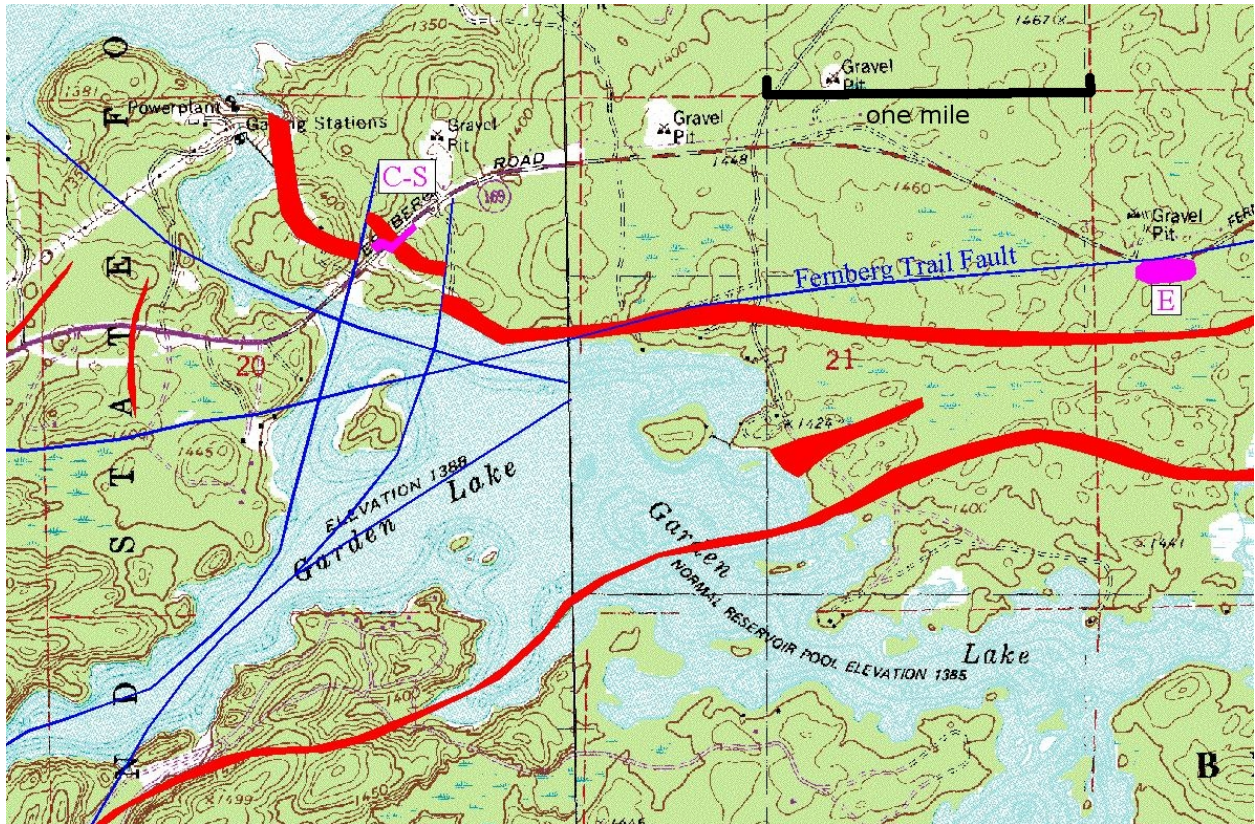


Figure 48. Simplified geology of the Garden Lake area showing the location of iron-formation lenses (red) and faults (blue) as gleaned from geologic maps by Green et al. (1966 – right side of figure) and Green and Schulz (1982 – left side of figure). The general locations of the CS and E anomalies are shown in magenta.

three graphite-bearing zones. The assay results are not interesting. For the sake of posterity, the following scanned materials are included in this report:

- Kerr_McGee_6115_1_log.pdf = geologic log of Kerr McGee drill hole 6115-6-1; and
- Kerr_McGee_6115_1_assays.pdf = assays for hole 6115-6-1.

West Two Rivers (6115-14-1 hole)

This property, located to the south of Tower (Section 14, T.61N., R.15W. – Fig. 16), was drilled by Kerr McGee, presumably for its VMS potential, in 1987. The hole

intersected interbedded basalt, tuff, and sediments with graphite-bearing zones. The assay results are not interesting. For the sake of posterity, the following scanned materials are included in this report:

- 6115_14_1_log.pdf = geologic log of Kerr McGee drill hole 6115-14-1; and
- 6115_14_1_ASSAYS.pdf = assays for hole 6115-14-1.

Tower

This property, located to the southwest of Tower (Section 12, T.61N., R.16W. – Fig. 16), was looked at by Kerr McGee. Outside of geophysical surveys, Kerr McGee sampled a

hole (26517) previously drilled by USS in this area (called the Moberg prospect by USS and described in Severson and Heine, 2007).

Nicholson Lake/Clear Lake

The Clear Lake area (Section 11, T.62N., R.14W. – Fig. 16) had originally been explored by Humble Oil/Exxon, who drilled three holes (CL-1, CL-2, and CL-3) in search of VMS deposits in 1970-71. In the 1980s, Kerr McGee and BHP explored this same area, renamed the Nicholson Lake area (also including sections 2, 3, and 10). According to a 1990 BHP internal report (as discussed in Severson and Heine, 2007), the following conclusions were made regarding the Nicholson Lake Area. All three of the CL-holes intersected iron-formation with variable amounts of sulfides. BHP re-assayed the sulfide-rich zones in these holes, but none yielded any anomalous gold values (all were <100 ppb Au). Slightly anomalous gold values in soil samples were found in the central part of the grid. The gold anomalies appeared to line up in a zone between two thick iron-formations, but were not associated with any strong IP anomalies. Overall, there was a general lack of alteration in the area, no well-developed structures, and the soil anomalies appeared to be related, in part, to biogenic effects along the margins of swamps.

Eagles Nest Shear

The Eagles Nest Shear prospect (Sections 22, 23, and 24, T.62N., R.14W.) is only one of two gold prospects situated in the Lower member of the Ely Greenstone. Meager records turned in to the MDNR suggest that Newmont found several samples with anomalous gold along the trend of a northeast-trending D₃ fault (Fig. 49). Geophysical surveys were conducted, and various targets were defined. Five holes were drilled by

Newmont in 1988 (holes EN-1 through EN-5) to target the auriferous fault and an east-west trending iron-formation. Rock types intersected in the holes consisted of mostly basalt, tuff, and intrusive quartz-feldspar porphyry. Drill hole EN-4, drilled well to the southeast, intersected an entirely different rock package consisting of interbedded tuff and sulfide-facies iron-formation with several intervals that returned assays of >100 ppb Au (maximum of 187 ppb Au); chalcopyrite was noted in the iron-formation at 406.4-413.7 feet. As only a maximum of 490 ppb Au was found associated with the northeast-trending fault, in a sheared basalt from hole EN-5, exploration activities shifted elsewhere on the prospect. Newmont drilled the property again in 1989. Hole EN-8 intersected mostly quartz-feldspar porphyry with no anomalous gold in the few intervals that were sampled. Holes EN-6 and EN-7 were drilled into the sulfide-facies iron-formation in the vicinity of EN-4. Three intervals with >300 ppb Au were intersected in hole EN-6; hole EN-7 appears to have not been sampled and assayed by Newmont. However, the lack of consistent and weakly mineralized gold zones at this property and elsewhere in the western Vermilion District eventually lead to abandonment of this prospect as exploration activity was shifted to the Virginia Horn area (see later discussions in this report).

Hudak and Morton (1999) relogged some of the holes from the Eagles Nest area and found the presence of up to 4 meters of VMS mineralization in hole EN-7 at 431-437 feet. Hovis (2001) also indicates the presence of VMS mineralization in nearby hole EN-6.

The MNDNR conducted a re-evaluation of the core from hole EN-5 in 2008-2009 (Frey and Hanson, 2009). Through the use of a hand-held, semi-quantitative XRF, they found a new gold zone in the hole at 267.1 feet with 4 ppm XRF gold.

Scanned materials pertaining to gold exploration at the Eagles Nest shear/prospect that are included with this report are:

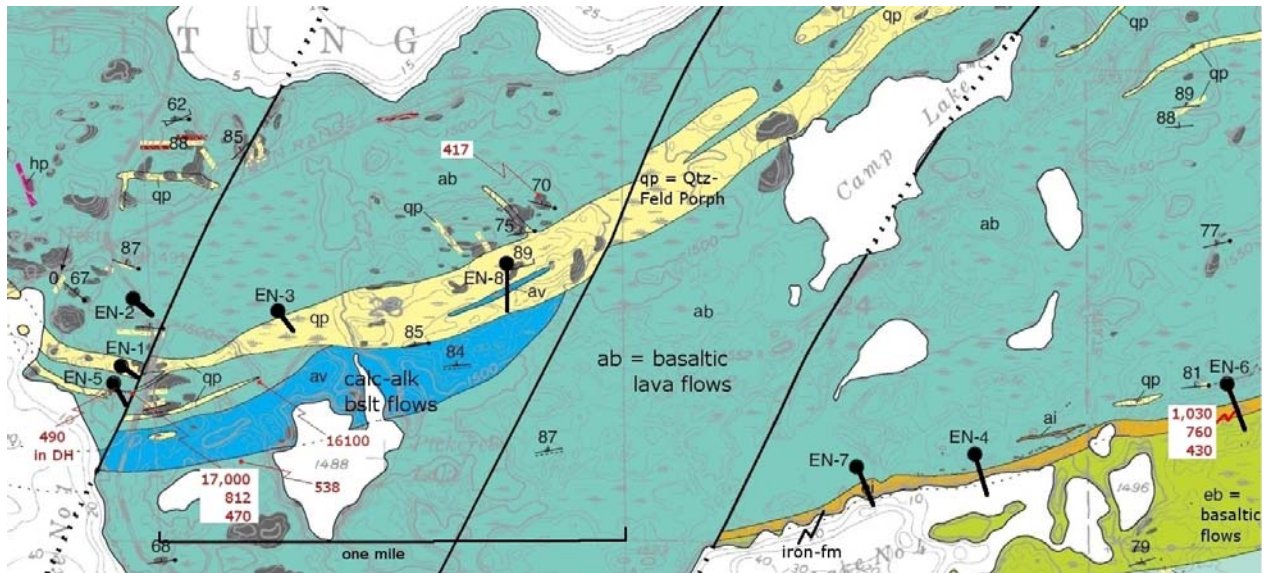


Figure 49. Geology of the Eagles Nest Shear prospect, modified from Jirsa et al. (2001), showing distribution of Newmont's drill holes. Anomalous gold values (all in ppb Au) are shown for outcrops and drill holes using a threshold of >300 ppb Au.

- Newmont_EAGLES_NEST_OUTCROP_ASSAYS.pdf = geochemistry results for outcrops sampled by Newmont in the Eagles Nest Shear prospect (UTMs are NAD-27); and
- Newmont_EN_[#]_log.pdf = geologic log, and posted gold assay results, for the appropriately-numbered Newmont holes (EN-1 through EN-8) at the Eagles Nest Shear prospect; note that there are no known assay results for hole EN-7.

Murray Shear

Gold mineralization along a portion of the Murray Shear zone had been known since the late 1970s. Cedric Iverson, the exploration manager for USS, had surmised from talks with Joe Pucel, a local prospector and Ely grocery store owner, that Joe had found a quartz vein with gold somewhere along the railroad grade at the Murray crossing (Fig. 50). According to Johnson (2009), the Murray Vein is at the southern end of an outcrop (561,258E; 5,296,174N) on the south side of the old railroad grade. The vein is 20 cm thick

and can be traced for 3 meters along a 275°/86°N trend. Gold values up to 8,500 ppb Au have been obtained from the Murray vein. Anomalous gold values (>300 ppb Au) in both outcrop and drill hole are posted in Figure 50.

Peterson and Patelke (2003) identified the Murray Shear Zone as an east-west trending, dextral, wedge-shaped panel. They divided the Murray region into four main structural domains that include: 1) the Murray Shear Zone; 2) the Mine Trend Shear Zone; 3) the Linking Zone; and 4) the Collapsed Hinge Zone.

Newmont Mining Company conducted explorations in the area of the Murray crossing in what they called the Murray prospect (Sections 30, 31, and 32, T.62N., R.14W., and Section 25, T.62N., R.15W.). After obtaining encouraging results from reconnaissance mapping and sampling along the northern edge of the Murray Shear, Newmont established a grid and conducted explorations that concentrated on shear-hosted, lode gold mineralization. Exploration for gold culminated in the drilling of eight holes (FM-1 through FM-8) in 1988-1989

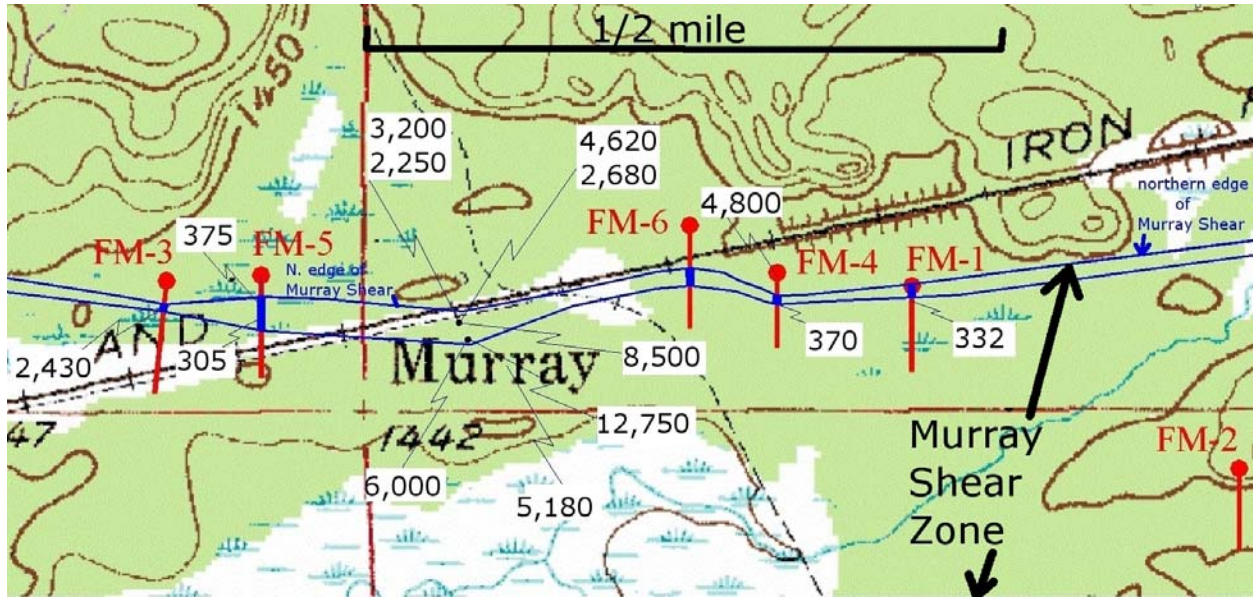


Figure 50. Distribution of drill holes and anomalous gold values (in ppb) for outcrop and drill hole samples at Newmont’s Murray prospect (using a threshold of >300 ppb Au). Posted gold values from outcrop are from Peterson and Jirsa (1999b). Only the northern edge of the Murray Shear Zone is shown. Drill hole intervals that are logged by Newmont as sheared rocks (chlorite-ankerite-sericite±garnet±pyrite schist) within the Murray Shear Zone are shown in blue. Drill holes FM-7 and FM-8 are located to the southeast and outside the area shown in this figure.

along the northern edge of the Murray Shear Zone. While some anomalous gold values were found in subsidiary shear zones intersected in the holes (outlined in blue in Fig. 50), the gold values were spotty overall, and no consistent mineralized zone was defined.

According to Peterson and Jirsa (1999b) mineralization associated with the Murray Shear Zone consists of quartz-carbonate-pyrite-galena-tetrahedrite veins in strongly sheared and carbonatized rocks of presumed mafic protolith associated with the lower member of the Ely Greenstone. Spikes in gold mineralization are closely correlated with high levels of pyritization. Johnson (2009) states that the gold mineralization exposed at the surface parallels the orientations of linear structures that he measured and compares well with linear structures measured in the vicinity by Peterson and Patelke (2003).

Larson (2004) conducted a basal till sampling campaign in the western Vermilion

District. Two of Larson’s till samples collected down-ice of the Murray shear zone contained anomalous gold as well as elevated lead and arsenic values.

The MNDNR conducted a re-evaluation of hole FM-5 from the Murray prospect in 2008-2009 (Frey and Hanson, 2009). With the use of a hand-held, semi-quantitative XRF, they found 3 ppm XRF Au at 94.1 feet. Overall, Frey and Hanson (2009) found two previously unknown zones with measurable gold, through use of the hand-held XRF, that were confirmed by assay results of: 662 ppb Au at 68-69 feet; and 1,830 ppb Au at 69-70 feet. Frey and Hanson noted that the gold is generally associated with elevated values of mercury, molybdenum, silver, and modest chromium (fuchsite).

Scanned materials pertaining to gold exploration at the Murray shear/prospect that are included with this report are:

- Newmont_FM_[#]_log.pdf = geologic logs, with posted gold assay results, for

the appropriately-numbered Newmont holes (FM-1 through FM-8) at their Murray Shear prospect.

Conclusions for western Vermilion District

Out of the 23 gold prospects that were extensively drilled and/or trenched, the best prospects that returned the highest gold values, and collectively the most mineralized zones, are located in the area bordered by the Vermilion Fault and Mud Creek Shear zone. Some of these prospects returned outcrop and drill hole assay values in the 10s of ppms. Taken collectively, the more highly anomalous gold values in these particular prospects show an overall increase toward the Vermilion Fault. Noranda did the most extensive work and identified that rheological differences, especially associated with brecciated iron-formation contacts, were the most important gold repository hosts. Shear zone-hosted gold was also explored in some detail at Spaulding Bay and the Murray Shear Zone. However, a minable gold deposit was never found. One obvious reason for this lack of success is that most of the targets, with a few exceptions, were tested by only a few drill holes. Secondly, some of the earliest companies that conducted drilling activities were looking for exceptionally large Hemlo-like deposits that, at the time, were believed to be stratabound. Thirdly, most of the drill holes were positioned on the basis of geophysics, and in the end graphitic conductors, but relatively no gold, were commonly intersected in the holes. And lastly, detailed structural analyses of **both** the outcrops and drill core were not collectively used to target any follow-up drilling activities.

Furthermore, glacial till sampling campaigns have consistently shown that some of the highest gold values were derived from

rock to the north, e.g., closer to the Vermilion Fault. Auriferous float is mentioned at: Raspberry; Dead Canary; Railroad Cut; Section 6/Pac Man Pond (NE Corner); Section 5; Clearcut; and McComber. Again, these glacial float samples generally have extremely high gold values and are situated close to the Vermilion Fault, suggesting that proximity to the fault may be important. To date, the Vermilion Fault itself, and potentially the more brittle granitic rocks located to the immediate north of the fault, have yet to be tested by drilling. (Unfortunately, both are very close to the BWCA Wilderness.) Granitic rocks in close proximity to a major fault zone (Marmion Fault) have been shown to host a low-grade gold deposit at the Hammond Reef deposit near Atikokan, Ontario (Osiko Draft Project Description @ [www.osiko.com/pdfs/10-1118-0020_Project_Description_Text\[8AP R11\].pdf](http://www.osiko.com/pdfs/10-1118-0020_Project_Description_Text[8AP R11].pdf)), and a similar relationship may apply to the Vermilion Fault area.

Rainy River Gold acquired most of the old Tamarack-held lands a few years ago. It has been rumored that they conducted a basal till survey, but no results have as yet been made publically-available by the MDNR (as of the end of 2011).

Gold Exploration in the Cook Area

The area to the immediate west of the western Vermilion District also received some exploration activities in the 1980s. The geology of this area is similar to the Vermilion District, with the main difference that outcrops are scarcer and exploration was almost totally dependent on geophysics. As a result, fewer holes were drilled, and any discussions relative to gold assay values are restricted to those drill holes. Figure 51 shows areas where ground geophysical surveys were conducted. Only areas where drilling or trenching took place are discussed below.

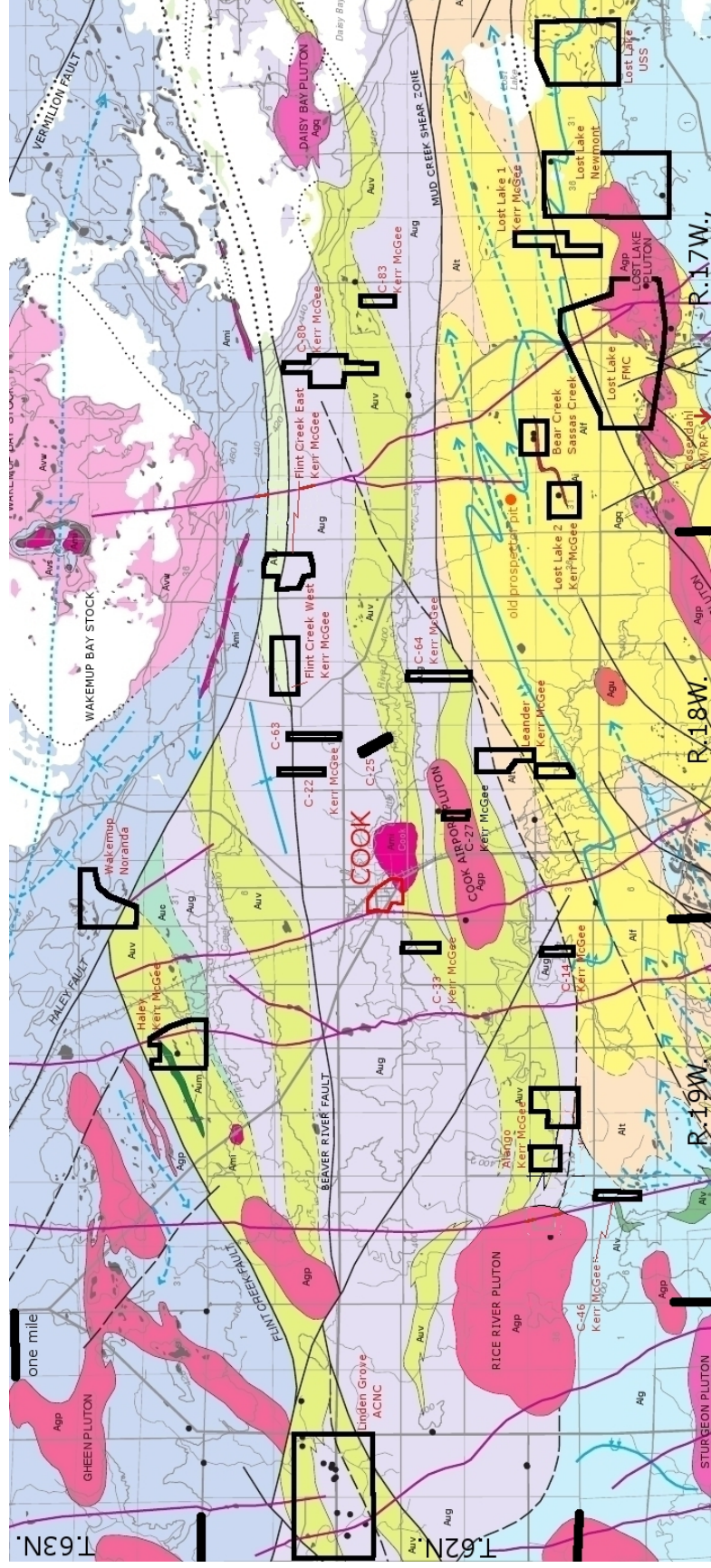


Figure 51. Geology of the Cook area, modified from Jirsa and Boerboom (2003a), showing areas where known geophysical surveys were conducted (black boxes). Labels for the areas include the name of the grid followed by the respective company that conducted the explorations. Some grids are only generally outlined. The Rosendahl grid, explored by Kerr McGee and Rhude and Fryberger, is located a few miles south of the area shown in this figure.

Sassas Creek – Bear Creek

Bear Creek flew a geophysical survey in the Cook area during the 1960s in search of VMS deposits. In 1970, they drilled two close-spaced holes to intersect a geophysical conductor in the Sassas Creek area (Section 29, T.62N., R.17W. – Fig. 52). Both of these holes (SC-1 and SC-2) intersected an iron-formation lense in the Gafvert Lake felsic sequence. Kerr McGee sampled these holes for gold in 1986 with extremely disappointing results. Scanned materials pertaining to gold exploration at the Sassas Creek area that are included with this report are:

- *Bear_Creek_SC_1_log.pdf* = lithologic log for hole SC-1;
- *Bear_Creek_SC_2_log.pdf* = lithologic log for hole SC-2; and
- *Kerr_McGee_SC_HOLES_ASSAYS.pdf* = assay results for samples collected by Kerr McGee from SC-1 and SC-2.

Lost Lake – USS

As recounted in Severson and Heine (2007), USS also conducted explorations for VMS deposits in the Cook area in the late 1960s. In 1970, USS drilled two holes (26505A and 26505B), located to the south of Lost Lake (Section 5, T.61N., R.16W. – Fig. 52), to intersect a geophysical conductor. These holes intersected tuffaceous rocks of the Gafvert Lake felsic complex that contained brecciated zones, quartz feldspar porphyry, and several zones with interbedded reworked tuffs and argillaceous sediments (some with thin carbonaceous beds). USS did not conduct any further activities as “...Highly conductive overburden hampers further exploration efforts” (USS statement quoted in Severson and Heine, 2007).

The Cook area was explored for gold by Rhude and Fryberger in the mid- to late-1980s. Hole 26505 was located in USS’s storage and was sampled in 1987 with disappointing results. Scanned materials pertaining to gold exploration at the USS Lost Lake area that are included with this report are:

- *R_F_26505A_LOG.pdf* = lithologic log, by Mark Severson, for USS hole 26505A;
- *R_F_26505B_LOG.pdf* = lithologic log, by Mark Severson, for USS hole 26505B; and
- *Rhude_Fryberger_assays_26505.pdf* = assay results for sampled intervals, by Rhude and Fryberger, from holes 26505 A and B.

Lost Lake – Newmont

Newmont conducted limited explorations in the Lost Lake area in an area they referred to as the Little Lost Lake area (Fig. 52). After conducting geophysics, they drilled two holes in the area (LL-1 and LL-2) in 1989. Hole LL-1 intersected a single zone with >10,000 ppb Au (actual interval footage unknown). The second hole, LL-2, did not intersect any intervals with >10 ppb Au. No further exploration activities were conducted due to potential issues dealing with wetland destruction that were encountered during the drilling of the two holes.

Years later, Peterson (2001) pointed out the similarity in scale and geology between the Lost Lake Pluton and a late alkalic intrusion that hosts the deposits of the Kirkland Lake gold camp (Peterson, 2001, Fig. 6.7 on p. 132). He further pointed out that the Lost Lake Pluton is crossed by a 2nd order D₂ shear that could potentially host gold mineralization.

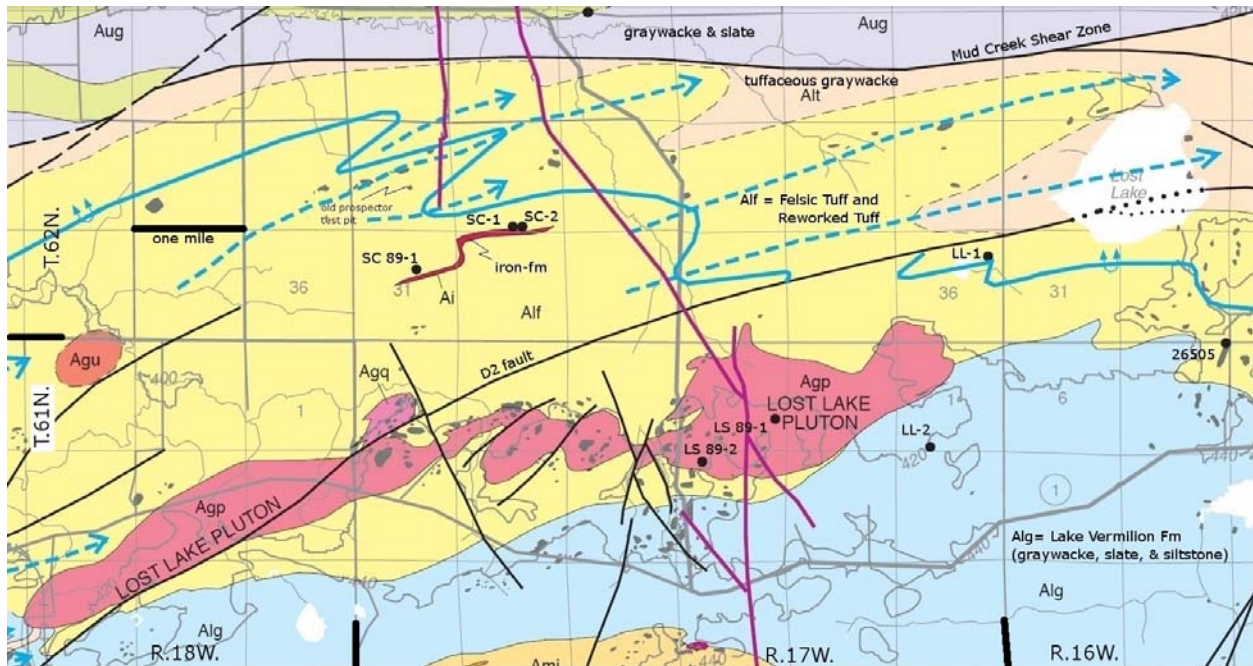


Figure 52. Geology of a portion of the Cook area, in the vicinity of Lost Lake (modified from Jirsa and Boerboom, 2003a), showing the location of holes drilled by mineral exploration companies.

Scanned materials pertaining to gold exploration at Newmont’s Little Lost Lake area that are included with this report are:

- Newmont_LL_1_log.pdf = lithologic log for Newmont hole LL-1;
- Newmont_LL_1_ASSAYS.pdf = assay results for intervals (footages unknown) sampled from hole LL-1;
- Newmont_LL_2_log.pdf = lithologic log for Newmont hole LL-2; and
- Newmont_LL_2_ASSAYS.pdf = assay results for hole LL-2.

felsic complex with veins and shear zones. Gold assay results were discouraging with no intervals assaying over detection limits. Scanned materials pertaining to gold exploration at the Kerr McGee Lost Lake 2 area included with this report are:

- FMC_SC_89_1_LOG.pdf = lithologic log for FMC hole SC-89-1; and
- FMC_SC_89_1_ASSAYS.pdf = assay results for hole SC-89-1.

Haley – Kerr McGee

Lost Lake 2 – Kerr McGee

Kerr McGee conducted ground geophysics near the Sassas Creek drill holes in an area they called the Lost Lake 2 grid (Section 31, T.62N., R.17W. – Fig. 51). Several years later, FMC worked on the same property in a joint venture with Kerr McGee. FMC drilled one hole (SC-89-1; Fig. 52) in 1989 that intersected felsic tuffs of the Gafvert Lake

The Haley grid area (Section 35, T.63.N., R.19W. – Fig. 51) shows a similar history as the Lost Lake 2 area. Kerr McGee conducted the initial geophysical surveys followed by drilling of the property by FMC in 1989. The core for this hole was turned over to the MDNR; however, there are no preserved records of the lithologic log or assay results. The only scanned material pertaining to gold exploration at the Haley area included with

this report is: FMC_H_89_1_abandonment.pdf = abandonment report for FMC hole H-89-1.

Flint Creek West – Kerr McGee

The Flint Creek area (Section 3, T.62N., R.18W. – Fig. 51) was first explored by USS in the early 1970s and was called the “island in the swamp” due to high ground (in the SW of the SE of Section 3) that was completely surrounded by swamp. According to Severson and Heine (2007), USS wrote a short field report concerning two small test pits into “limestone” and the results of a dithizone field test survey that is now on file at the MDNR. This site was visited by the author in 1979 and one small/heavily-vegetated test pit into highly altered rock could still be found. Thin veinlets were discovered in the test pit exposure that appeared to have minute purple cubic minerals that were assumed to be fluorite.

Acting on this knowledge, and due to the presence of airborne conductors in the area, Kerr McGee also conducted explorations in same general area that they called the Flint Creek West grid. Only geophysical results were turned over to the MDNR by Kerr McGee. However, it has recently been discovered (Bob Roe, pers. comm., Sept. 28, 2011) that Kerr McGee also dug six shallow test pits on the “island in the swamp” in 1986 to better expose the rock. Gold assay results must have been low, as no more work was performed.

Lost Lake – FMC

There are few records pertaining to the exploration activities of FMC in their Lost Lake area (Section 3, T.61N., R.17W. – Fig. 52). All that is known is that they ran a few geophysical lines (or obtained geophysical information via Kerr McGee) and drilled two

holes (LS-89-1 and LS-89-2) in 1989. Both holes intersected syenitic rocks of the Lost Lake Pluton, but only a few of the sampled intervals contained gold barely above detection limits. Scanned materials pertaining to gold exploration at FMC’s Lost Lake area included with this report are:

- FMC_LS_89_1_log.pdf = lithologic log for hole LS-89-1;
- FMC_LS_89_1_sample_list.pdf = list of sample numbers, with appropriate footages, for intervals sampled from hole LS-89-1;
- FMC_LS_89_1_assays.pdf = assay results for hole LS-89-1;
- FMC_LS_89_2_log.pdf = lithologic log for hole LS-89-2;
- FMC_LS_89_2_sample_list.pdf = list of sample numbers, with appropriate footages, for intervals sampled from hole LS-89-2; and
- FMC_LS_89_2_assays.pdf = assay results for hole LS-89-2.

Rosendahl Grid – Rhude and Fryberger

Kerr McGee first established a grid and conducted geophysical surveys in an area referred to as the Rosendahl grid (Section 20, T.61N., R.17W.). Their geophysical data eventually came under the auspices of Rhude and Fryberger, who conducted detailed geologic mapping in 1987. Intrigued by the coincidence of a magnetic high associated with a weak electromagnetic conductor and a clustering of weakly anomalous soil anomalies, Rhude and Fryberger dug a trench in late 1987 (Fig. 53). The trench exposed mafic volcanics with a thin iron-formation lense. Several channel and grab samples were collected, but only a maximum of 110 ppb Au was found in a grab sample. The trench was reclaimed, and the property was subsequently dropped.

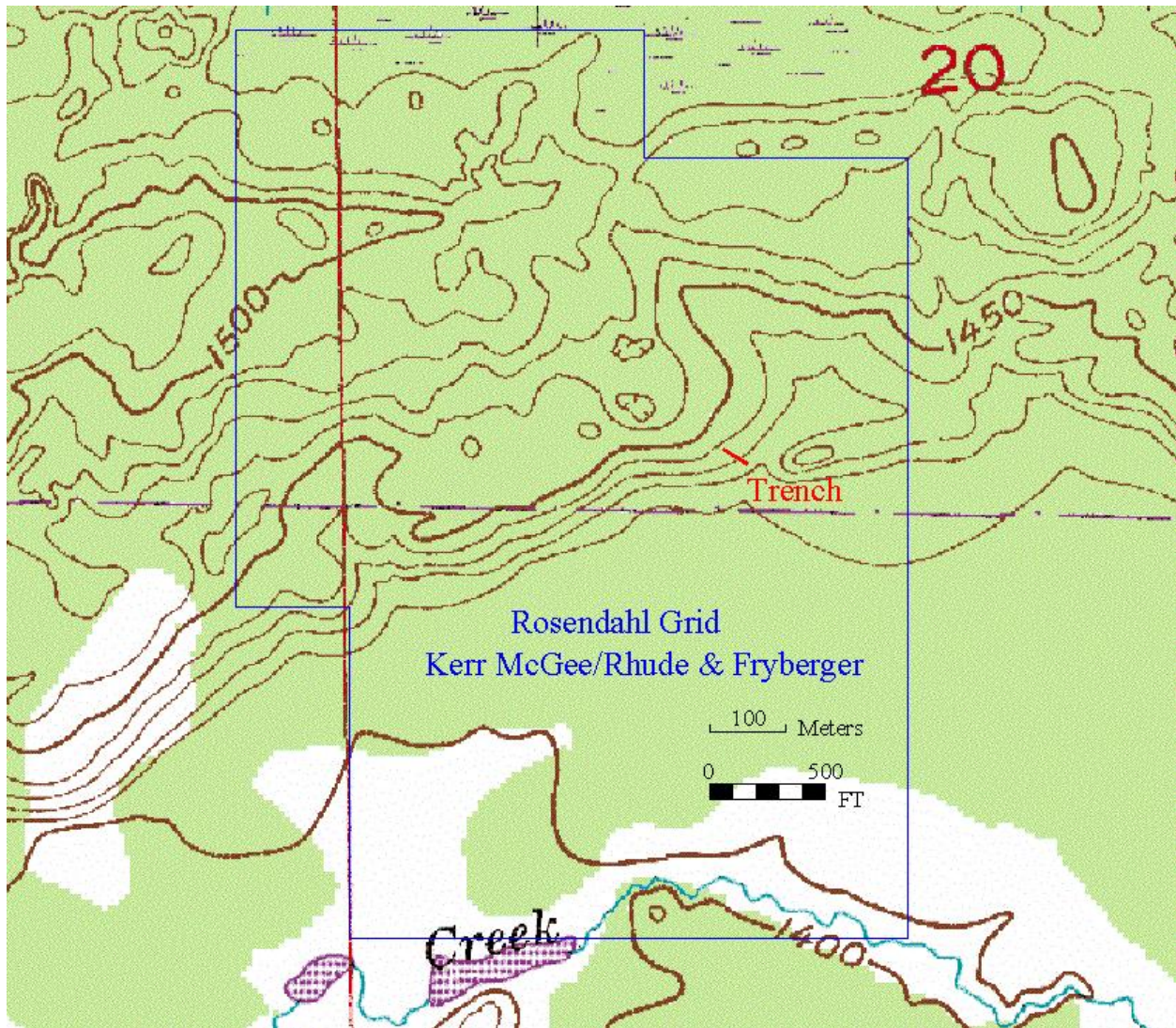


Figure 53. Map of the Rosendahl grid area showing approximate boundary of the Kerr McGee geophysical survey and location of the trench dug by Rhude and Fryberger.

Scanned materials pertaining to gold exploration at the Rosendahl Grid area included with this report are:

- Rosendahl_Geol_grid.pdf = geologic and grid map of the Rosendahl area produced by Rhude and Fryberger;
- Rosendahl_trench_sample_map.pdf = map showing location of channel and grab samples collected by Rhude and Fryberger from their trench on line 16+00E, ~2+00N; and
- ROSENDAHL_TRENCH_ASSAYS.pdf = assay results collected from the Rosendahl trench.

Linden Grove – ACNC

An overburden drilling program conducted by the MDNR (Martin et al., 1988) returned anomalous concentrations of gold and arsenopyrite within basal till (Rainy Lobe gravels) in the Linden Grove area (Fig. 54).

Furthermore, out of the 67 holes drilled in this MDNR program, the three most anomalous holes occur within three miles of the town of Linden Grove (Mornis, 1991). Hole 20801 was found to contain the most with 63 gold grains, of which 33 grains were delicate.

Shortly after announcement of this discovery, the American Copper and Nickel Company (ACNC – a subsidiary of Vale/Inco) obtained state leases and drilled twelve rotonic holes (82301 to 82312) in 1989. According to Mornis (1991), these holes, shown in Figure 54, were mostly positioned down-ice or peripheral to MDNR hole 20801. Ten more holes (rotary holes 82313 to 82322) were drilled in 1990. Most of these holes were positioned either up-ice and/or along the projected bedrock strike, based on aeromag-

netic patterns, of MDNR hole 20801. Results of heavy mineral concentrate (HMC) samples from the basal till showed anomalous gold (200-2,218 ppb Au) in all holes located up-ice of hole 20801. However, it needs to be pointed out that these ten holes were rotary holes, and the assay results were from different sampling medium than the earlier rotonic holes. The highest gold value (2,218 ppb Au) was from the basal till/bedrock contact zone in ACNC hole 82318. Similarly, assays of the HMC from nearby holes (from samples near the base of the basal till) also showed anomalous gold concentrations with the following results: hole 82317 with 1,370 ppb Au; hole 82314 with 819 ppb Au; and hole 82316 with 814 ppb Au.

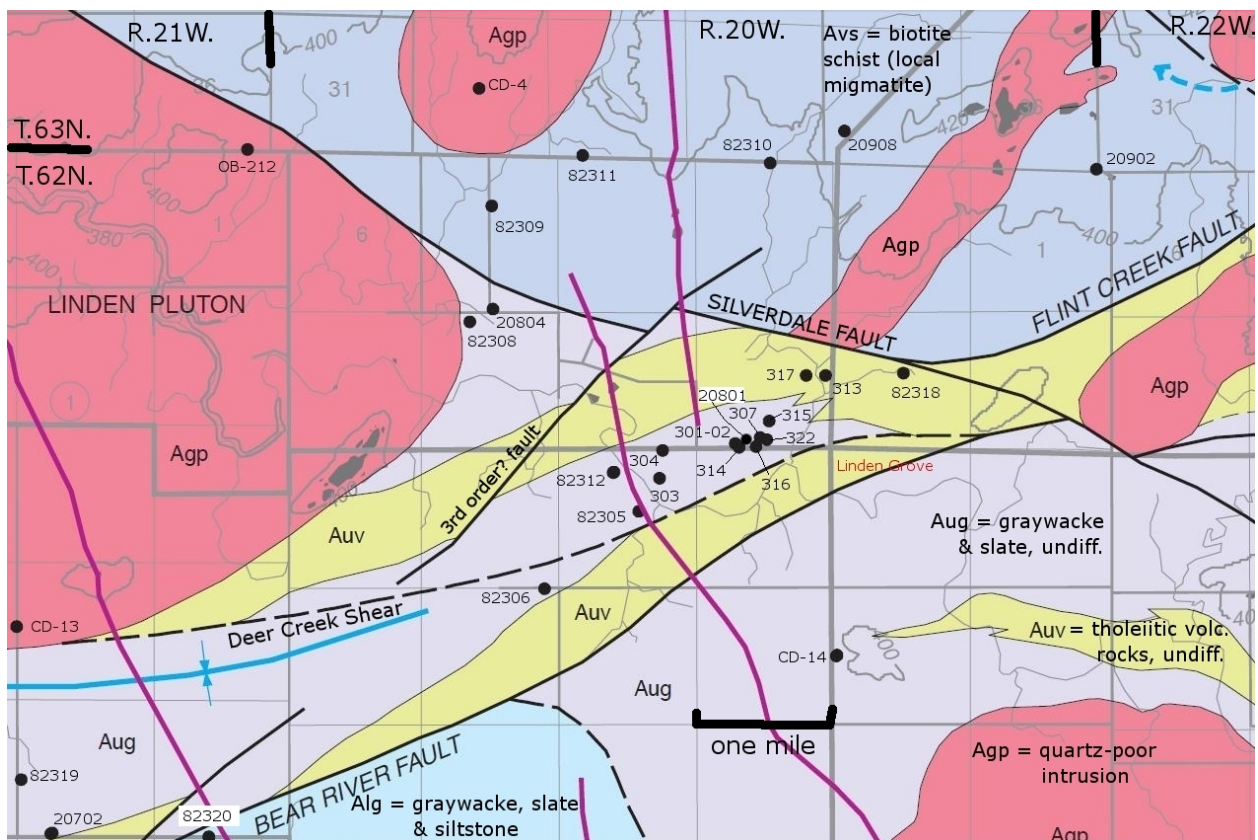


Figure 54. Geology of the Linden Grove area (modified from Jirsa and Boorboom, 2003a) showing distribution of holes drilled by ACNC (82,000-series holes), the Minnesota Geological Survey (CD-series holes), and the MDNR (OB-212 and 20,000-series holes). The 3-digit numbered holes in the center of the figure (eleven of them) are 82,000 series holes. Note that ACNC hole 82314 is a twin of MDNR hole 20801.

Overburden Management completed gold grain counts on the ACNC holes. This effort revealed that ACNC hole 82314 (the twin of MDNR hole 20801) contained the most gold grains with 23 grains in eleven samples (of which 16 grains were in the lowest four samples). Other ACNC holes with gold grains included: 82320 (14 gold grains near the top of the Rainy Lobe till); 82322 (7 gold grains); and 82318 and 82321 (four gold grains each). However, according to the Overburden Management report none of these gold grains could be classed as delicate.

Out of the 22 holes that were drilled by ACNC, 19 holes reached bedrock that was described dominantly as “schist” with a few exceptions such as lithic tuff, phyllite, basalt, and arkose. The HMC from the bedrock in hole 82313 assayed at 1,152 ppb Au. Similarly, the HMC from regolith in nearby hole 82322 assayed at 842 ppb Au.

ACNC believed that their results, and the MDNR results, suggested that a low-level gold-, arsenic-, base metal-enriched source was present somewhere in the local geologic setting (Mornis, 1991). They thought the low-level enrichment was associated with a pyrite-bearing, chlorite to sericite altered, partially silicified, felsic volcanic horizon associated with a magnetic low. However, while this enrichment was interesting, ACNC felt that the gold assays of the bedrock encountered by the drilling were too low overall and an economic deposit was not indicated.

Vermilion Gold, LLC (a company formed by William Rowell and Ernest Lehmann) has recently acquired the state leases in the Linden Grove area (as of 2010) and plans on reevaluating the gold potential.

Scanned materials pertaining to gold exploration at the Linden Grove area included with this report are:

- Linden_Grove_summary.pdf = ACNC summary report on the Linden Grove project by Steve Mornis;
- Linden_Grove_gold_grain_counts_ovbdrmngmt.pdf = 1989 report on the results of gold grain counts (for rotosonic holes only) by Overburden Management Inc.;
- ACNC_DH_assays.pdf = analytical results for HMC samples from both the ACNC rotosonic and rotary holes; and
- ACNC_823##_log.pdf = lithologic log of geological materials, and associated HMC assay results, for holes drilled by ACNC (82301 through 82322). Note that only the rotosonic holes (82301 through 82312) have preserved core from the till and underlying top portion of the bedrock.

Conclusions for the Cook Area

There are very few conclusions that can be drawn from the data that are available for the Cook area. The data suggest that the best gold potential is present at the Linden Grove area where several faults converge and structural preparation would be increased. The data certainly indicate that gold grains in the glacial till suggest a local source that was never intersected in the limited bedrock drilling that has taken place at Linden Grove. The Lost Lake Pluton is the second-most interesting area. Out of the nine holes drilled in the vicinity of the Lost Lake Pluton only one hole intersected a single gold mineralized zone. However, Sims and Day (1992) suggest this area still has gold potential. They point out that a large magnetic high, possibly representing a buried pluton having affinities with syenite and lamprophyre, is roughly coincident with an area that contains anomalous gold in A-horizon soils that were sampled by Alminas et al. (1992).

Gold Exploration in Itasca County

Geologic Setting

The geologic setting of the northwestern portion of Itasca County is recently well summarized by Southwick et al. (1998) and Jirsa and Chandler (2007). As at the western Vermilion District, the rocks in Itasca County are subdivided on the basis of stratigraphic and structural settings into: 1. the Soudan belt to the south; and 2. the Newton belt to the north. Lithostratigraphic units in Itasca County, as shown in Figure 55, include: 1. the Bear Lake sequence, an unnamed iron-formation member, the Sherry Lake sequence, and the Lake Vermilion Formation (LV) of the Soudan belt; 2. the Wilson Lake sequence, Thistledew Lake sequence, Deer Lake Complex, and Joy Lake sequence of the Newton belt; and 3. syn- to post-tectonic granitoid intrusions of the Giants Range batholith and a suite of smaller post-tectonic alkalic stocks and plutons. Current interpretations regarding the structure in Itasca County (Jirsa et al., 1992; Southwick et al., 1998; and Jirsa and Chandler, 2007) suggest the rocks in Itasca County, like the nearby western Vermilion District, underwent at least three periods of deformation as discussed previously. The Sherry Lake Anticline of Itasca County is the equivalent of the Tower-Soudan Anticline and is also envisioned to have formed during D₁ deformation.

Gold Exploration Activities

As at the western Vermilion District, the first phase of explorations for base metals in Itasca County took place during 1969-1972. Companies that conducted VMS and/or Ni-Cu exploration during this first phase included:

Inco, Hanna, USS, Humble/Exxon, Bear Creek, Duval, and W.S. Moore. Several conductors were tested by drilling with generally unsuccessful results as graphite-bearing sedimentary rocks were intersected in most of the holes. Many of these holes were sampled by other mineral exploration companies during the ensuing gold exploration phase in the 1980s. A brief period of VMS exploration also took place in the early 1980s by Lehmann Exploration Management, Inc. Most of the exploration by Lehmann was concentrated in the Bear Lake and Sherry Lake sequences. Some of Lehmann's projects were also in the Wilson Lake sequence, and these particular projects morphed into gold prospects in later years. Figure 56 displays areas where some form of exploration for VMS deposits took place.

In regard to gold exploration in Itasca County, there were at least 13 major gold exploration areas, shown in Figure 56, that were explored by a six companies from 1983 through 1990 (some drilling also took place recently in 2010). These companies included FMC Minerals, Lehmann Exploration Management Inc., Meridian Lands and Minerals Company, Noranda Exploration Inc., Normin Mining Company (Boise Cascade), and Santa Fe Pacific Gold. The companies drilled 55 holes and dug three trenches at eight of the prospects. Most of the prospects that were explored at the beginning of this exploration phase were evaluated for stratabound and structural zones associated with iron-formation lenses in the Wilson Lake sequence. However, as exploration progressed it became obvious that structure and rheological differences were the most important, e.g., the Lost Lake area. For the remainder of this chapter, each of the gold prospects in Itasca County that received some form of drilling or trenching (outlined in yellow in Fig. 56) will be described below.

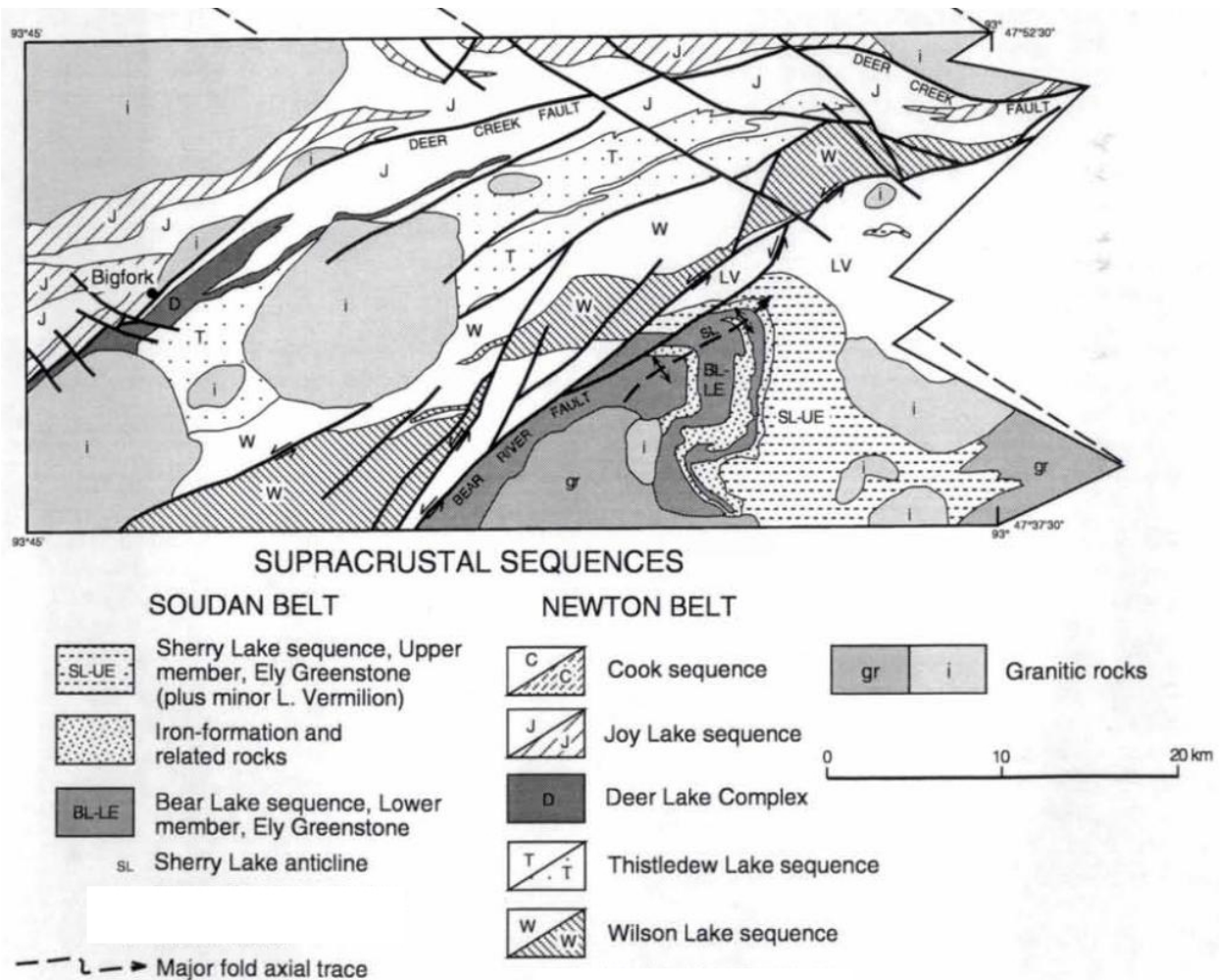
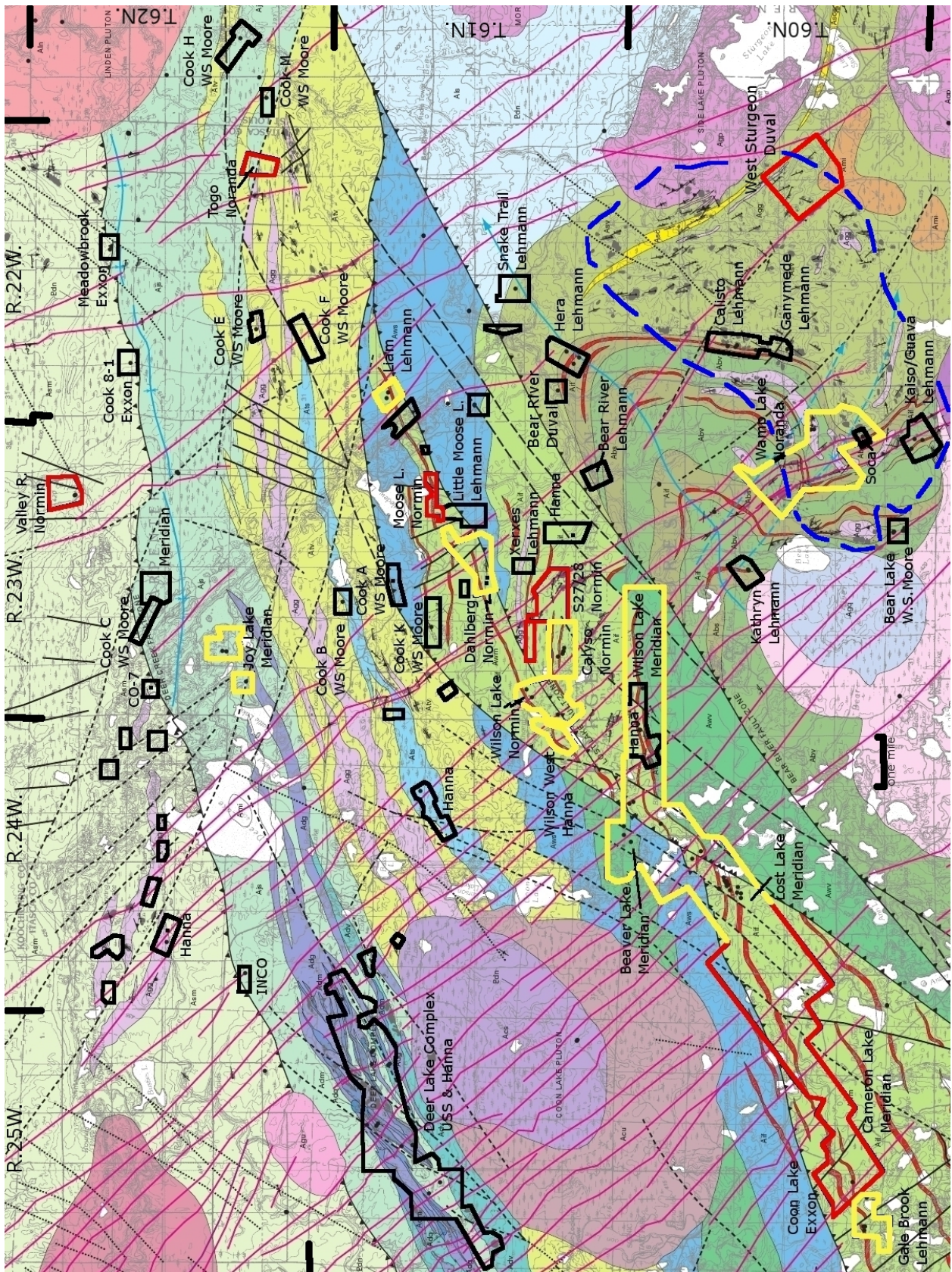


Figure 55. Simplified bedrock geology of the Soudan-Bigfork area (from Fig. 3, Southwick et al. 1998) showing major faults and the distribution of rock sequences. Unpatterned areas of are dominantly sedimentary and dacitic volcanic rocks; symbol LV denotes the Lake Vermilion Formation. North at top of figure.

Figure 56 [see figure on next page]. Geologic map of the northeastern Itasca County area (modified from Jirsa and Chandler, 2007) displaying where mineral exploration activities took place – the name of the grid and the company that conducted the exploration is posted next to the boxed areas. Black boxes represent areas where exploration took place for VMS deposits in the early 1970s and 1980s. Red boxes portray where geophysical surveys were conducted in pursuit of gold exploration. Yellow boxes indicate blocks where gold exploration activities culminated in drilling and/or trenching. Dashed blue lines outline an area that the MDNR defines as “largest cluster of gold anomalies in till in Minnesota.” A listing of the drill holes at each site is presented in the Itasca_County_drill_holes.xls in Appendix A.



[See previous page for figure caption.]

Lost Lake – Meridian/FMC

The Meridian Lands and Minerals Company, an affiliate of Burlington Northern Inc., began explorations to evaluate the mineral potential of their mineral rights in northeastern Itasca County in the early 1980s. After flying an airborne survey, around 1983, they established a large grid for ground geophysical surveys in the Wilson Lake sequence at the Lost Lake/Beaver Lake/Wilson Lake/Cameron Lake areas (Fig. 56). Most of these areas were eventually drilled; however, this section of the report only discusses the activities in the Lost Lake area (Sections 3, 8, 9, and 17, T.60N., R.24W. – Fig. 57). The first round of drilling took place in 1985 and consisted of five holes (LL-85-1 through LL-85-5) that were drilled on the basis of geophysics. All of the holes intersected intensely interbedded iron-formation, sedimentary rocks (including graphitic argillite), and variable amounts of mafic volcanics and dacitic tuffs. The iron-formation itself was highly variable and included zones that were: chert-rich; magnetite-rich; hematite-rich; graphite-bearing; highly brecciated and veined; altered/oxidized; and broken-up in zones with poor recovery. According to the geologic map of Jirsa (1990), shown in Figure 57, four of the holes were in the same geologic package (dominantly iron-formation and mafic-intermediate volcanics – units Awi and Awmv, respectively), whereas hole LL-85-2A was lower in the stratigraphy and included some felsic-intermediate volcanics (Awfv unit).

In regard to gold assays, the first hole, LL-85-1, intersected an eight-foot-thick zone, at 274-282 feet, that assayed at 4,000 ppb Au associated with a broken-up graphitic conductor. However, this auriferous zone was in a vuggy/poor recovery zone, and hole LL-85-5 was drilled in an attempt to re-examine the anomalous zone of LL-85-1. Hole LL-85-

5 was offset 50 feet to the south of LL-85-1 and drilled at a deeper inclination. The auriferous zone of LL-85-1 was intersected in LL-85-5 at 256-262 feet. However, the assay results were less spectacular with values of 1,400 ppb Au and 700 ppb Au (at 256-259 feet and 259-262 feet, respectively). The remaining LL-85-series holes were dead with respect to gold, and future activities would eventually be confined to the LL-85-1/LL-85-5 area.

After a hiatus of up to two years, Meridian and FMC entered into a joint venture to explore the Lost Lake area. During Feb-June, 1987, they drilled an additional twelve holes on the property (LL-87-series holes in Fig. 58). A “dog’s breath” of heterogeneous rock types were intersected in the holes with local differences in the volumes of rock types present in each hole. Iron-formation was the dominant rock type intersected in nine of the holes, and the drill logs indicate that it is intricately interbedded with numerous rock types including graphite-rich rocks. Hole LL-87-6 was collared at the same site as LL-85-1 and LL-85-5, the auriferous holes, and also intersected two auriferous intervals. The intervals at 445-450 feet and 450-455 feet were associated with brecciated and veined iron-formation and graphite and assayed at 1,250 ppb Au each. Hole LL-87-13 turned out to be the best hole with respect to gold in that it intersected six continuous intervals with >1,000 ppb Au (see Table 3 for detailed assay results).

FMC continued explorations on the property in early 1988 when they drilled a final six holes. The holes (LL-88-series) continued to encounter a heterogeneous mix of rock types as before. One hole, LL-88-19 intersected a 50-foot-thick interval (525-575 feet) wherein 14 out of 15 consecutive intervals assayed at >100 ppb Au with a maximum of 824 ppb Au. However, the data turned in to the MDNR indicate that corporate funding from FMC was waning at this stage,

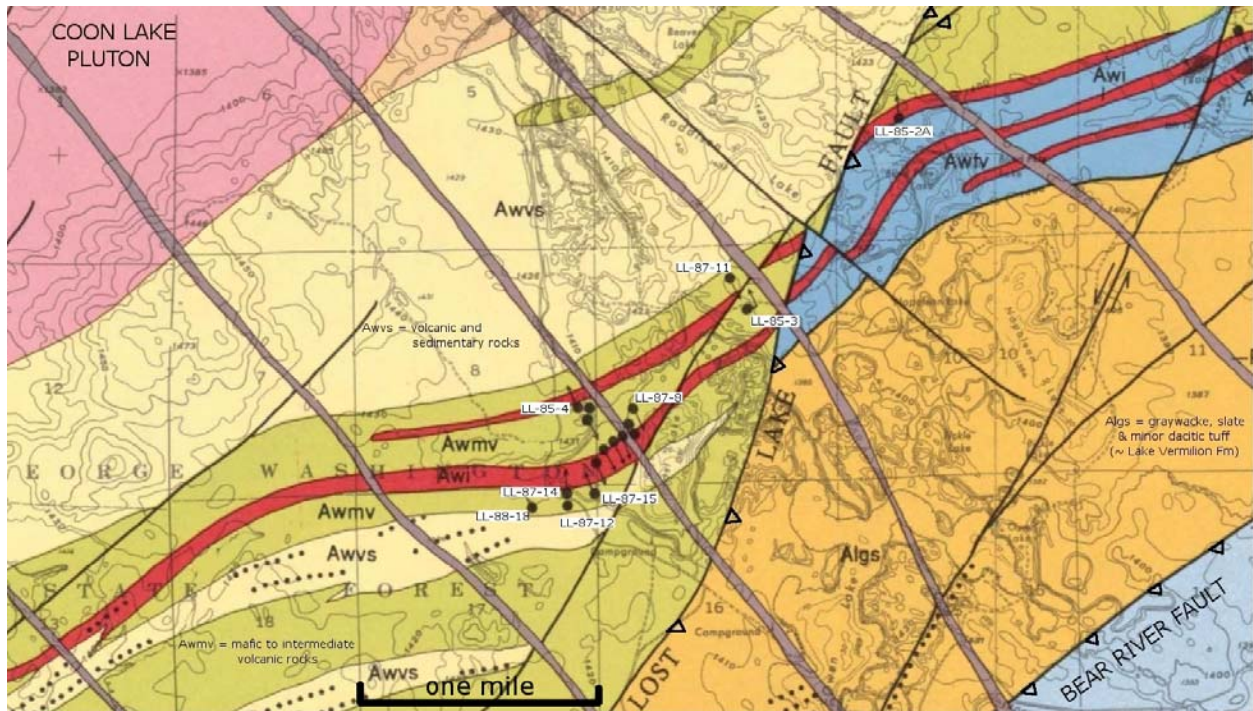


Figure 57. Geology of the Lost Lake gold prospect area in Itasca County, modified from Jirsa (1990), showing distribution of drill holes. The red bands (labeled Awi) are dominantly iron-formations. Unlabeled drill holes in the center of the figure are shown in a close-up of the area depicted in Figure 58.

as the only abandonment reports were turned in for the last two holes (LL-88-20 and LL-88-21), and no detailed geologic logs were ever prepared. Furthermore, hole LL-88-21 encountered difficulties in the overburden and was abandoned with no attempts to move a few tens of feet over and re-drill the site.

Vermilion Gold, LLC (a company formed by William Rowell and Ernest Lehmann) has recently acquired the state leases in the Lost Lake area and drilled an additional three holes in 2009-2010. According to a talk given by Mr. William Rowell of Vermilion Gold (at the AIME/SME convention held in Duluth in the

spring of 2011), gold mineralization was also intersected in at least one of their holes (LL-10-3) and is associated with “strong fracturing, silicification, and sulfidation of the iron-formation.” Overall, Rowell stated that the gold mineralization is associated with magnetic lows in the iron-formation due to sulfide replacement of oxides. Vermilion Gold flew a helicopter VTEM survey of the area, and the results suggest the presence of several “excellent untested geophysical targets” (Rowell’s AIME/SME talk). The known auriferous zones in the drill holes at Lost Lake are shown in Figure 59.

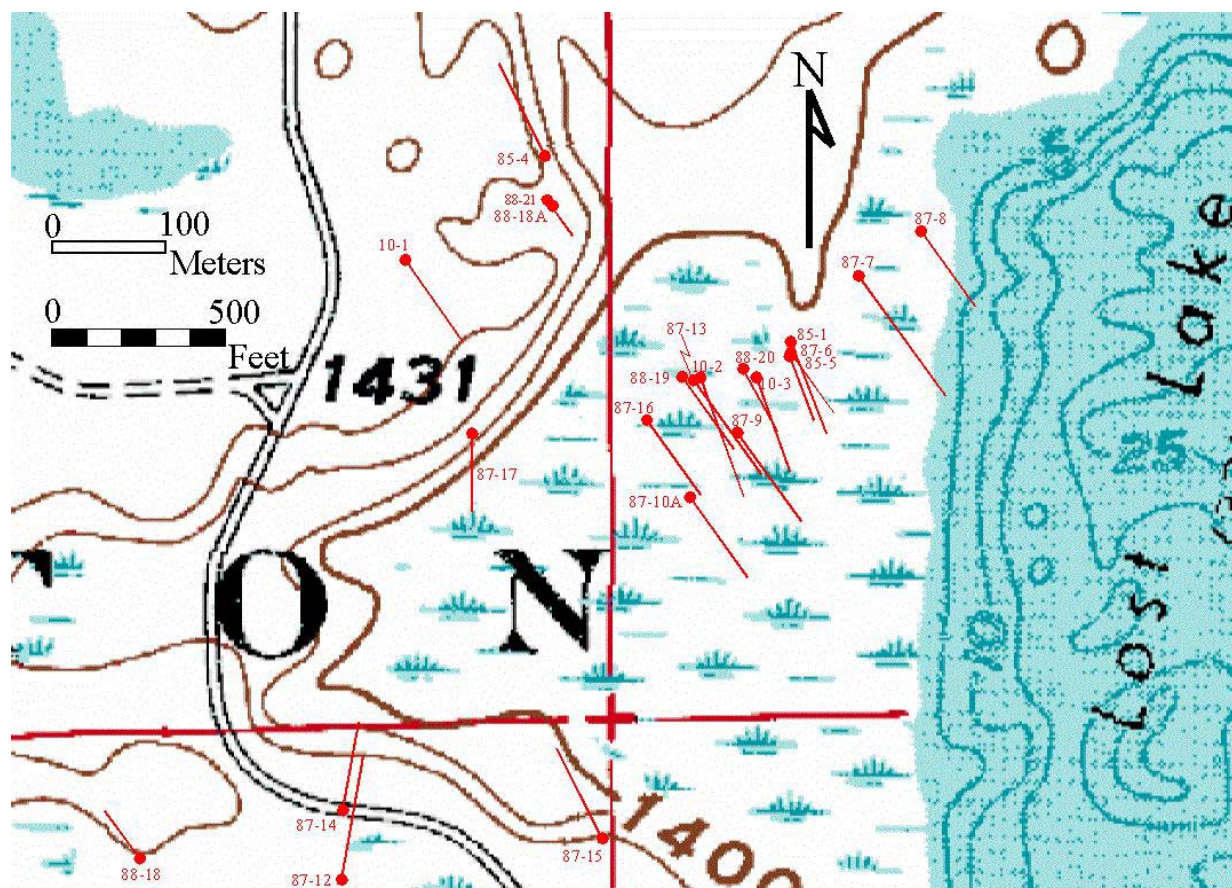


Figure 58. Distribution of drill holes in the Lost Lake gold prospect. All holes are prefixed by LL-, e.g., LL-87-15. Meridian drilled the LL-85-1 through LL-85-5 holes. The LL-87-series and LL-88-series holes were drilled by the FMC-Meridian joint venture. The most recent holes, the LL-10-series, were drilled by Vermilion Gold.

Table 3. Assay results for the gold-bearing zone intersected in drill hole LL-87-13.

Interval (feet)	Au (ppb)	Ag (ppm)	As (ppm)	Rock Type
314.8-318	1,250	1.0	70	Iron-fm – pyritic, brecciated, and vuggy.
318-323	3,000	1.0	85	Iron-formation – banded with pyritic bands.
323-328	1,350	0.7	110	Lean/cherty iron-fm with graphite and brecciated zones (breccia matrix = chlorite and pyrite).
328-333	5,400	1.5	800	As above.
333-337	3,200	1.0	200	As above.
337-340.55	4,300	1.4	110	As above.

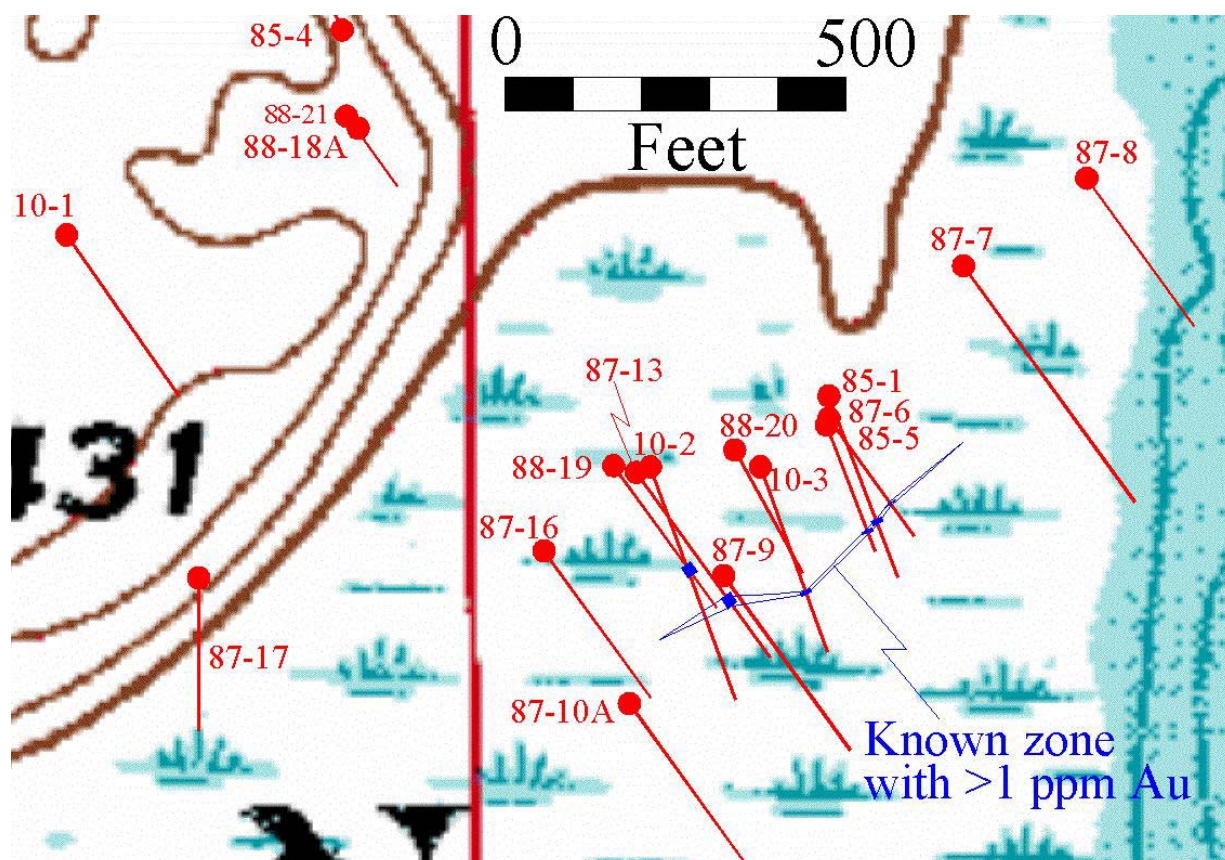


Figure 59. Map displaying the known gold zones (>1,000 ppb Au) in Lost Lake holes projected to the surface. Note that complete assay results for the LL-10-series holes are unknown. The gold zone shown in hole LL-88-19 is for an unrelated(?) 50-foot-thick interval with only 110-824 ppb Au.

Scanned materials pertaining to gold exploration at the Lost Lake prospect in Itasca County included with this report are:

- Meridian_FMC_Book1_LL_85&87_drill_holes.pdf = Book #1 with geologic logs, and associated assay results, for drill holes LL-85-series and LL-87-1 through LL-87-10A;
- Meridian_FMC_Book2_LL_87_drill_holes.pdf = Book #2 with geologic logs, and associated assay results, for drill holes LL-87-11 through LL-87-17, and the LL-88-series holes;
- LL-85-1-more-assays.pdf = additional assay results for LL-85-1 that are not include in Book #1;
- LL-6-chem.pdf = base metal and oxide geochemistry for LL-87-6 that are not included in Book #1;
- LL-6-one-chem.pdf = as above but only for one sample;
- LL-6-opt-Au.pdf = re-assay of specific zones in LL-87-6 that are reported in ounces per ton;
- LL-6-&-LL-7-assays.pdf = assay results for holes LL-87-6 and LL-87-7 that are clearer scans than the ones included in Book #1;
- LL-6-thru-LL-9-assays.pdf = assay results for holes LL-87-6 through LL-87-9 that are clearer scans than the ones included in Book #1;

- LL-10-&-LL-12-assays.pdf = assay results for holes LL-87-10 and LL-87-12 that are clearer scans than the ones included in Book #1;
- LL-13-chem.pdf = base metal and oxide geochemistry for LL-87-13 that are not included in Book #1;
- LL-19-assays1.pdf = assay results for the upper third of LL-88-19 that are clearer than the scans included in Book #2;
- LL-19-assays2.pdf = assay results for the middle third of LL-88-19 that are clearer than the scans included in Book #2;
- LL-19-assays3.pdf = assay results for the lower third of LL-88-19 that are clearer than the scans included in Book #2;
- LL-19-&-LL-20-few-more-assays1.pdf = additional assays for LL-88-19 and LL-88-20 (unfortunately, the assayed intervals are not known for LL-88-20) that are not included in Book #2;
- LL-6-&-LL-7-checks.pdf = assay checks on specific zones in LL-87-6 and LL-87-7 that are not included in Book #1;
- LL-6-LL-13-LL-16-checks.pdf = assay checks on specific zones in LL-87-6, LL-87-13, and LL-87-16 that are not included in Book #1;
- LL-13-checks.pdf = assay checks on specific zones in LL-87-13 that are not included in Book #1; and
- LL_8_thru_15_checks.pdf = assay checks on specific zones in LL-87-8 through and LL-87-15 that are not included in Book #1.

Beaver Lake/Wilson Lake – Meridian

The Hanna Mining Co. was one of the first companies to conduct explorations for VMS deposits in the northeastern Itasca County area, and they drilled up to 16 holes (T-series) into conductors spread throughout their “Togo” block. Three of their holes (T-2, T-3, and T-14) were drilled near the Wilson Lake

Road and intersected mixed “greenstone” and iron-formation. No VMS deposits were found during their exploration campaign.

In the early 1980s, the Meridian Lands and Minerals Company established several contiguous ground geophysical grids in the area – two of which were called the Beaver Lake and Wilson Lake grids (in Sections 1, 2, 3, and 4, T.60N., R.24W.; and Sections 34, 35, and 36, T.61N., R.24W. – Fig. 56). The rock types present in the area (now correlated with the Wilson Lake sequence) and the geophysical results looked interesting, and Meridian drilled six holes in 1985. Their first hole, WIL-85-1 (Fig. 60), intersected mostly felsic volcanics with abundant thin graphitic conductors. According to their lithologic log, no iron-formation was encountered in the hole. Assays for WIL-85-1 showed no gold enrichment (maximum of 35 ppb Au.) The BEV-series holes, drilled further to the west (Fig. 60), intersected an entirely different rock package consisting of interbedded mafic to felsic volcanic and volcanoclastic rocks with lesser metasedimentary zones. Each of the holes also intersected one conductor that consisted of pyrite-bearing, graphitic argillite that was locally brecciated and veined. Assays were run on the first of the four BEV-series holes and showed only weak gold enrichment at best (maximum of 80 ppb Au). During the FMC-Meridian joint venture, FMC assayed BEV-85-5 in 1987 and found one interval (155-160 feet) with a value of 1,470 ppb Au. As this was the only anomalous sample in the entire area, no more exploration was conducted.

Scanned materials pertaining to gold exploration at the Beaver Lake/Wilson Lake prospect in Itasca County included with this report are:

- Hanna_T_2_and_3_abbrev_logs.JPG = poor copy of rocks intersected in Hanna drill holes T-2 and T-3 taken from a Meridian file (the original Hanna logs for

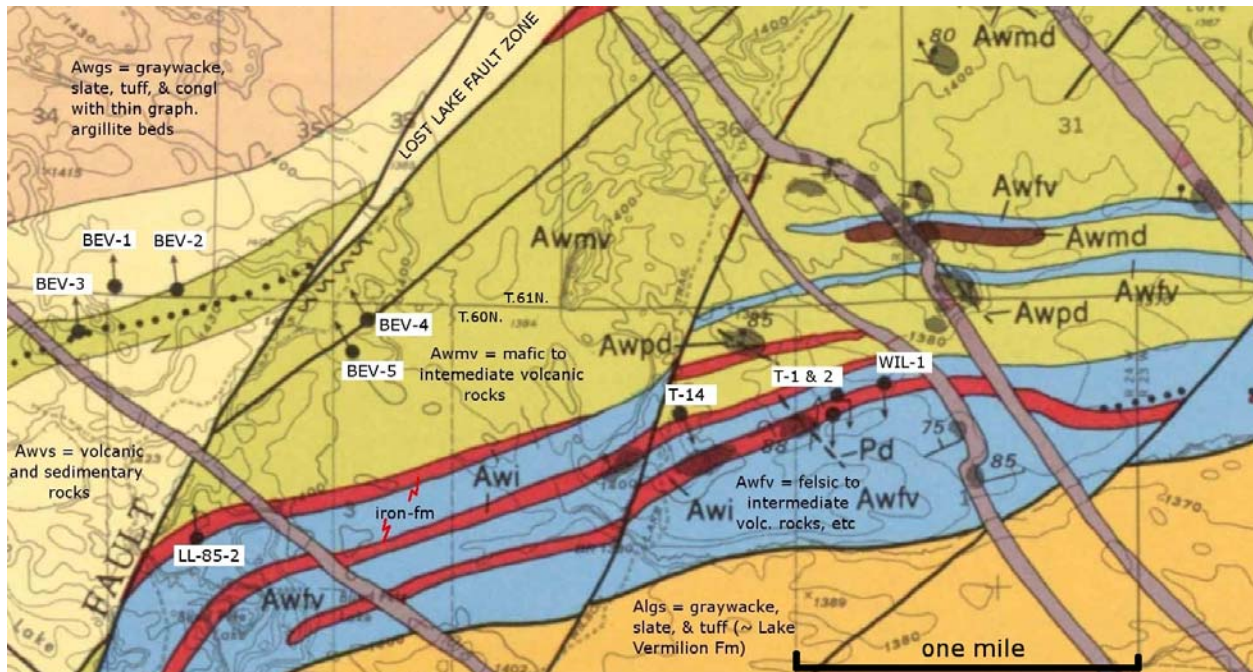


Figure 60. Geology of Meridian's Beaver Lake/Wilson Lake gold prospect, modified from Jirsa (1990), showing distribution of holes drilled by Hanna (T-series) and Meridian BEV-85-1 through BEV-85-5 and WIL-85-1). Note that the tops of both BEV-85-4 and BEV-85-5 are described as being extensively clay-altered – probably related to deeper weathering in close proximity to the fault as shown. Drill hole LL-85-2, included in Meridian's Lost Lake gridded area, also display similar weathering in the iron-formation intersected at the collar. North at top of map.

- these two holes, including T-14, could not be located);
- Meridian_Book3_WIL&BEV_drill_holes.pdf = Meridian Book #3 with geologic logs, and associated assay results, for drill holes WIL-85-1 and BEV-85-1 through BEV-85-5 (BEV-85-5 geologic log is incomplete and the assay results are not presented for most of 85-4 and all of 85-5); and
 - BEV_4_&_5_assays.pdf = 1987 assay results for most of BEV-85-4 and all of BEV-85-5.

Wilson Lake – Normin

The area surrounding Wilson Lake was also explored and drilled (T-4 and T-5) by Hanna during their exploration for VMS deposits in 1971. According to a Santa Fe

Pacific report by Severson (1986), these two Hanna holes were discovered in Hanna's facility in Nashwauk and were sampled by Santa Fe Pacific (in a joint venture with Normin) in 1986. One sample from each of the holes showed anomalous gold values (480 ppb Au in T-4 and 446 ppb Au in T-5) associated with an iron-formation trend in the Wilson Lake sequence. Subsequently, several grids were established along an iron-formation trend in the Wilson Lake sequence (Fig. 56). One of these grids, the Wilson Lake grid, was established close to the Hanna holes in nearby Section 30, T.61N., R.23.W. (Fig. 61). Mapping of the sparse outcrops and geophysical surveys were conducted accordingly. Soil samples were also collected along the grid lines from poorly-developed A-horizon and returned values up to 144 ppb Au. Even though several conductors were defined in the area, some with coincident groupings of

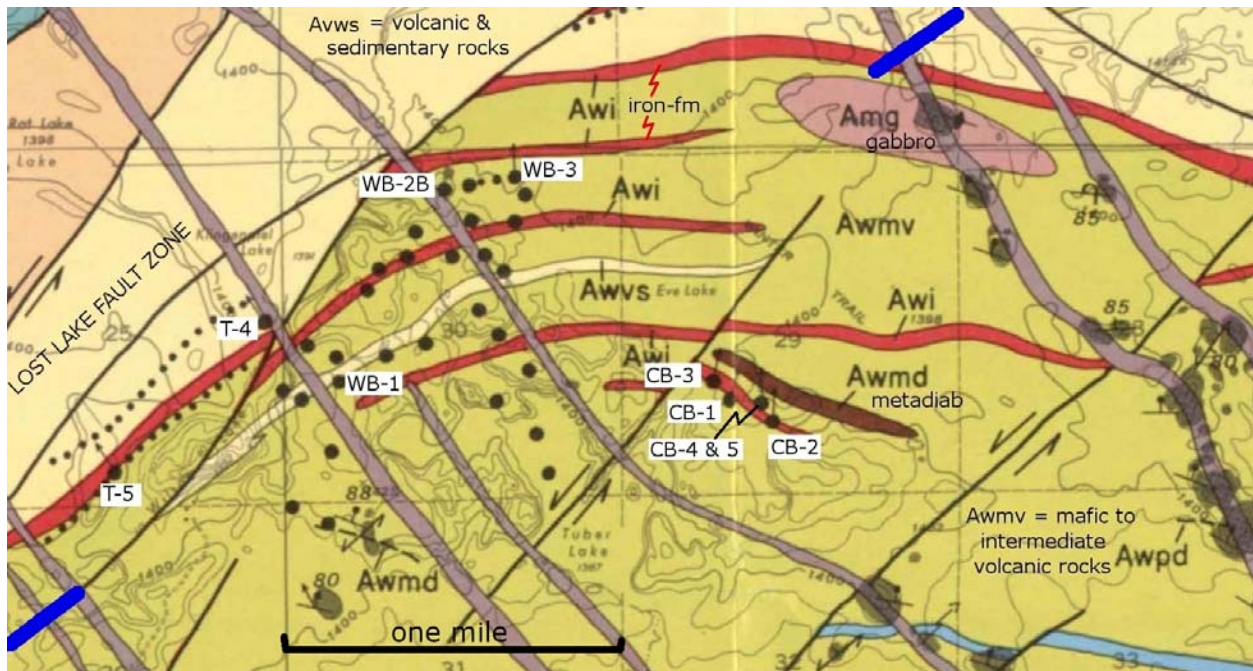


Figure 61. Geology, after Jirsa (1990), of the area covered by Normin’s Wilson Lake grid (Section 30), Calypso grid (Section 29), and Sec. 27/28 grid (partially shown on left of figure). Also shown are holes drilled by Hanna (T-series) and Normin (WB-series and CB-series); unlabeled holes were also drilled by Normin as part of their overburden sampling campaign. Note that a more recent geologic map (Jirsa and Chandler, 2007) shows a slightly different fault configuration with a major splay of the Lost Lake Fault zone projecting diagonally through the area along the trend between the two thick blue lines. North at top of map.

anomalous gold in soil values (Severson, 1986), Santa Fe Pacific lost interest in the area and in their joint venture with Normin.

Eventually, Normin found another joint venture partner (Battle Mountain Gold) and an overburden sampling campaign was begun in 1987. According to two Normin reports (Norton, 1988 and Chartier, 1988), both scanned and included with this report, 28 reverse circulation holes (WL-series in Fig. 62) were drilled to sample the entire glacial section and several feet of the underlying bedrock. All of the basal till and bedrock samples were processed by Normin and sent in for assay. Pebble counts were also made. Norton (1988) felt that the data Normin collected indicated that the basal till appeared to reflect bedrock conditions a short distance away. However, the bedrock topography

appears to be a major factor in sediment dispersal as there is “approximately twice the relief as the overburden surface” (Norton, 1988). The assay results for the processed basal till (posted in the scanned report by Norton) were significant in some holes with a maximum of 137,599 ppb Au in hole WL-9 (calculated assay as determined by Overburden Management as described in Chartier (1988)).

According to Chartier (1988), the overburden drilling defined several anomalous zones with delicate and irregular gold grains in the till (as shown in Fig. 63). Assuming that the glacial transport direction for the basal till (Rainy Lobe) was to the southwest, it appears that Normin positioned their core holes up-ice from the most anomalous basal till zones (Fig. 63).

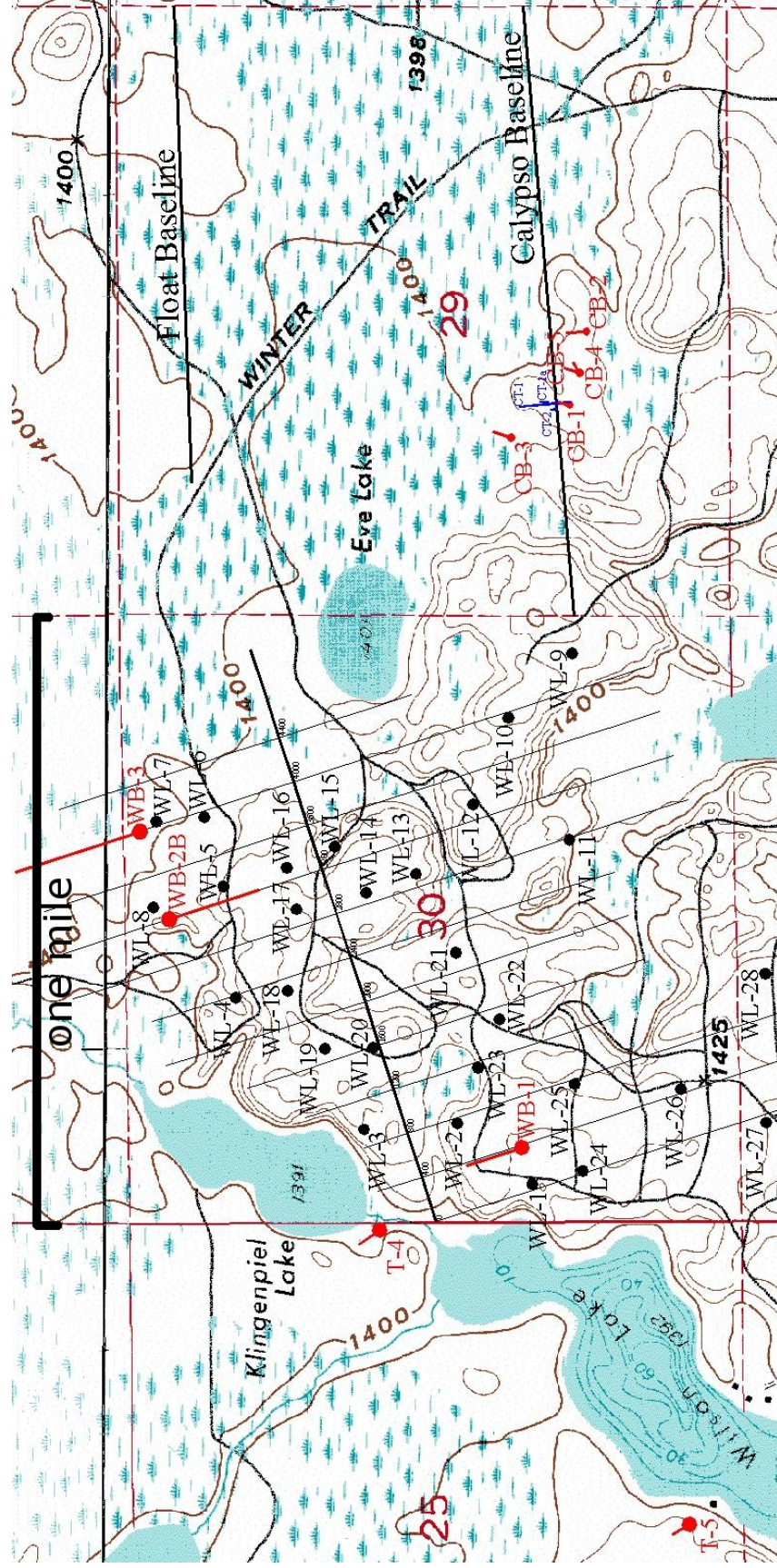


Figure 62. Topographic map displaying the geophysical grid established by Normin at Wilson Lake, as well as, the baselines for Normin's Calypso and Float grids (entire grids not shown). Red dots represent core holes drilled by Hanna (T-series) and Normin in the Wilson Lake (WB-series) and Calypso (CB-series) areas. Black holes (WL-series) are locations of reverse circulation holes drilled by Normin. Note that there is some discrepancy in the hole locations relative to those shown in Figure 61 – establishment of the grid lines for this report suggests that the actual hole locations in this figure are more accurate. North at top of map.

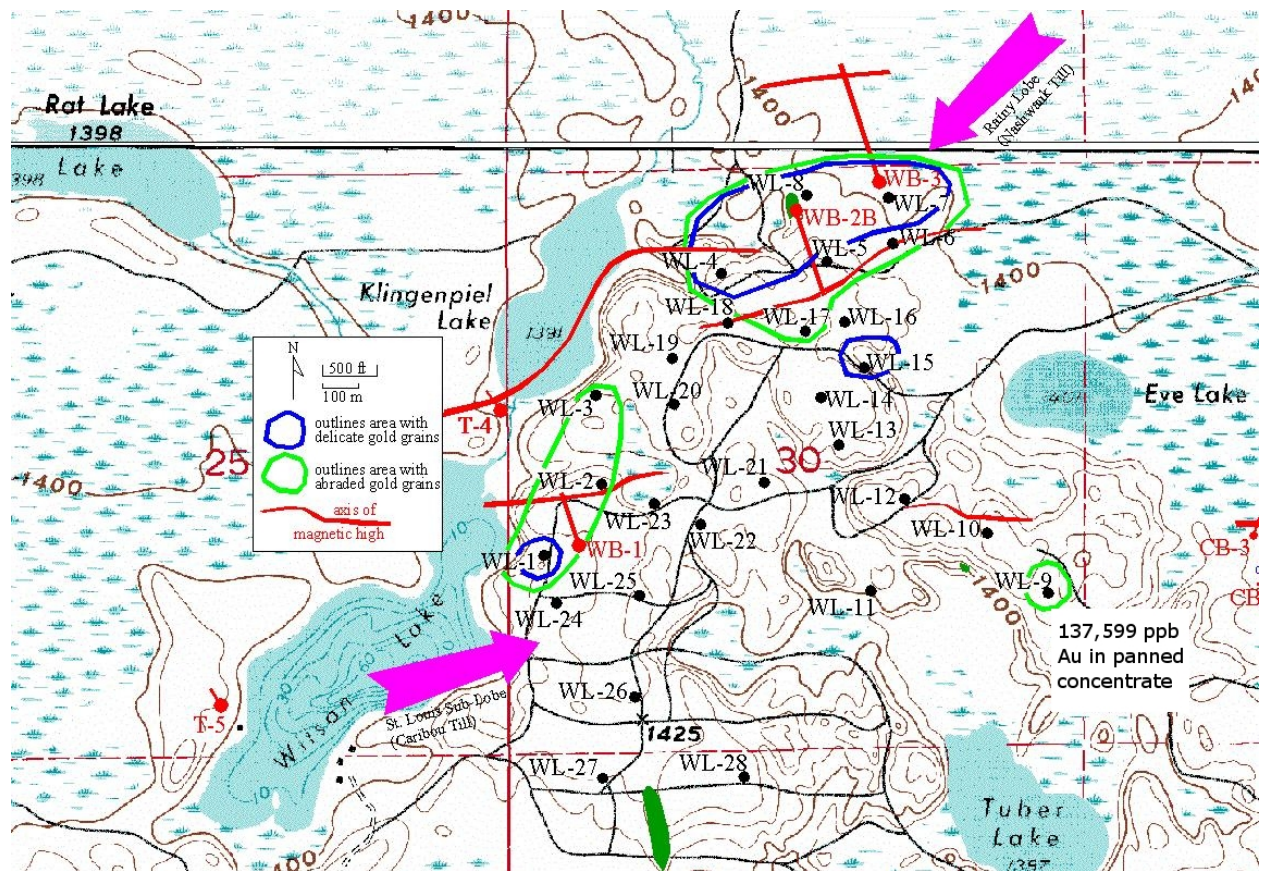


Figure 63. Map of the Wilson Lake area showing zones with anomalous concentrations of delicate and irregular gold grains in the Nashwauck till as determined by overburden drilling. Modified from Plate 1 and Figure 10 in Chartier (1988). Follow-up core drilling of the bedrock (WB-series holes) was an attempt to drill up-ice from these anomalous till zones. Note that the anomalous zone in drill hole WL-9 (with 137,599 ppb Au) was followed up by core drilling in the adjacent Calypso grid.

Follow-up core drilling by Normin took place in late 1988, when two core holes were drilled (WB-1 and WB-2B in Figs. 61 and 62). Hole WB-1 intersected a potpourri of rock types including mafic flows, graphitic argillite, carbonate-rich metasediments with iron-formation lenses, mafic tuffs with iron-formation lenses, and metasediments. Hole WB-2B intersected mostly mafic tuffs, flows, and intrusives in the top of the hole and a metasedimentary package, with five iron-formation lenses and a thin graphitic argillite, in the bottom of the hole. There is very little mention of brecciation and veining in either hole and gold assays were not good, with a maximum of 33 ppb Au in each hole. Normin

followed up with the drilling of WB-3 in the summer of 1989. This last hole intersected an intensely interbedded sequence of graphitic argillite, iron-formation (locally sulfide-rich), and tuff. Brecciation appears to have been more common in this hole, but the gold assays only maxed out at 75 ppb Au. Overall, the drilling indicated that numerous iron-formation lenses are present in the Wilson Lake sequence in the Wilson Lake area. However, structural preparation was generally lacking. Due to all of these discouraging results, and bolstered by much more encouraging results towards the immediate east in overburden hole WL-9 (with 137,599 calculated ppb Au in the basal till), Normin

discontinued their activities at Wilson Lake and moved east to their newly-established Calypso grid (see next section of this report).

Scanned materials pertaining to gold exploration at the Lost Lake prospect in Itasca County included with this report are:

- Hanna_T_4_LOG_SEVERSON.pdf = geologic log, with posted gold assays, of Hanna hole T-4 (complete analytical results are in Severson's 1986 Itasca County report at the MDNR);
- Hanna_T_5_log_Severson.pdf = geologic log, with posted gold assays, of Hanna hole T-5 (complete analytical results are in Severson's Itasca County report at the MDNR);
- Norton (1988) - Quaternary Geology Wilson Lake.pdf = scan of Art Norton's 1988 report concerning the results of the overburden drilling and sampling at Wilson Lake. This report also includes all of the geologic logs, with posted gold assay results for processed till samples, for all 28 of the reverse circulation holes (WL-1 through WL-28);
- Chartier (1988) - Overburden Drilling Program.pdf = scan of Torrie Chartier's 1988 report concerning the gold grain contents in processed samples from overburden drilling at Wilson Lake. This report is an in-depth review of panned and analytical results;
- Normin_WB_1_log.pdf = geologic log, with posted gold assay results, for drill hole WB-1;
- Normin_WB_2B_log.pdf = geologic log, with posted gold assay results, for drill hole WB-2B;
- Normin_WB_3_log.pdf = geologic log, with posted gold assay results, for drill hole WB-3;
- Normin_WB_1_assays.pdf = geochemistry results for hole WB-1;
- Normin_WB_2B_assays.pdf = geochemistry results for hole WB-2B; and

- Normin_WB_3_assays.pdf = geochemistry results for hole WB-3.

Calypso – Normin

As described above, Normin became interested in the Calypso area (Section 29, T.61.N., R.23W. – Figs. 62 and 63) as a result of the overburden drilling and sampling at their adjacent Wilson Lake area. A processed basal till sample with a calculated value of 137,599 ppb Au in drill hole WL-9 (Chartier, 1988) was probably the sole motivation for moving “up-ice” into this area. After establishing a grid and conducting geophysics in 1988, Normin was convinced that potentially auriferous rocks, coincident with a soil anomaly, were exposed close to the surface along an east-west trending ridge (Fig. 64). As recounted in a 1989 report by Art Norton (scanned and included in this report), Normin decided to dig a long north-south trench across this ridge in order “... to obtain a continuous sampling of bedrock and basal till across the soil anomaly in order to locate the source of the soil anomaly.” Trenching activities began in June of 1989, and after four days a 440-foot-long trench (trench CT-1 in Fig. 64) was completed. Bedrock was exposed in the trench except for a 25-foot-long zone in the middle of the trench that was presumed to represent a highly-weathered iron-formation lense. An adjacent trench (CT-1a) was dug immediately but still failed to expose the iron-formation at a depth of 20 feet deep. In August, a last attempt to uncover the iron-formation was made during reclamation of the earlier trenches. A different trench (CT-2) was dug to the west and succeeded in partially exposing the iron-formation.

According to Norton, extremely interesting results were obtained from the basal tills that were exposed in trenches CT-1 and CT-2. Continuous channel samples of the basal lodgement till were collected wherever possible and were wet sieved with the

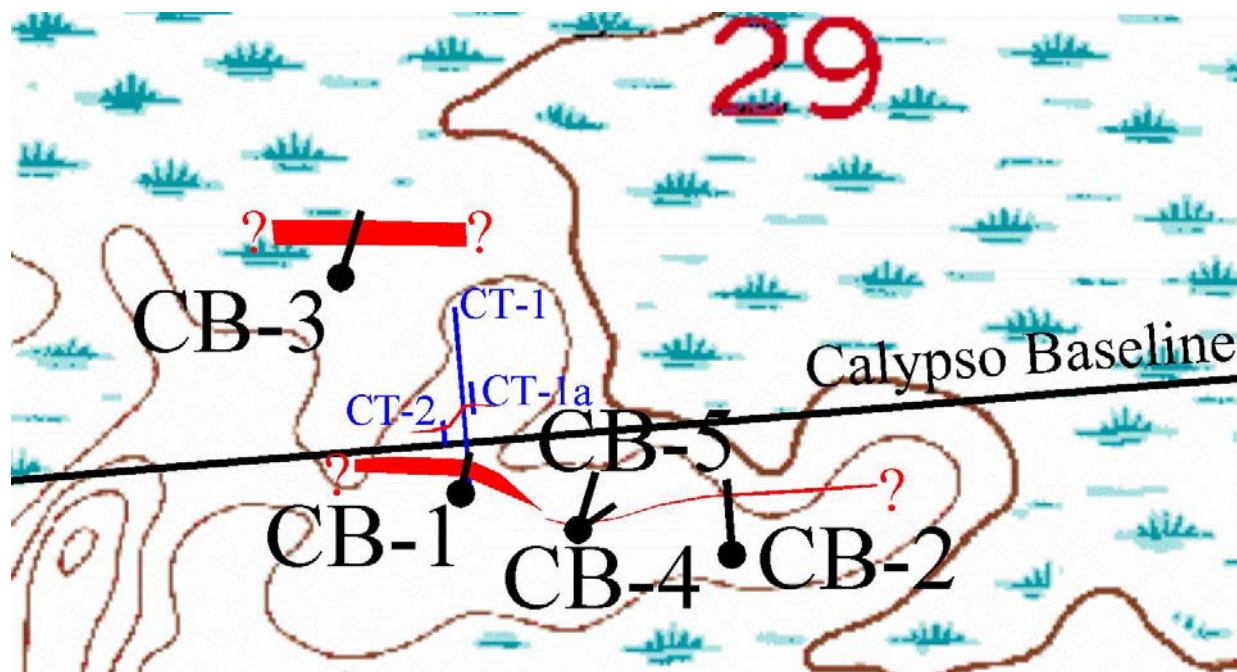


Figure 64. Distribution of drill holes (CB-series) and trenches (CT-series in blue) at Normin's Calypso prospect (see Fig. 61 for a more general location). Red bands are conceptual correlations of the numerous iron-formation lenses that were encountered in the drill holes and trenches.

oversized fraction sent to Overburden Drilling Management (ODM) for further tests (see Norton's report for more details). Two samples in specific, from near the northern contact of the iron-formation in trench CT-2, contained 28 and 74 gold grains. Norton relates that "Almost all of the gold grains in these two samples were very small and irregular or delicate in texture. Both factors are characteristic of extremely short transport distances." However, channel samples from the exposed bedrock in the trench were not particularly auriferous (maximum of 50 ppb Au in the iron-formation and 66 ppb Au in the mafic volcanics). Gold grains were also found in basal till samples collected from trench CT-1 (maximum of 13 grains in two samples), but most of these grains were abraded, suggesting another source to the north. Apparently, the "Float Grid" (shown in Fig. 62) was an attempt to ascertain the gold content in the till to the north of the Calypso grid; however, no information relative to activities at this grid was ever turned into the MDNR.

Buoyed by the abundant delicate gold grains in the two samples from the CT-2 trench, Normin began to drill a series of short core holes in the vicinity of the trenches (Fig. 64) in November of 1989. Hole CB-3 was drilled to the north of the ridge, apparently to check the potential of a slightly more removed gold source. Four out of the five holes intersected iron-formation lenses that apparently thicken-and-thin drastically (only a one-inch-thick bed was present in CB-4). As at Wilson Lake, Normin's drilling at Calypso indicated that small iron-formation lenses were fairly common, but again, structural preparation was lacking. Gold assays for each of these holes were low with most of the samples below detection limit and a maximum of only 38 ppb Au.

Scanned materials pertaining to gold exploration at the Calypso prospect in Itasca County included with this report are:

- Norton (1989) - Calypso Grid Overburden Bedrock Trenching Project.pdf = Art

Norton's report for Normin concerning their trenching activities at Calypso including detailed results of gold grain counts and assays;

- Normin_CB_[#]_log.pdf = geologic logs, with posted Au assays, for the appropriate-numbered Normin holes (CB-1 through CB-5); and
- Normin_CB_series_assays.pdf = assay results (gold only) for all of the CB-series holes.

Dahlberg – Normin

As mentioned earlier, the finding of anomalous gold in the old Hanna core holes at Wilson Lake lead to establishment of grids by Normin at several localities along an iron-formation trend in the Wilson Lake sequence (Fig. 56). The Dahlberg Road area was also drilled by Hanna in search of VMS deposits in

1971. These two holes (T-9 and T-10) did intersect iron-formation and were logged and sampled by Santa Fe. Besides iron-formation, the two holes intersected mostly metasedimentary rocks with graphite-rich intervals. Although rock types present in the holes and assay results were discouraging (only a maximum of 39 ppb Au), Normin established a grid called the Dahlberg grid in Sections 15, 21, and 22 (T.61N., R.23W. – Fig. 65). Geophysical surveys were conducted and, as expected from the previous Hanna data, several electromagnetic conductors were delineated. Soil samples were collected from A-horizon material, and even though anomalies were found (maximum of 410 ppb Au – the highest of all Normin's soil samples from all their grids), there was no clustering of the anomalies. Due to the overall discouraging results mentioned above, Normin decided to put the Dahlberg grid "on hold" and concentrate their efforts at Wilson Lake.

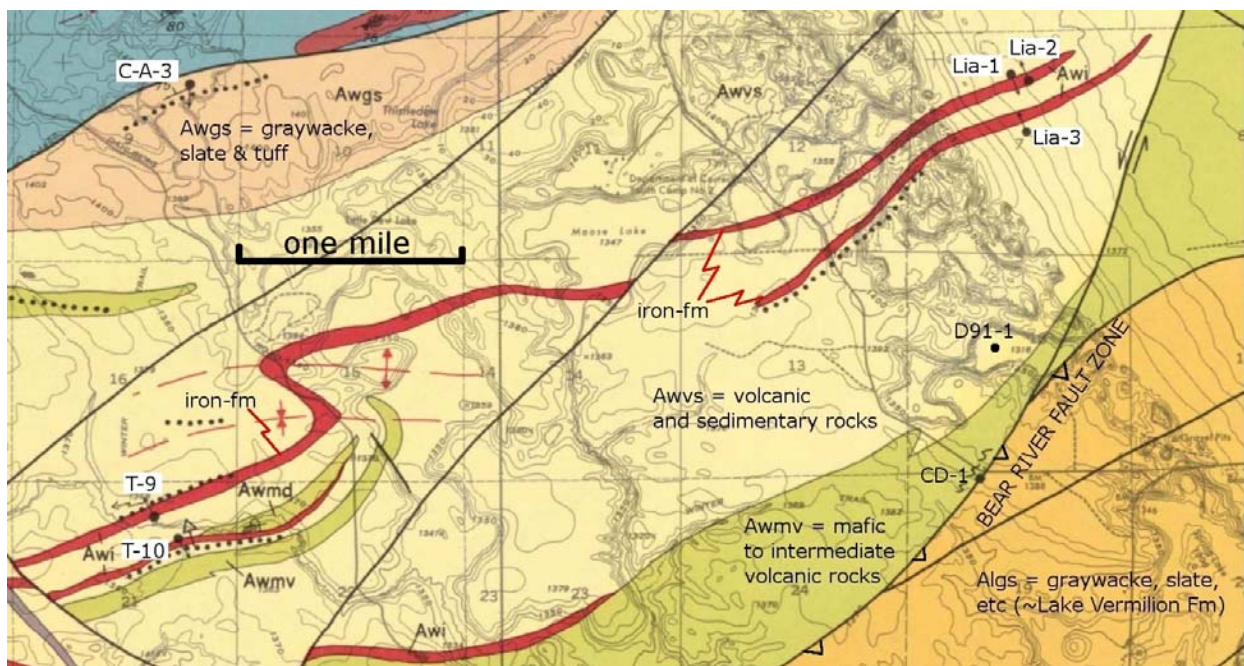


Figure 65. Geology of a portion of Itasca County, modified from Jirsa (1990), showing distribution of holes at the Dahlberg prospect (left side) and Liam prospect (right side). Note that a more recent geologic map (Jirsa and Chandler, 2007) shows a slightly different fault configuration and what is labeled as the Bear River Fault zone in this figure is now considered to be part of the Lost Lake Fault zone. Drill hole C-A-3 in the upper left was drilled by W.S. Moore in 1969. North at top.

Scanned materials pertaining to gold exploration at the Dahlberg prospect in Itasca County included with this report are:

- Hanna_T_9_log_Severson.pdf = geologic log, with posted gold assays, of Hanna hole T-9 (complete analytical results are in Severson's Itasca County report at the MDNR); and
- Hanna_T_10_log_Severson.pdf = geologic log, with posted gold assays, of Hanna hole T-10 (complete analytical results are in Severson's Itasca County report at the MDNR).

Liam – Lehmann

This exploration area (Section 7, T.61N., R.22W. – Fig. 65) appears to have originally been one of Lehmann's VMS prospects in the Wilson Lake sequence that morphed into a gold prospect. Out of the three holes drilled into electromagnetic conductors, in late-1982/early-1983, the information for only two of the holes (LIA-1 and LIA-2) is at the MDNR. The logs for these two holes indicate that the holes intersected altered felsic to intermediate tuffs and iron-formation (various facies types) that is interbedded with argillaceous sediments with hematite and/or graphite. Assay results for these two holes maxed out at 85 ppb Au.

The mystery of the third hole, LIA-3, is intriguing. The author of this report heard a rumor in 1986 that one of the LIA-series holes was reported to have intersected 10 feet of 0.15 opt gold. As the assays for the first two LIA holes document no such values, the rumored high gold, if any, must have been in LIA-3, for which no information has as yet been turned into the MDNR.

Scanned materials pertaining to gold exploration at the Liam prospect in Itasca County included with this report are:

- Lehmann_LIA_1_log.pdf = geologic log for drill hole LIA-1 with posted assay results; and
- Lehmann_LIA_2_log.pdf = geologic log for drill hole LIA-2 with posted assay results.

Gale Brook – Lehmann

Exxon was the first to explore in the Gale Brook area (Sections 29 and 30, T.60N., R.25W.) when they were looking for VMS deposits and drilled hole CN-16 in 1971 (Fig. 66). This hole intersected interbedded tuff, graphitic argillite, and two iron-formation lenses; some brecciation and veining was noted in the rocks, but no samples for gold assay were apparently ever taken. Lehmann also conducted VMS exploration in this area in the early 1980s. This area, like others associated with an iron-formation trend in the Wilson Lake sequence, morphed into a gold prospect. Several holes (Fig. 66) were drilled in: 1983 (GB-1); 1984 (GBD-1); and 1988-1989 (GB-88-1 and GB-88-2). All of the holes intersected alternating tuffs and flows with metasediments and graphitic argillite lenses. In addition, all but GB-88-1 intersected sulfidized iron-formation exhibiting variable brecciation and veining. The best assay encountered in these holes was from GBD-1 that contained 1,360 ppb Au (and 1,480 ppb Au in a repeat assay) in a 10-foot-thick zone (319-329 feet) associated with an iron-formation lense. Other anomalous gold values included 390 ppb Au and 210 ppb Au in GB-88-1 and GB-88-2, respectively.

More recently, Vermilion Gold drilled two holes (GB-09-1 and GB-10-2) in late-2009/early-2010. According to a talk given by Mr. William Rowell of Vermilion Gold (at the AIME/SME convention held in Duluth in the spring of 2011), anomalous gold values (actual assay values unknown) were

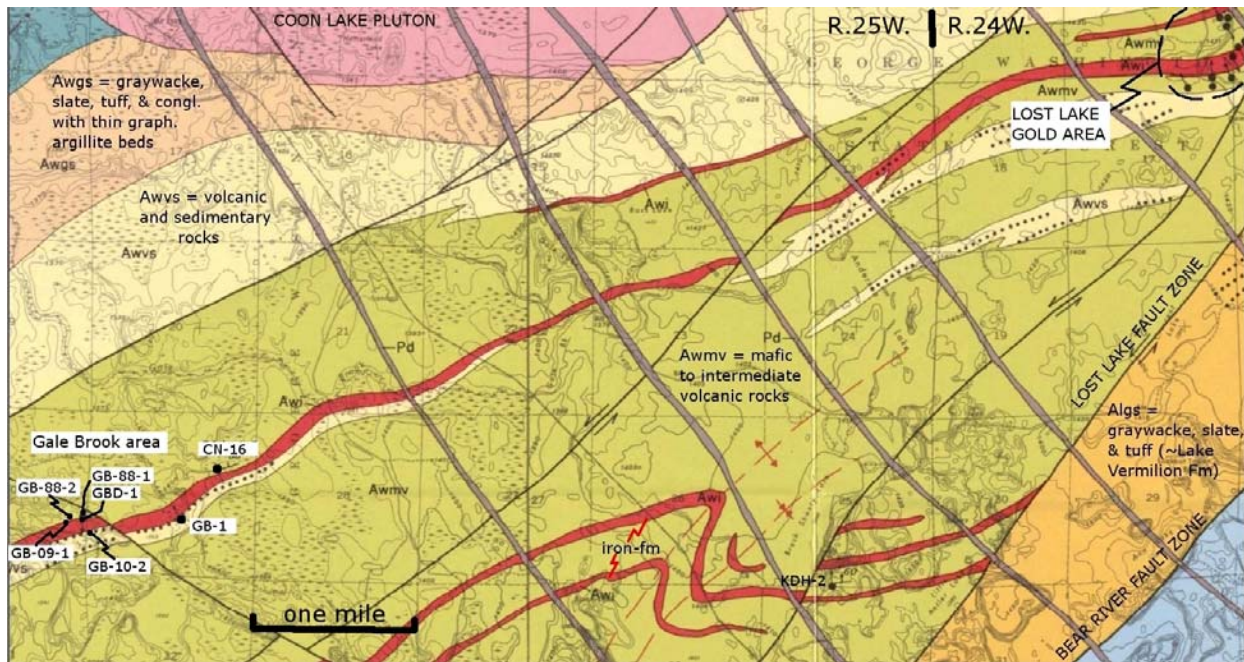


Figure 66. Geology of the Gale Brook area (left side of figure) showing the distribution of holes drilled by Humble/Exxon (CN-16), Lehmann (most of the GB-series holes), and Vermilion Gold (GB-09-1 and GB-10-2). Geology modified from Jirsa (1990). Note the down-strike relationship of the Gale Brook area to the Lost Lake area (upper right corner of figure).

encountered in both holes associated with strong silicification, quartz veining, and sulfidized iron-formation.

Scanned materials pertaining to gold exploration at the Gale Brook prospect in Itasca County included with this report are:

- Exxon_CN_16_log.pdf = geologic log for Humble/Exxon hole CN-16;
- GB_1_log.pdf = geologic log, with posted assay results, for Lehmann hole GB-1;
- Lehmann_GBD_1_log.pdf = geologic log, with posted assay results, for Lehmann hole GBD-1;
- Lehmann_GB88_1_log.pdf = geologic log, with posted assay results, for Lehmann hole GB-88-1; and
- Lehmann_GB88_2_log.pdf = geologic log, with posted assay results, for Lehmann hole GB-88-2.

Joy Lake – Meridian/FMC

The Joy Lake area, situated in Sections 20 and 30 (T.62N., R.23W. – Fig. 67), was explored by Meridian in the mid-1980s. Geophysical surveys were conducted that defined electromagnetic conductors. However, it was not until 1988 that the area was drilled under a Meridian/FMC joint venture. Three holes were drilled into the Joy Lake sequence and intersected the following: JL-88-1 = latite porphyry; JL-88-2 = dacitic tuffs; and JL-88-3 = graphite-rich metasediments. All of the rock types are described as being altered with common sheared and veined zones. It appears that samples were going to be taken, but there are no assay results in the files at the MDNR.

Scanned materials pertaining to gold exploration at the Joy Lake area in Itasca County included with this report are:

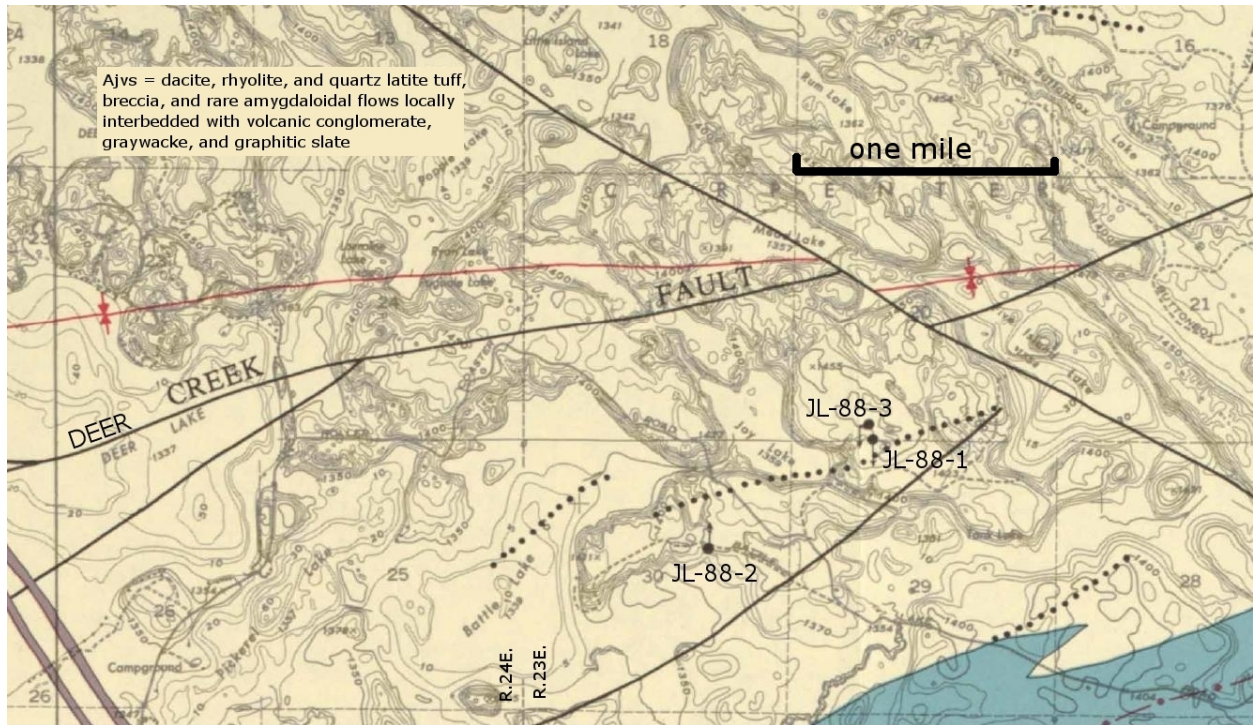


Figure 67. Geology of the Joy Lake area, from Jirsa (1990), showing the distribution of holes drilled by the Meridian/FMC joint venture. North at top.

- Meridian_JL88_1_log.pdf = geologic log for hole JL-88-1 (no assay results);
- Meridian_JL88_2_log.pdf = geologic log for hole JL-88-2 (no assay results); and
- Meridian_JL88_3_log.pdf = geologic log for hole JL-88-3 (no assay results).

immediate area at the Socrates area (SOC-1 in Fig. 68) into an iron-formation positioned between the Bear Lake and Sherry Lake sequences. The hole intersected metagabbro, iron-formation, and graphitic argillite with gold assaying up to 10 ppb Au at best.

Wamp Lake – Noranda

This prospect area is the only gold exploration area in the Bear Lake sequence in Itasca County. The gold exploration area depicted in Figure 68 is in Sections 14, 15, and 22 through 26 (T.60N., R.23W.). Explorations first took place in the general vicinity in search of VMS deposits by W.S. Moore and Inco around 1970. In the early 1980s, the area was explored again for VMS deposits by Lehmann (numerous sites as shown in Fig. 55), and to a lesser extent by Duval. Lehmann drilled one hole in the

Noranda explored this same general area in 1990. They established a large grid and ran geophysical surveys in addition to conducting geologic mapping, outcrop sampling, and soil sampling. Assay results for the outcrop and soil samples were not encouraging, but two holes were drilled in 1990. The first hole (WL-90-1; inclined to the south) was stopped short as the hole was being drilled down bedding planes in metasediments. The drill rig was moved to the south, and inclined to the north, and intersected a series of rocks as follows (with depth in the hole): metagabbro, metasediments with three thin iron-formation lenses; mafic flows; and metasediments with



Figure 68. Geology of the Wamp Lake area, modified from Jirsa (1990) showing the distribution of drill holes at the Wamp Lake grid (outlined area in black) that were drilled by Noranda in 1990 (holes WL-90-1 and WL-90-2). Note that the geology shown in this figure was published before the information regarding the Noranda holes was released. Also shown is the adjacent Socrates grid (outlined area in red) with the hole (SOC-1) drilled by Lehman. The KAT-series holes were drilled by Lehmann in 1984. North at top.

two thin iron-formation lenses. Core samples were sent for assay, but only a maximum of 23 ppb was found and Noranda discontinued their efforts at Wamp Lake.

According to a talk given by Mr. William Rowell (at the AIME/SME convention held in Duluth in the spring of 2011), Vermilion Gold has recently started exploration activities in the Wamp Lake area. In his talk, Mr. Rowell mentions that anomalous gold concentrations have been found in outcrop (actual locations

are classified, but state leases recently acquired by Vermilion Gold roughly correspond to Lehmann's Hera grid in Fig. 56).

The Wamp Lake area is situated on the west side of an area that has been identified by the MDNR as the "Largest cluster of anomalous gold in till in Minnesota" (Elsenheimer, 2011). Out of 133 samples collected from till, there were 55 samples with >10 gold grains (area outlined by dashed blue

line in Fig. 56) with a maximum of 324 gold grains (227 gold grains when normalized to 10 kg table weight). Most of the gold grains in these samples were reshaped, except for two of the samples that had over 10 modified grains. Work on the morphology of all the gold grains by Overburden Management indicated that many of the grains are flattened and display thicker rims that suggest reworking in a beach environment. The MDNR has speculated that the gold grains may have been liberated from a nearby bedrock source and were possibly redistributed in a paleoplacer deposit in the Cretaceous period, with still later glacial redistribution during the Quaternary period.

Scanned materials pertaining to gold exploration at the Wamp Lake area in Itasca County included with this report are:

- Lehmann_SOC_1_log.pdf = geologic log, with posted assay results, for Lehmann hole SOC-1;
- Noranda_Wamp_Lake_grid.pdf = map showing the Noranda Wamp Lake grid;
- Noranda_Wamp_Lake_otc_assays.pdf = assay results for outcrops sampled at Wamp Lake (sample locations are in grid coordinates);
- Noranda_Wamp_Lake_soil_assays.pdf = assay results for soil samples at Wamp Lake (sample locations are in grid coordinates);
- Noranda_Wamp_Lake_WL_90_1_log.pdf = geologic log for Noranda hole WL-90-1;
- Noranda_Wamp_Lake_WL_90-2_log.pdf = geologic log for Noranda hole WL-90-2;
- Noranda_Wamp_Lake_WL_90_2_assays.pdf = assay results for Noranda Hole WLs-90-2; and
- Noranda_Wamp_Lake_WL_90_holes_assays.pdf = assay results, plus additional elements, for both of Noranda's holes at Wamp Lake.

Conclusions for western Itasca County

A review of the gold prospects in Itasca County suggests that significant gold shows are present with up to 5,400 ppb Au at Lost Lake. In almost all cases, the high gold values are associated with iron-formation, especially structurally-prepared and sulfide-replaced zones. The glacial overburden sampling campaigns have reiterated this gold-to-iron-formation connection. Overall, the data suggest that future exploration in Itasca County should concentrate on areas where mapped fault zones and iron-formation trends intersect.

Gold Exploration in the Rainy Lake Area

Geologic Setting

The Rainy Lake area lies on the boundary between two lithotectonic subprovinces of the Superior Province: the Wabigoon granite-greenstone terrane to the north and the Quetico metasedimentary terrane, including the Vermilion Granitic Complex in Minnesota, to the south. Poulsen (1986) recognized the Rainy Lake boundary as a complex transpressive deformation zone that is bounded by two major structures: the Quetico and the Rainy Lake-Seine River faults. These two faults most likely behaved as both dextral faults and shear zones during their deformational histories (Czeck and Poulsen, 2010).

In Minnesota, rocks of the Wabigoon terrane consist of an older sequence of metavolcanic rocks that are variably schistose and include: pillowed, massive, and tuffaceous basalt; felsic tuff; hypabyssal intrusions; and metasedimentary rocks of apparent turbiditic origin (Jirsa and Hemstad, 2010). These rocks, as a whole within the

entire subprovince, occur in the range of 2,745-2,720 Ma (Corfu and Davis, 1992). The metavolcanic rocks are cut by plutonic rocks that range from 2,710-2,660 Ma. Still younger clastic successions, including the Seine Group, sit with a local unconformity on the older metavolcanic rocks and have ages of 2,711-2,686 Ma (Jirsa and Hemstad, 2010). The Seine Group consists of interbedded conglomerate, sandstone, and minor tuffs that were deposited in fault-related basins in a fluvial environment as “Timiskaming-type” sediments (Czeck and Poulsen, 2010; Jirsa and Hemstad, 2010).

Rocks of the Quetico terrane to the south of the Rainy Lake area consist largely of schist derived from turbiditic sedimentary rocks and a complex suite of granitic intrusions and associated migmatite. The migmatitic and plutonic rocks of the central zone of the Quetico terrane in Minnesota are collectively known as the Vermilion Granitic Complex (Southwick and Sims, 1970; Jirsa and Hemstad, 2010).

Both of these terranes have undergone three main phases of deformation. As described by Day (1990), these deformations are outlined below:

1. *D₁ Deformation.* The earliest deformation event produced tight to isoclinal, northeast-trending folds that plunge to the southwest and are locally overturned to the southeast. Czeck and Poulsen (2010) believe that the original orientations of many of the folds in adjacent Canada were nappe-like and were associated with thrusting or “stacking.” This first deformation event occurred shortly after deposition of the rocks in the range of 2,698-2,690 Ma (Valli et al., 2004).
2. *D₂ Deformation.* This deformation event was the most intense and was synchronous with peak regional metamorphism. It produced small-scale F₂ folds, a strong S₂ schistosity, a moderate S₂' cleavage, and mineral lineations, which strike east-

northeast. D₂ deformation was a dextral transpressional event and began around ~2,689 (Valli et al., 2004). The D₂ fabric is the most pronounced in the tectonic block between the Jackfish Bay and Rainy Lake-Seine River faults. The Seine Group was deposited in fault-related basins, e.g., “Timiskaming-like sediments,” during early D₂. This event probably initiated the earliest movement along the major faults in the area.

3. *D₃ Deformation.* The final deformation involved amplification of dextral strike-slip motion along high-angle faults and shear zones, most notably the Rainy Lake-Seine River fault (Day, 1990; Bauer and Bidwell, 1990; Bauer et al., 1992). Local late-stage brittle faults associated with north-south shortening have also been described (Tabor and Hudleston, 1991).

Gold Exploration Activities

As mentioned earlier, the first phase of explorations for gold in the Rainy Lake area took place in the 1890s wherever quartz veins were found in the highly sheared rocks of what is now recognized as the Rainy Lake-Seine River Fault zone and, to a lesser degree, the nearby Tilson Bay Fault zone. Five prospects were established in these two fault zones (Fig. 69), but only the Little American Mine ever produced any gold. The gold-bearing veins form concordant and locally discordant pods, boudins, and stringers within the Seine Group rocks indicating that mineralization was during or slightly later than shearing associated with the Rainy Lake-Seine River Fault Zone (Sims and Day, 1992). If any additional attempts were made to find gold immediately after the Rainy Lake Gold Rush, in the early to late 1900s, there are no records.

However, this lack of exploration changed in 1984 when the MDNR drilled hole RR-1 (Fig. 70) in order to increase the knowledge of

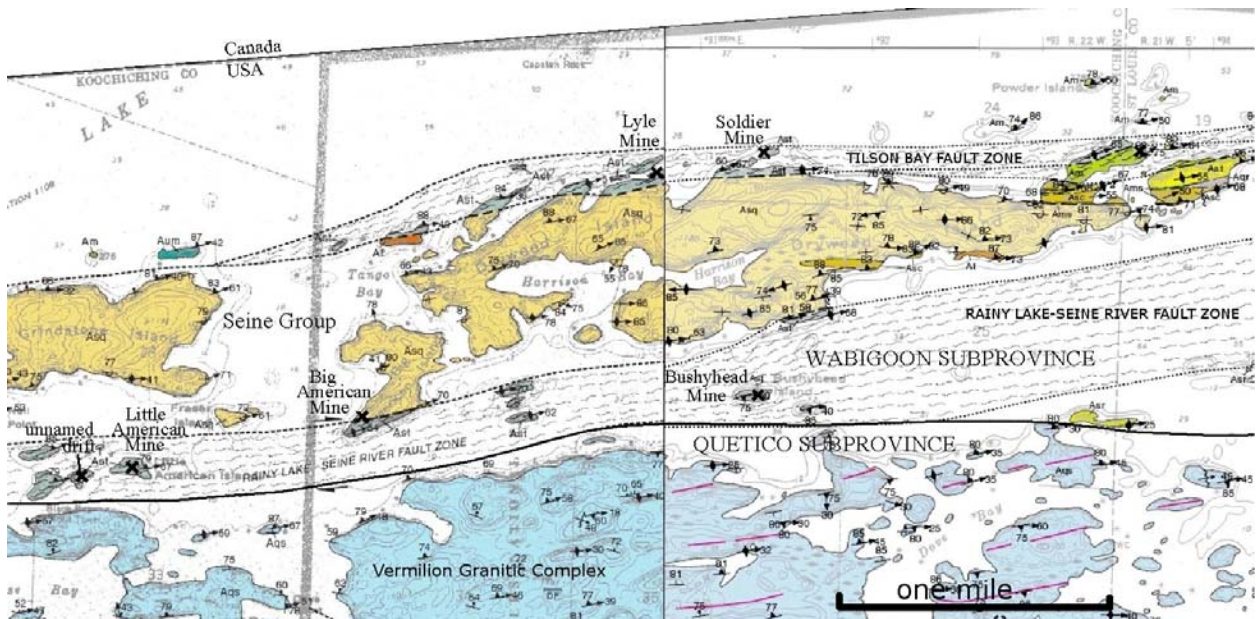


Figure 69. The geology of the Rainy Lake area in Minnesota showing the distribution of gold prospects along the Rainy Lake-Seine River and Tilson Bay fault zones. Geology from Hemstad et al. (2000, 2001). North at top of map.

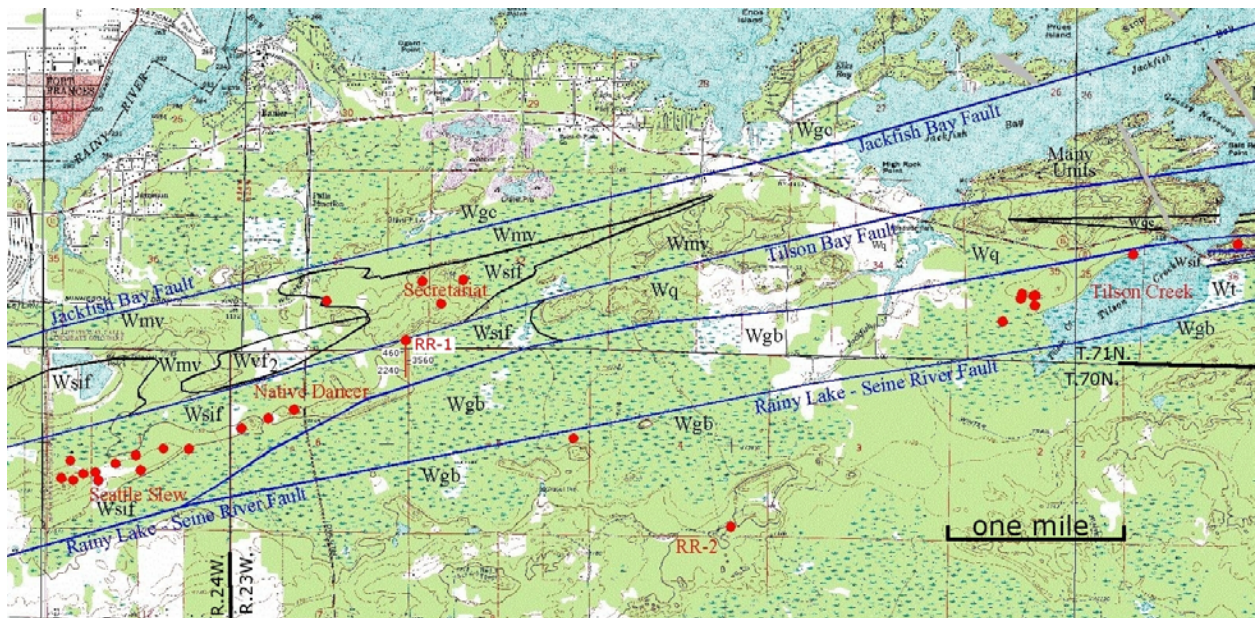


Figure 70. Distribution of drill holes, and names of the drilled areas in red, that were explored for gold in the late 1980s in the Rainy Lake area. Geological rock units, from Day (1990), are as follows: Wgb = schistose sedimentary rocks of the Vermilion Granitic Complex; Wt = tectonite in the Rainy Lake-Seine River Fault Zone, Wsif = amphibolite schist and iron-formation; Wmv = mixed volcanic flows and tuffs; Wvf₂ = carbonate-rich dacite tuffite; Wgc = schistose sedimentary rocks; Wq = feldspathic quartz arenite and minor conglomerate of the Seine Group; and Wqc = polymict conglomerate of the Seine Group. The northwest-trending, gray-colored bands on the right side of this figure are Paleoproterozoic dikes. Blue lines represent faults and black lines represent contacts. North at top of map.

the mineral potential in the area. The hole was drilled wholly within a mapped geologic unit (Day, 1990) consisting of amphibolite and iron-formation and intersected schistose rocks with varying amounts of metamorphic minerals. At the time, a geological consultant, working for Boise Cascade, took two samples from the core before the hole was to become publically available (author's recollection). Both of these samples returned assays with anomalous values of gold at 3,560 ppb Au and 2,240 ppb Au (at 899.4-900.1 feet and 1303.5-1304.0 feet, respectively). Encouraged by these high values, Boise Cascade formed Normin Mining Incorporated and began to explore their own mineral lands, as well as, lease state lands in the vicinity of hole RR-1. Other companies, including Kerr McGee and later Newmont, also began explorations in the vicinity. The activities of all of these companies are discussed below. A listing of the holes drilled in the Rainy Lake area is presented in Rainy_Lake_drill_holes.xls data file included in Appendix A.

Native Dancer and Secretariat

Shortly after the MDNR drilled hole RR-1, Normin began explorations in their Native Dancer and Secretariat blocks (Sections 31 and 32, T.71N., R.23W.; and Section 6, T.70N., R.23W.). Grid-based geologic mapping and geophysical surveys were conducted in 1984; however, as none of these lands were on state leases, none of these data were ever turned over to the MDNR. In early 1986, three holes were drilled at each of the respective blocks (Figs. 69 and 70) under a joint venture with Santa Fe Pacific Gold. Even though all of the holes were collared in "amphibolite and iron-formation" (Wsif unit in Fig. 71), it is difficult to tell what types of rock were drilled from the lithologic logs. Gold assays were discouraging, with a maximum of 520 ppb Au in hole ND-2.

Scanned materials pertaining to gold exploration at the Secretariat and Native Dancer blocks included with this report are:

- Normin_Secretariat_S_[#]_log.pdf = geologic logs, with posted gold assay results, for the appropriately-numbered Normin holes at the Secretariat block (S-1, S-2, and S-3); and
- Normin_Native_Dancer_ND_[#]_log.pdf = geologic logs, with posted gold assay results, for the appropriately-numbered Normin holes at the Native Dancer block (ND-1, ND-2, and ND-3).

Seattle Slew

Undaunted by their less than spectacular drilling results in 1986, Normin continued with their explorations in the area under a joint venture with Battle Mountain Gold in 1987. Four holes were drilled down strike and to the west of hole RR-1 in the "amphibolite and iron-formation" unit at Normin's Seattle Slew block (Section 1, T.70N., R. 24W. – Fig. 72). The major rock unit intersected in all of these holes (SS-1 through SS-3) is described as a schistose quartz-actinolite-chlorite "exhalite." Gold assay results for these first holes, posted in Figure 72, were highly encouraging with highs of 2,765 ppb Au and 2,780 ppb Au in holes SS-1 and SS-2A, respectively.

An additional eight holes were drilled to the east of the initial holes in 1989 (holes SS-4 through SS-11 in Fig. 72). The rocks intersected in these holes were logged by different geologists using different descriptive criteria, but the main rock types appear to have been massive and banded chlorite-actinolite-quartz schist with magnetite- and sulfide-bearing iron-formation lenses. The best assay results were from drill hole SS-4 with a maximum of 8,016 ppb Au; however, lesser amounts of gold were found to be

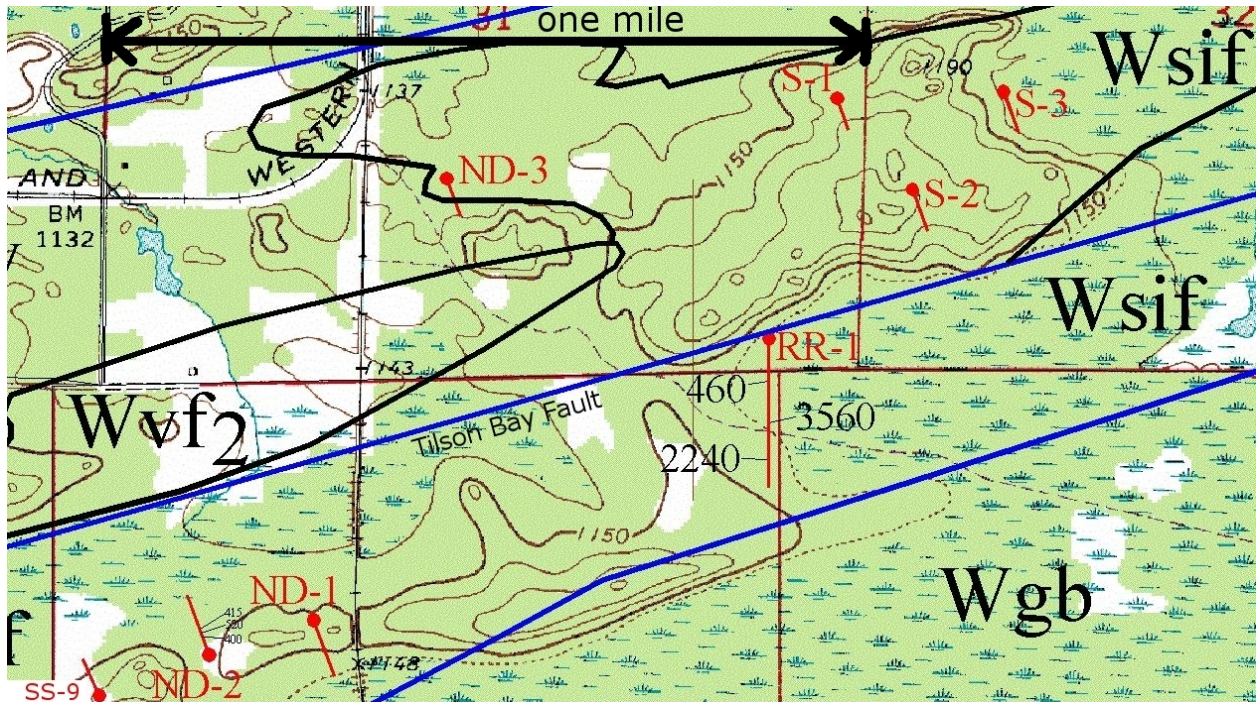


Figure 71. Distribution of drill holes at Normin's Secretariat block (S-series holes) and Native Dancer block (ND-series holes). Anomalous gold values (>400 ppb Au threshold) are posted for MDNR hole RR-1 and ND-2; all posted gold values are in ppb. Descriptions of the geologic map units can be found in Figure 70. Note that hole SS-9 is the eastern-most hole of Normin's Seattle Slew block. North at top of map.

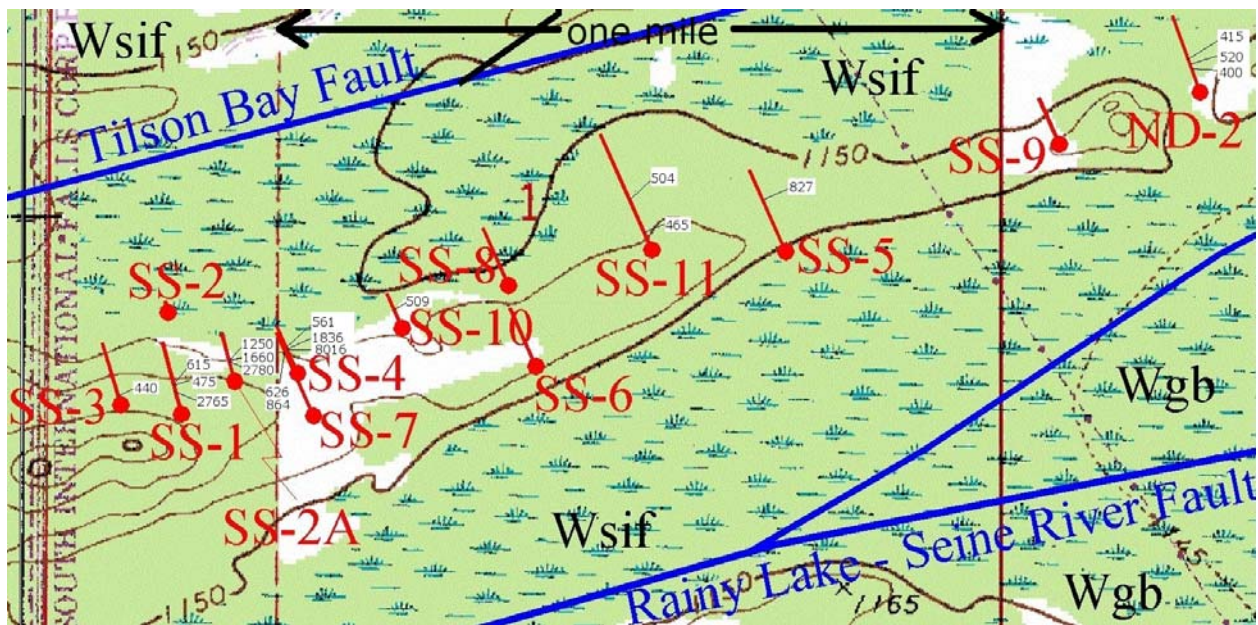


Figure 72. Distribution of holes at Normin's Seattle Slew block with posted gold assay results (>400 ppb Au threshold) in each of the holes; all of the Au values are in ppb. Descriptions of the geologic map units can be found in Figure 70.

present in the other SS-series holes (see posted values in Fig. 72). Drill hole SS-7, which was drilled to intersect the mineralized zone of SS-4 at depth, encountered rock with lesser gold values. As a result of the sporadic, but high, gold values intersected in all of the holes, Normin discontinued activities in the Rainy Lake area.

Scanned materials pertaining to gold exploration at the Seattle Slew block included with this report are:

- Normin_soil_geochem_map.pdf = soil sample map of the Seattle Slew block showing contoured gold values (in ppb). The highest gold values in this map, >8 ppb Au, correspond to the area situated between holes SS-5 and SS-6; and
- Normin_SS-[##]-log.pdf = geologic log, and posted gold assay results, for the appropriately-numbered Normin holes at the Seattle Slew block (SS-1 through SS-11).

Tilson Creek

Kerr McGee began explorations to the east of Normin's activities in 1987. They conducted mapping and rock sampling wholly within the Rainy Lake-Seine River Fault Zone in an area called the Tilson Creek block (Sections 35 and 36, T. 71N., R.23W. – Fig. 73). Samples collected from two outcrops (shown by the Xs in Fig. 73) returned assay results of 1,710 ppb and 640 ppb Au from an outcrop in the west part of the block, and 9,570 and 4,320 ppb Au from another outcrop in the east part of the block. These encouraging surface gold values led to the drilling of five holes (Fig. 73) in both areas (TC-35-1 through TC-35-4 in the west anomaly, and TC-36-1 in the east anomaly) in 1987-1988. All of the holes intersected variably-foliated rocks that are generally described as amphibole-chlorite-calcite schist

with interbeds of quartz-biotite-chlorite schist and a localized garnet-rich marker horizon. Assay results from the east area (hole TC-36-1) were a bust, and no more activities were conducted there. However, assay results from holes TC-35-1 and TC-35-3 returned encouraging high values of 1,460 ppb Au and 2,480 ppb Au, respectively. [Note that an assay value of 4,020 ppb Au may also be present in an unknown interval sampled in TC-35-1.] One hole, TC-35-2, was drilled further south into a geophysical conductor and did not intersect any auriferous zones associated with pyrrhotite-rich stockwork zones. In 1989, Newmont also conducted drilling activities at Tilson Creek under a joint venture with Kerr McGee. Only one out of Newmont's three holes (TC-35-5) intersected an auriferous zone (2,540 ppb Au), and both Newmont and Kerr McGee ceased activities.

Scanned materials pertaining to gold exploration at the Tilson Creek block included with this report are:

- Kerr_McGee_Tilson_Creek_east_geol_map.pdf = Kerr McGee map showing geology, drill hole TC-36-1, and outcrop sample numbers for the eastern area of the Tilson Creek block;
- Kerr_McGee_Tilson_Creek_west_geol_map.pdf = Kerr McGee map showing geology, drill holes (TC-35-1 through TC-35-4), and outcrop sample numbers for the western area of the Tilson Creek block;
- KM_otc_&_assort_TC_hole_assays.pdf = assay results for outcrop samples (DU-series) and whole rock geochemical results, for select intervals from the TC-35-series holes, collected by Kerr McGee;
- Kerr_McGee_TC_35_[#]_log.pdf = geologic logs for the appropriately-numbered Kerr McGee holes TC-35-1 through TC-35-4;
- TC_35_1_assays.pdf = assay results for appropriately-numbered Kerr McGee holes TC-35-1 through TC-35-4;

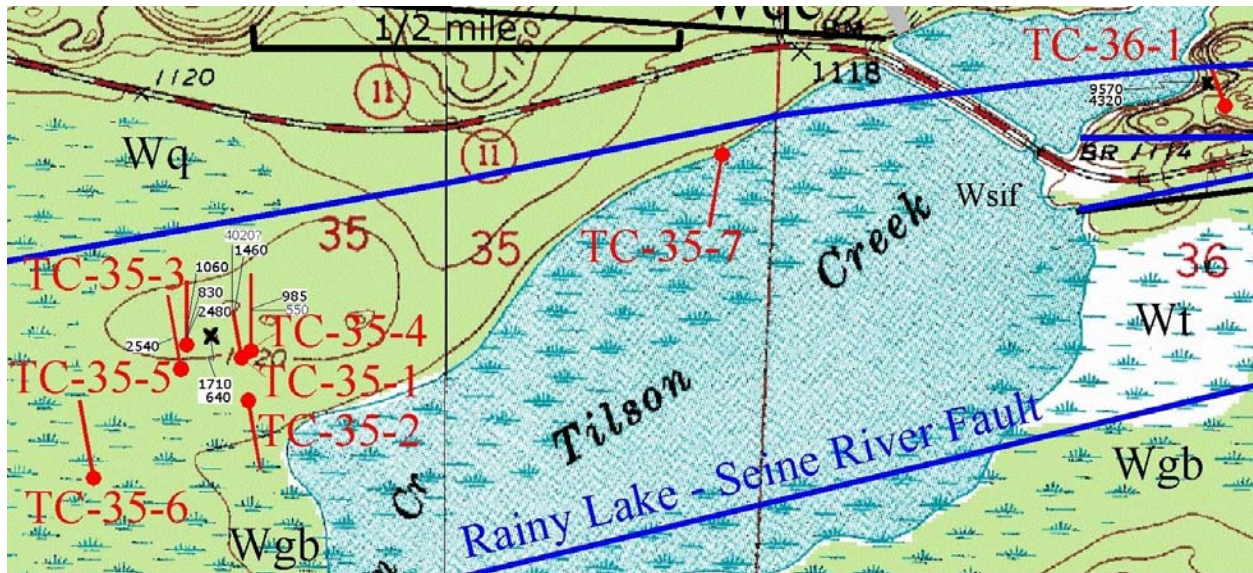


Figure 73. Distribution of drill holes at the Tilson Creek gold exploration block. Assay results for gold (all in ppb Au) are shown for both drill holes intervals (projected to the surface) and outcrop samples (Xs) using a cutoff of >400 ppb Au. Descriptions of the geologic map units can be found in Figure 70.

- Kerr_McGee_TC_36_1_log.pdf = geologic log for the hole drilled by Kerr McGee (TC-36-1) in the eastern part of the Tilson Creek block;
- TC_36_1_assays.pdf = assay results for Kerr McGee hole TC-36-1; and
- Newmont_TC_35_[#]_log.pdf = geologic logs, with posted gold assay results, for appropriately-numbered Newmont holes (TC-35-5 through TC-35-7) drilled in the western portion of the Tilson Creek block. Note that not all of the assay results for TC-35-7 are legible and the original copy should be obtained by the reader.

Conclusions for Rainy Lake area

A review of the exploration activities conducted at the gold prospects in the Rainy Lake area suggests significant gold anomalies are present within both the “iron-formation” unit of Day (1990) and the Rainy Lake-Seine River Fault Zone. However, the gold values obtained during drilling generally occur as

isolated values in a select number of drill holes. As at all of the other gold prospects in Minnesota, detailed structural analyses do not appear to have been used (or at least there are no records of such studies that are available) to help select drill targets. In addition, very little deep drilling was done to help determine the variation of gold in the third dimension. And lastly, the outermost edges of the faults were not drilled to intersect highly-sheared and quartz-veined rocks associated with the Rainy Lake-Seine River Fault.

The MDNR conducted some work on the drill holes in the area in 2009 (Frey, 2010). Through the use of a hand-held XRF, samples with anomalous gold were selected for assay. One of the samples, from drill hole ND-2 (235-240 feet), was found to contain 799 ppb Au in association with anomalous concentrations of bismuth and tellurium. Sampling of glacial overburden by the MDNR, as a test to locating gold mineralization in bedrock, is ongoing as of 2011.

Gold Exploration in Koochiching-Beltrami-Roseau-Lake of the Woods Counties

Geologic Setting

The geologic setting of the Koochiching-Beltrami-Roseau-Lake of the Woods (KBRLW) area is mainly known from drill holes and regional geophysical interpretations. A detailed description of the rocks, and a brief structural interpretation, is presented in Ojakangas et al. (1977). Since that time there have been no revisions to the rock descriptions, but the regional geology has been updated several times in various maps. The most recent version, by Jirsa et al. (2011), is used in the figures of this report.

Exploration for VMS deposits began in the Wabigoon subprovince of the KBRLW area as early as 1967 when Texas Gulf Oil drilled two holes. Exploration by Texas Gulf continued through 1973 when they drilled several areas, including six holes at their Hero massive sulfide deposit (Section 7, T.158N., R.36W.). The Hero deposit is highly weathered and oxidized in the top portions of the drill holes to hematite-limonite-goethite, and it appears that Texas Gulf was also looking at the deposit's iron ore potential. Additional companies that drilled in the KBRLW area during 1978-1975 included: Humble/Exxon, W.S. Moore, INCO, Amoco, Superior Oil Company, and even the MDNR. After a short hiatus, drilling and exploration for VMS deposits once again took place during 1982-1988 by companies that chronologically included: Cominco, Amselco, Houston Oil and Minerals, St. Joe, Duval, and Newmont. By the time Newmont entered the scene, VMS deposits with associated gold mineralization were probably sought. Drilling under this category continued intermittently through 1996 as more companies initiated exploration efforts that included: Kerr McGee/BHP joint venture, Noranda, Phelps Dodge, and Normin. Most of Normin's efforts were to define potential Cu-Ni-PGE minerali-

zation associated with the Winter Fire gabbroic intrusion – exploration that continues in 2011 by Prime Meridian. Overburden and “touch-down” holes into the bedrock were also drilled by the MDNR, Minnesota Geological Survey, Newmont, and Exmin (diamond exploration). In total, over 230 holes were drilled into the KBRLW area (Fig. 74).

Semi-massive to massive sulfide mineralization, mostly pyrite and pyrrhotite with moderately-elevated zinc values, was intersected in 52 of these holes (Severson and Heine, in prep.). The distribution of these holes is shown in Figure 74. In perusing the assay data for this report, it was noticed that twelve holes intersected zones with >500 ppb Au. These holes with anomalous gold are shown in Figure 75 and are listed in Table 4. Most of these anomalous gold values are isolated and thus will not be discussed in detail in this report.

Conclusions for the Koochiching-Beltrami-Roseau-Lake of the Woods area

The overall lack of data contained in the widely-spaced drill holes of the KBRLW area is disheartening, and very few conclusions can be made in this report. The data suggest that the Hero deposit has the most anomalous gold. Unfortunately, the known gold assay results at Hero are only from re-sampling efforts by Noranda and Chevron. In fact, all of Chevron's assay results from select Hero holes were extremely low and are not reflected in the postings of Table 4. Furthermore, it was rumored in the 1980s (William Ulland memorandum in the Ulland files at the NRRI) that Texas Gulf was taking another look at their Hero property. This rumor indicates that Texas Gulf was probably conducting gold assays on their in-house stored pulps and rejects. However, the results of any of these assays, and even the earlier 1970s-vintage assays by Texas Gulf, are not preserved at the MDNR.

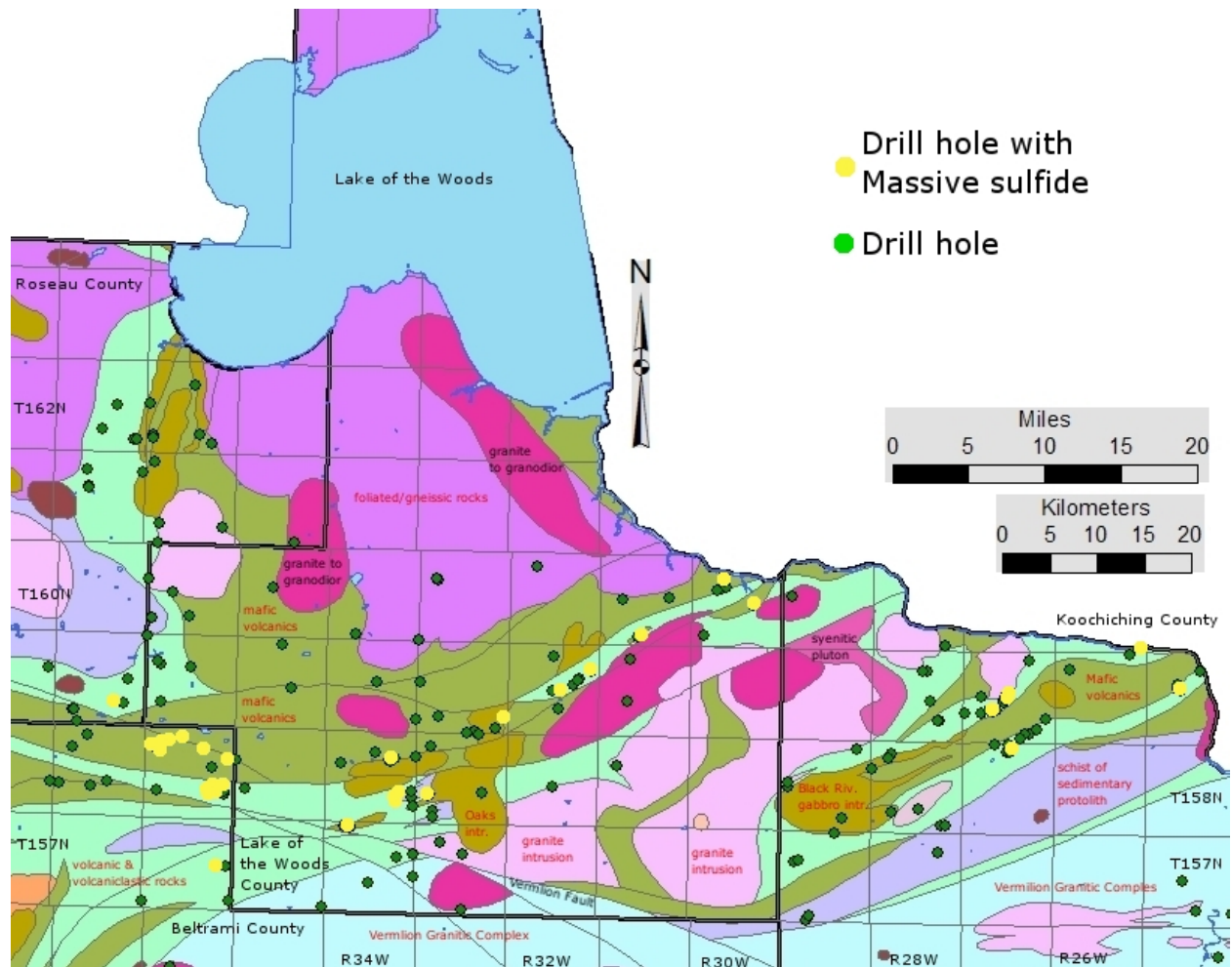


Figure 74. Distribution of holes (green dots) that were drilled in the Koochiching-Beltrami-Roseau-Lake of the Woods area. Holes that intersected >2 feet of semi-massive to massive sulfides are denoted by yellow dots. Geology from Jirsa et al. (2011). Note that additional holes were drilled in western Roseau and Beltrami counties and are not shown in this figure.

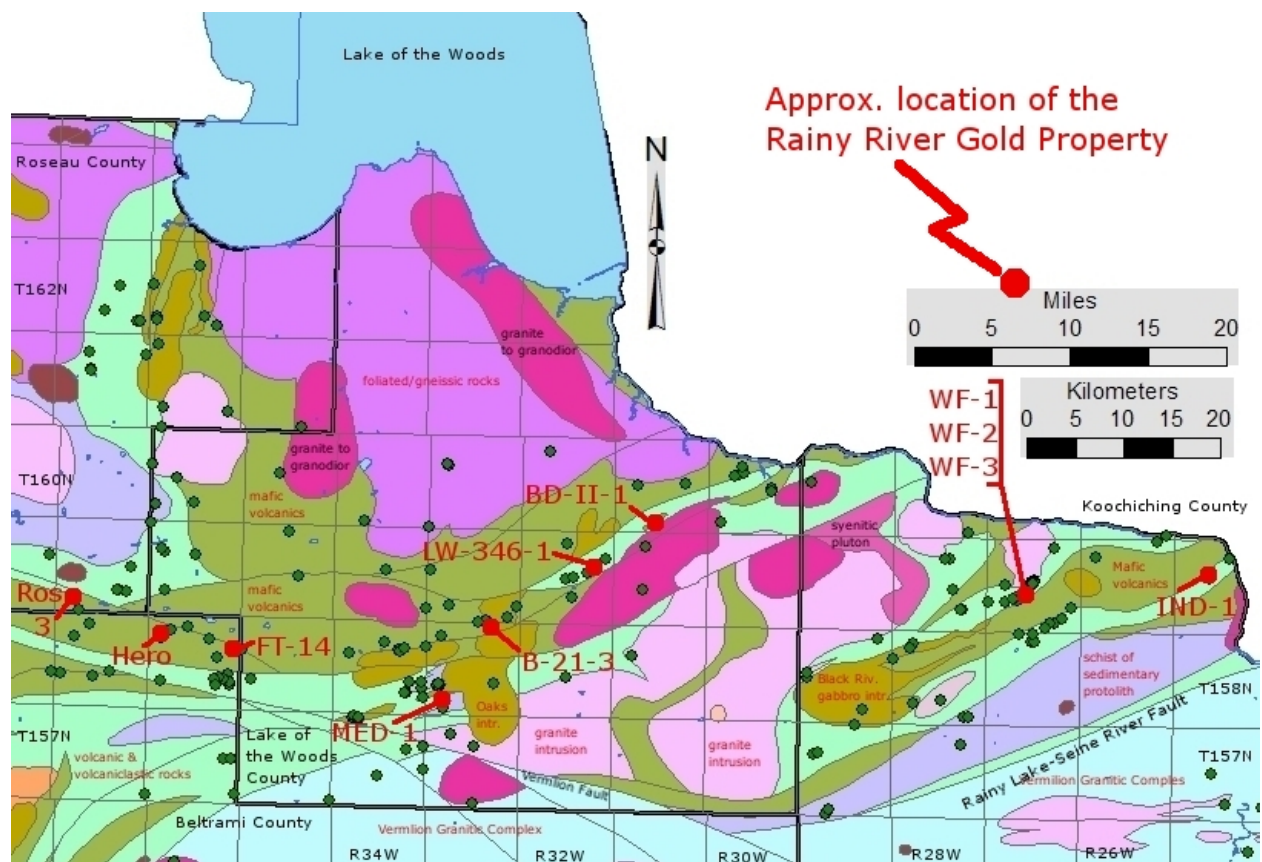


Figure 75. Distribution of holes, denoted by the red dots along with the drill hole number, that intersected one or more intervals with >500 ppb gold in the Koochiching-Beltrami-Roseau-Lake of the Woods area. Note location of the Rainy River Gold Property in Canada relative to the gold-bearing holes in the Wabigoon subprovince of Minnesota. The Hero deposit is a massive sulfide deposit drilled by Texas Gulf – two holes from Hero have several auriferous intervals (see Table 3). Geology from Jirsa et al. (2011). Note that the assay results for drill holes in western Roseau and Beltrami counties were not reviewed for this project.

Table 4. Listing of holes, and intervals, from the Koochiching-Beltrami-Roseau-Lake of the Woods area, as shown in Figure 75, that intersected one or more intervals with >500 ppb Au.

Hole	Sec-Twn-Rng	Au (ppb)	Interval (feet)	Rock Type
MED-1	32-158-33	550	451-456	Iron-formation
FT-14	13-158-36	700	495-500	Iron-formation
FT-14		2,745	500-502	Mass. sulfide
FT-14		1,500	502-504	Mass. sulfide
FT-14		520	504-506	Mass. sulfide
FT-10/Hero	7-158-36	720	674-679	Mass. sulfide
FT-21/Hero	7-158-36	753	580-585	Qtz Feld Porph
FT-21/Hero		1,440	619.5-626	“Granite”
FT-21/Hero		766	620-625	“Granite”
FT-21/Hero		946	635-640	“Granite”
IND-1	16-159-25	1,460	421-425	Chert
WF-1/Winterfire	2-159-27	560	286-287	Mass. sulfide
WF-2/Winterfire	21-159-27	660	119-120.1	Volcaniclastics
WF-3/Winterfire	21-159-27	690	410-413.5	Volcaniclastics
LW-346-1	14-159-32	790	285.9-286.3	Volcaniclastics
ROS-3	32-159-37	600	500-511	Metasediments
BD-II-1	33-160-31	580	615-618	Chemical sed.
B-21-3	2-158-33	660	456	Basalt

Gold Exploration in the Virginia Horn

Geologic Setting

The term “Virginia Horn” is a geographical term that applies to an area near the town of Virginia, MN, where the generally east-trending Mesabi Iron Range makes an abrupt bend to the southwest, creating an S-shaped horn (Fig. 76). The Paleoproterozoic rocks of the Mesabi Iron Range, including the Biwabik Iron Formation, unconformably overlie Neoproterozoic bedrock of the Wawa subprovince. The Neoproterozoic rocks in the Virginia Horn are subdivided into northern and southern panels, based on metamorphic grade and deformation style that are separated

by the east-trending, post-metamorphic, Laurentian fault (Jirsa and Boerboom, 2003b). The southern panel was explored for gold and contains greenschist-grade metamorphic rocks consisting of calc-alkalic to tholeiitic mafic volcanics, hypabyssal quartzofeldspathic intrusives, and clastic sediments including turbiditic rocks of the Mud Lake sequence (also discussed by Levy, 1991), and conglomerate and lithic sandstone of the Midway sequence (“Timiskaming-type” sediments as first described in Jirsa, 2000). The northern panel contains equivalent rocks, but they are intensely lineated and metamorphosed to amphibolite grade. No exploration for gold apparently took place in northern panel.

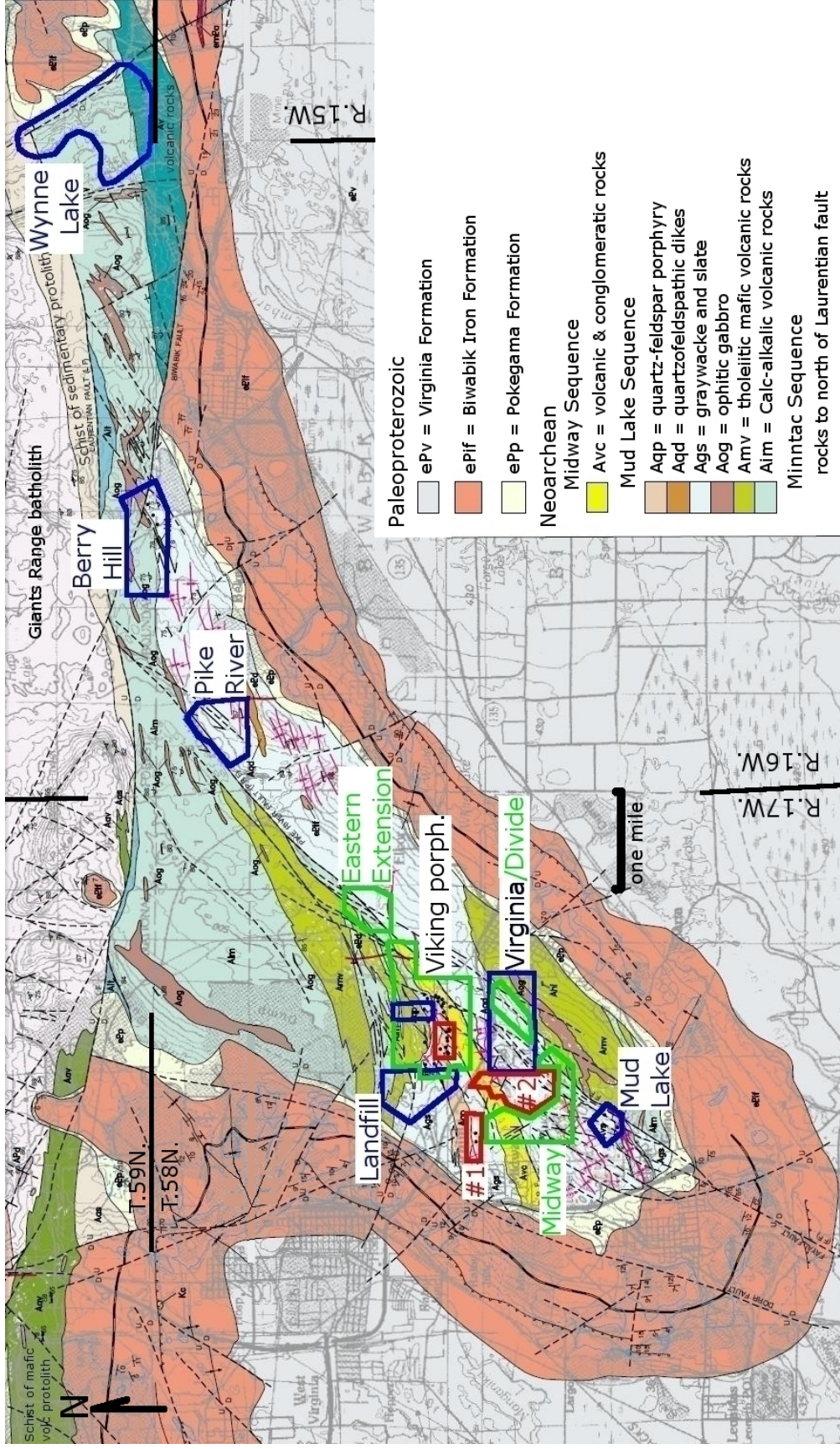


Figure 76. Geologic map of the Virginia Horn area (modified from Jirsa et al., 1998) that displays where mineral exploration activities took place as follows: blue boxes outline Resource Exploration grid areas; red boxes outline Rhude and Fryberger grid areas; and green boxes outline Newmont grid areas. Note that these boxed areas are generalized and there is considerable overlap by the three companies. A listing of the holes at each site is presented in the Virginia_Horn_drill_holes.xls in Appendix A.

Both of the panels have undergone three main phases of deformation. As described by Jirsa and Boerboom (2003b), these deformations are outlined below:

1. *D₁ Deformation.* The earliest deformation event, best recorded in the south panel, involved upright folding, soft-sediment deformation, and complex faulting to produce a southwest-plunging syncline that is cored by mainly graywacke and slate, and has outer limbs of calc-alkalic and tholeiitic volcanic strata. No cleavage development is associated with this event. All of the rocks were cut by quartz-feldspar intrusions (QFP) prior to *D₂*. After a period of uplift and subaerial erosion, the conglomeratic Midway sequence was deposited as a “Timiskaming-type” sequence in localized pull-apart basins along the ancestral Pike River fault.
2. *D₂ Deformation.* The second deformation event was the metamorphic cleavage-forming event in both panels. In the southern panel, this event produced rare, nearly-vertically dipping, tight to isoclinal, *F₂* folds with axial planar cleavage that is well developed in the metasediments. In the north panel, this same event produced strong flattening and an intense lineation. Carbonate-sericite alteration probably developed post- or late-*D₂* and was focused: 1. near and within quartzofeldspathic intrusions; 2. near major lithologic boundaries; 3. along major shear zones; and 4. as more widespread zones in the graywacke and conglomerate.
3. *D₃ Deformation.* The rocks in both the north and south panels were all affected by brittle deformation assigned to *D₃* that produced localized semi-brittle crenulation of *D₁* and *D₂* structures, and selective reactivation of earlier-formed faults.

Gold Exploration

During the late 1980s, exploration for gold was conducted by three companies: Newmont, Rhude and Fryberger, and Resource Exploration. This phase of exploration was prompted by an earlier mention of a gold discovery by J.W. Gruner in 1924 (Grout, 1937). Reportedly, Gruner found visible gold and arsenopyrite in veins associated with a quartzofeldspathic intrusion in railroad cuts near Virginia. Each of these companies established grids, conducted geophysical and mapping surveys, and conducted extensive soil and rock sampling campaigns. The first two companies primarily focused their efforts on a large, carbonate- and sericite-altered quartz-feldspar porphyry, informally called the Viking porphyry (Morey and Jirsa, 2003). Resource Exploration conducted some exploration on the Viking porphyry, but also explored in other areas of the Virginia Horn in alteration zones that were associated with structurally-modified contacts (Morey and Jirsa, 2003). American Shield drilled one hole in 1997. Vermilion Gold is currently exploring in the area and drilled nine holes in 2009-2010.

In regard to gold exploration in the Virginia Horn, there were at least nine gold exploration areas, shown in Figure 76, with most of the drilling and trenching taking place in the Viking Porphyry area (in portions of Sections 14, 15, 16, 21, and 22, T.58N., R.17W.). Overall, the Virginia Horn has been explored by five companies from 1987 through 2011. These companies drilled 51 holes, of which 36 holes were in or near the Viking porphyry, and collected samples from 11 channel samples and trenches (also in the Viking porphyry). For the remainder of this chapter, the activities and results at each of the gold prospects in the Virginia Horn will be described.

Viking Porphyry Area – Newmont

Newmont became interested in the Virginia Horn area in the mid-1980s. Even though considerable materials were turned over to the MDNR, it is difficult to reconcile the timing of events until the first holes were drilled in 1987. Prior to 1987, Newmont established several grids and conducted: 1. geophysical surveys; 2. geologic mapping (but nothing ever turned in to the MDNR); 3. rock sampling (as early as 1983 and continuing into 1989); and 4. soil/humus sampling. This initial effort returned interesting assay values from railroad cut exposures of a quartz-feldspar porphyry (QFP) intrusive, now called the Viking porphyry, and all further work was shifted to this site. Very little materials were ever turned in regarding Newmont's activities at their Midway and Divide grids (Fig. 76). In 1987, Newmont took several channel samples across the QFP at the east end of the Viking Porphyry area from a subarea they called the Railroad Zone (one of the sites where visible gold was discovered by Gruner in 1924). Gold assay results from this channel sampling campaign returned numerous samples with >1,000 ppb Au values (with a maximum of 13,400 ppb Au) from four of the northeasternmost channel samples (right side of Fig. 77). Visible gold and arsenopyrite are locally present in some of the veins within the QFP.

Drilling of the Railroad Zone by Newmont commenced in 1987 when holes VH-1 through VH-4 were put down (VH-1 was later extended in 1988). Each of the holes intersected various amounts of QFP (dominant rock type), turbiditic metasediments (Mud Lake sequence), and arkosic sandstone (Midway sequence). In regard to gold mineralization, the best hole by far was Hole VH-1 with six individual five-foot-thick intervals with >1,000 ppb Au (maximum of 10,100 ppb Au). The anomalous gold values encountered in VH-1 and other holes are shown in Figure 78. The other VH-series holes drilled in 1987 were not as encouraging

with respect to gold mineralization. Hole VH-2 had only one anomalous interval (4,200 ppb Au), whereas maximums of only 855 ppb Au and 628 ppb Au were encountered in holes VH-3 and VH-4, respectively.

Six more holes (VH-5 through VH-10), also in the Railroad Zone area, were drilled by Newmont in late 1988/early 1989. These holes intersected highly variable amounts of the Midway sequence sediments and the QFP, with lesser amounts of turbiditic sediments of the Mud Lake sequence. Two holes (VH-6 and VH-7) intersected mafic volcanic rocks of the Mud Lake sequence. Gold values were highest in the samples collected from the QFP with the highest number of anomalous intervals occurring in hole VH-8 (Fig. 78).

Starting in 1989, Newmont began to turn some of their attention to the mineralization potential in the western portion of the Viking Porphyry area in what they called the CV Zone (also a discovery outcrop of Gruner in 1924?). Channel samples were collected from the CV zone where a shear cutting the porphyry gave low grade, but wide-spread gold values including 77.5 feet of 0.035 opt (maximum values of 1,167 ppb Au and 1,122 ppb Au were obtained by Newmont – Fig. 77). Visible gold is locally present in the quartz veins of the QFP.

Two phases of drilling took place in 1989 when holes VH-12 through VH-14 were drilled in the Railroad Zone and VH-15 and VH-16 were drilled in the CV Zone. All of the holes in the Railroad Zone were collared in mafic volcanic rocks, then intersected various amounts of interfingering turbiditic sediments and the QFP (the thickest QFP interval being in VH-14), and were terminated in sedimentary rocks of the Midway sequence. Intervals with anomalous gold (>1,000 ppb Au) were generally lacking, with one zone in VH-12 (1,480 ppb Au) and three zones in VH-14 (see Fig. 78). Hole VH-14, which was drilled to intersect the auriferous zones of VH-1 at depth, failed to encounter the same degree of gold mineralization, and the QFP in

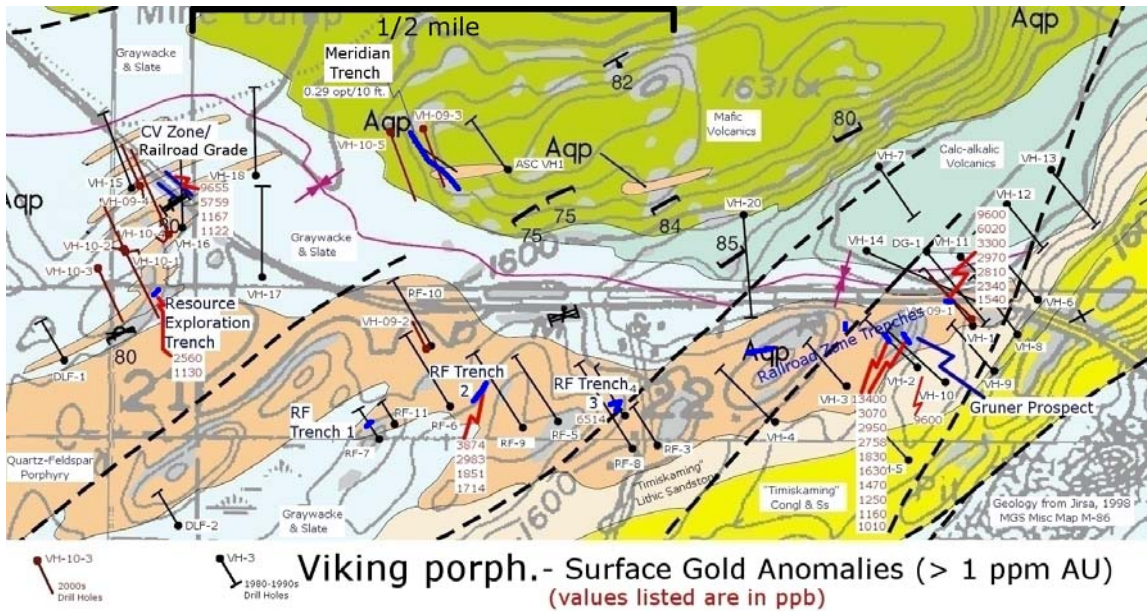


Figure 77. Geologic map of the Viking Porphyry area showing the distribution of anomalous surface gold values (>1,000 ppb Au threshold) that were collected from outcrop and in channel samples by all of the companies working in this area of the Virginia Horn. Blue lines represent channel samples/trenches dug by each of the companies (mostly by Newmont unless otherwise indicated on the figure).

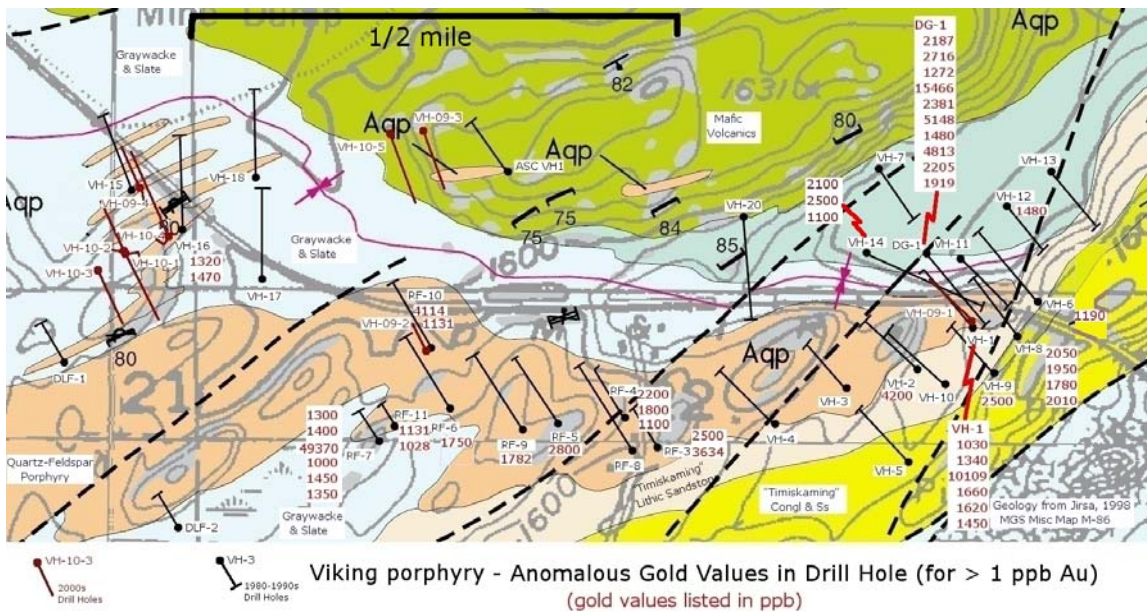


Figure 78. Geologic map of the Viking porphyry area of the Virginia Horn showing distribution of anomalous gold values (using a >1,000 ppb Au threshold) that were encountered in drill holes by all of the companies working in the area. Note that the RF-series holes in this figure were drilled by Rhude and Fryberger and were also called the VH-series holes; however, in order to distinguish them from the Newmont VH-series holes they are labeled as RF-series in this figure. There were three holes drilled into the Viking porphyry that are outside the area of this figure that include VH-19 (Newmont hole located further east), and RF-1 and RF-2 (Rhude and Fryberger holes located further west).

VH-14 appeared to thin with depth. The two holes drilled on strike of the CV Zone (VH-15 and VH-16) intersected numerous QFP-like dikes interfingering with turbiditic sediments of the Mud Lake sequence but failed to get any encouragement, as only two zones with anomalous gold concentrations were encountered in VH-16 (Fig. 78).

The last round of drilling by Newmont in the Virginia Horn took place in 1990 when they drilled four more holes. One hole (VH-19) was drilled in the Eastern Extension grid area (Figs. 76 and 79), presumably to check on the down-strike continuation of the Viking porphyry and as a follow up of anomalous gold values in nearby outcrop and humus samples (Fig. 79). The Viking porphyry was not intersected in VH-19 and gold values were low (maximum of 25 ppb Au). Three holes (VH-17, VH-18, and VH-20) were drilled in the Viking Porphyry area. Holes VH-17 and

VH-18 were positioned on strike of the CV Zones and VH-20 was collared in the mafic volcanics and drilled to the south. All of these holes were exceptionally discouraging with respect to gold assays (maximum of 645 ppb Au in VH-17), and Newmont began to discontinue their activities.

During their waning exploration effort, Newmont dug one last trench, called the Meridian Trench, that returned a value of 0.29 opt over ten feet associated with a sheared QFP with visible arsenopyrite. Before Newmont could complete an agreement for the lands near the Meridian Trench, their management terminated the project. While this discovery was found too late for Newmont to conduct further work, American Shield became aware of this information and did conduct some work that will be described later under the *Viking Porphyry - American Shield* portion of this report.

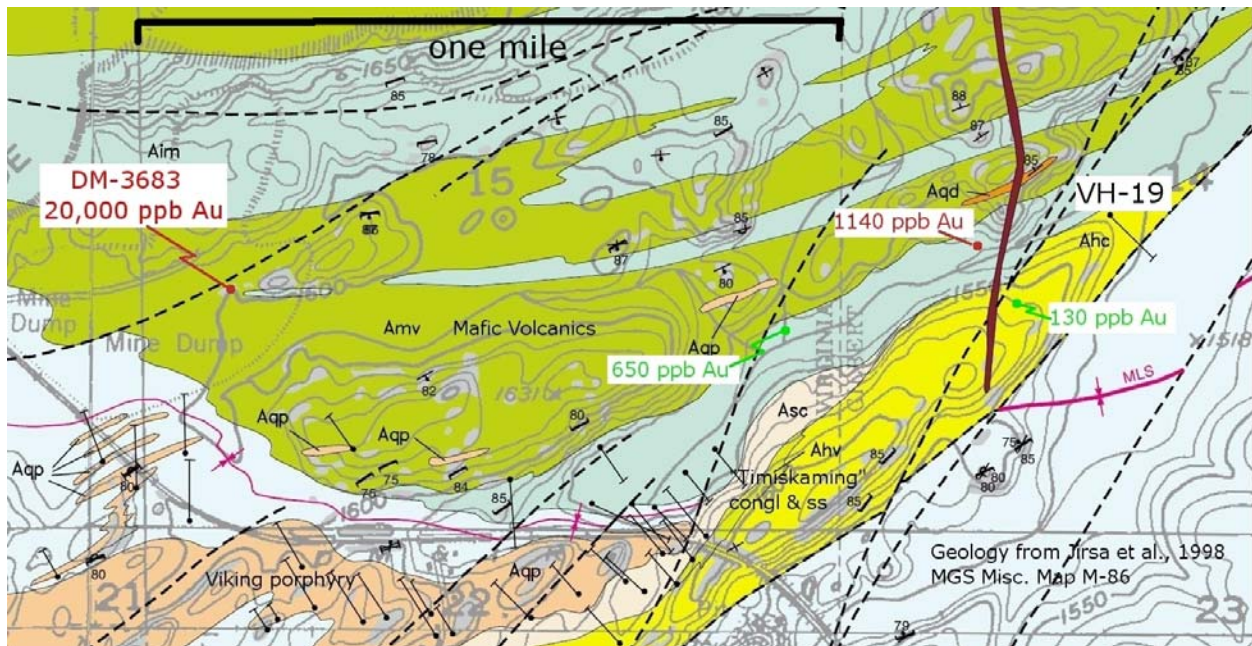


Figure 79. Geology of a portion of the Virginia Horn area showing the location of drill hole VH-19 relative to anomalous gold values in nearby rock samples (in red) and humus samples (in green – approximate location). Also shown is the location of a mysterious sample with 20,000 ppb Au (see discussions in text).

Lastly, an odd curiosity was discovered by the author whilst going over the materials turned in to the MDNR. The highest gold value (20,000 ppb Au in sample DM-3683) that was obtained by Newmont from all of their rock outcrop samples has UTM coordinates (537,989E/5,261,395N; NAD27) that positions the sample in a mine dump (Fig. 79). Another sample (DM-4503) with the exact same UTM coordinates assayed at 5,490 ppb Au. Now here is where things become strange. Sample DM-3683 is described as being near the railroad tracks – in essence nowhere near the mine dump location. Sample DM-4503 is described as a sample from the Deadwood Formation in South Dakota. Thus, due to the conflicting evidence for the two samples, any follow-up work should try to confirm the anomalous gold by re-locating the outcrop at the UTM location and collecting another sample for assay.

Scanned materials pertaining to Newmont's gold exploration at the Viking Porphyry area included with this report are:

- Newmont_all_grids_dh_map.pdf = Newmont map showing the location of all of their grids in the Virginia Horn area, as well as, land ownership and Newmont drill hole locations;
- Newmont_Viking_porphyry_map_with_sample_numbers.pdf = map of the Viking area showing locations of all of Newmont's rock and soil samples including the channel sample locations for the Railroad Zone, CV Zone, and Meridian Trench;
- Newmont_Railroad_zone_detail_map.pdf = map showing detail of sample numbers and gold assay results for Newmont samples collected in the Railroad Zone;
- Newmont_rock_soil_sample_map_outside_RR_zone.pdf = map showing rock and soil sample locations for area outside of the Newmont_Viking_porphyry_map as described above;
- Newmont_rock_assays.pdf = assay results for most of Newmont's rock samples collected in the Virginia Horn with associated UTM (NAD27) coordinates;
- Newmont_rock-samples-description.pdf = rock and general location descriptions for most of Newmont's rock samples collected in the Virginia Horn;
- Newmont_soil-assays.pdf = assay results for most of Newmont's soil samples collected in the Virginia Horn with associated UTM (NAD27) coordinates;
- Newmont_map-Au-values_humus.pdf = computer printout map showing the values of gold in soil samples for the Viking Porphyry area on a grid-only basis [Note that there are several more of these types of maps, for other elements other than gold, on file at the MDNR that were not acquired for this report];
- Newmont_CV_zone_map.pdf = cluttered map of gold assay results for samples collected from the CV Zone listed average gold contents or specific intervals (in feet);
- Newmont_VH-[###]-log.pdf = geologic log, with posted gold assay results, for the appropriately-numbered holes drilled by Newmont (VH-1 through VH-20);
- Newmont_VH-[###]-assays.pdf = assay results, for the appropriately-numbered holes drilled by Newmont (VH-1 through VH-20); and
- Newmont_cs-Au-and-sampling-problems.pdf = Newmont interoffice memorandum discussing how serious sampling and assaying problems could exist due to variability of the gold grain morphologies.

Viking Porphyry Area – Rhude and Fryberger

Rhude and Fryberger became interested in the Viking Porphyry area around 1985. After competitively outbidding Newmont in a State

Lease sale, Rhude and Fryberger acquired property that was referred to as Grid 3 in Sections 21 and 22 (T.58N., R.17W.). Various surveys were conducted in 1986 that included: mapping, geophysics, and soil and rock sampling. Seven holes were drilled in 1987 – two at their Grid 1 and five at their Grid 3. These holes were also called the VH-series holes by Rhude and Fryberger, as were the Newmont holes, but for the sake of simplicity they are herein called the RF-series holes. Holes RF-3 through RF-7 were located at Grid 3 (Fig. 78) and intersected mostly QFP of the Viking porphyry. Assay results were similar to Newmont's with some of the holes encountering a few anomalous zones with >1 ppm Au; the best hole of this group was RF-7 that intersected six such anomalous zones (Fig. 78) with a maximum of 1.44 opt gold (49,370 ppb Au) in an interval at 128 feet deep. Three, and possibly four, intervals in RF-7 are reported to contain visible gold.

Encouraged by the gold assay results, the next step Rhude and Fryberger took was to dig three shallow trenches (Fig. 77) in 1988. This trenching was done in order to map and sample the Viking porphyry in more detail. Trench 1 was dug near RF-7, but sampled gold values were low, with a maximum of 0.015 opt gold. Samples from Trench 2 returned several encouraging gold values with a maximum assay value of 0.113 opt gold. Trench 3 also returned low gold values overall, but one sample returned a 0.051 opt gold.

A last drilling phase took place in 1989 when Rhude and Fryberger drilled four reverse circulation holes at the Viking Porphyry area. These holes (VHRC-8 through VHRC-11) intersected mostly the QFP and returned scattered anomalous gold values with a maximum of 0.120 opt gold in VHRC-10.

Overall, while the auriferous intervals in the Viking porphyry drill holes were impressive, they were too scattered to define a mineable zone, and Rhude and Fryberger discontinued their explorations around 1990.

Scanned materials pertaining to Rhude and Fryberger's gold exploration at the Viking Porphyry area included with this report are:

- RF_grid_3_map_otc_dh.pdf = grid-based map showing geology, outcrops, and EM conductor locations for the Grid 3/Viking Porphyry area;
- RF_grid_3_map_otc_geophy.pdf = grid-based map showing outcrops and drill hole locations for the Grid 3/Viking Porphyry area;
- RF_grid_3_chip_sample_assays.pdf = assay results and associated sample cards giving grid locations for rock outcrops sampled in the Grid 3/Viking Porphyry area;
- RF_grid_3_soil_assays.pdf = assay results (no corresponding grid coordinates given) for soil samples collected in the Grid 3/Viking Porphyry area;
- RF_grid_3_soil_AuHg_map.pdf = grid-based map showing Au and Hg values for soil samples in the Grid 3/Viking Porphyry area;
- RF_trench_locations_map.pdf = generalized topographic map showing the locations of two of Rhude and Fryberger's trenches;
- RF_trench_1.pdf = map showing sample locations in Trench 1;
- RF_trench_2.pdf = map showing sample locations in Trench 2 (also some assay results provided);
- RF_trench_3.pdf = map showing sample locations in Trench 3;
- RF_Trench_Assays.pdf = assay results for Trenches 1, 2, and 3;
- RF_VH-[#]-log.pdf = geologic log for the appropriately-numbered Rhude and Fryberger holes (VH-3 through VH-7);
- RF_VH-[#]-assays.pdf = assay results for the appropriately-numbered Rhude and Fryberger holes (VH-3 through VH-7);
- RF_VHRC_series_logs.pdf = short descriptions of rock types encountered in the

Rhude and Fryberger reverse circulation holes (VHRC-8 through VFRC-11);

- RF_VHRC_[#]_assays.pdf = assay results for the appropriately-numbered Rhude and Fryberger reverse circulation holes (VHRC-8 through VFRC-11); and
- Several assay results for samples collected from unknown locations in the form of RF_assays2-###.pdf = corresponds to file number (2 or 3) followed by page number according to how they are stored in the paper files at the MNDR. Note that RF_assays2-38.pdf is too dark to read and another copy should be acquired.

Viking Porphyry Area – Resource Exploration

Resource Exploration appears to have started work in the Viking Porphyry area around 1986 when they established a grid on the western end of the porphyry called the Landfill Grid. Several different types of media were sampled that included: rock outcrops, soil, stream sediments, seeps and springs, and swamp material. Detailed channel sampling of the QFP along the railroad grade also took place at what were referred to as the “Railroad Grade” (same area as Newmont’s CV Zone) and the “Gruner outcrop” (same area as Newmont’s Railroad Zone). As to be expected, some of the samples from these two areas returned high gold values with maximums of 9,655 ppb Au and 5,759 ppb Au from the “Railroad Grade” Zone (Fig. 77), and 2,758 ppb Au and 1,630 ppb Au from the “Gruner outcrop” (Fig. 77). In addition, a shallow trench was dug and sampled for gold in the northeastern corner of the Landfill Grid that returned values of 2,560 and 1,130 ppb Au (Fig. 77).

Two short holes (DLF-1 and DLF-2) were drilled in 1988 (Fig. 78). Both holes intersected alternating metasediments and QFP with the highest gold values occurring in the QFP. Only two samples were collected

from DLF-1, but several were collected from DLF-2; however, only a maximum of 207 ppb Au was encountered in DLF-2.

According to a map at the MDNR, it appears that Resource Exploration controlled partial mineral rights in the area that was being actively drilled by Newmont. In 1990, Resource Exploration drilled hole DG-1 into the Viking porphyry from the north (Fig. 78). This hole was collared in turbiditic metasediments of the Mud Lake sequence, intersected a thick QFP zone, and was terminated in “Timiskaming-type” metasediments of the Midway sequence. Eight anomalous gold zones (>1 ppm Au) were encountered with a maximum of 15,466 ppb Au. However, in spite of these encouraging gold values, Resource Exploration appears to have done no further work.

Scanned materials pertaining to Resource Exploration’s gold exploration at the Viking Porphyry area included with this report are:

- RE_Landfill_sample_map.pdf = grid-based map showing locations of most of the samples collected in the Landfill grid (note that Fig. 5 in the NE corner of this map corresponds to the area that was trenched and sampled by Resource Exploration);
- RE_Landfill_SGL_assays.pdf = assay results for samples stream sediments, seeps and springs, and/or swamp materials from the Landfill Grid;
- RE_Landfill_assays.pdf = rock assay results for some of the samples from the Landfill Grid;
- RE_RR-grade-sample-map.pdf = geology and sample location map the Railroad Grade area (same area as Newmont’s CV Zone);
- RE_RR-grade-assays.pdf = assay results for rock samples from the Railroad Grade;
- RE_gruner_otc_sample_map.pdf = geology and sample location map for samples from the “Gruner outcrop” area (same area as Newmont’s Railroad Zone);

- RE_gruner_otc_assays.pdf = assay results for rock samples from the “Gruner outcrop” area;
- RE_trench-area-geol-map.pdf = geology and sample location map for Trench 1 dug by Resource Exploration;
- RE_trench-area-assays.pdf = assay results for samples from Trench 1;
- RE_DLF-1-log.pdf = geology log, and two assay results, for drill hole DLF-1;
- RE_DLF-2-log.pdf = geology log, and assay results, for drill hole DLF-2;
- RE_DG-1-log.pdf = geology log for drill hole DG-1; and
- RE_DG-1-assays.pdf = assay results for drill hole DG-1.

Grid 1 – Rhude and Fryberger

The Grid 1 area of Rhude and Fryberger was located along the western extension of the Viking porphyry in Section 21 (T.58N., R.17W.). Two holes (VH-1 and VH-2) were

drilled on this property in 1987 solely on the basis of geophysics (Fig. 80). The first hole, VH-1, was collared in turbiditic metasediments of the Mud Lake sequence and was terminated before reaching the Viking porphyry. The second hole, VH-2, was also collared in the metasediments, but did intersect some of the Viking porphyry at depth. Assay results for VH-2 were below detection limits in the metasediments, but were obviously much higher in the porphyry with a high of 700 ppb Au.

Scanned materials pertaining to Rhude and Fryberger’s gold exploration at the Grid 1 area (also situated in the Viking porphyry) included with this report are:

- No logs or assay results for VH-1 are at the MDNR;
- RF_VH-2-log.pdf = geologic log for VH-2; and
- RF_VH-2-assays.pdf = assay results for VH-2.

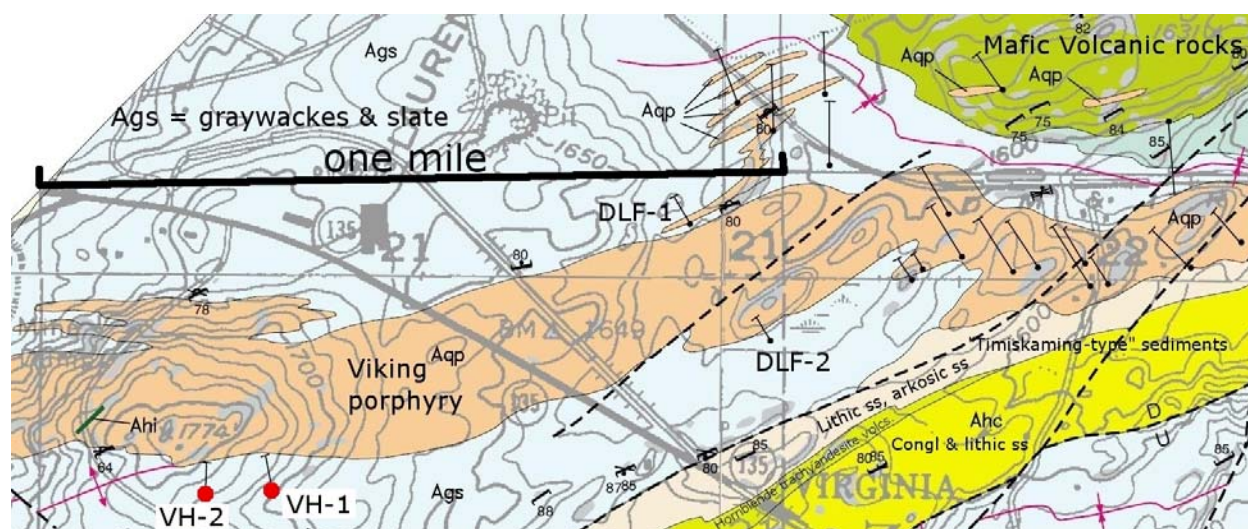


Figure 80. Geology of the Grid 1 area, modified from Jirsa et al. (1998), showing the distribution of the two Rhude and Fryberger holes (VH-1 and VH-2; also called RF-1 and RF-2).

Viking Porphyry Area – American Shield

American Shield conducted a minor amount of work in the Viking Porphyry area after the flurry of earlier explorations ended in 1990. Part of this resurgence in activity was due to two factors (as discussed in two memorandums that are included with this report):

1. A crude estimated reserve, arrived at by looking at the previous drilling results, was calculated as “**1 m.t. at 0.01 to 0.03 opt Au;**” and
2. Knowledge was passed down about high gold values that were obtained from the Meridian Trench (Fig. 77) that was dug in the waning exploration phases by Newmont. This trench encountered a ten-foot-wide zone, associated with quartz veined and sheared QFP with arsenopyrite, that assayed at 0.29 opt gold. However, none of these data was ever turned in to the MDNR (see memorandums).

American Shield appears to have failed to find a joint venture partner and eventually drilled a hole (ASC VH-1 – Fig. 78) in 1997 down strike from the Meridian Trench zone. No drill log or assay results were ever turned in to the MDNR; however, the drill core is preserved at the MDNR.

Scanned materials pertaining to American Shield’s exploration at the Viking Porphyry area included with this report are:

- Jongewaard_92_memo = 1992 internal Noranda memorandum by Peter Jongewaard discussing the estimated reserve calculations for the Viking Porphyry area and the Meridian Trench results;
- Ulland_95_memo = 1995 American Shield memorandum by William Ulland discussing the Meridian Trench results

and the potential to find auriferous targets on strike with the Meridian Trench;

- American_Shield_VH1_LOG.pdf = abandonment report for American Shield’s VH-1 hole (no true geologic log was ever turned into the MDNR); and
- American_Shield_VH1_assays.pdf = assay results for Hole VH-1 provided by Tom Gardner.

Viking Porphyry Area – Vermilion Gold

Vermilion Gold, LLC has recently acquired the state leases in the Viking Porphyry area and drilled an additional four holes in 2009 (VH-09-01 through VH-09-04) and five more holes in 2010 (VH-10-01 through VH-10-05) that are displayed in Figure 78. Hole VH-09-01 was drilled in the Railroad Zone and was positioned to intersect the auriferous zones previously encountered in VH-1 (Newmont hole) and DG-1 (Resource Exploration hole). Hole VH-09-02 was drilled in the same vicinity as previous reverse circulation hole VHRC-10. Two holes (VH-09-03 and VH-10-05) were drilled in the vicinity of the Meridian Trench. The remainder of the holes (VH-10-1 through VH-10-4, and VH-09-04) were drilled near Newmont’s CV Zone.

According to a talk given by Mr. William Rowell of Vermilion Gold (at the AIME/SME convention held in Duluth in the spring of 2011), all of the holes in the CV zone intersected mineralized intervals ranging from 0.16 gpt Au over 35.4 feet in hole VH-10-3 to 1.06 gpt over 197 feet in hole VH-09-4. The effects of shearing, as well as sericite and carbonate alteration, to the quartzofeldspathic dikes and in the adjacent metasediments, are obvious in the photos of core shown in Rowell’s talk. Visible gold was seen in a quartz vein in hole VH-09-04 that assayed at 16,050 ppb Au. Hole VH-10-1 also displayed visible gold and arsenopyrite associated with

quartz veins – one of these intervals assayed at 77,000 ppb Au over 2.3 feet. Even a zone in the sheared metasediments of one hole assayed at 919 ppb Au over five feet. Clearly, there are some impressive gold values in the Virginia Horn area, and more drilling is needed to fully assess the gold potential of the area.

There are no scanned items in this report associated with Vermilion Gold’s activities. These items are still confidential and not available to the public at this time.

Mud Lake – Resource Exploration

The earliest records of Resource Exploration’s involvement in the Mud Lake area (Section, 28, T.58N., R.17W. – Fig. 81) are the logs for three holes that were drilled in 1988 and 1990. What initially attracted them to this area appears to have been the discovery of a high-grade gold zone in the Mud Lake

sequence in an area that was later trenched at the 0+00 station on the baseline of their grid (this is mentioned in one of the drill logs). The most auriferous sample (RML-10) collected from the outcrop was described as a gossanous schist that assayed at 14,020 to 16,200 ppb Au. Two other samples collected from the same outcrop assayed at 1,080 ppb Au and 9,290 ppb Au. Resource Exploration cut a 75-foot-long trench across the zone and collected an additional 25 samples. Only one out of these trench samples assayed over 1 ppm with a value of 1,820 ppb Au. Hole DML-1 was drilled in 1988 to intersect the trenched zone at depth (Fig. 81). The hole encountered a package of metasedimentary rocks of the Mud Lake sequence that commonly exhibited the effects of shearing, alteration (sericite-iron carbonate), and veining (veinlets of quartz-epidote and quartz-iron carbonate). However, only a maximum of 146 ppb Au was encountered in the hole.

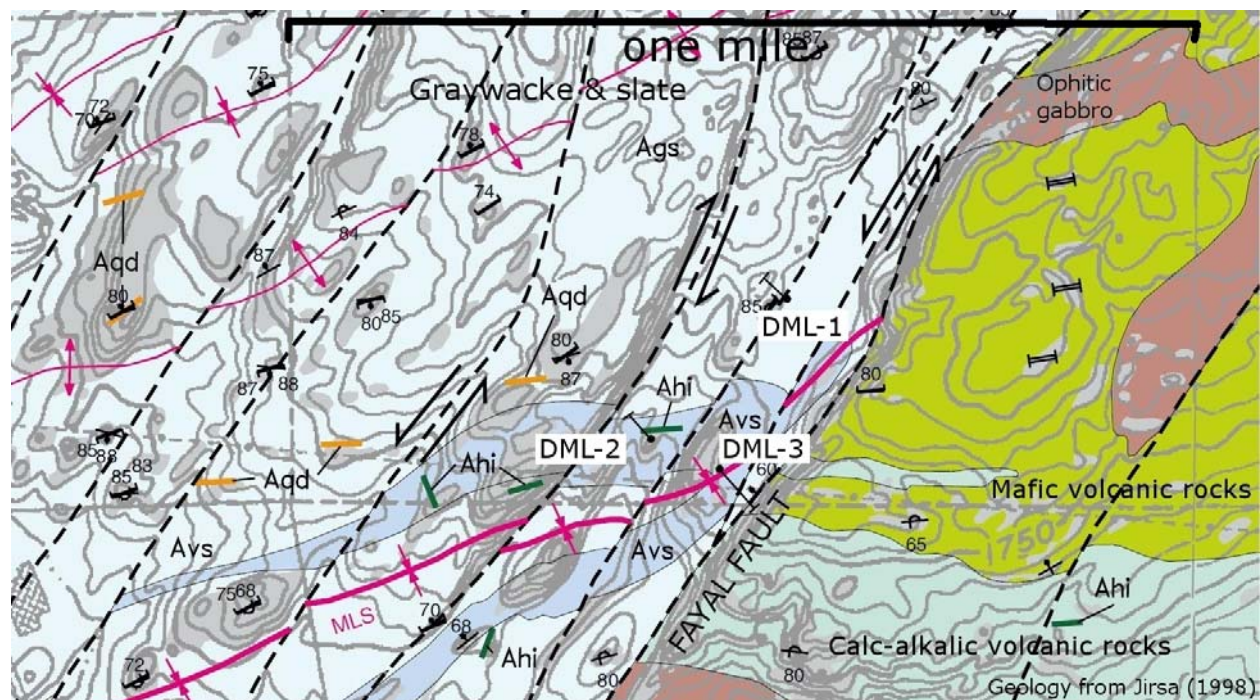


Figure 81. Geology of the Mud Lake area, modified from Jirsa (1998) showing the location of the DML-series drill holes. Avs = volcanoclastic sediments, MLS = Mud Lake syncline.

Resource Exploration returned to the property in 1990 and drilled two more holes. Hole DML-2 intersected a mixed package of argillaceous sediments and altered sediments (sericite-iron carbonate). Several altered and sheared zones were noted in this hole that displayed the features of the auriferous trench sample, but the assay results for this hole were extremely low with a maximum of 29 ppb Au. The third hole, DML-3, intersected a succession of rocks that included: sheared metasediments at the top of the hole, a thin feldspar-porphyry dike, a pyroclastic interval, a fault zone, and basalt in the bottom of the hole. Gold assay results were again extremely low with a maximum of 32 ppb Au; however, only a few samples were collected from this hole.

Additional work has been recently conducted on the Mud Lake drill holes by the MNDR (Frey and Hudak, 1997). During the course of re-examining the drill core, visible gold was found in hole DML-3, at 207.9-209 feet, in a quartz-calcite vein with broken ribbon texture parallel to the vein margins. This occurrence is associated with highly altered metasedimentary rocks of the Mud Lake sequence within the Fayal Fault.

Scanned materials pertaining to Resource Exploration's exploration efforts at Mud Lake included with this report are:

- RE_Mud_Lake_Grid_holes.pdf = grid-based map showing drill hole locations and distribution of rock and soil sample numbers – the area on this map with the notation “area of detail map” probably corresponds to the trenched area;
- RE_Mud_Lake_trench_area_detail.pdf = detailed map showing locations of samples collected from the trenched area near hole DML-1 (assay results for trench samples are unknown);
- RE_Mud_Lake_rock_and_soil_assays.pdf = assay results for both soil and rock samples, including the trench samples, as well as rock descriptions;

- RE_Mud_Lake_soil_south_28.pdf = plotted Au-As-Ag values for soil samples collected from the southern half of Section 28;
- RE_DML-1-log.pdf = geologic log, and related assay result, for drill hole DML-1;
- RE_DML-2-log.pdf = geologic log, and related assay result, for drill hole DML-2; and
- RE_DML-3-log.pdf = geologic log, and related assay result, for drill hole DML-3.

Virginia Block – Resource Exploration

The Virginia Block, situated within turbiditic metasediments and mafic volcanics of the Mud Lake sequence (Fig. 76), was explored by both Newmont and Resource Exploration during different periods. Data turned in to the MDNR by Resource Exploration for their exploration efforts in 1986 indicate that they conducted routine investigations in the block consisting of rock and soil sampling. Only one rock sample (G-40) showed anomalous gold contents of 1,300 ppb Au. Crude reckoning of the location of this sample indicates it was from near a northeast-trending fault zone just south of the center of Section 22. No more work was performed on this property.

Scanned materials pertaining to Resource Exploration's exploration efforts at the Virginia Block (Sections 15, 16, 21, and 22, T.58N., R.17W.) included with this report are:

- RE_Virginia_Block_sample_map.pdf = rock sample location map using only sections lines for reference;
- RE_VB_sample_map.pdf = badly faded rock sample location map, with a topographic base, showing distribution of geochemistry samples in Section 21 of the Virginia Block;
- RE_Virginia-block-assays.pdf = listing of assay results for rock samples collected from the Virginia Block; and

- RE_VB_soil_assays.pdf = assay results for soil samples collected from the Virginia Block.

Berry Hill – Resource Exploration

The Berry Hill prospect is located in the eastern part of the Virginia Horn (Fig. 76) in an area where several mapped faults converge. The first dated material turned in to the MDNR is for the first hole drilled at Berry Hill in 1988. This hole, DBH-1 (Fig. 82), intersected an intensely mixed package of sheared and altered volcanics, chemical sediments, brecciated chert, lamprophyre, QFP, and pyritic sediments. Assay results were lean, with a maximum of 204 ppb Au associated with sheared and altered volcanics with ribbon quartz veins. Soil sampling appears to have taken place in 1989, and a sample with 22 ppb Au is present.

Resource Exploration returned to Berry Hill in 1990 and drilled two more holes (Fig. 82). The first hole, DBH-2, intersected a mixed package of sheared and altered metasediments with felsic porphyry dikes in the top of the hole and mixed sheared volcanics in the bottom of the hole. An interesting phenomenon occurred at 156-175.5 feet consisting of exotic boulders and void spaces in a 20-foot-long zone that was interpreted to be an eroded crevice along a joint or fault that was filled with glacial materials. Hole DBH-2 intersected mixed volcanoclastics and metasediments with one felsic porphyry dike. Assayed gold values were low for both holes, with a maximum of 15 ppb Au in DBH-2 and 54 ppb Au in DBH-3.

Scanned materials pertaining to Resource Exploration’s exploration efforts at the Berry Hill Block (Sections 33 and 34, T.59N., R.16W., and Sections 3 and 4, T.58N., R.16W.) included with this report are:

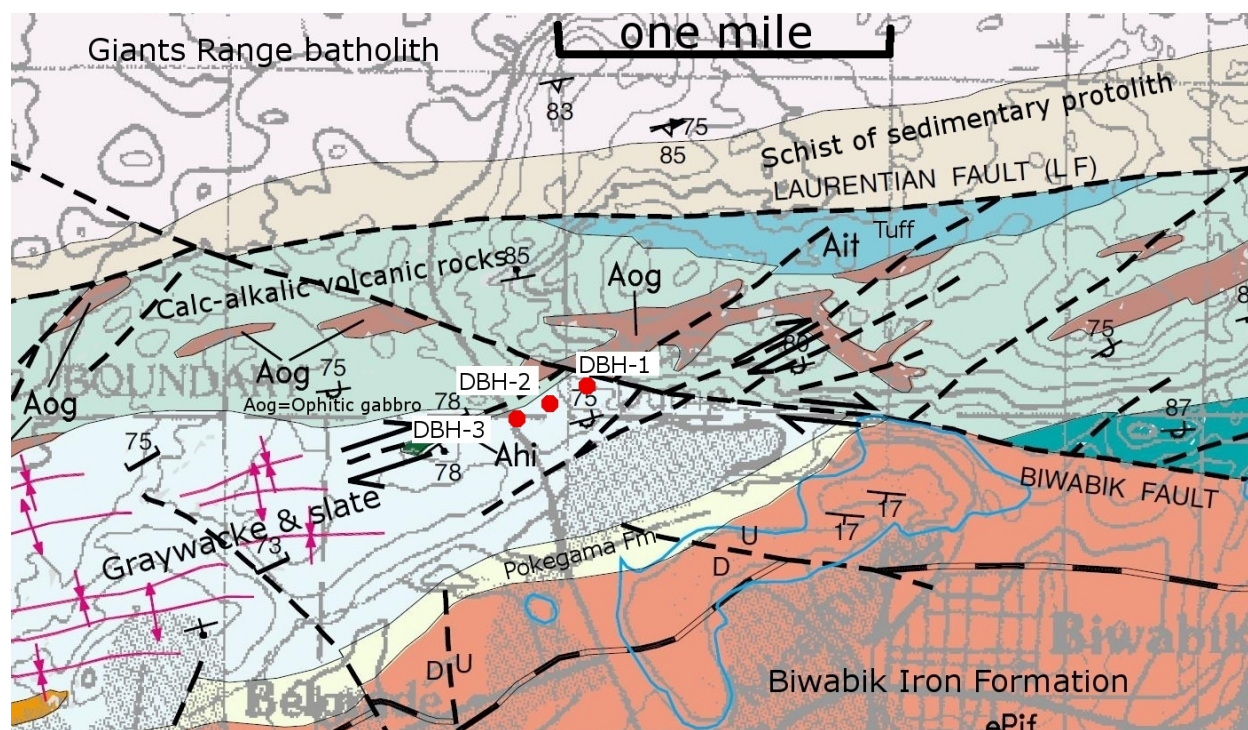


Figure 82. Geology of the Berry Hill area, modified from Jirsa (1998) showing the location of the DBH-series drill holes. North at top of figure.

- RE_Berry_Hill_grid_map.pdf = grid-based map show the distribution of both rock and soil sample locations;
- RE_Berry_Hill_sample_type_list.pdf = listing of the types of samples according to the numbering system (soil versus rock) used at Berry Hill;
- RE_Berry_Hill_soil_assays.pdf = assay results for soil samples collected at Berry Hill;
- RE_DBH-1-log.pdf = geologic log for drill hole DBH-1;
- RE_DBH-1-assays.pdf = assay results for drill hole D BH-1;
- RE_DBH-2-log.pdf = geologic log for drill hole DBH-2;
- RE_DBH-2-assays.pdf = assay results for drill hole D BH-2;
- RE_DBH-3-log.pdf = geologic log for drill hole DBH-3; and
- RE_DBH-3_assays.pdf = assay results for drill hole D BH-3.
- RE_Pike-River-chip_sample_map.pdf = map of the extreme southeast corner of Section 6 showing location of samples collected from the QFP;
- RE_Pike_River_assays_and_rock_descriptions.pdf = assay results and descriptions for all of the rock samples collected at Pike River;
- RE_Pike_River_Rock_assays.pdf = lab report on assay results for a few rock samples (these assays are included in the above item); and
- RE_Pike_River_soil_assays.pdf = assay results for soil samples collected at Pike River.

Pike River – Resource Exploration

Resource Exploration conducted a very limited exploration campaign in the Pike River Block (Fig. 76) in 1986. Both soil and rock samples were collected along a grid established in the SE1/4 of Section 6 (T.58N., R.16W.). A QFP body is present in the extreme southeast corner of the section and two samples collected from it assayed at 161 ppb Au (with 1,000 ppm As) and 210 ppb Au. All of the other results are less encouraging.

Scanned materials pertaining to Resource Exploration's exploration efforts at the Pike River Block included with this report are:

- RE_Pike_River_grid.pdf = topographic-based map showing the Pike River grid;
- RE_Pike_River_sample_location_map.pdf = grid-based map showing the locations of rock and soil samples;

Wynne Lake – Resource Exploration

In 1989, Resource Exploration conducted a reconnaissance exploration program in the vicinity of Wynne Lake (Sections 29, 31, and 32, T.58N., R.15W.) in area that is known as the Embarrass Gap (Fig. 76). A few rock samples were collected with negative results. Unfortunately, the materials turned in to the MDNR are of little use. The sample numbers that are posted on the sample location map do not jive with the sample numbers that are listed for the assay results.

Scanned materials pertaining to Resource Exploration's exploration efforts at the Wynne Lake Block included with this report are:

- RE_Wynne-Lake-sample-map.pdf = topographic-based map showing the location of samples collected in the Wynne Lake area; and
- RE_Wynne-lake-assays.pdf = assay results for an entirely different set of samples than are shown in the above item.

Hibbing Block – Resource Exploration

The Hibbing Block is similar to the Virginia Horn in that there is a sliver of Archean “greenstone” (depending on the vintage of the geologic map) that abuts against the Giants Range batholith to the north and is overlain by the Paleoproterozoic Pokegama Formation and Biwabik Iron Formation to the south. Resource Exploration conducted a short exploration campaign in a small area within Archean schistose rocks to the west of the Hibtac taconite processing facility in Sections 26, 27, 33, and 34, T.58N., R.21W. Rock samples were collected from a variety of rock types, and glacial boulders, that were described as dominantly schistose rocks that often contained quartz veins. Minor chalcopyrite and rare galena is mentioned in one of their samples. There are no assay results for these samples. Assay results that are available are for 37 soil samples that show mostly low gold concentrations with 5 samples containing >5 ppb Au, with a high of 27 ppb Au.

Scanned materials pertaining to Resource Exploration’s exploration efforts at the Hibbing Block included with this report are:

- RE_Hibbing_sample_map.pdf = map with section lines that shows the distribution of samples collected from the Hibbing Block;
- RE_Hibbing_sample_listing.pdf = listing of the types of samples, with associated sample numbers, that were collected from the Hibbing Block;
- RE_rock_descriptions.pdf = descriptions of both rock outcrops and boulders that were sampled at the Hibbing Block; and
- RE_Hibbing_soil_assays.pdf = soil assay results.

Nashwauk Block – Resource Exploration

Once again, the Nashwauk Block is similar to the Virginia Horn in that there is a sliver of Archean “greenstone” (depending on the vintage of the geologic map) that abuts against the Giants Range batholith to the north and is overlain by the Paleoproterozoic Pokegama Formation and Biwabik Iron Formation to the south. Resource Exploration conducted a short exploration campaign within Archean schistose rocks to the north of Nashwauk in the north half of Section 35 and extreme southern portion of Section 26 (T.57N., R.23W. – Fig. 83). Both rock and soil samples were collected. Assay results for ten rock samples are barely over detection limits for Au. However, soil sampling results are much more interesting as they showed a clustering of anomalous soil samples with highs of 441 ppb Au, 167 ppb Au, and 115 ppb Au (Fig. 83). For unknown reasons Resource Exploration did not conduct any follow up work.

The MDNR was aware of these anomalous gold in soil values and conducted an additional till sampling campaign in the area as part of an assessment for the future plant-site for Essar Steel LLC. They also found high gold assay values in the till but, judging from the shape of the gold grains, determined that they were “far traveled” (Dave Dahl – pers. comm., Oct. 31, 2011). Interestingly, most of the anomalous soil samples lie in a valley that drains to the northwest into Little McCarthy Lake.

Scanned materials pertaining to Resource Exploration’s exploration efforts at the Nashwauk Block included with this report are:

- RE_Nashwauk_block_sample_map.pdf = 1:1200 scale map (with only a section corner for spatial reference) showing the distribution of samples collected at the Nashwauk Block;

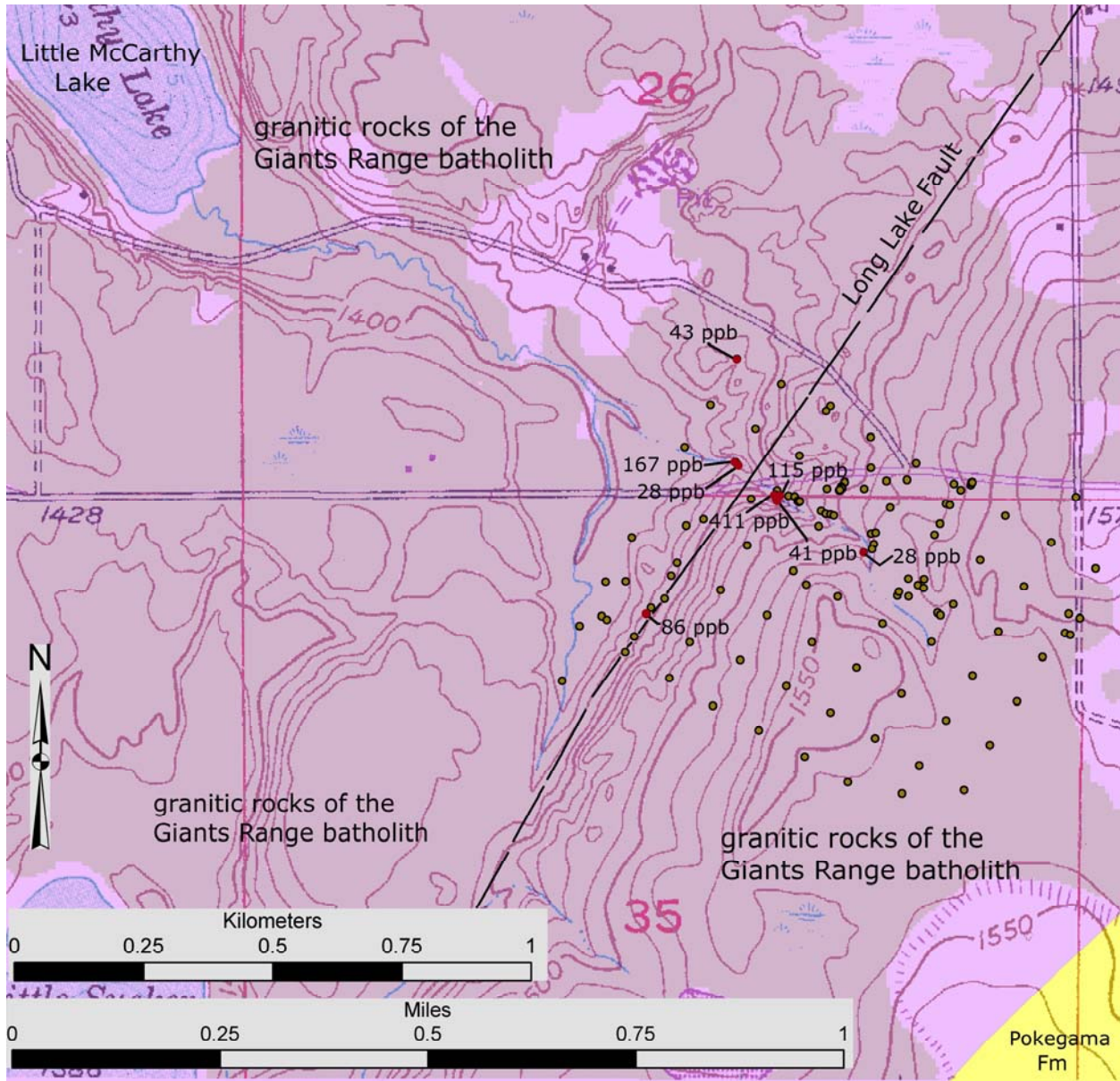


Figure 83. Geology of resource Exploration’s Nashwauk Block, from Jirsa et al. (2011), showing soil sample locations (brown dots) and anomalous soil sample locations (red dots) with corresponding assay results (all in ppb Au) using a threshold of >25 ppb Au. Data location points provided by Dave Dahl, MDNR, October, 2011.

- RE_Nashwauk-block-sample-list.pdf = listing of the types of samples, with associated sample numbers, that were collected from the Nashwauk Block;
- RE_Nashwauk_block_rock_assays.pdf = assay results for rock samples collected from the Nashwauk Block; and
- RE_Nashwauk_block_soil_assays.pdf = assay results for soil samples.

Conclusions for the Virginia Horn area

Drilling at the Viking Porphyry area has produced the most promising results with respect to highly anomalous gold (often visible in outcrop and drill core) that is associated with veins (often with visible arsenopyrite) and sericite-carbonate alteration in the Viking porphyry. Drilling was able to define a small low-grade gold deposit, but many areas in the Viking porphyry (over 2/3rds) remain to be tested by drilling. Lesser amounts of gold have been found associated with sheared and sericite-iron carbonate altered metasediments of the Mud Lake and Midway sequences in close proximity to faults and shear zones (see Figure 2.16 of Jirsa and Boerboom, 2003b). The conclusions reached by Jirsa and Boerboom (2003b), after conducting detailed mapping and core logging in the area are probably the most applicable and include:

1. gold is most abundant in the quartzofeldspathic intrusions;
2. analyses of >1 ppm Au occur almost exclusively in the quartzofeldspathic intrusives;
3. the highest gold contents occur in rocks that are pervasively altered and cut by quartz-rich veins;
4. anomalous quantities of gold exist locally in the sedimentary and volcanic strata; and
5. gold occurs in rocks affected by carbonate-sericite alteration.

Jirsa and Boerboom (2003b) recommended additional lode gold exploration should take place: 1) at depth within the QFP, and 2) along major structural features outside of the QFP (e.g., the Fayal and Pike River Faults). In addition, reinterpretation of a portion of the Virginia Horn as a Timiskiming-type terrain would support new exploration efforts beyond the Viking porphyry, and into both the overlying basal conglomerate and associated country rock, particularly where major shearing and alteration is found (Frey and Hudak, 1997).

It is interesting to note that the above conclusions were made without any knowledge of the gold grades encountered in the Meridian Trench (information that is still not fully known). This information suggests that the mafic volcanic rocks to the north of the Viking porphyry also have good prospectivity for gold. Vermilion Gold is following up on this information and at the time of this writing has intersected some very anomalous gold zones. It will be interesting to see how these, and new future developments, will change our perspectives on the gold potential of the Virginia Horn.

CONCLUSIONS

This report is more or less an *atlas* with regard to gold exploration in Minnesota. Considerable time and effort was spent in preparing the figures of this report in attempts to summarize where, and how high, anomalous gold values are located with respect to outcrops, trenches, and drill holes. A certain amount of *due diligence* and back-checking went into confirming the anomalous gold assay values for each of the prospects. Where such assay information is based mostly on hearsay, it is so described. Similarly, anomalous assay values with poorly-described or incorrectly-determined locations are identified as such.

The MDNR minerals archive website was used heavily to peruse the publically-available information, but it had to be checked time and time again as the *due diligence* work progressed for each prospect. In performing these checks, it was noted that one had to generally “know what you are looking for in order to find it.” In other words, it is difficult to separate all of the useful information for a particular prospect on a first pass basis. Hopefully, this atlas will help future explorers to better single out information they are seeking on the website. It was also noted on several occasions that the scanned materials were not always clear, specific items were not clearly labeled up front and had to be opened before they could be viewed, which is time consuming, and, in some cases, previously turned in materials were obviously missing from the website. Upgrades to both the quality of the scans provided and labeling information contained in the website should be planned in the future. It was occasionally noted that the electronic files containing the scanned materials became corrupt with time. Thus, the reader of this report should convert all of the provided scanned materials to paper files for the sake of prosperity.

Overall, there are several intriguing gold prospects that have been identified in each of the areas described in this report. The most interesting group of prospects occurs in the western Vermilion District, especially in the zone between the Mud Lake Shear zone and Vermilion fault. The data suggest that subsidiary shear zones much closer to the Vermilion fault should be investigated. Exploration efforts in this area should be coupled with detailed structural analyses of both drill core and outcrop. There are several other prospects elsewhere in the western Vermilion District that also show potential for shear-zone hosted gold. However, recreational developments throughout the western Vermilion District make this a difficult area to conduct explorations. The Linden Grove prospect in the Cook area is one area with less

recreational sites, and exploration there may be more “public-supported.” However, the gold potential of this area is known mostly from overburden drilling results, and much more drilling of the bedrock is needed.

The Virginia Horn is the second-most interesting area with respect to known gold mineralization. The first pass of drilling did succeed in finding a “small but low-grade” gold deposit, but considerably more drilling is needed to fully evaluate the gold potential of both the Viking porphyry and surrounding wall rocks. Again, detailed structural analyses of both drill core and outcrop are needed. As this is already an area with numerous taconite mining operations, the sentiment of developing a new type of mining is greater in this area than elsewhere in Minnesota.

In the Itasca area, the information suggests that the iron-formations of the Wilson Lake sequence hold the most promise as gold repositories. However, the most significant auriferous zones are associated with brecciated and sulfidized iron-formations at select locations with some degree of structural preparation. Clearly, more detailed information regarding the location of major fault zones, defined through use of available geophysical trends, are critical to finding the best repository sites. Oriented drill holes may also prove critical in further defining structurally-prepared horizons/zones.

Work conducted along the Rainy Lake-Seine River Fault suggests that significant, but scattered, gold zones are present throughout. Any work in this area should rely heavily on structural analyses to define potential ore shoots. More work to the west, and further away from recreational developments, should also proceed along the trace of the fault zone into the KBRLW area.

There are most likely other areas in Minnesota with good gold potential that have been overlooked in this report. However, bedrock drilling is either too sparse or nonexistent to make significant conclusions regarding their overall potential. Some of

these areas are covered by overburden drilling campaigns, or basal till sampling campaigns, that have been conducted by the MDNR over the past three decades. The merits of each of these overburden-drilled areas has been described in various MDNR reports, and anomalous zones with high gold grain counts have been highlighted on an individual report-by-report basis. However, each of these overburden sampling campaigns stand alone for spatially-restricted areas, and there has been as yet no attempt to collectively summarize all of the overburden sampling results on a state-wide basis in order to filter out truly anomalous zones.

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**APPENDIX A:
Drill Hole Listings**

(Also on CD in back pocket of this report)

(NOTE: UTM locations are NAD83)

Itasca_County_drill_holes.xls

DRILL HOLE NUMBER	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (ft)	EOH (ft)	ELEV (ft)	ANGLE	AZIMUTH	LOG	ASSAYS
C-A-3	VMS - Anomaly A	1969	WS Moore	61	23	9	479055	5292832	50	465		-50	180	y	Not Sampled? Jaynes report
C-B-1	VMS - Anomaly B	1969	WS Moore	61	23	4	478382	5294436	173	345		-45	180	New Scan	Jaynes report
C-H-4	VMS - Anomaly H/no core	1969	WS Moore	62	21	29	496609	5297812	123	406		-50	180	y	NS
C-K-2	VMS - Anomaly K	1969	Hanna/WS Moore	61	23	17	477572	5291577	44	352		-50	180	New Scan	Jaynes report
C-M-5	VMS - Anomaly M/no core	1969	WS Moore	62	21	30	494697	5296889	120	350		-50	180	y	NS
C-O-7	VMS - Anomaly O?	unknown	WS Moore	62	23	18	475502	5300652	224	323		-52	180	New Scan	Not Sampled? Jaynes report
C-E-6	VMS - Anomaly E	1970	WS Moore	62	22	29	487196	5297238	104	397		-55	0	New Scan	Jaynes report
COOK-8-1	VMS - Anomaly 8/no core	1970	Humble/Exxon	62	22	7	486108	5301299	126	383	1300	-45	0	y	on log
MDB-1-1	VMS - Meadowbrook #1	1970	Humble/Exxon	62	22	10	489782	5301953	108	593	1350	-45	0	y	on log
BL-D-1	VMS - Bear Lake	1970	WS Moore	60	23	34	480689	5276339	75	433		-50	180	y	no record
BL-D-2	VMS - Bear Lake	1970	WS Moore	60	23	34	480689	5276273	18	183		-60	0	y	no record
26502	Ni-Cu Deer Lake Complex	1970	USS	61	25	12	463889	5293413	48	1195		-45	135	y	Jaynes report also lithologic logs report 2009
26503	Ni-Cu Deer Lake Complex	1970	USS	61	25	12	463856	5293471	18	1500		-50	315	y	Jaynes report also lithologic logs report 2010
26506	Ni-Cu Deer Lake Complex	1971	USS	61	25	12	463463	5293461	27	602		-45	315	y	Jaynes report also lithologic logs report 2011
26507	Ni-Cu Deer Lake Complex	1971	USS	61	25	12	463456	5292910	60	193		-45	135	y	Jaynes report also lithologic logs report 2012
26508	Ni-Cu Deer Lake Complex	1971	USS	61	25	12	463466	5292878	72	1119		-48	135	y	Jaynes report also lithologic logs report 2013
26509	Ni-Cu Deer Lake Complex	1971	USS	61	25	10	461462	5293422	9	839		-45	135	y	Jaynes report also lithologic logs report 2014
26510	Ni-Cu Deer Lake Complex	1971	USS	61	25	10	461551	5293211	0	283		-45	315	y	Jaynes report also lithologic logs report 2015
26511	Ni-Cu Deer Lake Complex	1971	USS	61	25	10	461375	5293553	50	377		-45	315	y	Jaynes report also lithologic logs report 2016
26512	Ni-Cu Deer Lake Complex	1971	USS	61	25	10	460688	5292583	79	964		-45	315	y	Jaynes report also lithologic logs report 2017
26513	Ni-Cu Deer Lake Complex	1971	USS	61	25	10	460822	5292181	21	920		-45	135	y	Jaynes report also lithologic logs report 2018
26514	Ni-Cu Deer Lake Complex	1971	USS	61	25	16	459300	5291591	124	954		-45	315	y	Jaynes report also lithologic logs report 2019
T-2	VMS - Wilson Lake	1971	Hanna	60	24	1	474244	5284855	99	485		-75	135	bad copy	none found
T-3	VMS - Wilson Lake	1971	Hanna	60	24	1	474244	5284823	62	251		-50	135	bad copy	none found
T-4	VMS - Wilson Lake	1971	Hanna	61	24	25	474527	5287634	162	439		-60	325	New Scan	Jaynes report
T-5	VMS - Wilson Lake	1971	Hanna	61	24	25	473751	5287016	160.5	343		-60	328	y	Jaynes report
T-6	VMS	1971	Hanna	62	24	17	467718	5300093	109	309		-56	20	New Scan	Jaynes report
T-7	VMS	1971	Hanna	62	24	17	467389	5300123	163	364	1350	-60	202	New Scan	Jaynes report
T-9	VMS - Dahlberg	1971	Hanna	61	23	21	478765	5289825	138	390		-60	337	y	Jaynes report also lithologic logs report 2022
T-10	VMS - Dahlberg	1971	Hanna	61	23	21	478964	5289767	63	354		-60	157	y	Jaynes report also lithologic logs report 2023

DRILL HOLE NUMBER	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (ft)	EOH (ft)	ELEV (ft)	ANGLE	AZIMUTH	LOG	ASSAYS
T-13	VMS	1971	Hanna	61	24	11	472269	5291920	76	250	1425	-60	355	New Scan	Jaynes report
T-14	VMS - Wilson Lake - No Core	1971	Hanna	60	24	2	473530	5284780	no info	no info	no info	no info	no info	NO	NO
T-15	VMS	1971	Hanna	60	24	1	475586	5284734	30	415		-60	0	NO	
T-16	VMS	1971	Hanna	61	23	27	480725	5286980	190	415		-60	330	y	Jaynes report
CN-16	VMS - Coon Lake #16	1971	Humble/Exxon	60	25	29	459633	5277952	230	422		-45	160	y	on log
FL10-1	VMS - Franklin Lake Branch	1971	Bear Creek/Kennecott	62	23	2	481828	5303119	245	454		-55	0	y	Not Sampled
FL10-2	VMS - Franklin Lake Branch	1971	Bear Creek/Kennecott	62	23	2	481846	5303086	267	603		-55	0	New Scan	Not Sampled
40925	VMS	1972	INCO	60	22	19	486552	5280060	42	460	1465	-50	0	y	on log
40927	VMS	1972	INCO	62	24	30	466384	5297605	153	424	1360	-50	180	y	on log
26515	Ni-Cu Deer Lake Complex	1972	USS	61	25	16	459633	5291260	40	605		-45	135	y	Jaynes report
26516	Ni-Cu Deer Lake Complex	1972	USS	61	24	6	465551	5294385	10	802		-50	135	y	Jaynes report
CRI-1	VMS - Cricket	1981	Lehmann	60	23	34	480775	5276285	34	384	1400	-55	360	y	y
DRA-1	VMS - Dragon Fly	1981	Lehmann	60	23	34	480660	5276601	23	503	1390	-55	15	y	y
DRA-2	VMS - Dragon Fly	1981	Lehmann	60	23	34	480632	5276643	14	299	1390	-55	360	y	y
MIR-1	VMS - Miro	1982	Lehmann	61	26	26	453264	5288071	110	402	1350	-55	325	y	New Scan
MIR-2	VMS - Miro	1982	Lehmann	61	26	26	453021	5288311	89	464	1350	-55	325	y	New Scan
LIA-1	Gold - Liam	1982	Lehmann	61	22	7	484968	5293032	151	343	1372	-55	165	y	on log
LIA-2	Gold - Liam	1983	Lehmann	61	22	7	485156	5292972	71	490	1370	-55	345	y	on log
LIA-3	Gold - Liam	never submitted	Lehmann	61	22	7	485023	5292708	75	401		-50	NW		never submitted
CAL-1	VMS - Callisto	1983	Lehmann	60	22	7	486652	5281986	4	498	1450	-55	270	New Scan	y
CAL-2	VMS - Callisto	1983	Lehmann	60	22	18	486623	5281745	9	523	1475	-55	270	y	on log
CAL-3	VMS - Callisto	1983	Lehmann	60	22	18	486684	5281684	5	673	1495	-65	270	y	on log
SNIT-1	VMS - Snake Trail	1983	Lehmann	61	22	21	488511	5288847	107	623	1385	-55	0	y	log & (with Her 1&2)
SOC-1	VMS - Soca	1983	Lehmann	60	23	25	483736	5277618	66	353	1450	-50	60	y	on log
GAN-1	VMS - Ganymede	1983	Lehmann	60	22	18	486533	5281092	36	387	1485	-55	270	y	on log
GB-1	Gold - Gale Brook	1983	Lehmann	60	25	29	459120	5277514	240	803	1380	-55	335	y	on log
HER-1	VMS - Hera	1983	Lehmann	61	22	29	486077	5286985	206	653	1353	-55	25	y	y
HER-2	VMS - Hera	1983	Lehmann	61	22	32	486282	5286805	196	562	1355	-55	25	y	y
HER-3	VMS - Hera	1983	Lehmann	61	22	29	486477	5287193	124	553	1344	-55	25	y	on log
KAI-1	VMS - Kaiso	1983	Lehmann	60	23	35	483652	5275949	17	504	1445	-60	245	y	on log
KAI-2	VMS - Kaiso	1983	Lehmann	60	23	35	483620	5275696	79	693	1430	-50	65	y	on log
GUJA-1	VMS - Guava	1984	Lehmann	60	23	35	483339	5276067	9	453	1433	-55	240	y	y
GBD-1	Gold - Gale Brook	1984	Lehmann	60	25	30	458190	5277562	247	563	1370	-55	180	y	on log
KAT-1	VMS - Kathryn	1984	Lehmann	60	23	16	479430	5281346	124	265	1355	-55	245	New Scan	Not Sampled

DRILL HOLE NUMBER	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (ft)	EOH (ft)	ELEV (ft)	ANGLE	AZIMUTH	LOG	ASSAYS
KAT-2	VMS - Kathryn	1984	Lehmann	60	23	16	479400	5281310	113	702	1355	-45	245	y	on log
BR-1	VMS - Bear River	1985	Duval	61	22	30	485216	5287476	151	653	1330	-45	165	y	on log
WIL-85-1	Gold - Beaver Lake	1985	Meridian	60	24	1	474440	5284888	76	400	1385	-55	155	y	y
BEV-85-1	Gold - Beaver Lake	1985	Meridian	61	24	34	470850	5285339	58	350	1410	-60	0	y	y
BEV-85-2	Gold - Beaver Lake	1985	Meridian	61	24	34	471130	5285342	55	443	1415	-60	0	y	y
BEV-85-3	Gold - Beaver Lake	1985	Meridian	60	24	4	470625	5285123	53	370	1415	-55	0	y	y
BEV-85-4	Gold - Beaver Lake	1985	Meridian	60	24	3	471857	5285162	225	463	1415	-55	336	y	y
BEV-85-5	Gold - Beaver Lake	1985	Meridian	60	24	3	471921	5285041	120	499	1415	-55	330	y	y
LL-85-1	Gold - Lost Lake	1985	Meridian	60	24	9	469350	5282068	56	401	1400	-45	159	y	y
LL-85-2	Gold - Lost Lake	1985	Meridian	60	24	3	471211	5284145	140	410	1395	-55	323	y	y
LL-85-2A	Gold - Lost Lake	1985	Meridian	60	24	3	471211	5284145	143	412	1395	-55	323	y	dark page of scanned book
LL-85-3	Gold - Lost Lake	1985	Meridian	60	24	9	470326	5282871	129	473	1410	-55	224	y	y
LL-85-4	Gold - Lost Lake	1985	Meridian	60	24	8	469133	5282231	139	422	1420	-45	334	y	y
LL-85-5	Gold - Lost Lake	1985	Meridian	60	24	9	469349	5282055	60	307	1400	-50	159	y	y
LL-87-6	Gold - Lost Lake	1987	FMC	60	24	9	469350	5282058	43	620	1400	-70	144	y	y
LL-87-7	Gold - Lost Lake	1987	FMC	60	24	9	469410	5282126	72	603	1395	-50	144	y	y
LL-87-8	Gold - Lost Lake	1987	FMC	60	24	9	469465	5282165	85	377	1395	-45	144	y	y
LL-87-9	Gold - Lost Lake	1987	FMC	60	24	9	469303	5281988	85	490.5	1395	-50	144	y	y
LL-87-10	Gold - Lost Lake	1987	FMC	60	24	9	469261	5281931	78	78	1400	-45	144	y	Not Sampled
LL-87-10A	Gold - Lost Lake	1987	FMC	60	24	9	469261	5281931	110	402	1400	-45	144	y	y
LL-87-11	Gold - Lost Lake	1987	FMC	60	24	9	470080	5283153	141	457	1410	-45	144	y	y
LL-87-12	Gold - Lost Lake	1987	FMC	60	24	17	468954	5281595	86.5	511	1425	-45	10	y	y
LL-87-13	Gold - Lost Lake	1987	FMC	60	24	9	469264	5282034	57	472.5	1395	-45	144	y	y
LL-87-14	Gold - Lost Lake	1987	FMC	60	24	17	468955	5281656	93	365	1425	-45	10	y	y
LL-87-15	Gold - Lost Lake	1987	FMC	60	24	17	469184	5281631	138	411	1425	-45	333	y	y
LL-87-16	Gold - Lost Lake	1987	FMC	60	24	9	469223	5281999	79	375	1395	-45	144	y	y
LL-87-17	Gold - Lost Lake	1987	FMC	60	24	8	469069	5281987	85	347	1400	-50	180	y	y
KIB-10	MGS hole for mapping	1987	MGS	61	26	29	447513	5289161	81	99	1335	-90		IC-26	IC-26
KIB-11	MGS hole for mapping	1987	MGS	61	26	10	451893	5293662	50	81	1350	-90		IC-26	IC-26
KIB-12	MGS hole for mapping	1987	MGS	62	26	24	455376	5299925	145	177	1367	-90		IC-26	IC-26
KIB-2	MGS hole for mapping	1987	MGS	61	22	15	490223	5291828	49	73	1305	-90		IC-26	IC-26
KIB-4	MGS hole for mapping	1987	MGS	60	23	3	482195	5284205	78	180.3	1369	-90		IC-26	IC-26
KIB-5B	MGS hole for mapping	1987	MGS	60	24	36	475333	5276430	127	164	1384	-90		IC-26	IC-26
KIB-6	MGS hole for mapping	1987	MGS	61	25	36	464194	5286864	15	430	1414	-90		IC-26	IC-26

DRILL HOLE NUMBER	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (ft)	EOH (ft)	ELEV (ft)	ANGLE	AZIMUTH	LOG	ASSAYS
KIB-7	MGS hole for mapping	1987	MGS	60	26	20	449324	5280333	198	224.9	1365	-90		IC-26	IC-26
KIB-8	MGS hole for mapping	1987	MGS	61	26	13	453637	5291111	57	72.5	1330	-90		IC-26	IC-26
LL-88-18	Gold - Lost Lake	1988	FMC	60	24	9	468775	5281610	60	535	1430	-45	320	y	y
LL-88-18A	Gold - Lost Lake	1988	FMC	60	24	17	469140	5282187	75	240	1430	-45	144	abandonment only	NO
LL-88-19	Gold - Lost Lake	1988	FMC	60	24	9	469254	5282037	50	750	1405	-70	144	y	y
LL-88-20	Gold - Lost Lake	1988	FMC	60	24	9	469308	5282044	40	290	1405	-45	151	abandonment only	NO
LL-88-21	Gold - Lost Lake	1988	FMC	60	24	8	469135	5282193	190	190	1430	-48	144	overburden only	Not Sampled
JL-88-1	Gold - Joy Lake	1988	Meridian/FMC	62	23	20	476787	5298210	248	451	1448	-50	86	y	no record
JL-88-2	Gold - Joy Lake	1988	Meridian/FMC	62	23	30	475808	5297564	203	601.5	1395	-45	356	y	no record
JL-88-3	Gold - Joy Lake	1988	Meridian/FMC	62	23	20	476802	5298325	238	565.5	1448	-55	180	y	no record
WB-1	Gold - Wilson Lake	1988	Normin	61	23	30	474741	5287473	139	872	1430	-50	342	y	y
WB-2B	Gold - Wilson Lake	1988	Normin	61	23	30	475305	5288324	36	1152	1410	-45	162	y	y
OB-301	Overburden studies	1988	MDNR	61	26	25	453967	5287593			1367	-90			
OB-302	Overburden studies	1988	MDNR	62	25	35	463217	5296972			1366	-90			
OB-306	Overburden studies	1988	MDNR	61	26	16	449487	5292353			1352	-90			
OB-307	Overburden studies	1988	MDNR	62	26	16	449017	5300413			1335	-90			
KIB-1	MGS hole for mapping	1988	MGS	61	22	36	493609	5285996	106	122	1380	-90		IC-26	IC-26
KIB-3B	MGS hole for mapping	1988	MGS	62	23	13	482572	5299802	181	219	1345	-90		IC-26	IC-26
KIB-13	MGS hole for mapping	1988	MGS	62	25	33	458665	5296275	69	125	1301	-90		IC-26	IC-26
KIB-18	MGS hole for mapping	1988	MGS	62	24	35	472371	5295686	186	320	1375	-90		IC-26	Not Sampled
KIB-49	MGS hole for mapping	1988	MGS	60	26	23	455021	5278875	42	68	1372	-90		IC-26	IC-26
GB88-1	Gold - Gale Brook	1988	Lehmann	60	25	30	458192	5277607	281	800	1365	-55	180	y	on log
GB88-2	Gold - Gale Brook	1989	Lehmann	60	25	30	458067	5277587	269	475	1370	-55	160	y	on log
CB-1	Gold - Calypso	1989	Normin	61	23	29	476704	5287332	42	197	1411	-60	12	y	y
CB-2	Gold - Calypso	1989	Normin	61	23	29	476898	5287288	32	250	1409	-45	356	y	y
CB-3	Gold - Calypso	1989	Normin	61	23	29	476618	5287487	49	227	1408	-45	17	y	y
CB-4	Gold - Calypso	1989	Normin	61	23	29	476788	5287306	40	147	1412	-45	56	y	y
CB-5	Gold - Calypso	1989	Normin	61	23	29	476788	5287306	40	200	1412	-45	17	y	y
WB-3	Gold - Wilson Lake	1989	Normin	61	23	30	475559	5288491	136	1551	1395	-45	342	y	y
KDH-2	MGS hole for mapping	1989	MGS	60	25	36	465344	5276845	140	494	1425	-60	0	NO	NS
CD-1	MGS hole for mapping	1989	MGS	61	22	19	484749	5290175	240	250	1385	-90		IC-37	IC-37
CD-2B	MGS hole for mapping	1989	MGS	62	22	12	493549	5301373	70	79	1320	-90		IC-37	IC-37
CD-37	MGS hole for mapping	1990	MGS	62	22	14	490736	5301041	109	127	1320	-90		IC-37	IC-37
CD-40	MGS hole for mapping	1990	MGS	61	22	16	487790	5290367	135	147	1315	-90		IC-37	Not Sampled

DRILL HOLE NUMBER	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (ft)	EOH (ft)	ELEV (ft)	ANGLE	AZIMUTH	LOG	ASSAYS
CD-9	MGS hole for mapping	1990	MGS	59	22	1	493867	5274861	53	64.2	1400	-90		IC-37	Not Sampled
WL-90-1	Gold - Wamp Lake	1990	Noranda	60	23	24	483953	5279296	51	102	1460	-45	180	y	y
WL-90-2	Gold - Wamp Lake	1990	Noranda	60	23	24	483968	5279194	20	402	1463	-45	0	y	y
DD91-1	MGS hole for mapping	1991	MGS	61	22	19	484790	5291044	240	450	1385	-55	150	IC-37	IC-37
GB09-01	Gold - Gale Brook	2010	Lehmann	60	25	30	458045	5277539	218	612	1365	-55	165	abandonment only	NO
GB10-02	Gold - Gale Brook	2010	Lehmann	60	25	30	458240	5277447	295	786	1365	-55	145	abandonment only	NO
LL10-01	Gold - Lost Lake	2010	Lehmann	60	24	8	468996	5282152	137	407	1434	-45	345	abandonment only	NO
LL10-02	Gold - Lost Lake	2010	Lehmann	60	24	9	469244	5282056	81	513	1398	-45	160	abandonment only	NO
LL10-03	Gold - Lost Lake	2010	Lehmann	60	24	9	469300	5282053	54	407	1398	-45	160	abandonment only	NO

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DRILL HOLE NUMBER	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	LOG	ASSAYS
RR-1		3/27/1984	MDNR	71	23	31	475575	5382106	6	1602		-48	180	new scan	on scan
RR-2		6/6/1984	MDNR	70	23	4	478477	5380445	11	553		-43	348	new scan	on scan
ND-1	Native Dancer	2/3/1986	Normin	70	23	6	474578	5381488	18	603	1140	-45	160	Y	on log
ND-2	Native Dancer	2/10/1986	Normin	70	23	6	474349	5381412	29	645	1145	-45	340	Y	on log
ND-3	Native Dancer	3/4/1986	Normin	71	23	31	474869	5382458	29	409	1140	-45	160	Y	on log
S-1	Secretariat	2/17/1986	Normin	71	23	31	475724	5382634	25	343	1170	-45	160	Y	on log
S-2	Secretariat	2/20/1986	Normin	71	23	32	475889	5382434	4	452	1180	-45	160	Y	on log
S-3	Secretariat	2/26/1986	Normin	71	23	32	476089	5382649	0	454	1145	-45	160	Y	on log
SS-1	Seattle Slew	10/23/1987	Normin	70	24	1	472604	5380861	11	588	1165	-45	343	Y	on log
SS-2	Seattle Slew	12/11/1987	Normin	70	24	1	472581	5381035	20	93	1160	-45	345	Y	on log
SS-2A	Seattle Slew	12/15/1987	Normin	70	24	1	472695	5380917	20	400	1160	-45	345	Y	on log
SS-3	Seattle Slew	12/20/1987	Normin	70	24	1	472500	5380877	0	510	1170	-45	343	Y	on log
SS-4	Seattle Slew	1/18/1989	Normin	70	24	1	472803	5380931	39	412	1160	-45	336	Y	on log
SS-5	Seattle Slew	1/26/1989	Normin	70	24	1	473639	5381139	15	712	1155	-45	336	Y	on log
SS-6	Seattle Slew	2/2/1989	Normin	70	24	1	473211	5380943	18	502	1165	-45	336	Y	on log
SS-7	Seattle Slew	2/12/1989	Normin	70	24	1	472830	5380858	34	722	1162	-45	336	Y	on log
SS-8	Seattle Slew	6/29/1989	Normin	70	24	1	473164	5381081	31	502	1160	-45	336	Y	on log
SS-9	Seattle Slew	7/1/1989	Normin	70	23	6	474108	5381323	53	400	1150	-45	336	Y	on log
SS-10	Seattle Slew	7/2/1989	Normin	70	24	1	472982	5381008	47	301	1163	-45	336	Y	on log
SS-11	Seattle Slew	7/7/1989	Normin	70	24	1	473410	5381142	23	1006	1160	-45	336	Y	on log
TC-35-1	Tilson Creek	10/25/1987	Kerr McGee	71	23	35	481177	5382497	80	462		-50	350	Y	Y
TC-35-2	Tilson Creek	10/30/1987	Kerr McGee	71	23	35	481190	5382418	197	598		-45	170	Y	Y
TC-35-3	Tilson Creek	2/15/1988	Kerr McGee	71	23	35	481076	5382521	12	551		-45	360	Y	Y
TC-35-4	Tilson Creek	2/23/1988	Kerr McGee	71	23	35	481195	5382510	43	611		-40	360	Y	Y
TC-35-5	Tilson Creek	12/9/1989	Newmont	71	23	35	481065	5382476	194	707	1115	-50	350	Y	on log
TC-35-6	Tilson Creek	12/16/1989	Newmont	71	23	35	480903	5382274	170	747	1115	-50	350	Y	on log
TC-35-7	Tilson Creek	12/19/1989	Newmont	71	23	35	482069	5382874	131	697	1110	-50	190	Y	on log
TC-36-1	Tilson Creek	10/8/1987	Kerr McGee	71	23	36	483002	5382964	3	403		-50	340	Y	Y

Vermilion_District_drillholes_trenches_shafts_list.xls

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
2606	Iron Ore - Mud Creek Mine	1905	USS	62	14	5	562980	5303562	13	389		-65	0	y - mnarchive	none submitted	USS
2636	Iron Ore - Mud Creek Mine	1905	USS	62	14	5	563062	5303443	28	401		-66	0	y - mnarchive	none submitted	
2728	Iron Ore - Mud Creek Mine	1906	USS	62	14	5	562937	5303460	10	307		-90	0	y - mnarchive	none submitted	
2680	Iron Ore - Section 4/9	1906	USS	62	13	9	574820	5302713	9	1073		-65	39	y - mnarchive	none submitted	USS
2815	Iron Ore - Section 4/9	1906	USS	62	13	4	574856	5302803	15	900		-65	305	y - mnarchive	none submitted	USS
2939	Iron Ore - Section 4/9	1906	USS	62	13	4	574820	5302926	8	562		-75	180	y - mnarchive	none submitted	USS
3034	Iron Ore - Section 4/9	1906	USS	62	13	4	574870	5302863	25	360		-60	250	y - mnarchive	none submitted	USS
Berg-2	Iron Ore - Walsh Shaft	unknown	Bergland Lumber	62	14	4	unknown	unknown	110	115		unknown	unknown	none	none submitted	
Berg-2A	Iron Ore - Walsh Shaft	unknown	Bergland Lumber	62	14	4	unknown	unknown	46	125		unknown	unknown	none	none submitted	
Berg-3	Iron Ore - Walsh Shaft	unknown	Bergland Lumber	62	14	4	unknown	unknown	65	346		unknown	unknown	none	none submitted	American Shield
M-1	Taconite - McComber	1954	WS Moore	62	14	14	568698	5300430	10	185		unknown	unknown	y - mnarchive	not sampled	not preserved
M-2	Taconite - McComber	1954	WS Moore	62	14	13	569983	5300618	14	175		-60	180	new scan	not sampled	not preserved
M-3	Taconite - McComber	1954	WS Moore	62	14	14	568993	5300572	24	185		-60	180	new scan	not sampled	not preserved
M-4	Taconite - McComber	1954	WS Moore	62	14	13	569983	5300655	0	678		-90		new scan	not sampled	not preserved
M-5	Taconite - McComber	1954	WS Moore	62	14	13	570980	5300452	unknown	200		-90		new scan	not sampled	not preserved
5401	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	591285	5307222	14	529	1431.6	-30	180	No - but available on mnarchive	not sampled	not preserved
5402	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	591285	5307252	28	785	1436.7	-38	180	No - but available on mnarchive	not sampled	not preserved
5403	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	591043	5307086	57	851	1394.8	-30	000	No - but available on mnarchive	not sampled	not preserved
5404	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	592427	5307410	21	561	1404	-30	180	No - but available on mnarchive	not sampled	not preserved
5405	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	591043	5307105	62	98	1395.2	-45	180	No - but available on mnarchive	not sampled	not preserved
5406	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	590693	5307442	5	720	1427.6	-30	180	No - but available on mnarchive	not sampled	not preserved
5407	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	590845	5307420	12	580	1455.2	-30	180	No - but available on mnarchive	not sampled	not preserved
5409	Taconite - Section 30	1954	Jones & Laughlin Steel Co.	63	11	30	590233	5307341	22	242	1387	-30	180	No - but available on mnarchive	not sampled	not preserved
5408	Taconite - Section 30	1955	Jones & Laughlin Steel Co.	63	11	30	589941	5307255	13	733	1374.8	-30	000	No - but available on mnarchive	not sampled	not preserved
5410	Taconite - Section 30	1955	Jones & Laughlin Steel Co.	63	11	30	590233	5307361	114	200	1388	-30	000	No - but available on mnarchive	not sampled	not preserved

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
5411	Taconite - Section 30	1955	Jones & Laughlin Steel Co.	63	11	30	590233	5307310	49	180	1413.4	-45	180	No - but available on mnarchive	not sampled	
5615	Taconite - Section 30	1956	Jones & Laughlin Steel Co.	63	11	30	589920	5307569	16	576	1379.6	-30	300	No - but available on mnarchive	not sampled	
1	Taconite - Clear Lake	1957	WS Moore	62	14	13	569588	5300918	83	1655		-90	0	Y - mnarchive	none submitted	
GL-1	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	22	596539	5309741	6	348		-40	-340	No - but available on mnarchive		
GL-2	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	15	596591	5309974	10	155		-45	0	No - but available on mnarchive		
GL-3	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	22	596350	5309341	78	236		-50	0	No - but available on mnarchive		
GL-4	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	596744	5309426	17	111		-90?		No - but available on mnarchive		
GL-5	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	596738	5309311	29	100		-90?		No - but available on mnarchive		
GL-6	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	596726	5309164	40	104		-90?		No - but available on mnarchive		
GL-7	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	22	596533	5309366	21	84		-90?		No - but available on mnarchive		
GL-8	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	22	596380	5309113	8	75		-90?		No - but available on mnarchive		
GL-9	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	597309	5309375	11	131		-90?		No - but available on mnarchive		
GL-10	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	597357	5309390	5	87		-90?		No - but available on mnarchive		
GL-11	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	597159	5309305	37	114		-90?		No - but available on mnarchive		
GL-12	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	597351	5309080	11	106		-90?		No - but available on mnarchive		
GL-13	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	23	596597	5309664	52	165		-90?		No - but available on mnarchive		
GL-14	Taconite - Garden Lake	1958	Garden Lake Mining	63	11	22	596443	5309432	15	462		-90?	unknown	No - but available on mnarchive		
WS-1	Gold - Raspberry	1962	Whiteside	63	13	25	580391	5306422	10	200		-90		Y - mnarchive	on log	
WS-2	Gold - Raspberry	1962	Whiteside	63	13	25	580309	5306448	1	200		unknown	unknown	Y - mnarchive	on log	
WS-3	Gold - Raspberry	1962	Whiteside	63	13	25	580305	5306449	8	208		-90		Y - mnarchive	on log	American Shield
WS-4	Gold - Raspberry	1962	Whiteside	63	13	25	580263	5306475	21	200		-45	106	Y - mnarchive	on log	
WS-5	Gold - Raspberry	1962	Whiteside	63	12	30	580520	5306462	1	210		unknown	unknown	Y - mnarchive	on log	
WS-6	Gold - Raspberry	1963	Whiteside	63	12	30	580509	5306463	7	204		unknown	unknown	Y - mnarchive	on log	
WS-7	Gold - Raspberry	1963	Whiteside?	63	12	30	unknown	unknown	unknown	unknown		unknown	unknown	none	unknown results	
WS-8	Gold - Raspberry	1963	Whiteside?	63	12	30	unknown	unknown	unknown	unknown		unknown	unknown	none	unknown results	
WS-9	Gold - Raspberry	1963	Whiteside?	63	12	30	unknown	unknown	unknown	unknown		unknown	unknown	none	unknown results	
S-1	VMS - Raspberry	1969	Bear Cr	63	12	30	581519	5306871	10	348	1390	-45	0	Y - mnarchive	on log	American Shield
S-2	VMS - Raspberry	1969	Bear Cr	63	12	30	580900	5306332	2	210	1435	-45	300	Y - mnarchive	on log	American Shield
S-3	VMS - Raspberry	1969	Bear Cr	63	12	30	581043	5306308	12	173	1370	-45	330	Y - mnarchive	on log	American Shield
TL-4	VMS - Twin Lakes	1969	Bear Cr	62	12	17	582096	5300789	43	313	1490	-45	0	Y - mnarchive	on log	
TL-7	VMS - Twin Lakes	1969	Bear Cr	62	12	18	581737	5300789	0	89	1530	-45	180	Y - mnarchive	on log	
T-5	VMS - Tower	1969	Bear Cr	61	15	5	553545	5292940	11	307	1470	-45	195	Y - mnarchive	on log	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVFB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
T-6	VMS - Tower	1969	Bear Cr	61	15	6	553400	5292860	15	114	1455	-45	202	y - mnarchive	on log	
TL-8	VMS - Twin Lakes	1970	Bear Cr	62	13	12	580456	5302824	0	128	1530	-55	0	y - mnarchive	on log	
TL-9	VMS - Twin Lakes	1970	Bear Cr	62	13	14	577942	5300258	177	394	1410	-60	7	y - mnarchive	on log	
RL-10	VMS - Bass Lake	1970	Bear Cr	62	15	2	558924	5303796	56	138	1430	-45	160	y - mnarchive	on log	
V-2	VMS - Buckshot Lake	1970	Hanna	63	14	32	563302	5304488	61	376	1430	-60	0	new scan	none submitted	
CL-1	VMS - Clear Lake	1970	Humble/Exxon	62	14	11	569159	5301884	7	573	1570	-45	180	y - mnarchive	on log	BHP-no gold
CL-2	VMS - Clear Lake	1970	Humble/Exxon	62	14	11	568551	5302206	36	493	1500	-45	180	y - mnarchive	on log	BHP-no gold
CL-3	VMS - Clear Lake	1970	Humble/Exxon	62	14	11	567927	5302241	49	474	1450	-45	180	y - mnarchive	on log	BHP-no gold
Arm-1	VMS - Armstrong Bay	1970	Humble/Exxon	62	14	18	562152	5299562	6	583	1430	-45	180	y - mnarchive	on log	Noranda
Arm-2	VMS - Armstrong Bay	1970	Humble/Exxon	62	14	18	562771	5299446	48	603	1440	-45	180	y - mnarchive	on log	Noranda
Arm-3	VMS - Armstrong Bay	1970	Humble/Exxon	62	14	18	561894	5299542	17	223	1390	-45	180	y - mnarchive	on log	Noranda
V-1	VMS - Almar Mine	1970	Hanna	62	14	15	567573	5300245	6	259	1485	-60	324	new scan	none submitted	
M-1	VMS - Mitchell Lake	1970	Humble/Exxon	62	12	4	583532	5303186	16	422	1485	-45	170	y - mnarchive	on log	
M-2	VMS - Mitchell Lake	1970	Humble/Exxon	62	12	4	581726	5302488	15	562	1510	-45	170	y - mnarchive	on log	
LL-1	Ni-Cu - Little Long Lake	1970	Humble/Exxon	63	12	16	583665	5309744	11	343	1450	-45	160	y - mnarchive	on log	
LL-2	Ni-Cu - Little Long Lake	1970	Humble/Exxon	63	12	16	583977	5309989	9	572	1460	-45	160	y - mnarchive	on log	
LL-3	Ni-Cu - Little Long Lake	1970	Humble/Exxon	63	12	16	583831	5310168	5	653	1470	-45	160	y - mnarchive	on log	
BL-1	Ni-Cu - Bright Lake	1970	Humble/Exxon	64	12	36	589154	5314893	5	301	1410	-45	155	y - mnarchive	on log	
ET-1	VMS - East Two Rivers	1970	Humble/Exxon	61	15	10	558171	5292716	75	375	1440	-45	190	y - mnarchive	on log	
WW-1	VMS - White Iron Lake	1970	Humble/Exxon	63	12	35	588044	5304957	17	173		-45	165	y - mnarchive	on log	
SC-1	VMS - Sassas Creek	1970	Bear Cr	62	17	29	534548	5296358	80	498	1350	-65	180	y - mnarchive	on log	
SC-2	VMS - Sassas Creek	1970	Bear Cr	62	17	29	534615	5296344	47	220	1350	-60	180	y - mnarchive	on log	
26504	VMS - La Rue Mine	1970	USS	62	14	8	563017	5301131	19	875		-60	315	new scan	on log	
26500	VMS - Froben	1970	USS	62	15	24	560064	5298154	13	689		-50	45	new scan	none submitted	
26501	VMS - Froben	1970	USS	62	15	24	560067	5298290	6.6	589		-50	225	new scan	none submitted	
26505A	VMS - Lost Lake	1971	USS	62	16	32	545340	5294375	26	435		-60	360	new scan	on log	
26505B	VMS - Lost Lake	1971	USS	62	16	32	545340	5294375	27	797		-60	360	new scan	on log	
V-5	VMS - Section 5	1971	Hanna	62	14	5	564396	5304084	7	13	1490	-90	0	new scan	none submitted	
V-6	VMS - Section 5	1971	Hanna	62	14	5	564396	5304084	6	17	1490	-90	0	new scan	none submitted	
26517	VMS - Moberg	1972	USS	61	16	12	551212	5292586	26	1104	1104	-50	180	y - mnarchive	none submitted	Kerr McGee
P-1	VMS - Pine Island	1972	Humble/Exxon	62	15	6	551952	5303461	16	141	1450	-45	186	y - mnarchive	on log	
RZ-1	Gold - Raspberry	1974	Whiteside	63	12	30	580734	5306402	20	454		-45	295	none	none submitted	
RZ-2	Gold - Raspberry	1974	Whiteside	63	12	30	580665	5306327	5	306		-45	320	none	none submitted	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVH (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
RZ-3	Gold - Raspberry	1974	Whiteside	63	12	30	580758	5306486	8	459		-45	295	none	none submitted	
RZ-4	Gold - Raspberry	1974	Whiteside	63	12	30	580565	5306437	35	413		-45	325	none	none submitted	
RZ-5	Gold - Raspberry	1974	Whiteside	63	12	30	580572	5306400	13	354		-55	325	none	none submitted	
RZ-6	Gold - Raspberry	1974	Whiteside	63	13	25	580428	5306399	25	443		-45	327	new scan	none submitted	
SL-1	VMS - Skeleton Lake	1974	Humble/Exxon	61	14	8	563422	5292255	79	350		-50	180	y - mnarchive	on log	
SL-2	VMS - Skeleton Lake	1974	Humble/Exxon	61	14	8	563542	5292211	60	400		-50	180	y - mnarchive	on log	
SL-3	VMS - Skeleton Lake	1975	Humble/Exxon	61	14	8	563453	5292301	110	536		-50	180	y - mnarchive	on log	
EDH-1	Gold - Raspberry	1980	Goldfields	63	12	30	580510	5306879	cuttings	180		-45		y - mnarchive	on log	
EDH-2	Gold - Raspberry	1980	Goldfields	63	13	25	580229	5306873	cuttings	160		-45		y - mnarchive	on log	
EDH-3	Gold - Raspberry	1980	Goldfields	63	13	25	580096	5306835	cuttings	160		-45		y - mnarchive	on log	
EDH-4	Gold - Raspberry	1980	Goldfields	63	13	25	580107	5306598	cuttings	200		-90		y - mnarchive	on log	
EDH-5	Gold - Raspberry	1980	Goldfields	63	13	25	580069	5306879	cuttings	160		-45		y - mnarchive	on log	
EDH-6	Gold - Raspberry	1980	Goldfields	63	13	25	580375	5306509	cuttings	210		-90		y - mnarchive	on log	
EDH-7	Gold - Raspberry	1980	Goldfields	63	12	30	580502	6306536	cuttings	200		-90		y - mnarchive	on log	
EDH-8	Gold - Raspberry	1980	Goldfields	63	12	30	580451	5306504	cuttings	200		-90		y - mnarchive	on log	
EDH-9	Gold - Raspberry	1980	Goldfields	63	13	25	580392	5306249	cuttings	225		-90		y - mnarchive	on log	
EDH-10	Gold - Raspberry	1980	Goldfields	63	12	30	580555	5306569	cuttings	200		-90		y - mnarchive	on log	
EDH-11	Gold - Raspberry	1980	Goldfields	63	13	25	580429	5306307	cuttings	205		-90		y - mnarchive	on log	
EDH-12	Gold - Raspberry	1980	Goldfields	63	12	30	580624	5306339	cuttings	200		-90		y - mnarchive	on log	
EDH-13	Gold - Raspberry	1980	Goldfields	63	12	30	580480	5306341	cuttings	200		-90		y - mnarchive	on log	
EDH-14	Gold - Raspberry	1980	Goldfields	63	12	30	580461	5306256	cuttings	210		-90		y - mnarchive	on log	
EDH-15	Gold - Raspberry	1980	Goldfields	63	13	25	580400	5306353	cuttings	200		-90		y - mnarchive	on log	
EDH-16	Gold - Raspberry	1980	Goldfields	63	12	30	580512	5306290	cuttings	205		-90		y - mnarchive	on log	
EDH-17	Gold - Raspberry	1980	Goldfields	63	13	25	580328	5306352	cuttings	225		-90		y - mnarchive	on log	
EDH-18	Gold - Raspberry	1980	Goldfields	63	12	30	580579	5306299	cuttings	200		-90		y - mnarchive	on log	
EDH-19	Gold - Raspberry	1980	Goldfields	63	13	25	580360	5306300	cuttings	205		-90		y - mnarchive	on log	
EDH-20	Gold - Raspberry	1980	Goldfields	63	12	30	580540	5306363	cuttings	205		-90		y - mnarchive	on log	
EDH-21	Gold - Raspberry	1980	Goldfields	63	12	30	580464	5306366	cuttings	205		-90		y - mnarchive	on log	
EDH-22	Gold - Raspberry	1980	Goldfields	63	12	30	580509	5306413	cuttings	205		-90		y - mnarchive	on log	
EDH-23	Gold - Raspberry	1980	Goldfields	63	12	30	580619	5306468	cuttings	215		-90		y - mnarchive	on log	
EDH-24	Gold - Raspberry	1980	Goldfields	63	12	30	580588	5306517	cuttings	208		-90		y - mnarchive	on log	
27013	Gold - Section 9	1981	USS	62	14	9	565344	5301857	0	1412		-50	180	new scan	on log	
27014	Gold - Section 9	1981	USS	62	14	10	566558	5301742	6	822		-50	328	new scan	on log	
R-1	Gold - Raspberry	1982	Nicor	63	13	25	580108	5306359	14	273	1400	-50	340	y - mnarchive	on log	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
R-2	Gold - Raspberry	1982	Nicor	63	13	25	580316	5306490	7	492	1400	-42	332	y - mnarchive	on log	
R-3	Gold - Raspberry	1982	Nicor	63	12	30	580776	5306676	4	354	1400	-45	332	y - mnarchive	not sampled	
R-4	Gold - Raspberry	1982	Nicor	63	13	25	580084	5306344	6	240	1400	-46	332	y - mnarchive	not sampled	
R-5	Gold - Raspberry	1982	Nicor	63	13	25	580133	5306375	11	243	1400	-48	332	y - mnarchive	not sampled	
28019	Gold - Bass Lake	1983	USS	62	15	1	560595	5303539	25	483		-50	180	new scan	on log	
28020	Gold - Bass Lake	1983	USS	62	15	1	560221	5303527	10	494		-50	180	new scan	on log	
28017	Gold - Section 9	1983	USS	62	14	9	565708	5301657	0	667		-50	360	new scan	on log	
28018	Wolf Lake	1983	USS	62	13	5	572660	5302893	75	577		-50	180	new scan	on log	
28021	Wolf Lake	1983	USS	62	13	5	572687	5302869	61	513		-50	123	new scan	none submitted	
6312-23-1	Gold - Spaulding Bay	1983	Kerr McGee	63	12	23	587387	5308987	8	601	1375	-52	150	y - mnarchive	on log	
6312-23-2	Gold - Spaulding Bay	1983	Kerr McGee/BHP	63	12	23	587149	5308865	18	120	1375	-50	330	new scan	not sampled	
6312-23-3	Gold - Spaulding Bay	1983	Kerr McGee/BHP	63	12	23	587152	5308873	20	583	1375	-50	330	new scan	on log	
PSL-4	VMS - Skeleton Lake	1983	Lehmann	61	14	8	563489	5292281	113	800	1495	-60	190	y - mnarchive	on log	
PSL-5	VMS - Skeleton Lake	1983	Lehmann	61	14	8	563206	5291491	27	604	1495	-60	190	y - mnarchive	on log	
PSL-6	VMS - Skeleton Lake	1983	Lehmann	61	14	17	563493	5291546	62	282	1495	-55	190	y - mnarchive	on log	
PSL-7	VMS - Skeleton Lake	1983	Lehmann	61	14	8	563331	5291248	9	403	1545	-55	190	y - mnarchive	on log	
PSL-8	VMS - Skeleton Lake	1983	Lehmann	61	14	17	563459	5291276	27	302	1510	-55	190	y - mnarchive	on log	
PSL-9	VMS - Skeleton Lake	1983	Lehmann	61	14	17	563703	5291248	0	600	1530	-55	190	y - mnarchive	y	
Trench 1	Gold - Dead Canary	1984	Cyprus	63	15	36	561100	5304568	NA	trench		NA	NA	did not reach bedrock	NA	
Trench 2	Gold - Dead Canary	1984	Cyprus	63	15	36	560960	5304566	NA	trench		NA	NA	did not reach bedrock	NA	
Trench 3	Gold - Dead Canary	1984	Cyprus	63	15	36	560832	5304647	NA	trench		NA	NA	y - mnarchive	y	
Trench 4	Gold - Dead Canary	1984	Cyprus	63	15	36	560780	5304560	NA	trench		NA	NA	y - mnarchive	y	
6314-36-1	Gold - Foss Lake	1984	Kerr McGee	63	14	36	570926	5304426	29	499	1410	-45	170	y - mnarchive	on log	
6314-36-2	Gold - Foss Lake	1984	Kerr McGee	63	14	36	570724	5304525	16	451	1410	-45	0	y - mnarchive	on log	
6313-27-1	Gold - Burntside East	1984	Kerr McGee	63	13	27	576775	5306982	29	812	1430	-50	320	y - mnarchive	y	
6313-27-2	Gold - Burntside East	1984	Kerr McGee	63	13	27	576905	5307276	64	867	1421	-50	305	y - mnarchive	y	
R-6	Gold - Raspberry	1984	Amoco	63	13	25	579593	5306520	49	541		-47	332	y - mnarchive	on log	
R-7	Gold - Raspberry	1984	Amoco	63	13	25	579798	5306617	48	432		-45	332	y - mnarchive	on log	
R-8	Gold - Raspberry	1984	Amoco	63	13	25	579968	5306709	29	400		-45	332	y - mnarchive	on log	
R-9	Gold - Raspberry	1984	Amoco	63	13	36	580099	5306293	16	194		-45	350	y - mnarchive	on log	
R-10	Gold - Raspberry	1984	Amoco	63	13	36	580329	5306246	4	1051	1400	-45	16	y - mnarchive	on log	
R-11	Gold - Raspberry	1984	Amoco	63	13	36	580400	5306308	37	766		-45	16	y - mnarchive	on log	
R-12	Gold - Raspberry	1984	Amoco	63	13	25	580177	5306227	29	389		-45	141	y - mnarchive	on log	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
QH-84-1	Gold - Quartz Hill	1984	St. Joe	63	13	36	580303	5306129	12	253		-60	220	y - mnarchive	on log	
QH-84-2	Gold - Quartz Hill	1984	St. Joe	63	13	36	580257	5306151	16	243		-60	220	y - mnarchive	on log	
QH-84-3	Gold - Quartz Hill	1984	St. Joe	63	13	36	580290	5306133	11	302		-60	288	y - mnarchive	on log	
6312-23-4	Gold - Spaulding Bay	1984	Kerr McGee	63	12	23	587604	5306940	13	750	1378	-60	150	y - mnarchive	w/log	
6312-23-5	Gold - Spaulding Bay	1984	Kerr McGee/BHP	63	12	23	587442	5308995	29	482	1370	-50	335	new scan	on log	
6312-23-6	Gold - Spaulding Bay	1984	Kerr McGee	63	12	23	587089	5308866	3	571	1375	-51	150	y - mnarchive	on log	
6312-23-7	Gold - Spaulding Bay	1984	Kerr McGee/BHP	63	12	23	587169	5308900	22	452	1370	-50	150	new scan	on log	
6312-23-8	Gold - Spaulding Bay	1984	Kerr McGee/BHP	63	12	23	587842	5308816	14	681	1360	-50	330	new scan	on log	
6312-23-9	Gold - Spaulding Bay	1984	Kerr McGee	63	12	23	587094	5308697	21	948	1355	-50	350	y - mnarchive	w/log	
6312-23-9A	Gold - Spaulding Bay	1984	Kerr McGee	63	12	23	587093	5308697	20	50	1355	-55	350	y - mnarchive	w/log	
6312-24-1	Gold - Spaulding Bay	1984	Kerr McGee/BHP	63	12	24	588644	5309134	75	1144	1375	-50	330	new scan	on log	
6312-23-10	Gold - Spaulding Bay	1985	Kerr McGee	63	12	23	587384	5308821	15	728	1370	-50	150	y - mnarchive	w/log	
6312-23-11	Gold - Spaulding Bay	1985	Kerr McGee	63	12	23	587120	5308685	24	753	1355	-50	137	y - mnarchive	w/log	
6115-6-1	Gold - Pike Bay	1985	Kerr McGee	61	15	6	552416	5294353	104	525	1355	-50	180	y - mnarchive	new scan	
V-1	Gold - Railroad Cut	1985	Cyprus	63	14	33	565033	5304469	18	620		-45	196	new scan	on log	Chevron-paper
V-2	Gold - Railroad Cut	1985	Cyprus	63	14	33	565033	5304469	6	100		-60	190	new scan	on log	
V-3	Gold - Railroad Cut	1985	Cyprus	63	14	33	565033	5304469	12	205		-45	359	new scan	on log	
V-4	Gold - Railroad Cut	1985	Cyprus	63	14	33	565099	5304388	1	112		-45	360	new scan	on log	
V-5	Gold - Railroad Cut	1985	Cyprus	63	14	33	565099	5304388	0	588		-45	180	new scan	on log	Chevron-paper
V-6	Gold - Walsh Shaft	1985	Cyprus	62	14	4	564781	5304125	16	399		-45	180	new scan	on log	
V-7	Gold - Walsh Shaft	1985	Cyprus	62	14	4	565222	5303880	8	212		-45	10	new scan	on log	
V-8	Gold - Walsh Shaft	1985	Cyprus	62	14	4	565261	5303920	9	142		-45	347	new scan	on log	
6313-27-3	Gold - Burntside East	1985	Kerr McGee	63	13	27	576308	5306312	19	984	1348	-50	300	y - mnarchive	y	
6313-33-1	Gold - Burntside East	1985	Kerr McGee	63	13	33	575607	5306013	18	994	1365	-50	330	y - mnarchive	y	
BL-25-1	Gold - Raspberry North	1985	Kerr McGee	63	13	25	580288	5307132	17	704	1349	-50	335	y - mnarchive	y	
QH-85-4	Gold - Quartz Hill	1985	St. Joe	63	13	36	580230	5306112	3	303		-64	21	y - mnarchive	on log	
QH-85-5	Gold - Quartz Hill	1985	St. Joe	63	13	36	580228	5306073	15	304		-60	330	y - mnarchive	on log	
QH-85-6	Gold - Quartz Hill	1985	St. Joe	63	13	36	580216	5306119	0	253		-80	332	y - mnarchive	on log	
QH-85-7	Gold - Quartz Hill	1985	St. Joe	63	13	36	580258	5306119	5	182		-48	330	y - mnarchive	on log	
Trench 1	Gold - Quartz Hill	1985	St. Joe	63	13	36	580252	5306148	NA	trench		NA	NA	none	y	
Trench 2	Gold - Quartz Hill	1985	St. Joe	63	13	36	580267	5306138	NA	trench		NA	NA	none	y	
Trench 3	Gold - Quartz Hill	1985	St. Joe	63	13	36	580243	5306126	NA	trench		NA	NA	none	y	
Trench 4	Gold - Quartz Hill	1985	St. Joe	63	13	36	580247	5306110	NA	trench		NA	NA	none	y	

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Trench 5	Gold - Quartz Hill	1985	St. Joe	63	13	36	580200	5306105	NA	trench		NA	NA	none	Y	
Trench 10	Gold - Quartz Hill	1985	St. Joe	63	13	36	580203	5306096	NA	trench		NA	NA	none	Y	
Trench 11	Gold - Quartz Hill	1985	St. Joe	63	13	36	580229	5306082	NA	trench		NA	NA	none	Y	
CC-1	Gold - Section 6/Pac Man Pond	1986	Cyprus	62	14	6	561931	5303581	25	200	1440	-45	135	new scan	new scan	
Trench CC-Tr-1	Gold - Section 6/Pac Man Pond	1986	Cyprus	62	14	6	561808	5303553	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-2	Gold - Section 6/Pac Man Pond	1986	Cyprus	62	14	6	561799	5303492	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-3	Gold - Section 6/Pac Man Pond	1986	Cyprus	62	14	6	561869	5303548	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-4	Gold - Section 6/Pac Man Pond	1986	Cyprus	62	14	6	561868	5303505	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-5	Gold - Section 6/Pac Man Pond	1986	Cyprus	62	14	6	561881	5303476	NA	trench		NA	NA	Y - mnarchive	abbreviated	
CC-2	Gold - Clearcut	1986	Cyprus	62	14	6	561867	5304095	30	312	1450	-45	360	new scan	new scan	
Trench CC-Tr-6	Gold - Clearcut	1986	Cyprus	62	14	6	562058	5303996	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-7	Gold - Clearcut	1986	Cyprus	62	14	6	562114	5304036	NA	trench		NA	NA	did not reach bedrock	NA	
Trench CC-Tr-8	Gold - Clearcut	1986	Cyprus	63	14	31	561746	5304175	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-9	Gold - Clearcut	1986	Cyprus	63	14	31	561767	5304185	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-10	Gold - Clearcut	1986	Cyprus	62	14	6	561869	5304118	NA	trench		NA	NA	Y - mnarchive	abbreviated	
Trench CC-Tr-11	Gold - Clearcut	1986	Cyprus	63	14	31	561904	5304146	NA	trench		NA	NA	Y - mnarchive	abbreviated	
6214-2-1	Gold - Mud Lake	1986	Kerr McGee	62	14	2	568318	5303574	29	600	1470	-50	340	Y - mnarchive	on log	
6214-3-1	Gold - Mud Lake	1986	Kerr McGee	62	14	3	567318	5303468	12	500	1435	-45	160	Y - mnarchive	on log	
6214-3-2	Gold - Mud Lake	1986	Kerr McGee	62	14	3	567277	5303464	14	378	1430	-45	300	Y - mnarchive	on log	
QH-86-8	Gold - Quartz Hill	1985	St. Joe	63	13	36	580344	5306084	12	342		-50	330	NEVER TURNED INTO MDNR	mixed with trench assays	
QH-86-9	Gold - Quartz Hill	1986	St. Joe	63	13	36	580388	5306032	7	352		-50	333	Y - mnarchive	mixed with trench assays	
5 trenches	Gold - North American Mine	1986	Kerr McGee	61	15	4			NA	trenches		NA	NA	none	Y	
RC-1	Gold - Dead Canary	1987	Chevron	63	15	36	560877	5304624	13	504	1400	-45	180	Y - mnarchive	on log	
RC-2	Gold - Dead Canary	1987	Chevron	63	15	36	560626	5304577	100	603	1400	-44	180	Y - mnarchive	on log	
Trench 1	Gold - Dead Canary	1987	Chevron	63	15	36	560613	5304510	NA	trench		NA	NA	Y - mnarchive	Y	
Trench 2	Gold - Dead Canary	1987	Chevron	63	15	36	560698	5304487	NA	trench		NA	NA	Y - mnarchive	Y	
Trench 3	Gold - Dead Canary	1987	Chevron	63	15	36	560779	5304543	NA	trench		NA	NA	Y - mnarchive	Y	
RC-3	Gold - Buckshot Lake	1987	Chevron	62	14	5	562906	5304163	10	793	1470	-45	360	Y - mnarchive	on log	
6214-3-3	Gold - Mud Lake	1987	Kerr McGee	62	14	3	567372	5303462	9	383	1425	-45	340	Y - mnarchive	on log	
6214-3-4	Gold - Mud Lake	1987	Kerr McGee	62	14	3	567108	5303487	16	297	1375	-45	160	Y - mnarchive	on log	
Trench	Gold - Mud Lake	1987	Kerr McGee	62	14	3	567299	5303467	NA	trench		NA	NA	none	paper	
Trench	Gold - Mud Lake	1987	Kerr McGee	62	14	3	567258	5303461	NA	trench		NA	NA	none	paper	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
6214-9-1	Gold - Section 9	1987	Kerr McGee	62	14	9	565049	5301740	39	600	1495	-50	180	y - mnarchive	new scan	
6214-9-2	Gold - Section 9	1987	Kerr McGee	62	14	9	565750	5301852	3	741	1475	-50	160	y - mnarchive	new scan	
6115-14-1	West Two Rivers	1987	Kerr McGee	61	15	14	559075	5290049	62	590		-50	205	y - mnarchive	paper	
Trench 1	Gold - Rosendahl	1987	Rhude & Flyberger	61	17	20	534607	5288002	NA	trench		NA	NA	y - mnarchive	on map	
Trench CC T-1	Gold - Clearcut	1988	Chevron	62	14	6	Location from Peterson and Patelke, 2003	Location from Peterson and Patelke, 2003	NA	trench		NA	NA	y - mnarchive	y	
Trench CC T-2	Gold - Clearcut	1988	Chevron	62	14	6	Location from Peterson and Patelke, 2003	Location from Peterson and Patelke, 2003	NA	trench		NA	NA	y - mnarchive	y	
Trench CC T-3	Gold - Clearcut	1988	Chevron	62	14	6	Location from Peterson and Patelke, 2003	Location from Peterson and Patelke, 2003	NA	trench		NA	NA	y - mnarchive	y	
Trench CC T-4	Gold - Clearcut	1988	Chevron	62	14	6	Location from Peterson and Patelke, 2003	Location from Peterson and Patelke, 2003	NA	trench		NA	NA	none	Y - from Peterson and Patelke, 2003	
RC-5	Gold - Clearcut	1988	Chevron	62	14	6	561998	5304133	9	500	1430	-45	360	y - mnarchive	y	
RC-4	Gold - Buckshot Lake	1988	Chevron	63	14	32	563249	5304326	39	403	1420	-45	0	y - mnarchive	handwritten on copy of log	
Trench BL-1	Gold - Buckshot Lake	1988	Chevron	63	14	32	563320	5304308	NA	trench		NA	NA	none	y	
Trench BL-2	Gold - Buckshot Lake	1988	Chevron	63	14	32	563506	5304411	NA	trench		NA	NA	none	y	
RC-6	West Mud Creek	1988	Chevron	62	14	6	562818	5303023	4	420	1520	-45	180	y - mnarchive	y	
RC-6N	West Mud Creek	1988	Chevron	62	14	6	562810	5303015	4	203	1520	-45	360	y - mnarchive	y	
RC-7	West Mud Creek	1988	Chevron	62	14	6	562902	5303037	4	334	1500	-45	180	y - mnarchive	y	
SH-1	Gold - Raspberry	1988	Coca Mines	63	13	25	580406	5306402	cuttings	122		-90		y - mnarchive	y	
SH-2	Gold - Raspberry	1988	Coca Mines	63	13	25	580381	5306424	cuttings	102		-90		y - mnarchive	y	
SH-3	Gold - Raspberry	1988	Coca Mines	63	13	25	580366	5306408	cuttings	102		-90		y - mnarchive	y	
SH-4	Gold - Raspberry	1988	Coca Mines	63	13	25	580387	5306406	cuttings	102		-90		y - mnarchive	y	
SH-5	Gold - Raspberry	1988	Coca Mines	63	13	25	580347	5306416	cuttings	102		-90		y - mnarchive	y	
SH-6	Gold - Raspberry	1988	Coca Mines	63	13	25	580404	5306431	cuttings	142		-90		y - mnarchive	y	
SH-7	Gold - Raspberry	1988	Coca Mines	63	13	25	580450	5306448	cuttings	102		-90		y - mnarchive	y	
SH-8	Gold - Raspberry	1988	Coca Mines	63	12	30	580452	5306415	cuttings	102		-90		y - mnarchive	y	
SH-9	Gold - Raspberry	1988	Coca Mines	63	12	30	580552	5306485	cuttings	122		-90		y - mnarchive	y	
SH-10	Gold - Raspberry	1988	Coca Mines	63	12	30	580582	5306496	cuttings	132		-90		y - mnarchive	y	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
SH-11	Gold - Raspberry	1988	Coca Mines	63	12	30	580600	5306505	cuttings	122		-90		y- mnarchive	y	
SH-12	Gold - Raspberry	1988	Coca Mines	63	12	30	580619	5306448	cuttings	122		-90		y- mnarchive	y	
SH-13	Gold - Raspberry	1988	Coca Mines	63	12	30	580653	5306525	cuttings	162		-90		y- mnarchive	y	
SH-14	Gold - Raspberry	1988	Coca Mines	63	12	30	580702	5306447	cuttings	122		-90		y- mnarchive	y	
SH-15	Gold - Raspberry	1988	Coca Mines	63	12	30	580726	5306462	cuttings	62		-90		y- mnarchive	y	
SH-16	Gold - Raspberry	1988	Coca Mines	63	12	30	580734	5306396	cuttings	122		-90		y- mnarchive	y	
SH-17	Gold - Raspberry	1988	Coca Mines	63	12	30	580579	5306299	cuttings	122		-90		y- mnarchive	y	
SH-18	Gold - Raspberry	1988	Coca Mines	63	12	30	580563	5306325	cuttings	122		-90		y- mnarchive	y	
SH-19	Gold - Raspberry	1988	Coca Mines	63	12	30	580653	5306525	cuttings	122		-90		y- mnarchive	y	
EN-1	Gold - Eagles Nest Shear	1988	Newmont	62	14	22	567657	5298469	9	533	1520	-45	120	y- mnarchive	on log	
EN-2	Gold - Eagles Nest Shear	1988	Newmont	62	14	22	567697	5298699	23	752	1490	-45	125	y- mnarchive	on log	
EN-3	Gold - Eagles Nest Shear	1988	Newmont	62	14	23	568987	5298839	105	723		-45	180	y- mnarchive	on log	
EN-4	Gold - Eagles Nest Shear	1988	Newmont	62	14	24	570616	5298199	29	752	1535	-45	164	y- mnarchive	on log	
EN-5	Gold - Eagles Nest Shear	1988	Newmont	62	14	22	567637	5298409	56	496	1500	-45	120	y- mnarchive	on log	
FM-1	Gold - Murray Shear	1988	Newmont	62	14	30	562048	5296247	0	479	1450	-45	180	y- mnarchive	on log	
FM-2	Gold - Murray Shear	1988	Newmont	62	14	31	562449	5296024	34	460	1465	-45	180	y- mnarchive	on log	
FM-3	Gold - Murray Shear	1988	Newmont	62	15	25	561135	5296253	19	640	1450	-45	186	y- mnarchive	on log	
FM-4	Gold - Murray Shear	1988	Newmont	62	14	30	561251	5296280	9	422	1450	-45	180	y- mnarchive	on log	
V-89-1	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562341	5303765	30	567	1446	-45	186	y- mnarchive	on log	
Trench TR-1	Gold - Railroad Cut	1989	Noranda	63	14	33	564951	5304368	NA	trench		NA	NA	new scan	faded paper copy	
RAS-1	Gold - Raspberry	1989	BHP	63	13	25	580326	5306408	6	964	1420	-80	355	abandonment report only	unknown results	
RAS-2	Gold - Raspberry	1989	BHP	63	13	25	579872	5306602	48	345	1430	-45	5	y- mnarchive	y	
EN-6	Gold - Eagles Nest Shear	1989	Newmont	62	13	19	571578	5298452	70	648	1505	-45	172	y- mnarchive	on log	
EN-7	Gold - Eagles Nest Shear	1989	Newmont	62	14	24	570278	5298138	51	532	1510	-45	165	y- mnarchive	on log	
EN-8	Gold - Eagles Nest Shear	1989	Newmont	62	14	23	568977	5298844	19	612	1505	-45	140	y- mnarchive	on log	
FM-5	Gold - Murray Shear	1989	Newmont	62	15	25	561251	5296280	75	583	1450	-45	180	y- mnarchive	on log	
FM-6	Gold - Murray Shear	1989	Newmont	62	14	30	561776	5296321	2	582	1450	-45	180	y- mnarchive	on log	
FM-7	Gold - Murray Shear	1989	Newmont	62	14	32	563872	5295563	47	606	1490	-50	180	y- mnarchive	on log	
FM-8	Gold - Murray Shear	1989	Newmont	62	14	32	563551	5295545	42	596	1500	-45	180	y- mnarchive	on log	
LS-89-1	Gold - Lost Lake	1989	FMC	61	17	3	538655	5293343	8	352	1380	-45	180	y- mnarchive	y	
LS-89-2	Gold - Lost Lake	1989	FMC	61	17	3	537618	5292822	38	402	1430	-45	0	y- mnarchive	y	
H-89-1	Gold - Haley	1989	FMC	63	19	35	519327	5305036	11	552	1340	-45	315	abandonment report only	none submitted	
SC-89-1	Gold - Sassas Creek	1989	FMC	62	17	31	533358	5295471	153	533	1345	-60	180	new scan	new scan	

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CD-25	Lost Lake	1989	MGS	62	17	14	538841	5300590	22	32	1395	-90	0	IC-37	IC-37	
Trench TR-1	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	561962	5303882	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-5	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562241	5303756	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-6	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562252	5303755	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-7	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562273	5303764	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-8	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562262	5303724	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-9	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562220	5303765	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-11	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562141	5303764	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-11	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562182	5303768	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-14	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562812	5303998	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-15	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562843	5303990	NA	trench		NA	NA	Y- paper@MNDNR	none submitted	
Trench TR-16	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562885	5303984	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench TR-17	Gold - Section 6/Pac Man Pond	1989	Noranda	62	14	6	562896	5302956	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 2	West Mud Creek	1989	Noranda	62	14	6	562518	5303091	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 3	West Mud Creek	1989	Noranda	62	14	6	562442	5303070	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 4	West Mud Creek	1989	Noranda	62	14	6	562181	5302967	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 12	West Mud Creek	1989	Noranda	62	14	6	562191	5303059	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 13	West Mud Creek	1989	Noranda	62	14	6	562165	5303037	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 14	West Mud Creek	1989	Noranda	62	14	6	562341	5303854	30	665	1448	-45	186	Y- mnarchive	on log	
V-90-2	Gold - Section 6/Pac Man Pond	1990	Noranda	62	14	6	562455	5303854	35	517	1448	-45	186	Y- mnarchive	on log	
V-90-3	Gold - Section 6/Pac Man Pond	1990	Noranda	62	14	6	562305	5303832	10	401	1450	-45	186	Y- mnarchive	on log	
V-90-4	Gold - Section 6/Pac Man Pond	1990	Noranda	62	14	6	562537	5303818	30	547	1455	-45	186	Y- mnarchive	on log	
V-90-6	Gold - Section 6/Pac Man Pond	1990	Noranda	62	14	6	562001	5303885	31	347	1444	-45	165	Y- mnarchive	on log	
V-90-7	Gold - Section 6/Pac Man Pond	1990	Noranda	62	14	5	563656	5303822	28	407	1495	-45	3	Y- mnarchive	on log	
V-90-5	Gold - Section 5	1990	Noranda	62	14	5	563637	5303873	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 1-90	Gold - Section 5	1990	Noranda	62	14	5	563635	5303874	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 2-90	Gold - Section 5	1990	Noranda	62	14	5	563712	5303876	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 3-90	Gold - Section 5	1990	Noranda	62	14	5	563679	5303871	NA	trench		NA	NA	Y- paper@MNDNR	Y	
Trench Tr 4-90	Gold - Section 5	1990	Noranda	62	14	5	563679	5303871	NA	trench		NA	NA	Y- paper@MNDNR	Y	
SP90-1	Gold - Spaulding Bay	1990	BHP	63	12	22	585997	5308213	115	583	1350	-54	335	new scan	on log	
LL-1	Gold - Lost Lake	1990	Newmont	62	17	36	541765	5295653	135	530	1365	-55	160	Y- mnarchive	paper	
LL-2	Gold - Lost Lake	1990	Newmont	61	17	1	540942	5292872	64	419	1385	-45	350	Y- mnarchive	paper	
CD-24	Lost Lake	1990	MGS	62	17	16	535880	5299288	17	27	1340	-90	0	IC-37	not sampled	

DRILL HOLE/TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
Bio-1	Gold - Raspberry	1991	NRRI/American Shield	63	13	25	579873	5306802	10	439	1392	-45	334	new scan	new scan	
DD-91-2	Lost Lake	1991	MGS	62	17	16	535914	5299259	10	161	1340	-50	155	IC-37	not sampled	
SXL-1	VMS - Five Mile Lake	1994	Teck	62	14	28	564915	5296996	31	482	1515	-45	188	y - mnarchive	paper	
SXL-2	VMS - Five Mile Lake	1994	Teck	62	14	29	564429	5297127	13	471	1500	-45	188	y - mnarchive	paper	
SXL-3	VMS - Five Mile Lake	1994	Teck	62	14	29	564270	5297080	20	487	1480	-45	188	y - mnarchive	paper	
SXL-4	VMS - Five Mile Lake	1994	Teck	62	14	28	564822	5297054	9	508	1480	-45	188	y - mnarchive	paper	
VN-1	Gold - Dead Canary	1995	Cominco	63	15	36	559984	5304313	19	183	1415	-50	180	new scan	new scan	
VN-2	Gold - Dead Canary	1995	Cominco	63	15	36	560477	5304273	15	154	1435	-50	180	new scan	new scan	
VN-3	Gold - Dead Canary	1995	Cominco	63	15	36	560635	5304522	29	196	1415	-50	180	new scan	new scan	
VN-4	Gold - Section 6/Pac Man Pond	1995	Cominco	62	14	5	562901	5303986	39	178	1480	-45	180	new scan	new scan	
VN-5	Gold - Mud Creek Mine	1995	Cominco	62	14	5	563630	5303468	29	313	1495	-45	180	new scan	new scan	
VN-6	Gold - Walsh Shaft	1996	Cominco	62	14	4	565261	5303920	9	663	1450	-45	360	new scan	new scan	
PR-1	VMS - Purvis	1999	RENDRAG	62	13	22	576316	5298832	19	399	1525	-45	17	new scan	new scan	
unnamed shaft	Iron Ore - Scott-Bevier Mine	1906-1911	Scott & Bevier	63	15	36	560545	5304695		87 deep						
Vermilion Shaft (Shaft #1)	Iron Ore - Mud Creek Mine	1883-1920	Consolidated Vermilion & Extension	62	14	5	563175	5303655		360 deep with levels						
Extension Shaft (Shaft #2)	Iron Ore - Mud Creek Mine	1883-1920	Consolidated Vermilion & Extension	62	14	5	564020	5303350		400 deep with levels						
unnamed shaft	Iron Ore - Mud Creek Mine	1883-1920	Consolidated Vermilion & Extension	62	14	5	563560	5303335		125 with drift to north						
"northern" Shaft	Iron Ore - Walsh Shaft	early 1900s	several companies	62	14	4	565240	5303920		125 with 88' drift to north						
Walsh Shaft	Iron Ore - Walsh Shaft	early 1900s	several companies	62	14	4	565185	5303885		230 with drift to north						
Adit #1	Iron Ore - La Rue Mine	1882-1922	Chippewa Iron Co.	62	14	7	562930	5301140		31 m long						
Adit #2	Iron Ore - La Rue Mine	1882-1922	Chippewa Iron Co.	62	14	7	562780	5301050		175 m long						
unnamed shaft	Iron Ore - La Rue Mine	1882-1922	Chippewa Iron Co.	62	14	7	562895	5301115		120? deep						
unnamed shaft	Iron Ore - Almar Mine	1909-1911	unknown	62	14	16	567795	5300320		128 deep						
Shaft #1	Iron Ore - McComber Mine	1888-1923	many companies	62	14	14	569175	5300565		400 deep with 5 levels						
Shaft #2	Iron Ore - McComber Mine	1888-1923	many companies	62	14	14	568700	5300355		200 deep with 3 levels						
Walsh Shaft	Iron Ore (Gold?) - No. American Mine	1900-1912	several companies	61	15	4	555535	5294245		25 deep						
Shaft #1	Iron Ore - Roy Claims	1900-1903	Sharon Ore Co.	61	15	3	556825	5293690		132 deep with 75' drift to north						

DRILL HOLE/ TRENCH	AREA	DATE DRILLED	COMPANY	TWP	RNG	SEC	UTM-E(83)	UTM-N(83)	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	SCANNED LOG?	ASSAYS?	REASSAYED?
unnamed shaft	Iron Ore - Section 4/9	1910?	unknown	62	13	4 and 9	574820	5302875		unknown						
Lucky Boy Shaft	Lucky Boy-Anderson-Camp Mines	1891-1916	many companies	62	12	5	583435	5304540		unknown						
Anderson Shaft	Lucky Boy-Anderson-Camp Mines	1890-1916	many companies	62	12	5	as above?	as above?		unknown						
Camp Shaft	Lucky Boy-Anderson-Camp Mines	1887-1916	many companies	63	12	33	583510	5304800		unknown						
Shaft A	Lucky Boy-Anderson-Camp Mines	1913-1916	many companies	62	12	4	583780	5304515		unknown						
Shaft B	Lucky Boy-Anderson-Camp Mines	1913-1916	many companies	62	12	4	583740	5304485		unknown						
Shaft #1	Iron Ore - White Iron Lake	1905-1907	White Iron Lake Co.	62	12	2	587840	5304425		175 deep						
Shaft #2	Iron Ore - White Iron Lake	1911-1916	White Iron Lake Co.	62	12	2	587855	5304070		67 deep						
unnamed shaft	Iron Ore - Romberg Mine	1902-1921	several companies	63	12	25	589760	5307415		252 deep with 3 levels						
west pit etc	Iron Ore - Section 30	1885-1923	several companies	63	11	30	590570	5307255		unknown						
east pit etc	Iron Ore - Section 30	1865-1923	several companies	63	11	30	590800	5307230		unknown						
unnamed shaft	Iron Ore - Chippewa Mine	1902-1920	Chippewa Iron Co.	63	11	30	591505	5307145		345 deep with 3 levels						

Virginia_Horn_drill_holes.xls

DRILL HOLE	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	LOG	ASSAYS
VH-1	Virginia Horn	8/5/1987	NEWMONT	58	17	22	538959	5261030	13	572	1570	-45	320	Y	Y
VH-2	Virginia Horn	8/20/1987	NEWMONT	58	17	22	538921	5260967	25	492	1570	-45	315	Y	Y
VH-3	Virginia Horn	8/29/1987	NEWMONT	58	17	22	538768	5260899	16	383	1580	-45	320	Y	Y
VH-4	Virginia Horn	9/1/1987	NEWMONT	58	17	22	538680	5260861	19	429	1580	-45	320	Y	Y
VH #1	Virginia Horn	9/12/1987	RHUDE & FRYBERGER	58	17	21	536479	5260360	35	302	1730	-46	360	no record	no record
VH #2	Virginia Horn	9/17/1987	RHUDE & FRYBERGER	58	17	21	536602	5260338	9	342	1710	-45	350	Y	Y
VH #3	Virginia Horn	12/3/1987	RHUDE & FRYBERGER	58	17	22	538527	5260838	6	312	1615	-45	330	Y	Y
VH #4	Virginia Horn	12/21/1987	RHUDE & FRYBERGER	58	17	22	538467	5260880	11	402	1600	-45	330	Y	Y
VH #5	Virginia Horn	12/7/1987	RHUDE & FRYBERGER	58	17	22	538361	5260834	14	502	1635	-45	330	Y	Y
VH #6	Virginia Horn	12/16/1987	RHUDE & FRYBERGER	58	17	22	538199	5260855	12	551	1620	-45	330	Y	Y
VH #7	Virginia Horn	12/17/1987	RHUDE & FRYBERGER	58	17	22	538076	5260827	24	233	1630	-45	330	Y	on log
VH-5	Virginia Horn	6/7/1988	NEWMONT	58	17	22	538876	5260840	23	572	1570	-45	320	Y	Y
VH-6	Virginia Horn	6/15/1988	NEWMONT	58	17	15	539066	5261079	19	650	1570	-45	320	Y	Y
VH-7	Virginia Horn	6/21/1988	NEWMONT	58	17	15	538856	5261310	14	405	1555	-45	136	Y	Y
VH-8	Virginia Horn	6/29/1988	NEWMONT	58	17	22	538974	5261027	29	550	1570	-45	327	Y	Y
VH-9	Virginia Horn	9/28/1988	NEWMONT	58	17	22	538999	5261017	19	624	1570	-60	320	Y	Y
VH-10	Virginia Horn	10/5/1988	NEWMONT	58	17	22	538945	5260929	22	739	1570	-60	320	Y	Y
DBH-1	Berry Hill	10/19/1988	RESOURCE EXPLOR	59	16	34	547610	5266097	15	537	1540	-45	150	Y	Y
DLF-1	Land Fill	10/13/1988	RESOURCE EXPLOR	58	17	21	537608	5260959	11	332	1625	-45	330	Y	on log
DLF-2	Land Fill	10/18/1988	RESOURCE EXPLOR	58	17	21	537750	5260715	18	302	1605	-45	330	Y	on log
DML-1	Mud Lake	3/17/1988	RESOURCE EXPLOR	58	17	28	536997	5258131	14	170	1705	-45	315	Y	on log
VH-11	Virginia Horn	2/21/1989	NEWMONT	58	17	15	538955	5261187	74	602	1550	-60	140	Y	Y
VH-12	Virginia Horn	2/27/1989	NEWMONT	58	17	15	538998	5261227	50	528	1550	-60	140	Y	Y
VH-13	Virginia Horn	3/2/1989	NEWMONT	58	17	15	539066	5261261	70	519	1550	-50	140	Y	Y
VH-14	Virginia Horn	10/27/1989	NEWMONT	58	17	15	538795	5261162	82	1216	1550	-75	116	Y	Y
VH-15	Virginia Horn	10/30/1989	NEWMONT	58	17	16	537688	5261206	16	635	1620	-50	345	Y	Y
VH-16	Virginia Horn	11/1/1989	NEWMONT	58	17	16	537755	5261161	17	716	1610	-50	0	Y	Y
VHRC #8	Virginia Horn	10/18/1989	RHUDE & FRYBERGER	58	17	22	538458	5260814	31	624	1600	-45	330	Y	Y

DRILL HOLE	AREA	DRILLED	COMPANY	TWP	RNG	SEC	UTM_E	UTM_N	OVB (FT)	EOH (FT)	ELEV (FT)	ANGLE	AZIMUTH	LOG	ASSAYS
VHRC #9	Virginia Horn	10/22/1989	RHUDE & FRYBERGER	58	17	22	538298	5260833	17	623	1630	-45	330	Y	Y
VHRC #10	Virginia Horn	10/26/1989	RHUDE & FRYBERGER	58	17	22	538189	5260961	30	604	1615	-45	330	Y	Y
VHRC #11	Virginia Horn	10/30/1989	RHUDE & FRYBERGER	58	17	22	538102	5260842	13	243	1625	-70	330	Y	Y
VH-17	Virginia Horn	3/10/1990	NEWMONT	58	17	15	537849	5261107	36	740	1595	-45	0	Y	Y
VH-18	Virginia Horn	3/14/1990	NEWMONT	58	17	15	537877	5261218	72	587	1601	-45	0	Y	Y
VH-19	Virginia Horn	3/18/1990	NEWMONT	58	17	14	540025	5261573	30	625	1520	-45	134	Y	Y
VH-20	Virginia Horn	6/28/1990	NEWMONT	58	17	15	538563	5261178	21	1150	1595	-65	175	Y	Y
VH-20A	Virginia Horn	6/27/1990	NEWMONT	58	17	15	538563	5261178	21	87	1595	-65	175	NA	NA
DG-1	Gilbert	3/22/1990	RESOURCE EXPLOR	58	17	15	538885	5261136	74	487	1550	-45	145	Y	Y
DBH-2	Berry Hill	3/13/1990	RESOURCE EXPLOR	59	16	33	547463	5266026	33	423	1560	-45	360	Y	Y
DBH-3	Berry Hill	3/20/1990	RESOURCE EXPLOR	58	16	4	547269	5265970	21	100	1550	-45	360	Y	Y
DML-2	Mud Lake	3/22/1990	RESOURCE EXPLOR	58	17	28	536772	5257872	20	233	1690	-45	315	Y	on log
DML-3	Mud Lake	3/27/1990	RESOURCE EXPLOR	58	17	28	536895	5257850	30	310	1695	-45	135	Y	on log
ASC VH-1	Virginia Horn	9/25/1997	AMERICAN SHIELD	58	17	15	538267	5261397	19	423	1620	-45	330	abandonment report only	NEW SCAN
VH-09-01	Virginia Horn	12/6/2009	Vermillion Gold				538960	5261040	60	422		-45	315	abandonment report only	abandonment report only
VH-09-02	Virginia Horn	12/7/2009	Vermillion Gold				538171	5260930	4	163		-45	335	abandonment report only	abandonment report only
VH-09-03	Virginia Horn	12/11/2009	Vermillion Gold				538123	5261317	50	408		-45	160	abandonment report only	abandonment report only
VH-09-04	Virginia Horn	12/15/2009	Vermillion Gold				537706	5261209	7.7	326		-45	340	abandonment report only	abandonment report only
VH-10-01	Virginia Horn	9/17/2010	Vermillion Gold				537680	5261129	70	517		-45	155	abandonment report only	abandonment report only
VH-10-02	Virginia Horn	9/19/2010	Vermillion Gold				537680	5261129	10.4	467		-45	335	abandonment report only	abandonment report only
VH-10-03	Virginia Horn	9/23/2010	Vermillion Gold				537627	5261096	24	407		-45	155	abandonment report only	abandonment report only
VH-10-04	Virginia Horn	9/26/2010	Vermillion Gold				537740	5261152	8.3	547		-45	340	abandonment report only	abandonment report only
VH-10-05	Virginia Horn	9/30/2010	Vermillion Gold				538073	5261310	5.9	457		-45	160	abandonment report only	abandonment report only

APPENDIX B:
Vermilion District Prospects
(On CD in back pocket of this report)

**APPENDIX C:
Cook Area Prospects**

(On CD in back pocket of this report)

APPENDIX D:
Itasca County Prospects
(On CD in back pocket of this report)

**APPENDIX E:
Rainy Lake Prospects**

(On CD in back pocket of this report)

APPENDIX F:
Virginia Horn Prospects
(On CD in back pocket of this report)