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MINERAL EXPLORATION IN THE GREY RIVER AND FRANÇOIS AREAS, SOUTH COAST OF NEWFOUNDLAND: A REVIEW

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ABSTRACT

The initial geological mapping and exploration of the Grey River area were carried out by the Buchans Mining Company in the 1950s. Numerous detailed and regional mapping projects were undertaken following the 1955 tungsten discovery. Subsequently, other exploration companies have carried out regional reconnaissance mineral surveys for gold and base metals, and of the Gulch Cove silica deposit located 9 km east of the community of Grey River.

Reconnaissance-level regional geological and surficial mapping and airborne aeromagnetic and radiometric surveys were completed by the Geological Survey of Canada. The provincial Geological Survey has undertaken more detailed regional bedrock mapping, lithogeochemical, glacial mapping, and bedrock-aggregate exploration surveys. The Gulch Cove silica deposit was examined in detail 1966 and 1967. More recently, renewed interest in the region's gold and base-metal potential has led to extensive staking and exploration in the Grey River and François areas.

EXPLORATION AND SURVEY REVIEW

INDUSTRIAL EXPLORATION SURVEYS

The earliest recorded work for the Buchans Mining Company Limited (BMC) is the reconnaissance survey of Scott and Conn (1950). This survey included the entire BMC concession (Anglo-Newfoundland Development Company Limited concession). Their reconnaissance maps, published at 1:63 360 scale, were the first for these areas. Major contacts such as that between the Grey River metamorphic rocks, the Burgeo Intrusive Suite and the François Granite were outlined, and the occurrence of molybdenum and copper sulphides near the community of Grey River was noted.

In 1955, following an initial report of tin mineralization at Grey River, a geological survey from the BMC discovered numerous tungsten-bearing veins near the community of Grey River and "Long Pond" (Figure 1) (also locally termed "Big Pond"), 1.5 km to the northeast (*in* Bahyrycz, 1956, page 1). "Lead-bearing veins" were also discovered in 1955.

Bahyrycz (1956, 1957) surveyed the area around the community of Grey River in detail. He reported that paragneiss and schist dominated the area. Highly sheared granites were described from the Long Pond and Dog Cove Brook areas. The metasedimentary rocks of the Grey River area were reported to contain foliated and massive diabase dykes and ultramafic intrusive rocks. The mineralized quartz veins between Grey River and Dog Cove Brook were systematically examined. An apparent concentric zoning of minerals was described and considered to be centred on the Long Pond area. Bahyrycz (1956) also reported high-grade gold assays from the headwaters of Dog Cove.

LeDoux (1957) carried out and also supervised several widespread regional mapping programs from a base camp at "Park Lake" (local name recorded by LeDoux), which is 5 km due north of Bay de Vieux (Figure 1). During these surveys, sulphide mineralization (Zn, Fe, Pb, Cu) was discovered along Dog Cove Brook and galena was discovered between La Hune Bay and Aviron Bay. (The exact location of the galena mineralization is unknown). Gray (1958) also completed a thesis on mineralization in the Grey River area, under the auspices of the BMC. The distribution of metallic minerals indicated that a centre of mineralization lay south of Long Pond. In addition to the widespread occurrences of tungsten and other base metals, it was noted that base metals were concentrated in the main granite and the granite tongue, east of Long Pond, and that the galena contained bismuth, silver and gold.

From 1955 to 1985, the BMC and its successors, the American Smelting and Refining Company Limited (ASARCO) and Abitibi-Price Limited, carried out a series of projects on the Grey River tungsten deposit. The most intensive exploration and assessment programs were done from 1956 to 1970. The largest and richest wolframite-bearing quartz veins (Nos. 6 and 10 of Bahyrycz, 1956)

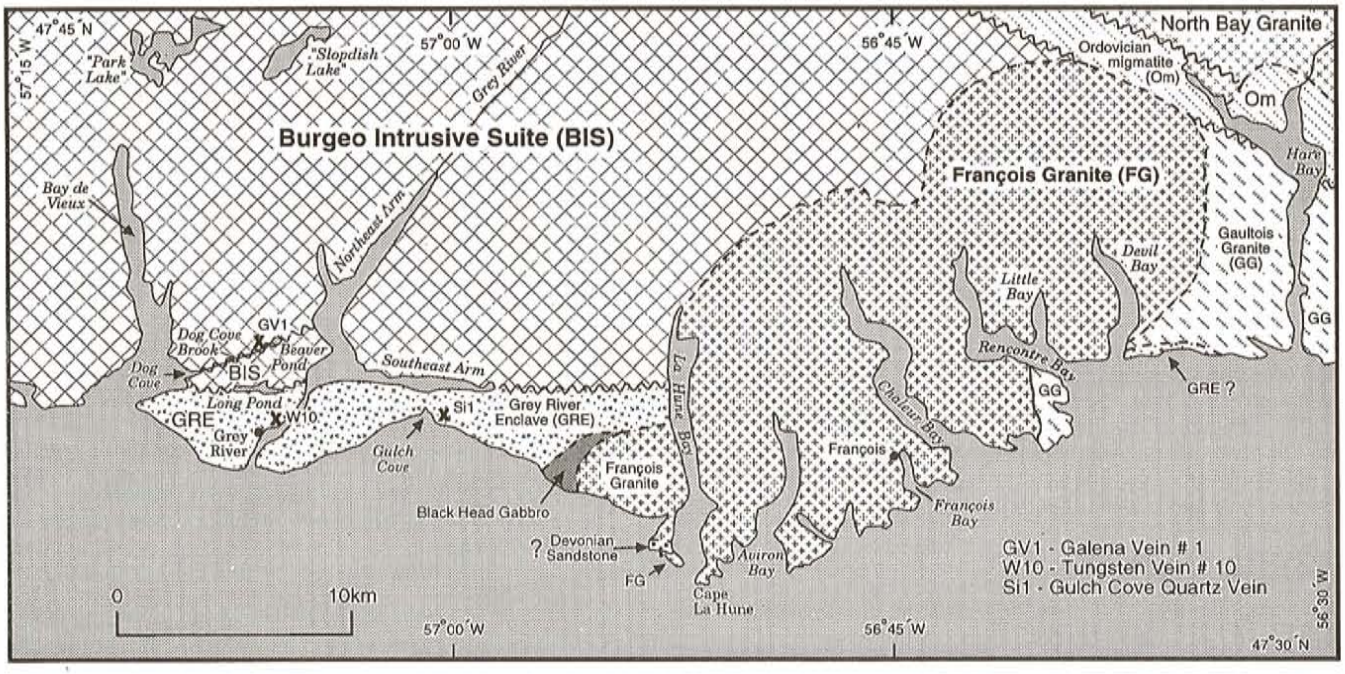

Figure 1. *Geology of the Grey River and François areas, southern Newfoundland.*

received much detailed study. This included trenching, surface diamond-drilling, and construction of an extensive, 1.5-km-long adit system along No. 10 vein. Metallurgical testing of the tungsten ore indicated that significant beneficiation of the ore was possible.

Higgins (*see* Higgins, 1980a,b, 1985; Higgins and Kerrich, 1982) carried out a detailed study on the tungsten veins and adjacent rocks. This work showed that mylonitic granitoids occurred along the northern contact of the enclave and that the mineralized veins were probably derived from a magmatic system centred on the community of Grey River. The veins were Late Devonian and therefore younger than the adjacent Burgeo Granite.

Other subsequent projects included resampling of the adit (Thurlow, 1980), and assays of the "galena vein #1" at Beaver Pond (Figure 1). Thurlow and Pearce (1979) summarized exploration and drilling on the Grey River property to 1978. Thurlow (1981) reported a gold value of 0.74 ozs/ton from the galena vein #1. Soil sampling of the Long Pond area was done in 1985 (Thurlow, 1985).

Resources Engineering of Canada examined the silica deposits at Gulch Cove (Figure 1) for the Continental Ore Corporation (1967) to determine the feasibility of quarrying the deposits.

CEGB (Canada) Limited did some reconnaissance uranium exploration in and around the François Granite (Skopik, 1986). Holmes (1986) of Selco-BP (Canada) Limited reported anomalous gold values from the Gulch Cove silica prospect. Several samples of pyritic quartz exceeded 100 mg/t and a high of 1050 mg/t was obtained from the east side of Gulch Cove. Minor Sb and Pb anomalies were also found but did not contain anomalous gold. A lake-sediment sample containing 11 mg/t Au was obtained approximately 1.2 km east of Gulch Cove.

Miller (1990) reported on a geochemical and geological assessment of the Dog Cove area, northwest of Grey River. No significant values were obtained from stream sediment or bedrock samples. However, mineralized vein-quartz boulders containing molybdenite and chalcopyrite were found in Dog Cove Brook (Figure 1).

Royal Oak Mines Incorporated (1996, page 36) have reported that the Grey River area contains "several gold showings and a low-grade porphyry molybdenum–copper deposit that has been named the Moly Brook deposit." Several other targets obtained from a lake-sediment survey in 1996 have also been prospected. These presumably include the numerous claim blocks in the Grey River and François areas staked by Royal Oak Mines Incorporated.

FEDERAL GEOLOGICAL SURVEYS

The Geological Survey of Canada produced the first 1:250 000-scale regional geology map of the Burgeo (NTS 11P west half) map area (Riley, 1959), which includes the community of Grey River. The Burgeo (NTS 11P east half) map area was surveyed by Williams (1971) who outlined the

main contacts. The Grey River terrane was shown as dominated by metavolcanic rocks that continued to the east of the François Granite. Williams implied that the metavolcanic rocks west of La Hune Bay were possibly correlatives of the Neoproterozoic Love Cove Group of eastern Newfoundland. Numerous glacial striae (along with the orientation of the numerous fiords) indicated a southerly ice-flow direction.

An airborne radiometric survey of the south coast of Newfoundland (Geological Survey of Canada, 1983, 1986; Broome *et al.*, 1987) indicated that the François Granite is highly enriched in radioelements compared to the adjacent granitoid rocks. The metasedimentary and metavolcanic rocks of the Bay du Nord Group and Grey River terrane are relatively depleted. The various maps (Geological Survey of Canada, 1983, 1986) indicate a relationship between the radiometric patterns and the structure of the François Granite. These element patterns and distributions can generally be correlated with the lithological variations shown on the geological maps.

PROVINCIAL GEOLOGICAL SURVEYS

The first major project by the provincial Department of Mines and Energy was a detailed examination, in 1967, of an extensive silica deposit located around Gulch Cove, 9 km east of the community of Grey River. The survey included mapping, diamond drilling, and geochemical and metallurgical analyses and is summarized in Butler and Greene (1976), which also contains a comprehensive list of references.

Reconnaissance lake-sediment geochemistry surveys by Butler and Davenport (1978, 1980) indicated that anomalous Pb, U, F and Mo values are concentrated over the François Granite. Anomalous F and Mo values are also widely scattered over the Burgeo Intrusive Suite. Copper, Pb and Ag are most anomalous in the vicinity of the Grey River tungsten veins having an isolated Cu anomaly located just to the northeast of the Dog Cove Brook Cu–Pb–Zn–Ag–Au prospect. Davenport and Butler (1982) reported anomalous W values from the northern portion of the François Granite.

McConnell (1983, 1984) carried out a follow-up geochemistry project on the northern part of the François Granite that previous geochemical surveys (Butler and Davenport, 1978; Davenport and Butler, 1982) showed to contain anomalous granophile element values. McConnell (1984) also analyzed stream sediments and bedrock samples for base metals and granophile elements. The lack of well-developed soil prevented the use of soil geochemistry analyses. The stream-sediment geochemistry indicated multi-element anomalies (Cu, Pb, Zn, Co, Ag, Mo, F, U, W) in the vicinity of Sugarloaf (1 km north of Little Bay).

Systematic bedrock mapping projects were completed during 1984 in the Grey River area by Blackwood (1985) and in the remainder of the Cape La Hune and Ramea map areas (Dickson *et al.*, 1984a, b). The fault-bounded Grey River enclave of highly metamorphosed sedimentary, volcanic and plutonic rocks is polydeformed and intruded by massive gabbroic and granitic rocks. The Burgeo Intrusive Suite is a composite and contains syn- to postkinematic granitoid rocks. The François Granite was shown to consist of two overlapping, composite ring complexes that intruded the adjacent units and major structural features such as the Dragon Bay Fault Zone. The geology of the Grey River enclave was summarized by Blackwood (1985) and that of the Burgeo Intrusive Suite and the François Granite by Dickson *et al.* (1985) and the François Granite was described in more detail by Poole *et al.* (1985).

The geology of the Cape La Hune and Ramea map areas was compiled with the remainder of the NTS 11P map area at a 1:250 000 scale by O'Brien and Dickson (1986) and the mineral occurrences, on the same geological base, were compiled by Brewer (1986). O'Brien *et al.* (1986) summarized the geology of NTS 11P. This work indicated the extent and composite nature of the syn- to postkinematic Burgeo Intrusive Suite, and the composite, postkinematic nature of the François and Chetwynd granites. Dickson *et al.* (1989) discussed some aspects of the geochemistry of the plutonic rocks in the Burgeo (NTS 11P) map area and showed that the François and Chetwynd granites are similar to other postkinematic granites in southern Newfoundland, e.g., Ackley Granite Suite and Harbour Breton Granite. Williams *et al.* (1989) correlated the Burgeo Intrusive Suite with composite granitoid complexes that lie within the Gander Zone of Williams *et al.* (1988).

Davenport *et al.* (1989) re-analyzed the lake-sediment samples of Butler and Davenport (1978, 1980) for a variety of elements including Au, As, Sb, Sc, Pb, W, and Zn. Plots of these elements indicated anomalous Au values in Dog Cove Brook, Gulch Cove and the François Granite. Copper was anomalous in the area between the community of Grey River and Gulch Cove. Lead and zinc anomalies formed a large bull's eye anomaly in the northeastern portion of the François Granite, and W was anomalous near the community of Grey River, although higher values were obtained in the upper reaches of Grey River (NTS map areas 11P/14 and 15).

Bragg *et al.* (1990) examined the various rock types along the south coast to determine their suitability for the production of bedrock aggregate. The leucocratic, massive granites of the Burgeo Intrusive Suite and the François Granite and the foliated metagabbro north of the community of Grey River were considered good material for aggregate.

A comprehensive report was recently published by Dickson *et al.* (1996) that describes in detail the geology, geochemistry and mineral potential of the Grey River and François areas.

Table 1. Assays of four channel samples from Galena Vein No. 1, Dog Cove Brook (from Bahyrycz, 1956); measurements in feet (') and inches (")

Sample No. + location	Width of vein	Gold oz/ton	Silver oz/ton	Copper %	Lead %	Zinc %	Iron %
S.1 wall 20-21'	2'2"	2.90	1.30	0.2	12.3	3.9	7.4
S.2 vein 20-21'	2'2"	0.04	4.20	0.3	18.5	3.7	10.8
S.3 vein 25-26'	1'2"	0.04	2.6	trace	13.9	1.4	6.5
S.4 vein 30-31'	0'8"	0.04	3.0	0.1	4.0	2.4	6.9

ECONOMIC MINERALIZATION

THE GREY RIVER TUNGSTEN VEINS

The quartz veins north of Grey River are well known for the wolframite and associated metallic mineralization. Bahyrycz (1956, 1957) mapped and/or examined over 600 quartz veins. Most veins are less than 15 m long and are 2 to 5 cm wide. The largest veins were termed No. 10, No. 6, No. 2 and No. 5 and each contained significant but sporadic wolframite mineralization. Vein No. 10 (Figure 1) was estimated, in 1956, to be at least 2000 feet (≈ 650 m) long and 2 to 14 feet (0.6 to 4.3 m) wide.

Subsequent work indicated that the largest vein (No. 10) extends over 1500 m in length (*see* Higgins and Smyth, 1980). Extensive drilling and underground work by the BMC indicated a probable 360 000 tonnes of ore, grading 1.09% WO_3, and a further 160 000 tonnes possible. The veins follow north- to northeast-trending faults, joints and fissures that sharply truncate the foliation in the host rocks.

Higgins (1980a) and Higgins and Kerrich (1982) have described the veins in great detail and report that there were four main episodes of vein emplacement. In summary, a pegmatitic assemblage of quartz–K-feldspar–muscovite–molybdenite is the earliest episode. This was followed by a variety of mineralized quartz veins that represent the most significant episode of vein emplacement. These veins were formed in several stages at successively lower temperatures, salinities, fluid pressure, and CO_2 content. Wolframite deposition occurred during the later stages of vein emplacement. Associated metallic minerals found in these wolframite (+ scheelite)–quartz veins include pyrite, chalcopyrite, bismuthinite, marcasite, chalcopyrite, galena and sphalerite. The gangue minerals are fluorite, calcite, quartz and selvages of muscovite. The later episodes of vein formation resulted in the crystallization of quartz ± fluorite, sphalerite, calcite, barite, galena, apophylite and harmotome (Higgins and Smyth, 1980).

THE GREY RIVER BASE-METAL–GOLD VEINS

Base-metal–gold mineralization was noted in a quartz vein (Galena vein No. 1) at the head of Dog Cove Brook, just west of "Beaver Pond", 3.7 km north of the community of Grey River (Bahyrycz, 1956, 1957; LeDoux, 1957). The vein is exposed over 10 m, is 15 to 75 cm wide, trends 020° and dips 60 to 65°S. It occurs along a prominent fault in highly sheared and altered granite. The quartz vein and the altered wall rock contain significant base-metal sulphide mineralization. Identified sulphide minerals (Bahyrycz, 1956) are pyrite, galena, sphalerite and molybdenite. Four sections were channel sampled along the vein. Samples 1 and 2 are adjacent wall rock and vein samples respectively; samples 3 and 4 are 10 feet (3 m) and 20 feet (6 m) farther south along the vein (*see* Bahyrycz, 1956; Table 1). The altered granite wall rock assayed 2.90 oz/ton gold over 1 foot (30 cm). Thurlow (1981) reported a gold value of 0.74 oz/ton for this occurrence. Similar mineralization was reported for over 100 m to the west along Dog Cove Brook.

THE GREY RIVER SILICA OCCURRENCES

The Continental Ore Corporation (1967) assessed the Grey River quartz vein in the Gulch Cove area and reported that SiO_2 values typically range from 96.98 percent to 99.21 percent with 1.17 percent Al_2O_3 in the lower-silica quartzite. They also noted that ASARCO had mapped the veins and estimated that the deposit contained 400 million tons of ore.

Butler and Greene (1976) examined a part of the silica deposit and assessed 12 million short tons by drilling. Analyses indicate an average grade of 95.5 percent SiO_2 and 1.9 percent Al_2O_3, based on 477 core samples of 10 feet or less (< 3.1 m). Ninety-three analyzed samples averaged 0.56 percent Fe_2O_3. Size-fraction analysis of one representative sample indicated that some increase in purity could be obtained (*see* Grice, 1973, *in* Butler and Greene, 1976). The major sources of impurities are free mica, feldspar, magnetite and mica particles adhering to quartz (Butler and Greene,

1976). This vein system was explored for gold by Selco-BP (Canada) Limited (Holmes, 1986) but no significant mineralization was discovered.

CURRENT STATUS OF MINERAL EXPLORATION

The Grey River and François areas are currently being actively explored. Ground is held by various companies and individuals. These are Royal Oak Mines (Mercer, 1995a, b), with numerous holdings in the Grey River to François area, and Celtic Minerals, Raventures Inc. (Webster, 1996), Edwin Northcott, Gilbert Lushman, and White Bear Resources, in the Grey River area, William Barter (Grey River and Northeast Arm areas; Barter, 1996), and Trinity Resources and Energy Limited in the Gulch Cove area.

The presence of numerous exploration companies and individual explorers indicates that the area is still attractive and has the potential to host more extensive mineralization than was determined by the Buchans Mining Company Limited during the late 1950s and 60s.

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