Endogranitic Sn potential beneath the Nigadoo River base-metal vein/lode deposit, northern New Brunswick

S.R. McCutcheon
New Brunswick Department of Natural Resources, Geological Surveys Branch, P.O. Box 50, Bathurst, New Brunswick E2A 3Z1, Canada
D.R. Lentz
Geological Survey of Canada, P.O. Box 50, Bathurst, New Brunswick E2A 3Z1, Canada
and
W.W. Gardiner
New Brunswick Department of Natural Resources and Energy, Geological Surveys Branch, P.O. Box 6000, Fredericton, New Brunswick E3B 5H1, Canada

The abandoned Nigadoo River Mine is located about 15 km northwest of Bathurst in the Nigadoo River Synclinorium, part of the Tobique-Chaleur tectonostratigraphic zone. Initially discovered in 1953, development at the Nigadoo deposit continued until 1958. The northwesterly trending Main and Anthonian vein-systems (A and C zones, respectively) produced approximately 1.9 million tonnes grading 2.2% Pb, 2.1% Zn, 0.2% Cu, and 90 g/t Ag, mostly from the 1075 m long, 640 m deep, and 1 m wide A-Zone. The deposit is centred upon the Nigadoo Porphyry and crosscuts both the porphyry and enclosing country rocks, which consist of northeast-trending, steeply dipping, greenish grey calcareous slates, siltstones, and limestones of the Late Silurian LaPlante Formation. In general, the Nigadoo Porphyry is a steep-walled, quartz-orthoclase porphyritic plug that has been sericitized, chloritized, and locally silicified by vein-forming hydrothermal fluids.

The Nigadoo Porphyry was considered to be synorogenic, but recent mapping and radiometric dating indicate that it is post-tectonic and probably Late Devonian in age like other Sn-W-Mo-bearing granites in central and southern New Brunswick. Quartz-feldspar porphyry, which is texturally identical to the Nigadoo Porphyry, is a late phase in the nearby Antinouri Lake Granite (371 ± 4 Ma; U-Pb zircon). Zn-Pb-Cu-Ag vein mineralization is, in part, hosted in texturally similar porphyry at the old Keymet Mine, located about 10 km north of the Nigadoo mine.

Previously published literature suggested three stages of vein formation: (1) early pyrite-pyrrhotite-sphalerite-arsenopyrite veins; (2) the main stage sulphide veins; and (3) late-stage carbonate veins. In general, the main stage sulphides are coarse-grained and consist of monoclinic pyrrhotite, hexagonal pyrrhotite, pyrite (marcasite), Fe-rich sphalerite (≈22 mole % FeS), galena, chalcopyrite, arsenopyrite, cassiterite, stannite, argentiferous tetrahedrite, and native bismuth. In addition, there are several complex Ag-Pb-Bi-Sb sulphosalts. Needle-cassiterite occurs within the pyrrhotite (hex)-arsenopyrite-rich parts of the lode, that predominate below the 270 m level. Textural evidence indicates complex sulphide replacements within the lode, as well as late-stage shearing of the sulphides. The sulphide assemblage reflects formation from a low-temperature (200°-300°C) and low-pressure [<50 MPa (500 bars)] hydrothermal fluid with low $f(S_2)$, low $f(O_2)$, and low pH. This type of hydrothermal fluid is commonly responsible for the formation of tin-sulphide lode deposits worldwide. Furthermore, the narrow range of $\delta^{34}S$ isotopic values of 1.4 ± 1.0‰ (n=11; published data) obtained on various sulphides is consistent with a magmatic origin for the mineralizing fluid. Closed-system sulphur isotopic fractionation of pyrite and pyrrhotite from an H_2S-dominated, magmatically-derived hydrothermal fluid is consistent with the isotopic compositions found in the veins.

Unfortunately, Sn was not routinely assayed during the mining operation. However, reported Sn contents of the first Zn, Pb, and Cu concentrates were 0.02%, 0.1%, and 0.2%, respectively. It was also reported that the highest In and Bi contents were coincident with the porphyry-hosted portion of the vein/lode. If the Nigadoo lodes are analogous to the Mount Pleasant base-metal-tin lodes (0.25 million tonnes grading 2.3% Zn, 0.36% Pb, 0.3% Cu, and 0.6% Sn), then there should be endogranitic Sn at depth as there is at Mount Pleasant (2.14 million tonnes grading 0.81% Zn, 0.45% Sn, 0.06% W, and 0.03% Mo). However, an endogranitic tin zone at Nigadoo could be considerably larger than the one at Mount Pleasant if the size of the base-metal lodes is any indication.

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