

Metcalf & McClaren 2002

Detailed geological mapping, described below, was carried out subsequent to analysis of the soil samples. The mapping indicated that the gneiss outcrops exposed to the east along the road are in fact screens or pendants within the intrusion; outcrops further to the east are of basic and ultramafic intrusive rock. The soil line, therefore, does not extend sufficiently to the east to constrain the possible eastward extent of the mineralization. In the western half of the intrusion, the mineralization appears to be confined to the projected subcrop of gabbro-norite and pyroxenite. It is probable that the mineralization is similarly bounded to the east.

Rock sampling

Rock sampling was carried out by McClaren on outcrops along and immediately to the south of the soil line. Sample locations and analytical results are shown in Table 2 and in Figs. 4 and 5.

The initial results of the litho-geochemical sampling returned only subeconomic grades. It may be noted, however, that three of the thirteen samples of outcrop returned combined base-metal values in excess of 0.1%. Rocks with similar or greater concentrations of base metals, in this area of the Cordillera, weather recessively, particularly in areas of moderate topography (Metcalf, unpubl. data).

In the main area of sampling, bedrock is exposed over approximately 25% of the total surface; these exposures will consist, logically, of less mineralized material.

The results from soil sampling include one sample in excess of 0.1% aggregated base metal values and two other samples with half those concentrations. These values, when dilution in soil is considered, suggest that recessively weathering areas are probably underlain by rocks with more anomalous mineralization. The area sampled therefore remains prospective for magmatic Ni-Cu mineralization, although no new showings were discovered during the course of assessment work.

As noted above, the authors were in error in their initial estimate of the eastern contact of the Pacific Nickel intrusion, owing to the presence of gneissic screens within the intrusion. As a consequence, the eastern part of the intrusion was not adequately sampled. At least two hundred metres across the true width of the intrusion remain open. More sampling is required.

Geological mapping

Detailed geological mapping was carried out after essential soil and rock geochemical sampling, using a topographic map and a stereopair of aerial photographs. Two traverses were carried out near the Sable showing, along the showing road and along Fir Creek beneath the showing (Fig. 2). A third traverse was carried out across the northeast part of the claim to test the existence of Ni-Cu mineralization. Figs. 6 and 7 are geological maps based on these observations and showing, respectively, lithological and structural information.

Metamorphic country rocks

The country rock underlying the SABLE claim and surrounding area comprises schistose and gneissic rocks assigned to the Settler Schist and Custer Gneiss (Monger 1991); Monger (pers. comm. December 2001) considers these units equivalent. On the SABLE claim, the distinction between schist and gneiss is based mainly on their degree of metamorphic banding and their mica content.

The metamorphic rocks are light grey in colour, weathering to light grey or light rusty brown. Their pyrite content varies from trace amounts to, more commonly, 5-10%. The common rock-forming mineral assemblage comprises quartz, feldspar biotite and muscovite. Hornblende is less common but may occur to the exclusion of other phases. Kyanite and euhedral garnet were observed half a kilometre east of the claim boundary, the former oriented in b-lineation. Garnet also occurs some tens of metres west of the Sable showing. Staurolite and sillimanite are reported in the area (Reamsbottom 1974) but were not noted during mapping.

The metamorphic rocks are dominantly gneissic with banding developed parallel to the regional foliation. The quartzofeldspathic zones also contain biotite and muscovite in varying proportions. The mafic zones are often monomineralic hornblendite. The rocks contain between 2% and 15% subhedral pyrite, but pyrrhotite is absent except near intrusive contacts.

Structures

Structural features were noted in the metamorphic rocks, in xenoliths within the intrusion and at its margins. The interior of the intrusion hosting the mineralization exhibits no metamorphic fabric, therefore structural measurements were taken from outcrops of metamorphic rock only to determine the extent to which the intrusion's contacts are constrained by regional structure. At each station where a structural measurement was recorded, the orientation represents the mean of at least two and usually three measurements taken of the plane or line at that outcrop. A map including these structural measurements is shown in Fig. 7.

The structures in metamorphic rocks examined along the Sable showing road are typical of those in the area. These comprise a single penetrative vertical or near-vertical foliation, defined by phyllosilicate minerals, with a dominant northwesterly strike between 330 and 340; minor variations occur locally. Hornblende and kyanite are oriented parallel to the foliation, with a penetrative lineation plunging to the northwest at angle between 20° and 30°. This lineation is interpreted as a b-lineation and lies parallel to parasitic folds in the foliation. These folds were observed to the east and west of the intrusive rocks hosting the mineralization, in both cases verging towards a contact. It is possible therefore that the core of a small, northwesterly-plunging antiform crosses the eastern part of the SABLE claim.

Intrusive rocks

The SABLE claim encloses the contacts of an intrusion of unknown shape but suspected NNW elongation. Lithologies associated with this intrusion received most detailed examination along the road to the Sable mineral occurrence (MINFILE 092HNW077) and in exposures along Fir Creek, to the south and downhill from the showing. Contact attitudes, where exposed, are near-vertical, with strikes close to 330. Outcrop dispositions of both intrusive and metamorphic rocks are consistent with this contact orientation.

The intrusive lithologies exposed on the SABLE claim have been patchily to pervasively metamorphosed to greenschist facies, with the formation of talc and actinolitic or hornblendic amphibole after pyroxene and (probably) with albitization of plagioclase. Despite the metamorphism, deformation is confined to the contacts and to small shears within the intrusion, subparallel to the contacts. Pending detailed petrographic examination, hand specimens representative of this assemblage will therefore be described in terms of their primary mineralogy.

Three lithologies compose the mafic intrusive assemblage exposed on the SABLE claim. All

are typically coarse-grained, pyroxene-phyric and mafic to ultramafic in composition and are identical in texture and mineralogy to lithologies exposed at Giant Mascot and which compose the Pacific Nickel Complex (Aho 1954, 1956, Muir 1971). The minimal, localized deformation permits identification of both orthorhombic and monoclinic relic phenocrysts; the assemblage is a two-pyroxene system and therefore subalkaline in chemical composition. The name *Abronzite* has been used to describe several pyroxenites in the area to the south of the SABLE claim, although it is unclear as to whether the name assignment is based on detailed petrography. Gonzalez (1973), in a geological, geochemical and geophysical assessment report on the NI 336 claim group along Cogburn Creek, noted that clinopyroxene and orthopyroxene are present in the gabbros of the suite in proportions of roughly 2:1. On the SABLE claim, although discrete, coarse (7- 10 mm), euhedral to subhedral monoclinic and orthorhombic pyroxene phenocrysts are visible in hand specimen, an accurate mode was not obtained. The more leucocratic intrusive rocks are therefore assigned the name *Agabbronite* until more detailed petrographic information is available.

The most common intrusive rocks on the SABLE claim are coarse-grained pyroxenites, black to dark green on fresh surfaces and weathering to dark green or rusty brown, depending upon the contained sulphide. The pyroxenites comprise 20-30% euhedral to anhedral crystal forms particular to olivine, 1-2 mm in size and pseudomorphically replaced by bronze-black pyroxene. These pseudomorphs are poikilitically enclosed by subhedral to anhedral crystals of bronze-black pyroxene and 15% subhedral to anhedral crystals of jet-black pyroxene, probably clinopyroxene. The two later-formed pyroxene phases are subhedral and 7-10 mm in size in most samples, although their grain size may be as coarse as 20 mm. These pyroxene crystals exhibit a mutually interpenetrant and interlocking texture with 5-15% pyrrhotite, the latter often exhibiting small amounts of exsolved chalcopyrite. This rock type is interpreted as a sulphide-bearing adcumulate.

Intersertal plagioclase occurs in the pyroxenites in amounts that vary from trace to as much as 55% of the whole rock, at the expense of the other phases in their respective proportions. Where plagioclase forms a significant part of the mode, the rock has been assigned the name *gabbronite*. Sulphide is less abundant, often absent, from the *gabbronites* and sparse, fine-grained, anhedral and possibly xenocrystic quartz is an accessory phase.

Plagioclase in the *gabbronites* is usually white and, presumably, albitic. One sample of float from the general area contains plagioclase which darkens in colour across the width of a 10 cm sample, from an albitic white to the distinctive light purplish brown of calcic plagioclase. It is probable therefore that much of the plagioclase-bearing rock in the area has undergone lower greenschist metamorphism, with consequent albitization of plagioclase, during the waning stages of regional metamorphism. Much of the *Adiorite* and *Aquartz diorite* identified from this part of the Canadian Cordillera may, therefore, be weakly metamorphosed or altered *gabbronite*.

The third lithology exposed on the SABLE claim underlies a small area in the north-central part of the claim (Fig.6). It is a fine-grained, dense, dark greenish grey, medium grey-weathering rock containing abundant talc and subordinate amounts of magnetite. A preliminary petrographic examination showed that the rock is a talc-altered peridotite, probably a dunite and identical to a lithology exposed in Talc Creek, at the NI / NI 752 showing (MINFILE 092HSW081). The exposures there were examined by the authors during the course of 2001 fieldwork and interpreted as altered or metamorphosed peridotite or dunite.

The microscopic and macroscopic petrographic features observed in pyroxenite and *gabbronite* on the SABLE claim are common to all pyroxenite samples from the Pacific Nickel

Complex, including those hosting the Ni-Cu occurrences at Choate, Giant Nickel, Giant Mascot, Star of Emory, Pride of Emory (MINFILE occurrences 092HSW125 092HSW093 092HSW004) and at Settler Creek and Ni Zone 4 (MINFILE occurrence 092HNW045). The identity in microtextures, over distances of more than 40 km, suggests very strongly that all pyroxene megacryst-bearing intrusive rocks in this area of the Cordillera are comagmatic. Although cumulates are well-represented in the system, the absence of sheeted dykes, submarine volcanic features (*e.g.* pillows) and submarine sedimentary rocks strongly suggest that the system is not part of an ophiolite complex.

Textural variations in the pyroxenite on the SABLE claim are best exposed in the watercourse of Fir Creek (Fig.6). The pyroxenite is, typically, coarse-grained but at this locality also contains abundant inclusions of hornblende and of foliated and banded Settler Gneiss. The latter are clearly xenoliths and exhibit various stages of dissolution, soaking and absorption by the enclosing pyroxenite. Peripheral to the gneissic inclusions are areas of pyroxene-phyric gabbro, with coarse intersertal plagioclase and sparse anhedral quartz. Pyroxene subhedra transect the boundary between the gabbro and the enclosing pyroxenite; the areas are interpreted as the result of contamination of a pyroxenite accumulation mush by anatexis of the gneiss.

Both the pyroxenite and the areas of contaminant gabbro adjacent to gneissic xenoliths are crosscut by thin dykes or sills of pyroxene- or hornblende-bearing, medium grained granodiorite. These in turn are cut by dykes and sills of progressively finer-grained and more leucocratic granodiorite or granophyre, as wide as 50 cm. These later, more leucocratic intrusions are non-porphyrific, allotriomorphic and contain 10-15% anhedral quartz, 1-3 mm in size and 85-90% anhedral untwinned feldspar, with mafic minerals scarce or absent. These latest intrusions generally have sharper contacts with the pyroxenite, although there is no evidence of chilling at the margins in the outcrops examined. Beneath the old logging bridge across Fir Creek, a volume of granophyre was injected sufficient to brecciate the enclosing pyroxenite and to heal the subangular breccia with a network of anastomosing granophyric veins. The closest analogy to this texture observed by either of the present authors is the Quartz Dolerite of Sgurr nam Meann in the Ardnamurchan ring-dyke complex of northwestern Scotland (Richey and Thomas 1930, Metcalfe, unpubl. data). The ring dyke described is veined extensively by granophyre, possibly as a result of remelting of country rock by the large (in excess of 100 km³) basic intrusion. The intrusive sequence exposed on the SABLE claim is interpreted as the result of melting of the wallrock at progressively lower temperatures, as the pyroxenite body cooled, followed by brecciation and veining of the subsolidus pyroxenite by these melted metamorphic rocks.

The hornblende inclusions exposed along Fir Creek contain a planar fabric, which is also oriented generally north-northwest. Although rounding and/or plastic deformation of these inclusions has taken place, they do not exhibit the same degree of resorption as do the quartzofeldspathic gneiss xenoliths. Some fining in the grain size of the enclosing pyroxenites was observed in borders of 0.5-2 cm width around the inclusions. Our preliminary interpretation of this texture is that the hornblendites are fragments of the first-cooled border phase of the mafic intrusion which were stopped into the magma or crystal mush.

In the northern part of the SABLE claim, a small valley crosses the claim with a trend of roughly 055 (Figs.6 and 7). The structure is not exposed and its existence is hypothetical, but the lineament marks the northernmost occurrence of ultramafic rocks discovered on the SABLE claim, although an area of gabbro-norite float or subcrop was observed at the claim's northern boundary. If present, the displacement which has occurred along the fault is unknown. The intrusion is open to the south.

Mineralization

Mineralization on the SABLE claim has hitherto been noted only within the Pacific Nickel intrusion and a narrow zone immediately adjacent to its intrusive contacts with the metamorphic wallrock. The sulphide mineral phases are nickeliferous pyrrhotite and chalcopyrite, which commonly exhibit intersertal and partial net textures. The sulphide phases poikilitically enclose earlier-formed pyroxene/olivine phenocrysts and are intergrown with later-formed coarse pyroxene crystals. Little or no pyrite was observed within the intrusion; pyrrhotite is equally rare in the metamorphic wallrock.

Sulphide concentrations are increased at the intrusion's western margin and in the immediate vicinity of the abundant xenoliths of pyritiferous schist and gneiss enclosed by the gabbro-norite and pyroxenite. In these areas, anhedral globular aggregates of segregated sulphide, as large as 3 cm, occur, usually enclosed by pyroxenite.

Age of the intrusion and related mineralization

The timing of the mafic intrusion has received some recent attention. Several workers have identified the nickeliferous ultramafic rocks of the Pacific Nickel Complex with the Permo-Triassic Bridge-River assemblage. This is impossible. Potassium-argon ages from the Pacific Nickel Complex range from about 120 to 95 million years. The Pacific Nickel Complex is truncated by diorite of the Late Cretaceous Spuzzum intrusions, at 79 to 89 Ma (McLeod *et. al.* 1976). On this basis, Journeay (December 2001 pers. comm to M. McClaren) cites the age of closure of the Coast Range metamorphism as roughly 86 Ma. Metamorphic mineral development in the Pacific Nickel Complex on the SABLE claim is limited to development of talc and uralitic actinolite in the main body of the intrusions, with formation of foliated hornblende at the contacts. Metamorphic fabrics are absent, except within 2 m of a contact or within 10 cm of rare, small fractures which cut the intrusive rocks. The earliest age at which the intrusions crystallized must therefore postdate both dynamic metamorphism and all but the retrograde stages of metamorphic mineral formation. The age of the mineralization on the SABLE claim is therefore late Cretaceous and represents, as part of the Pacific Nickel Complex a separate and distinct metallogenic event in the evolution of the Canadian Cordillera.

Stream sediment sampling

A total of five stream sediment samples were collected from various locations on the SABLE claim during the course of geological mapping (Fig.2). Sampling coincided with mapping on a property scale. Four of the samples were from locations along Fir Creek, the fifth from a tributary to Fir Creek draining the northern part of the claim. Samples were analysed for Cu, Ni and Co using cold extractable cation (CEC) methods. In one case (SBSL-1), the sample was analysed using inductively coupled plasma spectroscopy (ICP) of a sample partially digested in aqua regia. Sample locations and analytical results are listed in Table 3 and are summarised in Fig.8.

Regional geochemical sampling carried out by the British Columbia Geological Survey Branch (BCGSB) and the Geological Survey of Canada (GSC) in 1991 (GSB/GSC 1994) permits assessment of local geochemical data. Samples collected during regional sampling, from lithologies similar to those exposed on the SABLE claim, indicate that the 95th percentile values for Cu, Ni, Co and Arsenic (As) are, respectively, 55, 47, 13 and 18 parts per million (ppm). It can be noted that, in three of the five samples taken, Ni and Co values lie in the 95th percentile, although Cu is significantly lower. In the single sample analyzed by ICP, As lies at the 95th percentile and phosphorous (P) is elevated; there is no statistical basis for evaluating this last value at present. SBSL-1, a mere 1 km downstream from the pyroxenite outcrops, is significantly depleted in Ni and Co relative to more proximal samples. In none of the samples are Cu values elevated beyond the 80th percentile.

Table 3. List of analytical results and locations for stream sediment samples.

Sample	UTME 83	UTMN 83	Width (m)	Depth (m)	*Locn/ Active	As ppm	Co ppm	Cu ppm	Ni ppm	P ppm
27/9/13-PT	583986	5509412	3.00	0.25	CA		20	18	52	
SBSL-1	583258	5507959	6.00	1.00	RA	18	7	20	33	1150
SB-01-17	584580	5508242	4.00	1.00			18	28	52	
SB-01-18	584647	5508269	4.00	1.00			8	16	14	
SB-01-19	584695	5508285	4.00	1.00			16	32	56	

*C Centre of creek channel

*R Right bank

*L Left bank

*A Active

*I Inactive

Conclusions and recommendations

Assessment work carried out by these authors on the SABLE mineral claim during the summer of 2001 confirmed that the western part of the claim is underlain in part by a mineralized, mafic to ultramafic intrusion comagmatic with the Pacific Nickel Complex. This latter complex hosts the past-producing Ni-Cu deposits of the Giant Mascot Mine, which also contain zones anomalous in platinum group elements. This discovery of mineralized, comagmatic rocks 40 km to the northeast of the established outcrop of the Pacific Nickel Complex suggests strongly that the size of its magmatic system and its consequent potential for hosting magmatic sulphide deposits have both been greatly underestimated.

The total area of Pacific Nickel Complex subcrop on the SABLE claim is at least 0.45 km², over an elevation difference of 0.3 km. This intrusion is apparently displaced an unknown distance north of a fault in the northern part of the claim, but lies open to the south. The southern part of the property underlain by the projected extension of the intrusion is as yet unexplored.

Anomalous values of nickel, copper and platinum group elements were returned from assay of 1 m² outcrop panel samples and 1 m outcrop channel samples, dominantly of pyroxenite and gabbro-norite, taken during fieldwork. None of the samples taken contained economic grades of Cu, Ni or Co, nor were consistently anomalous values of Pt and Pd returned. The single analysis of a sample taken by Houle (*c.f.* MINFILE), which returned 80 ppb Pd, may be the result of a nugget effect. The base metal values from this grab sample exceed those returned from the panel sampling by a factor of three, but this is not unusual, given the disparity of the sampling methods.

The stream sediment sampling carried out on the SABLE claim confirms data from the Regional Geochemical Sampling (RGS) program carried out by the federal and provincial governments (BCGSB/GSC 1994). Similar results from stream sediment sampling have been associated with the discovery of mineralized float elsewhere in the Coast Ranges of British Columbia (Metcalf and McClaren, unpubl. data). The tracer elements for Cu-Ni mineralization are, unsurprisingly, Cu, Ni and Co.

Analysis of soil samples produced the most promising results. At least three anomalous areas are present along the incomplete soil line 1. The most prominent of these lies near the western contact of the intrusion and comprises combined base metal values in excess of 0.1 %, greater than all but two of the rock samples taken from outcrop. It is highly probable therefore, based on the limited amount of information available, that recessively weathering, mineralized parts of the Pacific Nickel Complex occur on the SABLE claim. The third of the anomalies lies at the eastern end of the soil line and is presently open to the east. The intrusion extends a further 300 m beyond a large gneissic screen; this extension was only discovered after sampling of the soil line.

Mineralization is restricted to the Pacific Nickel intrusion and a narrow zone within the wallrock. The sulphide minerals are pyrrhotite and chalcopyrite. Both sulphide phases exhibit intersertal and partial net textures, poikilitically enclose early-formed pyroxene/olivine phenocrysts and are intergrown with later-formed coarse pyroxene crystals. In areas of higher sulphide content, segregated aggregates of pyrrhotite, as coarse as 3 cm occur in pyroxenite.

Based upon the abundance of sulphide-rich xenolithic material (at all scales) within the Pacific Nickel intrusion and upon the proximity of at least part of the mineralization to intrusive contacts, it is probable that some of the sulphur is exogenic. However, little, if any, of the mineralization appears to have extended beyond the intrusions and a narrow zone in the contact aureole. Future exploration

should prioritize the outcrop area of the Pacific Nickel intrusion, unless contradictory evidence becomes available from prospecting work.

On the basis of the findings summarized above, it is recommended that further exploration be carried out on the SABLE property. The purpose of this exploration is twofold:

1. To constrain the area of outcrop of the Pacific Nickel Complex on the SABLE property;
2. To establish the presence or absence of areas of anomalous lithochemistry, soil geochemistry and geophysical response as targets for trenching.

It is recommended that the first soil line be extended to the east-northeast along the same bearing, in order to sample the part of the intrusion to the northeast of the thick gneiss screen or pendant. The total line length would be approximately 800 m, in order to establish a baseline value of samples from the wallrock. At the same time a soil grid should be constructed with a line spacing of 100 m, with lines running parallel to that already sampled. The latter would become Line 1N of the grid, with Line 0 running subparallel to the Sable showing road. Stations should be marked at 25 m intervals on each line. Grid spacing should not be corrected for slope.

Initial sampling of the soil grid should be carried out on soil lines 3N, 5N and 7N, that is: at a line spacing of 200 m, with a sample interval of 25 m. Prospecting and geological mapping should be carried out during this initial phase of sampling, to trace the contact of the Pacific Nickel intrusion northward and southward from the Sable showing road. Contingent on favourable results from this phase, the soil sampling can be extended further to the north and south and the central areas filled in to a 100 m line spacing.

The SABLE claim is overlain by a moderate, sharp aeromagnetic anomaly (BCDMPR / GSC 1973), which attenuates rapidly to the north. This may be the result of rapid attenuation of the magnetic signal through plunging of the mafic/ultramafic intrusion down the axis of an isoclinal fold or it may be due to an offset of the body by a fault.

The magnetic response of the Pacific Nickel intrusion of the SABLE claim is shown by its aeromagnetic signature (BCDMPR / GSC 1973). It is recommended that a ground geophysical survey be carried out, employing a combined magnetometer and VLF/EM. In addition, the density contrast of the ultramafic intrusion with the host Settler Schist and Custer Gneiss suggests that a gravity survey would provide valuable information, if the method is logistically feasible for this area. It is, however, recommended that these methods only be employed contingent upon favourable results from prospecting, further mapping and the first two phases of soil sampling.

At present, a single, disjointed occurrence of coarse, unmineralized gabbro-norite has been noted in the northern part of the SABLE claim. The acquisition of more ground to the north of the claim should be considered, but only if favourable geochemical results are returned from samples taken near the claim's northern boundary. At present, the Sable showing is the most northerly mineral occurrence along the outcrop trend of the Pacific Nickel Complex; any extension of the belt would therefore have important implications for the size of its mineralizing, magmatic system.