TO : P.A. Christopher

020417

Regional Setting of the Giant Mascot Mine

by Mark R. Vining

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Introduction

Field work was carried on during the summer of 1975, under the supervision of Dr. K. C. McTaggart of the University of British Columbia and Dr. P. A. Christopher of the B. C. Dept. of Mines and Petroleum Resources.

Thanks are given to Mr. F. W. Holland of Giant Mascot Mines Ltd., to Dr. McTaggart, to Dr. Chrintopher, to Mr. C. L. Hronek of B. C. Speleo Research, to Mr. M. Doherty of the University of New Brunswick for invaluable field assistance through the month of August, and finally to the British Columbia Department of Mines and Petroleum Resources for financing the project.

The purpose of the project was to study the field relations between the ultramafites of the Giant Mascot property and the surrounding plutonic rocks. Necessary for this is understanding the field relations of the described units of earlier workers (Aho, 1956; McTaggart and Thompson, 1967; and Richards, 1972). Work was begun in mid-June at American Creek and extended northward to Emory Creek, finishing in mid-Septenber. This area is heavily forrested to an elevation of 4700 feet, and open areas above this level are thickly overgrown with brush.

A. E. Aho (1956) describes the ulrtabasic rocks and surrounding "diorites and norites" as being roughly contemporaneous, and showing ambiguous contact relationships. He refers to three earlier writers who concluded that the diorites are younger than the ultrabasics.

McTaggart and Thompson (1967) suggest that the metasediments east of the mine were metamorphosed contemporaneous with the intrusion of the Spuzzum Intrusions to the north in Late Cretaceous time. The diorites and tonalites southwest of Yale, B. C. were correlated by Richards and White (1970) with the Spuzzum Intrusions. Richards (1972) describes the "Spuzzum Intrusions" south of American Creek as a zoned diorite to tonalite pluton, with ages of 79, 81, 83, and 103 m.y. for the tonalite. He found tonalite truncating the foliation and zonation of the dioritic core. McLeod (1975) reports ages of 95 to 119 m.y. for various ultramafites from the Giant Mascot property.

Geology

Schist

The oldest rocks seen are schists, xenoliths of which occur in tonalite and diorite. They consist of pelitic schists with interbeds of calcsilicate rock and quartzite, numerous synkinematic dykes and sills of aplite, and rare ultrabasic pods. The pelites contain abundant staurolite, garnet, and kyanite away from igneous contacts, and are upgraded to contain sillimanite in contact aureoles. Ultrabasic pods contain directionless talc and radiating clots of acicular anthophyllite or tremolite. These rocks are tentatively correlated with the Hozameen Group by McTaggart and Thompson (1967).

Ultramafites

Aho (1956) described a suite of ultrabasic rocks on the Giant Mascot property ranging from pyroxenite at the periphery to dunite at several cores of a crudely concentrically zoned complex. All phases of the complex have varying amounts of sievy hornblende, the mineral being most abundant in this form in lherzolitic peridotite and in pyroxenite. Angular xenoliths of these with sharp contacts are found in diorite, and dykes of diorite cut peridotite and pyroxenite at the perimeter of the complex. The ultrabasic rocks intrude schists as small stocks, and perhaps a sill, south and east of the mine.

Rimming the complex is hornblendite which ranges from medium grained anhedral hornblende to coarsely porphyritic anhedral hornblende with a medium grained hornblende matrix. In places these rocks contain plagioclase which is either interstitial to large hornblende crystals, or intimately mixed with euhedral hornblende in a fine grained interstitial aggregate. The former grades imperceptibly to gabbro, and to diorite with euhedral acicular hornblende, with increasing amount of plagioclase.

Hornblendite to hornblende gabbro occurs also as fine grained dykes or veins cutting the less hydrous ultrabasic rocks. Some of these have hypersthene phenocrysts, or biotite, but generally they have only hornblende as the mafic mineral.

Spuzzum Diorite

Intruding the schist and ultramafites is a zoned suite of diorites, having anhydrous mafic phases in several cores and hydrated ones at the periphery.

¶ ← Richards described three types of diorites in the Spuzzum Intrusions south of American Creek: Type-I: hypersthene-augite diorite, having pink to gray plagioclase and only a trace of hornblende; Type-II: augite-hypersthene-hornblende diorite with gray, to rarer pink, plagioclase and a trace of biotite; Type-III: biotite-hypersthene-hornblende diorite, generally with gray plagioclase and no augite. These three types have roughly constant proportions of hypersthene and plagioclase. Other types seen north of American Creek include: (a) Hornblende diorite, with or without biotite, and with no pyroxene. Plagioclase is generally less abundant than in typical type-III diorite. (b) ~~Euhedral~~ Hornblende diorite, with small to very large (several cm) acicular euhedral crystals of hornblende in anhedral white plagioclase of smaller grainsize. This grades to a gabbro of the same texture, and thence to plagioclase-bearing hornblendite. (c) "Noritic" diorite in which the most common mafic mineral is hypersthene, with variable amounts of hornblende and augite. The plagioclase ~~content~~ proportion varies from just under that of typical type-I diorite, to ~~nearly gabbroic amounts~~ as little as 50 percent (rare). This type has a peculiar texture of eu- to subhedral hypersthene, and clots of augite and sievy hornblende, which occurs also in compositions much like type-II diorite.

Foliation and lineation are common in these rocks. ~~and the tonalite.~~ Generally these are expressed as alignment of plagioclase and hornblende ~~laths~~ crystals, but ~~is~~ locally expressed by alignment of elongate pyroxenes in type-I diorite, or biotite flakes in type-III diorite. ~~and in tonalite.~~ The structural continuity is broken near the North Fork of American Creek by ~~swirling relationships~~ large scale swirls, perhaps associated with a large schist reentrant from the east.

Hornblendite Inclusions

Richards (1972) ~~describes~~ states, "Ultramafic bodies, found only in the diorite, are of two types: pyroxenite and hornblendite. Pyroxenite is largely confined to type-I diorite and hornblendite is largely confined to type-III diorite. Hornblendite is much more common and forms larger bodies than pyroxenite." (p.24) He goes on to say that the form of these bodies is most commonly lenticular, but that some "Hornblendite 'dykes' up to 5 feet across have sharp to gradational contacts with diorite." (p.26) The origin of both types of ultramafic bodies is attributed to metasomatic removal of SiO_2, Na_2O, and CaO by hydrothermal fluid.

Field observation during the present work suggests that their mechanism of formation is not simple. Hornblendites in diorite are seen as irregular rounded bodies (see photo 1) ranging in size from several centimeters to somewhat under one meter, in what appears to be an interconnected three dimensional net within hornblende diorite. At the contact with a hornblendite body the foliation of the diorite is either truncated, or somewhat contorted, or concordant, but generally rather obscure. Contacts are generally very sharp. This type of occurrence may grade to another in which the hornblendite veins are filled with very coarse hornblende crystals, usually with skeletal plagioclase cores, and with or without minor interstitial plagioclase. These could indeed be termed pegmatitic hornblendite dykes or veins (see photo 2), and are suggestive of a very volatile-rich environment. Hornblendite occurs also as narrow veins, usually under 5 cm, commonly associated with nearly pure plagioclase "veins" or "segregations", and in many places showing signs of alteration of their host diorite. Elsewhere, pyroxenitic diorite is altered to hornblendic diorite in association with hornblendic veins. This evidence speaks of an event of metasomatism or hydro-thermal deposition (see photo 3).

Pyroxenite bodies are scarce and small. Certainly they do not record as much geological history as the suite of hornblendites. Probably, as Richards wrote, the pyroxenite bodies and some of the hornblendites are attributable to a single hydrothermal event (on cooling of the diorite). However, there is evidence of an additional event, perhaps hydrothermal in some places and more intrusive in others, which is responsible for the complex field relationships seen in hornblendites and their hosts.

Tonalite

Tonalite intrudes diorite, truncating the zoning pattern in many places, and also the foliation of the diorite visibly in one place (Richards, 1972). Xenoliths of granofels and hornfelsed schist occur in the tonalite in most localities. Granofels is thoroughly recrystallized, but appears more mafic than tonalite, and with less or no quartz. It is thought, therefore, to be Spuzzum diorite.

The mineralogy of the tonalite is fairly constant: plagioclase 55 to 60%, quartz 15 to 20%, hornblende plus biotite 25 to 30%. The greatest visible variation is in the ratio of hornblende to biotite, which ranges from ½ to 2. These rocks are quite strongly foliated and in places lineated, expressed as alignment of hornblende and biotite. Protoclastic textures are common.

Late Phases

¶ A late differentiate of the tonalite - a plagioclase, quartz, tourmaline, mica pegmatite - fills joints. Possibly contemporaneous with this pegmatite are quartz veins, which cut most of the rock units. Lastly, a garnet bearing, strongly foliated, leucocratic dyke-rock cuts the above mentioned pegmatite, and ~~the~~ tonalite.

Breccias containing fragments of virtually all units (older than ~~the~~ tonalite) have a fine grained matrix of plagioclase and hornblende. The texture of the matrix looks metamorphic, but it is not certain weather the xenoliths have undergone recrystallization. This is perhaps a result of the intrusion of ~~the~~ tonalite, but the question remains as to the unchanged nature of the ultrabasics.

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FROM: M.R. Vining

References

Aho, A. E., 1956, "Geology and Genesis of Ultrabasic Nickel-Copper-Pyrrhotite Deposits at the Pacific Nickel Property, Southwestern British Columbia." Econ. Geol., Vol. 51, pp 444-481.

McLeod, J., 1975, personal communication.

McTaggart, K. C., and Thompson, R. M., 1967, "Geology of Part of the Northern Cascades in Southern British Columbia." Can. Jour. of Earth Sci., Vol. 4, pp 1199-1228.

Richards, T. A., 1972, "Plutonic Rocks Between Hope, B. C., and the 49th Parallel." Ph. D. Thesis, U. B. C.

Richards, T. A., and White, W. H., 1970, "K-Ar Ages of Plutonic Rocks Between Hope, B. C., and the 49th Parallel." Can. Jour. of Earth Sci., Vol. 7, No. 5, pp 1203-1207.

Note: Please return photos

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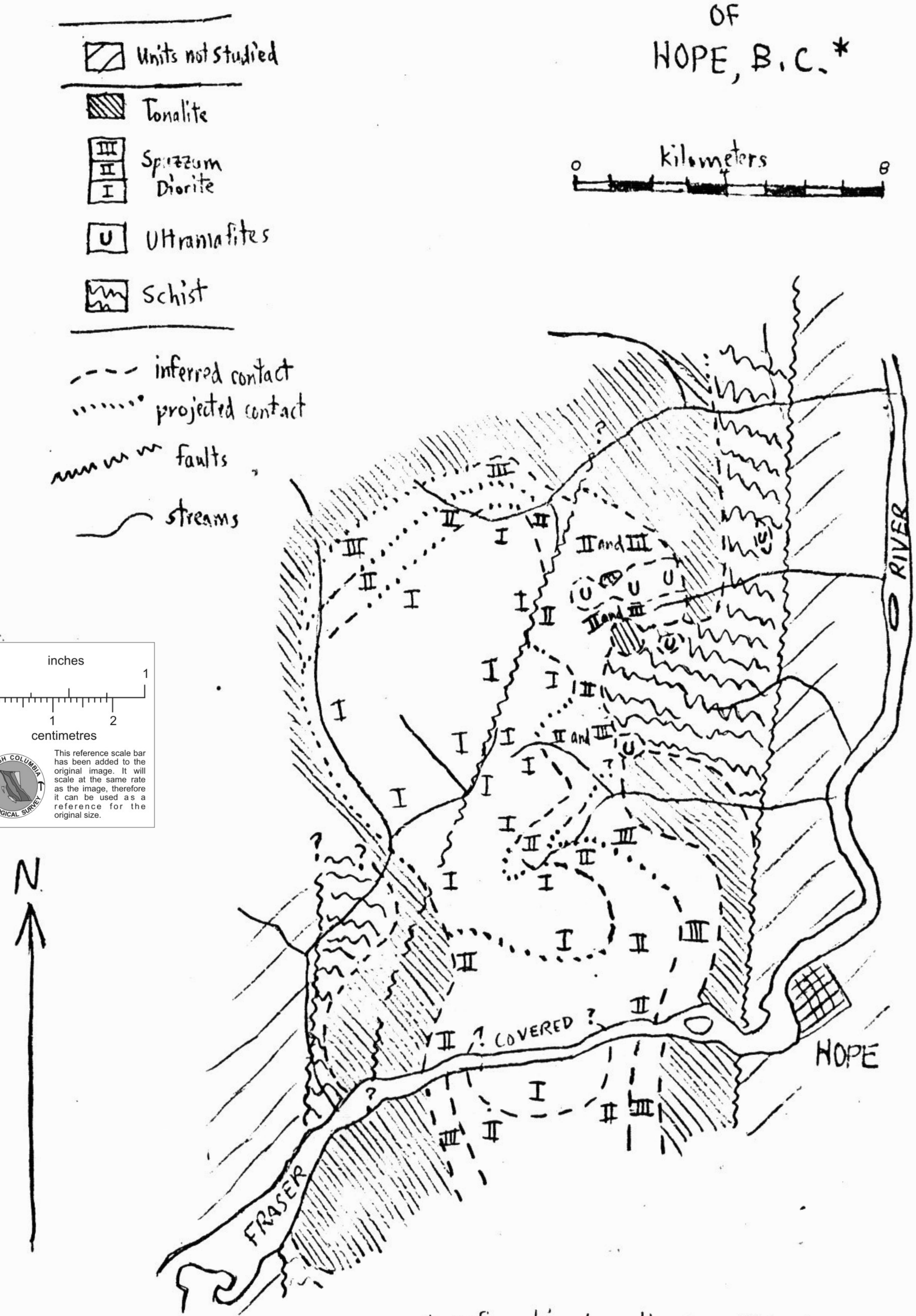
GEOLOGY NW OF HOPE, B.C.*



* configuration in south after Richards 1972