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021762 (1)

Lynx - Late

Introduction

This report is intended as a review of an interesting copper prospect recently discovered in a young Coryell-type ~~syenite~~ stock located 18 miles northeast of Okanagan Falls near Allendale Lake.

The geological and mineralogical observations which form the basis of this study were made during a one week visit to the area by the writer in June 1971.

History

Scattered copper mineralization was discovered by R.W. McLean in 1966 on the hill immediately west of Allendale Lake in the area now included in the Lynx - Late claim block (see Figure 2 CHURCH). After some preliminary prospecting and sampling by McLean and his partner K.G. Emkers the property was optioned to General Resources Ltd. who reportedly spent $25,000 mainly in construction of access roads and bulldozer trenching. Gunnex Limited acquired an option on the property in 1968 and completed detailed geochemical and magnetometer surveys. After a short period of inactivity in the area Selco Exploration Co. Ltd. optioned the property, ~~and has~~ ~~buy~~ in late 1971, and ~~has~~ began an exploration program with geochemical silt sampling and an induced polarization survey in vicinity of the main showings.

Physiography

The area is in the Okanagon Highland physiographic subdivision of Southern British Columbia, on the Okanagon Valley - Kettle River drainage divide. The region is characterized by a glacially carved rolling landscape surmounted by a few isolated crags.

Elevations range from 4500 feet on Shuttleworth Creek, in the south part of the map-area, to 6400 feet on the east summit of Mt. Christie, 3½ miles to the northwest. Maximum relief on the Lynx - Late claim block is about 1000 feet, with slopes rising from Allendale lake at approximately 5100 feet, near the east boundary of the map-area, to a centrally located peak at ~~6100~~ an elevation of 6100 feet, a few miles to the west.

Southwesterly moving Pleistocene glaciers were responsible for the erosion of the broad U-shaped bottomed valleys found in the region, such as the one occupied by the most westerly of the Clark lakes in the west part of the map-area. The mean glacial striae direction was determined as ~~found to be approximately~~ 208 ~~210~~ degrees. In typical crag-and-tail fashion, the low rounded hills in the vicinity of the most easterly of the Clark Lakes are strung out on the lee side of the central mountain mass, which ~~proves to be~~ a glacially resistant ~~core~~ ~~knoll~~ syenitic stock.

Except for a small area of sandy ~~shores~~ glacial outwash and esker immediately west ~~of~~ and northwest of Allendale lake, the valleys and lower slopes are filled with coarse boulder till. Good bed rock exposures are found mainly on the ridge tops.

The area is ~~embraced in a belt of~~ timbered with mature pine. Northwood Mills Ltd., a subsidiary of Noranda Mines Ltd. is currently constructing a truck road through the ~~area~~ region to connect several logging operations ~~in the area~~ with the company's saw mill at Okanagon Falls.

Owing to dry summer conditions in the Okanagon Valley, many small lakes have been dammed for irregation control. ~~purposes.~~ Some of these, such as Allendale Lake, are stocked with trout and are readily accessible ~~by~~ to the general public ~~on~~ by a network of gravel and dirt roads.

General Geology

The geology of the area features at least three main lithological units and a unique structural setting. A small Coryell-type stock is intruded at an apparent point of structural weakness at the junction of the Pre-Permian Shuswap gneiss complex and ~~the~~ Mesozoic Nelson and Valhalla granitic ~~rocks~~ batholiths. ~~All of~~ these units crop out on or near the Lynx-Late claim block except for the Nelson ~~plutons~~ granite which ~~according to mapping by Little 1961,~~ is exposed to the west on Mt. Christie (Little 1961).

The Shuswap Metamorphic Rocks

The Shuswap rocks are ~~best~~ found ~~exposed~~ in the area south of Shuttleworth Creek near the Clark Lakes. Typically the formation is medium grained with alternate layers composed of light coloured granites ~~gneiss~~ and darker ferromagnesian-rich zones. The layers are generally gently dipping, however, contortions, complex refolds, and augen structures are locally conspicuous. Pegmatite dykes and segregations form a minor part of the formation.

Microscopically the gneissic units consist of subhedral quartz and plagioclase averaging 2 to 3 millimeters in diameter with scattered interstitial biotite, small patches of myrmekite, and irregular ragged concentrations of biotite and green amphibole. The remainder of the rock consists of accessory magnetite, apatite, and sphene, and, less commonly, zoisite. ~~Potassium~~ Potassic feldspar is also accessory and is usually associated with quartz-rich segregations. Locally the rocks display cataclastic textures and evidence of retrograde metamorphism, such as chloritization of the ferromagnesian

The Valhalla ~~Intrusion~~

The so-called Valhalla granitic rocks are found to the north and south of Allendale Lake, near the east boundary of the map-area. These are leucocratic, foliated, and fine to medium grained. The rocks display both porphyritic and granoblastic textures with evidence of some crushing and mineral alignment due to cataclasis. Examination of four thin sections shows an average of ~~quartz~~ 40 per ~~cent~~ quartz, and ~~Feldspar~~ 50 ~~per cent~~ feldspar; the accessory minerals ~~consist of~~ are amphibole, biotite, magnetite, apatite, sphene, and allanite, in order of decreasing abundance. Phenocrysts of orthoclase are scattered sparingly throughout the rock; these measure up to 6 millimeters in length and usually carry a few small plagioclase inclusions. ~~Little, 1960,~~ The characteristically smoky ~~condition~~ appearance of the quartz is attributed to the above average radioactivity ~~condition~~ of the rock, according to H. W. Little 1960.

The Coryell Intrusion

The Coryell intrusion is a small stock occupying much of the east central part of the map-area. According to Little (1961) this body is a satellite of the main Coryell batholith centred in the Rossland area to the east. These rocks are typically alkaline and are probably co-magmatic with some of the Early Tertiary volcanic deposits of south central British Columbia (see Figure CHURCH-13). Various phases of the Coryell batholith ~~have been~~ were dated by Baadsgaard et al. (1961) yielding ages of 54 and 58 million years; ~~Yates and Engels (1968) 50.4 million years~~ and more recently similar ages were obtained from the Rossland area by Fyles (personal communication).

The Coryell body found in the map-area is somewhat elongated and kidney-shaped ~~measuring~~ about 3 miles long and between the north and south contacts and 1½ miles in width. The intrusion comprises syenite, monzonite, and ~~shonkinitic~~ phases.

The main phase of the intrusion is biotite-pyroxene monzonite. Typically the rock is porphyritic consisting of a spongy framework of chunky alkali feldspar phenocrysts, ~~1~~ 1 to 2 centimeters in diameter, with finer grained dark ferromagnesian minerals in the interstices. In polished sections the large feldspar crystals are commonly smoky grey, often having a bluish iridescence; small feldspar grains and the margins of some phenocrysts tend to be milky or cream coloured.

Detailed examination of numerous thin sections shows that ~~much~~ most of the feldspar is thermally re-ordered, resulting in exsolution of albite and relatively pure orthoclase blebs from large plates of alkali feldspar. The typical checkerboard, perthitic blebs and antiperthitic textures have evidently formed from the unmixing of solitary ~~grains~~ crystals of high temperature orthoclase and zoned ~~or mixed crystals of~~ orthoclase ~~and~~ anorthoclase individuals.

The interstitial mafic minerals ~~comprise~~ constitutes only about 10 ~~or~~ 15 per cent of the rock, the rest being ~~largely~~ alkali feldspar. Green diopsidic augite and fresh brown biotite are present in about equal amounts ~~forming~~ as single grains or, more commonly, in ~~as~~ aggregates with apatite, magnetite, and sphene. These ~~crystals~~ minerals range from 1 to 6 millimeters in diameter.

The chemical analysis of a representative sample of this rock is comparable with Daly's analysis of the Coryell intrusion ~~four miles northwest of~~ near Rossland*. Of special note, the lime and magnesia content of these rocks is low whereas soda and potash ~~are~~ is high. Calculations show that the rocks are undersaturated in silica resulting in normative olivine and some nepheline. ~~However,~~ Since olivine and nepheline ~~were~~ are ~~not~~ found in thin sections ~~therefore~~ it seems most likely that the silica deficiency is taken up by the biotite. Also, it is noted that the general absence of non-perthitic plagioclase is in keeping with the very low normative anorthite content of these rocks (~~see~~ Nos. 1 and 2 in the accompanying Table of Chemical Analyses)* ~~Nos. 1 and 2.~~)

The syenitic phase of the intrusion is found only in small pockets in the main body of the monzonite. Although no analyses are available, the chemical composition of this rock is probably similar to the Wausau phonolites of the White Lake basin (analysis No. 3). Characteristically both the syenite and phonolite are known to contain distinctive rhomb-shaped anorthoclase phenocrysts (see the accompanying Plate Church II B and Plate XVIII G.E.M. 1970 Plate XVIII p. 396).

A shonkinitic contact phase is exposed along the west and southwest margins of the intrusion where it possibly forms a continuous zone ranging from several hundred to a few thousand feet wide. This phase is relatively enriched in ferromagnesian minerals; it is probably a basic differentiate of the monzonite. The rock is medium grained composed essentially of intermixed anorthoclase or orthoclase perthite, about 80 percent, and prismatic and pyroxene, about 15 percent. Microscopic examination shows that biotite and hornblende are accessory occurring in clots with pyroxene, magnetite, and apatite, or as poikilitic inclusions in large augite grains. Small grains of partly altered nepheline, 1 to ½ millimeters in diameter, are disseminated sparingly throughout the rock and in places form inclusions in anorthoclase crystals.

Pegmatite dykes cut the syenite and bronzonite ~~phases~~ in the north, east central, and south parts of the stock. In contrast with the host rock, the pegmatite is quartz-rich and much of the feldspar consists of very coarse albite; the main ferromagnesian minerals ~~are~~ are biotite and actinolite. Sphene, allanite, and magnetite are accessory minerals ~~forming~~ found as disseminations ~~and~~ or in small clusters.

Structure

As previously indicated, the Coryell stock is intruded at the three-way contact of the Nelson granite, Valhalla granite, and Shuswap metamorphic complex. This ~~jinction~~ junction of major units was evidently a weak point - possibly a focal point of major fractures which may have facilitated emplacement of the young stock.

The results of a statistical study of fractures and lineaments is shown in Figure CHURCH 3. On the basis of 75 measurements the main fractures within the Coryell stock have a mean attitude of 035 degrees dipping 80 degrees southeast. Strong subsidiary fractures strike about 065 degrees dipping 55 degrees northwest and two weaker sets are noted striking roughly 010 degrees dipping 55 degrees northwest and 135 degrees vertical.

Although a wide range of topographic lineaments are observed ~~have been recorded from~~ on aerial photographs of the region, the only strongly developed trend lies between 010 and 040 degrees. This is probably largely the expression of glacial striations (028 degrees), however, there is a coincidence of lineaments with the strong northeasterly developed fracture system as well as the weaker northerly trending set.

~~It is also evident that~~ The southeasterly

trending fractures and the ones striking between 060 and 070 degrees have apparently little topographic expression. It seems possible that these are simply short cross fractures ~~and~~ which are not readily recognized as lineaments owing to limitations in photographic resolution.

Mineralization

Mineralization within the Coryell stock is varied and widely scattered, consisting mainly of sulphide replacements in xenoliths and disseminations in the host monzonite. Although no economic deposit has been discovered, these occurrences are unusual and warrant some detailed description.

The petrography of the main phases of the Coryell intrusion, outlined above, leaves little doubt that these rocks are hypersolvus - that is, the original magma was intruded at high temperature, perhaps as high as 900°c. Rapid cooling and dispersal of volatiles allowed preservation of the perthitic feldspars that characterize these rocks. It is believed that this early migration of volatiles within the intrusion resulted in the mineralization of the xenoliths. Metalliferous solutions trapped interstitially in the crystal mush of the solidifying magma is possibly responsible for the disseminated sulphide deposits.

(perhaps)

The effect of the Coryell intrusion on the surrounding country rocks, including the possibilities of sulphide replacements, is largely unknown because of poor bed rock exposure.

Mineralization

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Mineralized Xenoliths:

Xenoliths are locally abundant, forming clusters of small fragments or occurring as isolated blocks; they range from a few feet up to 30 feet long. Rounded, partially assimilated ~~light coloured~~ ~~aplat~~ aplitic fragments are most common, however angular blocks of dark refractory gneiss are also present (see Plate CHURCH III A). The source of this foreign debris appears to have been the Valhalla and Shuswap rocks which form the main walls of the stock.

The most ~~knightly~~ digested aplitic xenoliths are ~~appear to be mineralized~~ best mineralized. These are stained with malachite and azurite; internally they are commonly charged with ~~bornite and chalco~~ blebs of bornite and chalcocite (see Plate CHURCH III B).

At station 'A', shown on the accompanying map, mineralized xenoliths in syenite and monzonite are exposed over a length of about 200 feet. According to a company report the best sample from this area contained assayed 0.75 per cent copper and 0.6 ounces per ton silver across 33 feet; other samples taken nearby contained much less copper. A well mineralized

grab sample collected by the writer from the same area contained assayed 2.42 per cent copper, 0.6 ounces per ton silver, and 3.60 per cent iron.

Elsewhere, some xenoliths are simply pyritized with no sign of copper.

Disseminated Mineralization

Much of the prospecting in the area has been directed toward discovery of large tonnage disseminated copper sulphide deposits, the xenolith-type mineralization being considered only as an indication of a favourable geological environment.

At station 'B' shown on the accompanying map, chalcopyrite, and to a less extent bornite, are found interstitial to large feldspar crystals in the monzonite. These sulphides are distributed over several hundred square feet in concentrations ranging to 2 or 3 per cent of the rock and locally comprise 2 or 3 per cent of the total rock. Close examination of polished samples shows that chalcopyrite is sometimes associated with magnetite and replaces the interstitial ferromagnesian silicates, forming grains usually less than 1/3 millimeters long. Also very small specks of chalcopyrite are also found visible in the feldspar marginal along hair-line cracks (why chalcopyrite mainly, why peripheral) to large feldspar phenocrysts. (See CHURCH Plate II A)

A typical well mineralized sample of this rock submitted for assay by the writer shows 0.48 per cent copper, 0.2 ounces per ton silver, and 3.52 per cent iron.

Silt Geochemistry

Four silt samples were taken from streams draining the main showings and the east part of the Coryell stock. Analyses yielded unexpectedly low results with a range of 30 to 62 ppm copper. These low results are possibly due to a masking effect of thick till deposits in the valleys

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- References -

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