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Mount Cleveland Mine Prospect.

The Mount Cleveland deposits occur in country rocks belonging to the Dundas Series, and consisting of slates with interbedded, altered breccias, tuffs and lavas. In places the country rocks are silicified to cherts or quartzites. The deposits consisted originally, according to Reid in Bulletin 34, of narrow irregular fissures filled with quartz and mineralised by pyrite and cassiterite. On either side of the fissures were pyrrhotite-chalcopyrite ore bodies much less rich in cassiterite, and these remained after the higher grade ore had been removed.

The lower grade deposits are apparently due to replacement, because country rocks have been impregnated with sulphides that preserve the original sedimentary bedding, as may be seen in hole No. 10 Hall's lode 97', hole No. 16 Henry's lode 145', hole No. 5 Battery lode 115'.

The mineralisation is hydrothermal to pneumatolytic. The country rocks have been replaced by quartz, carbonate, sulphides and cassiterite giving a granular structure, well seen in Hall's lode hole No. 14, 150' where all the replacing minerals have about the same grain size, and all crystallinities from allotriomorphic to idiomorphic. With temperature increasing above 500°C quartz and carbonates reacted to give wollastonite as shown in Hall's lode, hole No. 14, 150' and Henry's lode hole No. 20 112'. This reaction is however, very incomplete, quartz and carbonates being always present with wollastonite. With increasing temperature, magnesia solutions, possibly derived from minerals of the country rock, reacted with quartz to give cordierite; and the introduction of Boron and Fluorine gave rise to tourmaline and fluorite, prominent in Hall's lode, hole No. 24, 94'.

Sulphides include pyrrhotite, pyrite, chalcopyrite and arsenopyrite. Cassiterite occurs with the sulphides. In a polished section, Waterhole lode, hole No. 11, 66'-84', three sulphides occur together. Pyrrhotite occurs as an inclusion in arsenopyrite, which has chalcopyrite along its edges, showing the order of deposition to be:- pyrrhotite-arsenopyrite-chalcopyrite, however, the ore minerals all appear to belong to the earlier hydrothermal phase.

The last important alteration to the country rocks resulted in the formation of chert. The chert represents the silicification of the finer grained more slaty rocks of the Dundas series. These rocks were fine-grained and less permeable than the tuffs and breccias, consequently they are much less mineralised and appear to have been longer in altering. Thus veinlets of quartz and carbonate are subsequent to incipient brecciation and shattering of the original rock in Battery lode, hole No. 3, 85'. Possibly the alteration of slate to chert was completed as a secondary process.

Sulphides that occur in the more cherty rocks are often associated with carbonate remnants of tuff or breccia that became included in the slates during deposition.

Hole No. 14, 214' Henry's Lode

Banded chert

In thin section the rock consists of microcrystalline quartz and cloudy opaque carbonate with disseminated sulphides. Cassiterite is rare and very fine grained. The sulphides tend, very strongly, to be associated with carbonate. Rare larger grains of quartz are associated with the sulphides and carbonates. From these associations it would seem that microcrystalline silica has replaced country rock bearing sulphides.

Hole No. 14. 150' Henry's Lode

The core consists of massive sulphides, mainly pyrrhotite, and 1 mm. veinlets of chalcopyrite with a little pyrrhotite, in a fine grained greenish rock, largely replaced by granular quartz.

In thin section the specimen is a mosaic of quartz grains, averaging .2 mm. across, with sericitic and chloritic inclusions and reds of rutile. The inclusions may be oriented, and have the same orientation for a patch of quartz grains, but those in an adjacent patch may have a quite different orientation. Carbonate is present in irregular patches, intergrown with radiating wollastonite. Opaque sulphides appear to be moulded on quartz grains, and may enclose other minerals including cassiterite, which occurs as irregular cracked grains of uneven pale brown colour.

In polished section pyrrhotite is pale yellow and strongly anisotropic giving yellow th deep bronze variation in colour with the nickels not quite crossed. Chalcopyrite is deep brass yellow and weakly anisotropic. The two occur together as replacements of rock minerals, with pyrrhotite much in excess. However they also occur as fine veinlets suggesting fissure filling, and in these structures chalcopyrite is much in excess of pyrrhotite. Evidently there has been overlap in the periods of deposition. The average grain size for pyrrhotite is about .25 mm. with some grains as much as 1 mm. and the cassiterite averages .125 mm.

Hole No. 16. 145' Henry's Lode

Partly massive pyrrhotite and chalcopyrite with fluorite, and partly sulphide replacement in finely banded rock.

In thin section the rock consists of euhedral chlorite in books averaging .2 mm. long, with granular cordierite and much quartz in small euhedral and subhedral crystals. Sulphides with which a little cassiterite is associated, enclose the other minerals including the chlorite, which is probably pseudomorphous after biotite. A little carbonate is present.

In polished section pyrrhotite of average grain size of .3 mm. is associated with lesser amounts chalcopyrite and cassiterite. The latter may occur in quartz apart from any sulphide.

Hole No. 20 120' Henry's Lode

Fine grained dark green rock with disseminated sulphides and faulted bands of chert. Development of secondary minerals including micas, is apparent and fine veins of these penetrate chert.

In thin section the rock is a very fine grained microcrystalline aggregate with minute grains and granular masses of sulphides, widely disseminated. There are numerous fine veinlets of chlorite and carbonate.

Hole No. 20 112' Henry's Lode

Silicified and carbonated rock containing masses of pyrite crystals in small vughs.

In thin section the rock consists of chert and carbonate with euhedral, subhedral and anhedral quartz and anhedral cordierite. Both quartz and cordierite contain minute inclusions, more especially the latter, and occur in grains up to 1 mm. across. Much of the carbonate shows crude rosette structure and is closely associated with radiating needles of wollastonite. Cassiterite occurs in disseminated grains about .1 mm. across and badly fractured. Pyrite and chalcopyrite occur in very irregular masses that are moulded on, and include, euhedral crystals of other minerals.

Hole No. 10. 97' Hall's Lode

Massive sulphides in banded silicified and carbonated rock.

In thin section the sulphides form a network enclosing rock forming minerals, on which they are moulded, and which they replace in part. Carbonate may be moulded on quartz grains, and form veinlets in sulphides. A little cassiterite is associated with the sulphides.

In polished section the sulphide is pyrrhotite with a little chalcopyrite.

Hole No. 9. 71' Hall's Lode

Fine grained silicified rock with occasional veinlets of carbonate and disseminated sulphides.

In thin section it is a mass of microcrystalline silica, and fine grained carbonate.

Polished section shows irregular grains and smaller masses of pyrite.

Hole No. 11. 92' Hall's Lode

Pyrite and chalcopyrite in silicified rock, showing banding.

In polished section the sulphides consist of pyrite and chalcopyrite.

In thin section the rock is a hetergeneous and non-uniform assemblage of minerals. In part it is a mosaic of quartz grains about 1 mm. across, with

numerous minute oriented inclusions, showing that the original material has been replaced with quartz. In places the quartz grains are of smaller size and chlorite and carbonates are present, together with needles and rosettes of wollastonite. Cassiterite occurs in anhedral cracked grains about .3 mm. across in association with other sulphides.

Hole 24. 94' Hall's Lode

Fine grained dark grey rock with dark, irregular, fine veinlets. The rock has a vitreous to pearly lustre on cleavage faces indicating the presence of fluorite.

In thin section the rock has a poikilitic texture with granular quartz, greenish-brown tourmaline, fine grained carbonate and acicular wollastonite in larger fluorite crystals, the sizes of which are indicated by the extensive cleavage faces. Tourmaline is in euhedral to subhedral crystals, sometimes zoned and strongly pleochroic from pale brown to deep yellow green. It is associated with fine grained carbonate and radiating needles of wollastonite. Rare sulphides occur in this complex and a little cassiterite is associated with them.

Hole No. 13. 65'-84' . Waterhole Lode

Chert - pale greenish grey rock with paler bands about $\frac{1}{8}$" thick.

In thin section the core consists of very fine grained quartz and structureless cloudy carbonate. A very fine grained, greenish, semi-opaque chloritic substance is present. Cassiterite occurs as fractured crystals down to .02 mm. grain size.

In polished section the core contains arsenopyrite, pyrrhotite and chalcopyrite. The arsenopyrite is evidently of replacement origin. Pyrrhotite is included in the arsenopyrite as an area with indefinite boundaries and has obviously been replaced. Chalcopyrite occurs on the peripheries of a much larger mass of arsenopyrite which exerts its crystalline form against the chalcopyrite.

Hole No. 13. 90' Waterhole Lode

Silicified rock with massive sulphides and fluorite.

In thin section the rock is a mosaic of anhedral quartz, with a little shapeless fine grained carbonate and much chlorite in irregular and radiating aggregates of small books averaging .1 mm. long. There is a little cassiterite associated with opaque sulphides.

In polished section the sulphides are mainly pyrrhotile with a little chalcopyrite and pyrite.

Hole No. 17. 100'

Fine grained dark grey rock with quartz, carbonate and disseminated sulphides.

In thin section the rock is a structureless mass of granular quartz and irregular plates of chlorite. The quartz grains vary from .2 mm across to the finest visible size and the chlorite plates are about .2 mm

average diameter. Sulphides are present in small irregular crystalline masses about .2 mm. across and there is a little fine carbonate.

In polished section the sulphides appear as pyrrhotite, pyrite and chalcopyrite.

Hole No. 13. 58'. Waterhole Lode

Chert with disseminated sulphides.

In thin section the rock consists of microcrystalline quartz with scattered patches of very fine grained semi-opaque carbonate. Sulphides are pyrite and chalcopyrite, with which is associated a little cphalerite. In some places the sulphides have a thin rim of cassiterite and are associated with cloudy carbonates. These islands of sulphides and carbonates are remnants of original rock which has been replaced by chert.

Hole No. 17. 113'

Fine grained dark grey rock with introduced quartz.

In thin section the rock consists of granular quartz, radiating chlorite and carbonate. The sulphides are rimmed with carbonate, which also penetrates deeply into sulphide aggregates. Cassiterite occurs in cracked grains up to .5 mm. across.

In polished section the sulphides pyrite and chalcopyrite.

Hole No. 4. 71' Battery Lode

Massive sulphides in fine grained silicified and carbonated rock.

In hand specimen the rock has a mottled appearance, but in thin section the texture is fairly uniform consisting of very fine grained siliceous matrix, with ragged plates of chlorite and irregular masses of fine grained chlorite. Irregular untwinned porphyroblasts of cordierite, crowded with inclusions and giving a rather ill-defined biaxial fugure, are common. Ragged reticulate masses of sulphide are plentiful with which are associated, irregular broken crystals of cassiterite.

The sulphides are pyrrhotite and minor chalcopyrite.

Hole No. 5 88' Battery Lode.

Fine grained grey banded rock.

In thin section the rock is structureless aggregate of granular quartz and very fine grained carbonate. The quartz grains are ragged and irregular and crowded with very fine acicular inclusions. The carbonate forms sub-radiating and shapeless masses, which are often so fine grained as to be semi-opaque. Cassiterite is difficult to distinguish, but there is a little associated with the sulphides.

In polished section pyrrhotite appears as small grains about .3 mm. across and as granular aggregates.

Hole 5 115' Battery Lode

Banded mineralised chert.

In thin section the rock consists of a very fine grained siliceous matrix with a good deal of bladed sericite. There are occasional larger grains of quartz and cordierite (about 1 mm. diameter) with numerous acicular inclusions, and irregular patches of carbonate. Cassiterite occurs as grains about .2 mm across wither free or attached to sulphide. Fluorite occurs in patches 1 - 3 mm. across.

In polished section the sulphide is pyrrhotite.

Hole No. 5 75'

Vughy sulphides in siliceous rock.

In thin section the rock consists of anhedral interlocking quartz grains about .5 mm. across, together with crystalline carbonate, cassiterite and sulphides. The quartz grains have acicular oriented inclusions, but the orientation does not remain constant for more than a small group of grains. Fluorite is prominent.

The chert from the Mount Cleveland Mine are pale grey, very fine grained, siliceous rocks, two specimens of which, viz. Battery lode hole No. 4, 93', and Henry's lode hole 14, 214' show undisturbed bedding in handspecimen.

In thin section the Battery lode specimen consists essentially of microcrystalline quartz and sericite, with sparse, small patches of carbonate, and occasional veinlets of quartz and carbonate.

The specimen from Henry's lode hole No. 14, 241' is a little coarser grained, with much fine grained disseminated sulphide. Carbonate is fairly plentiful in irregular masses, and the sulphide tends to be associated with it.

Specimen, Henry's lode hole No. 14, 103', does not show distinct bedding, but is plainly a brecciated rock with broken veinlets of carbonate and quartz. In thin section it consists of very fine grained quartz and sericite. There are numerous irregular, semi opaque, white, masses of carbonate.

Hall's lode hole No. 12, 106'. This specimen shows indistinct and somewhat contorted bedding. In thin section the rock consists of microcrystalline quartz and sericite with minute, disseminated masses of carbonate crystals.

Specimen, Hall's lode hole No. 11, 98', is a very fine grained, sheared rock with limenitic banding. In thin section it consists of microcrystalline quartz and oriented minute shreds of sericite. Carbonate is present in small semi opaque white masses, dissiminated through the section. These are veinlets and inclusions of secondary silica. Some veinlets have been sheared with the rest of the rock, others are post shearing.

Specimen, Battery lode, hole No. 3, 85', shows bedding and microfaulting to give an imbricate structure. In this section the rock is similar to the foregoing. It contains veinlets of quartz and of carbonate and these, for the most part, cut across the microfaults without being displaced, or follow along them. Therefore they have been formed subsequently.

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