



**PRELIMINARY REPORT ON THE SAM GOOSLY COPPER-SILVER DEPOSIT
(93L/1E)**

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INTRODUCTION

Sam Goosly copper-silver deposit, 56 kilometres by road southeast of Houston, contains 39.5 million tonnes of ore grading 86.5 ppm silver, 0.81 ppm gold, and 0.33 per cent copper (George, 1977). The ores occur within an inlier of steeply dipping Mesozoic pyroclastic and volcanoclastic sedimentary rocks. This inlier is flanked by flat-lying to shallow-dipping Tertiary andesites and basalts. Previous workers (Wojdak, 1974; Schroeter, 1976) have described two ore zones, the Main zone and the Southern Tail zone. During the summer of 1978, a detailed examination of about 4 875 metres of selected drill cores was carried out in an effort to better define the local volcanic stratigraphy and the relationship between the Main and Southern Tail zones.

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VOLCANIC STRATIGRAPHY

Mesozoic strata at Sam Goosly are thought to be right-side-up (Church, 1969; Ney, *et al.*, 1972, and Wojdak, 1974) describe three major units which, from bottom to top are:

- (I) A **clastic** sequence composed primarily of chert pebble and volcanic conglomerates, quartzites, plus minor tuffs and tuffaceous sediments.
- (II) A **pyroclastic** sequence containing lapilli, ash, and dust tuffs, plus local lenses of volcanic conglomerates and sandstones.
- (III) A **sedimentary/volcanic** sequence composed of volcanic conglomerates and sandstones, tuffs, and tuffaceous sediments, all generally well bedded.

Five subdivisions of the pyroclastic sequence (unit II) were defined. These are:

- (IIa) **Pyroclastic flow or flow breccia** unit with minor ash tuffs and local volcanoclastic lenses. This unit was observed only in drill holes 3, 7, and 29.
- (IIb) **Dust tuff** which is the main host for ore in the Southern Tail zone. This unit has rare bedding and is intensely fractured and/or brecciated where mineralized. Dust tuffs are developed best in the Southern Tail, but a tongue of dust tuff and dust tuff breccia can be traced into the Main zone and locally overlies IIa.
- (IIc) Dark grey to green **lapilli and ash tuff** unit with local lenses of dust tuff. This unit is well developed within the Main zone and overlies IIb or IIa if the dust tuff unit is absent.
- (IIId) **Volcanoclastic** unit composed dominantly of conglomerates containing chloritic clasts within a silicic matrix. This unit forms lenses of locally reworked material within IIa and IIc.
- (IIe) Pale-coloured **lapilli, ash, and dust tuff** unit. The presence of local layers of welded tuff and beds of light-coloured volcanic conglomerate with a tuffaceous matrix makes this unit distinct from IIc.

These five subdivisions, dacitic in composition (Church, 1969), are those described by Wojdak (1974), with the exception of unit IIb. Wojdak concluded that the breccia which contains much of the Main zone ore was a brecciated dacite and distinct from the dust tuffs of the Southern Tail zone. Examination of drill core which was not available to Wojdak indicates that breccia and dust tuff are stratigraphically continuous and therefore equivalent.

In addition to these general subdivisions, four stratigraphic marker beds have been identified (Fig. 36). These thin ash tuff markers define a sequence with strikes of 013 degrees to 018 degrees and dips of about 40 degrees to 45 degrees west throughout both the Main and Southern Tail zones. The most extensive marker has been traced more than 400 metres along strike, at least 150 metres down dip, and is known in 17 drill holes. All four markers are locally distinctive ash tuff beds from 1.5 to 6.1 metres thick.

The Mesozoic strata are flanked and unconformably overlain by gently dipping (<35 degrees) andesitic flows of the Ootsa Group and basaltic lavas of the Endako Group (Church, 1969).

INTRUSIVE ROCKS

Stocks

Two stock-like intrusions crosscut Mesozoic stratigraphy.

A quartz monzonite stock with sparse copper-molybdenum mineralization cuts Mesozoic strata (300 to 600 metres) west of the ore zones. Ney, *et al.* (1972) report tetrahedrite veins within the south end of this stock and a lens of silver-bearing sulphide in a shear zone along the axis of the stock. This stock has been dated by K/Ar methods at 56.2±3 Ma* (Church, 1969) and 61.1 Ma with no error limits given (Ney, *et al.*, 1972).

*Recalculated model ages using presently accepted decay constants are: quartz monzonite, 55.8±2.3 Ma; gabbro monzonite, 48.4±1.9 Ma.

A gabbro-monzonite complex intrudes Mesozoic strata just east of the Main zone. This stock is thought to be post-mineral and contains magnetite and traces of disseminated pyrite (Wojdak, 1974). K/Ar ages of 48.8 ± 3 Ma* (Church, 1969) and 52.5 Ma with no error limits given (Ney, *et al.*, 1972) have been reported.

Dykes

Dykes of several different compositions, both pre and post-mineral in age, have been identified at Sam Goosly. Pre-mineral diorite, andesite, and quartz latite dykes have been noted during the present study. For example, a pre-mineral diorite dyke (diamond-drill hole 19 at 59 to 63 metres) is cut by pyrite veins with quartz-sericite envelopes and by gypsum veins. Some andesite dykes, in both the Main and Southern Tail zones, are weakly veined with quartz, pyrite, and specular hematite. Some quartz latite dykes, found in the Southern Tail, contain veins of quartz, pyrite, specular hematite, and tetrahedrite; chalcopyrite, sphalerite, and galena have been identified in polished sections.

Post-mineral trachyandesite, andesite, and quartz latite dykes have been described by Wojdak (1974). Varieties intermediate in texture to trachyandesite and andesite have been noted and it is thought that these dykes are related to one another and to the gabbro-monzonite complex to the east (Church, 1969), and may be feeders to trachyandesitic flows of Goosly Lake volcanic rocks of the Ootsa Group.

MINERAL DEPOSITS

Ore minerals at Sam Goosly occur predominantly as veins and disseminations, with massive sulphides present as local patches within the Main zone. Main zone ores are fine grained, generally occurring as disseminations with a lesser abundance of veins. Southern Tail ores, on the other hand, are coarse grained and occur predominantly as veins with only local disseminated sulphides. The primary ore controls appear to be structural; sulphides are developed best in zones of intense fracturing and brecciation. The ores are generally restricted to a tabular fracture zone which roughly parallels stratigraphy. However, copper-silver sulphides occur throughout the stratigraphic column and sulphide veins up to 5 metres in length cross bedding in outcrop and up to 3 metres along drill core.

The most abundant sulphide is pyrite. Other major sulphides include chalcopyrite, tetrahedrite, pyrrhotite (observed macroscopically only in the Main zone), arsenopyrite, and sphalerite. Magnetite and specular hematite are also common. On the basis of macroscopic vein relations and limited mineralographic study, a consistent vein paragenesis has been observed in both the Main and Southern Tail zones, which from oldest (1) to youngest (6) is:†

1. Chlorite veins; quartz veins
2. Chlorite veins and quartz veins, each with pyrite and/or magnetite

*Recalculated model ages using presently accepted decay constants are: quartz monzonite, 55.8 ± 2.3 Ma; gabbro monzonite, 48.4 ± 1.9 Ma.

†Arsenopyrite, identified in both zones, fits between stages 2 and 4 in the paragenetic sequence but its relationship to stage 3 is uncertain.

3. Chlorite veins with pyrite and/or specular hematite (\pm chalcopyrite); quartz-pyrite veins with tourmaline or specular hematite (\pm chalcopyrite); calcite-pyrite veins
4. Copper sulphides \pm tourmaline
 - (a) Tetrahedrite (\pm later chalcopyrite), or
 - (b) Chalcopyrite (\pm later tetrahedrite) \pm pyrrhotite
5. Galena-bearing and sphalerite-bearing veins
6. Gypsum veins; calcite veins

This consistency of paragenesis suggests that the two ore zones are related genetically. Examination of drill core shows that sulphides occur continuously between the Main and Southern Tail zones.

An epigenetic origin for the Sam Goosly ores is indicated by: local sulphide rim textures in coarse fragments suggesting a replacement origin; abundant sulphide veins that cut both clasts and rock matrix; the consistency of macroscopic vein paragenesis; and the presence of mineralized dykes within the ore zones.

ALTERATION

No new field data have been identified that would change Wojdak's (1974) description of corundum, andalusite, and scorzalite alteration zones about the Main zone ores. However, examination of drill core not available to Wojdak has provided additional data on the Southern Tail assemblages.

Quartz-sericite alteration is developed best in the south-central portion of the Southern Tail zone (at 9100N, 12700E company grid, Fig. 36). In drill holes north, south, and east of this area, quartz-sericite alteration feathers out, forming thin irregular layers interspersed with zones of chloritic alteration. Insufficient data exist to the west to place limits on extent of alteration in this direction. Generally, the zone of most abundant quartz-sericite alteration appears to coincide with an area of very coarse-grained tetrahedrite and pyrite veining which occurs in intensely brecciated dust tuffs. This central zone is flanked by less intensely fractured rocks that seem to be roughly coincident with a zone of andalusite-pyrophyllite-chlorite alteration described by Wojdak (1974). A whole rock K/Ar age of 57.1 ± 2 Ma for the mineralizing event has been obtained on a sample of intense sericite-tourmaline alteration from diamond-drill hole 54 at 250 metres, representative of a large alteration zone about 600 metres northwest of the Main zone. The analysis was performed by the geochronology laboratory at the University of British Columbia.

DISCUSSION AND CONCLUSIONS

After deposition and lithification of the Mesozoic rocks that contain the Goosly orebodies, the strata were tilted into a west-facing homocline with an approximate attitude of 015 degrees dipping 45 degrees west. These rocks were subsequently intruded by the quartz monzonite stock to the west. The limited K/Ar data available suggest that mineralization was nearly contemporaneous with emplacement of the quartz monzonite. Features such as tetrahedrite veining and silver mineralization in shear zones within the quartz monzonite stock suggest that the Sam Goosly copper-silver ores are younger than or cogenetic with the quartz monzonite.

Prior to mineralization, an extensive fracture system developed subparallel to the strike and dip of the host rocks. The coarse-grained, vein-like nature of the ores in the Southern Tail zone and the lateral feathering out of associated quartz-sericite alteration indicate the existence of an ill-defined centre of mineralization. As ore-bearing fluids moved along the fracture system away from the centre, the sulphides became finer grained and the alteration intensity decreased, resulting in an andalusite-pyrophyllite halo. Andalusite alteration in the Main zone may be related to this halo or to another principal centre of mineralization.

A post-ore gabbro-monzonite complex intruded the Mesozoic rocks on the eastern side of the property. Contact metamorphism resulted in the formation of a biotite hornfels and local pyrite porphyroblasts (Wojdak, 1974). Pyrrhotite may also have formed during contact metamorphism (Ney, *et al.*, 1972). Another possible contact metamorphic effect is the dewatering and conversion of some pyrophyllite to andalusite plus quartz. This could account for the relative abundance of andalusite and lack of pyrophyllite within the Main zone described by Wojdak (1974). Pyrophyllite might be expected to the west of the Main zone beyond the effects of contact metamorphism as has been documented by Nielson (1969).

Slightly after or simultaneous with the gabbro-monzonite intrusion, the entire region was covered by a series of andesitic flows which are cogenetic with the gabbro-monzonite stock according to Church (1969).

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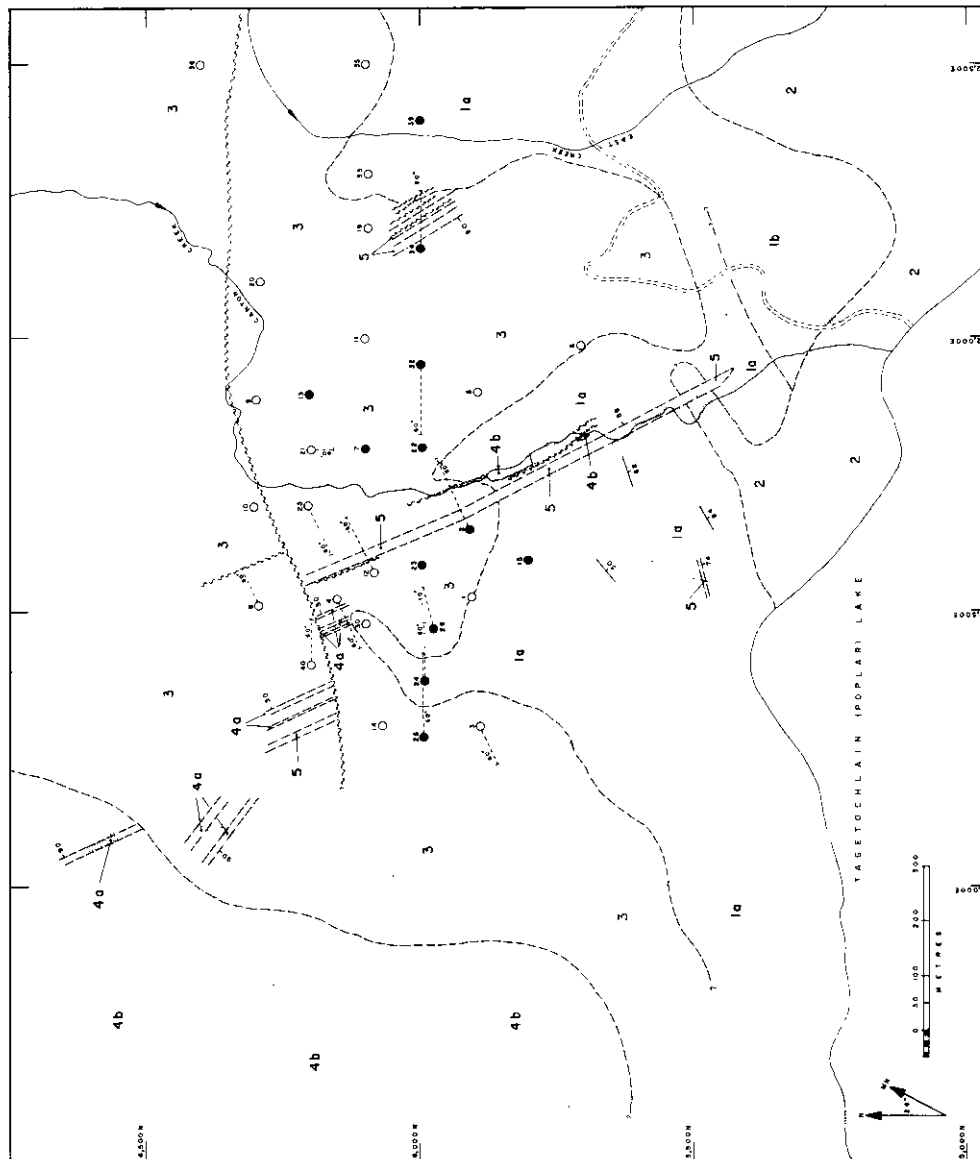


Figure 37. Geology of the Poplar porphyry copper-molybdenum deposit.