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PRELIMINARY RESULTS OF A FLUID INCLUSION STUDY OF SAM GOOSLY DEPOSIT EQUITY MINES LTD., HOUSTON

By K. Shen and A.J. Sinclair
Department of Geological Sciences
University of British Columbia

INTRODUCTION

Sam Goosly copper-silver deposit (MDI No. 093L/001) of Equity Mines Ltd. is 35 kilometres southeast of Houston. The deposit was put into production in 1980 with about 35 million tonnes of reserves grading 0.33 per cent copper, 87 grams silver per tonne, and small but significant amounts of gold and antimony. Recent studies (Wetherell, 1979; Wetherell, et al., 1979; Wodjak, 1974; and Ney, et al., 1972) have led to proposal of several genetic models. Our fluid inclusion work has been undertaken to obtain information concerning the ore-forming process as a means of establishing a genetic model for the deposit. Samples used in our study were obtained from a collection made originally by Wetherell (1979) representing all principal stages of the paragenetic sequence that he described. It also includes samples from all the principal centres of mineralization known on the property.

Four mineralized zones are located on the property. The Main and Southern Tail zones are the most important deposits; present production is entirely from the Southern Tail zone. The Tourmaline Breccia zone and a small porphyry-type copper-molybdenum zone in the quartz monzonite stock are of special interest because they may be genetically related to ore (Wetherell, 1979).

Sulphides in both ore zones consist mainly of pyrite, tetrahedrite and chalcopyrite with less abundant arsenopyrite, galena, sphalerite, pyrrhotite, and various sulphosalts. These minerals occur mostly as stockworks, veins, and disseminations. Locally they form massive zones. Dominant gangue minerals are quartz and sericite with lesser amounts of chlorite, tourmaline, corundum, andalusite, calcite, and pyrophyllite. The two ore zones are part of a single, larger mineralized zone that is apparently epigenetic and crosscuts stratigraphy.

METHOD OF STUDY

Twelve samples were selected for detailed fluid inclusion study, seven from the Southern Tail zone, one from the Main zone, two from the Tourmaline Breccia zone, one from a vein at the contact of the quartz monzonite stock, and one from the porphyry-type occurrence within the quartz monzonite stock. Doubly polished plates were prepared for each sample to locate fluid inclusions and several chips containing fluid inclusions were selected from each doubly polished plate for heating and freezing experiments. Filling and last melting temperatures were determined using a Chaixmeca stage. Temperature measurements were producible to about 0.1 degrees C with the freezing stage and to less than 5 degrees C with the heating stage. Inclusions in quartz were studied most commonly because of the ease with which they could be examined and the presence of quartz in most stages of the paragenetic sequence. Associated minerals and indications of any stages of deposition were noted. Several samples of sphalerite and calcite and one of vein andalusite were also examined.

RESULTS

Three types of inclusions are recognized based on phase relations at room temperature.

Type I: Two-phase inclusions consisting of liquid and a small gas bubble generally comprising 10 to 20 volume per cent of the inclusion.

Type II: Two-phase inclusions consisting of a large bubble and a condensed liquid. The bubble generally occupies more than 60 volume per cent of the inclusion.

Type III: Multi-phase inclusions consisting of liquid, a small bubble (about 15 volume per cent of the inclusion), and one or more (up to four) solid phases. Solid phases are most commonly halite although hematite has been identified and sylvite is suspected in some cases.

Primary inclusions are recognized in all paragenetic stages examined, largely by relations to crystal growth zones. In many cases, however, individual inclusions cannot be proved with certainty to be primary or secondary. Many inclusions are clearly secondary relative to their host mineral, although it seems likely that many of these may represent younger stages in the primary paragenetic sequence.

A histogram of filling temperatures is shown on Figure 1 where peaks correspond to specific stages in the paragenetic sequence. The filling temperatures are not corrected for pressure, but indicate a regular decrease in filling temperature (and therefore temperature of deposition) with increasingly young stages of mineralization. Most of the filling temperatures represented on Figure 2 are for quartz from various paragenetic stages. However, it is of interest to note that calcite is late in the paragenetic sequence and filling temperatures in it are all relatively low. Similarily, inclusions in pale sphalerite have relatively low filling temperatures, comparable to those in calcite, but with a more restricted range. A single inclusion from vein andalusite has a filling temperature of about 305 degrees C.

Freezing temperatures (Figure 2) indicate a wide range of salinities. In general, the lower temperature stages of mineralization have higher

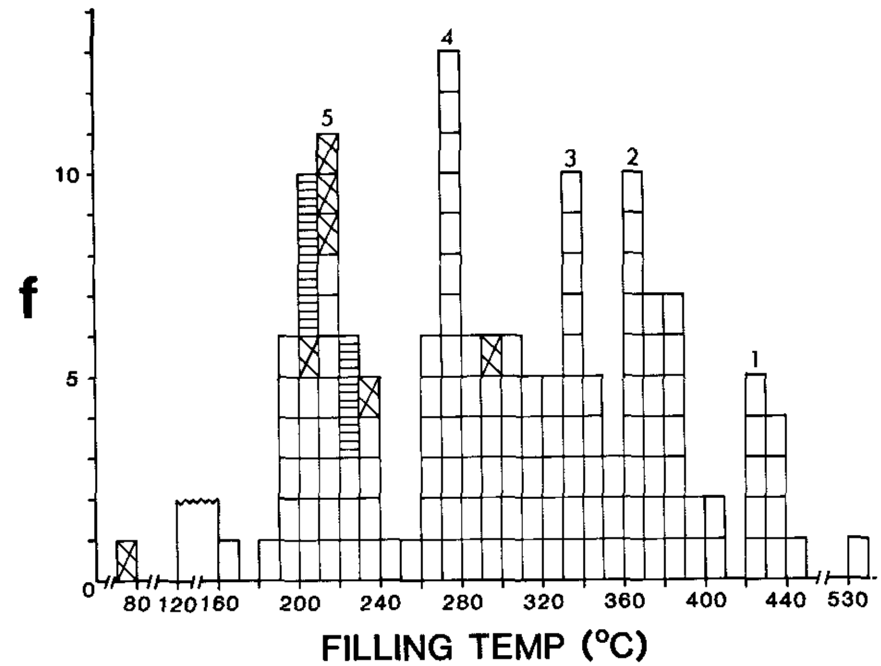

Figure 1. Filling temperatures for 147 inclusions, Sam Goosly deposit. Most are for quartz (blank); other symbols are defined on Figure 2. Numbered peaks related to specific mineral assemblages as follows: 1 - porphyry-type mineralization, 2 - Tourmaline Breccia zone, 3 to 5 - Main and Southern Tail zones.

melting temperatures and therefore lower salinities. Highest salinities are indicated for fluid inclusions from the porphyry-type occurrence for which halite crystals dissolved between 360 degrees C and 425 degrees C.

Intermediate salinities were obtained for fluid inclusions from the Tourmaline Breccia, and a range of low salinities is indicated for most of the stages of mineralization in the Main and Southern Tail zones.

DISCUSSION

The temperature of filling of primary inclusions decreased with time, as shown by the relationship with paragenetic sequence illustrated on Figure 2. In addition, there is a spatial component to variations in filling temperatures. Highest temperatures are for porphyry-type mineralization directly associated with a quartz monzonite stock. Somewhat lower filling temperatures relate to a Tourmaline Breccia zone north of the ore zones and a wide range of filling temperatures closely related to paragenetic sequence exists within the Main and Southern Tail zones.

These data are consistent with the model proposed by Wetherell (1979) in which the quartz monzonite stock just west of the principal ore zones provided the energy to drive a circulating geothermal system. Periodic fracturing during mineralization combined with a generally decreasing temperature regime led to a clearly defined paragenetic sequence of veining.

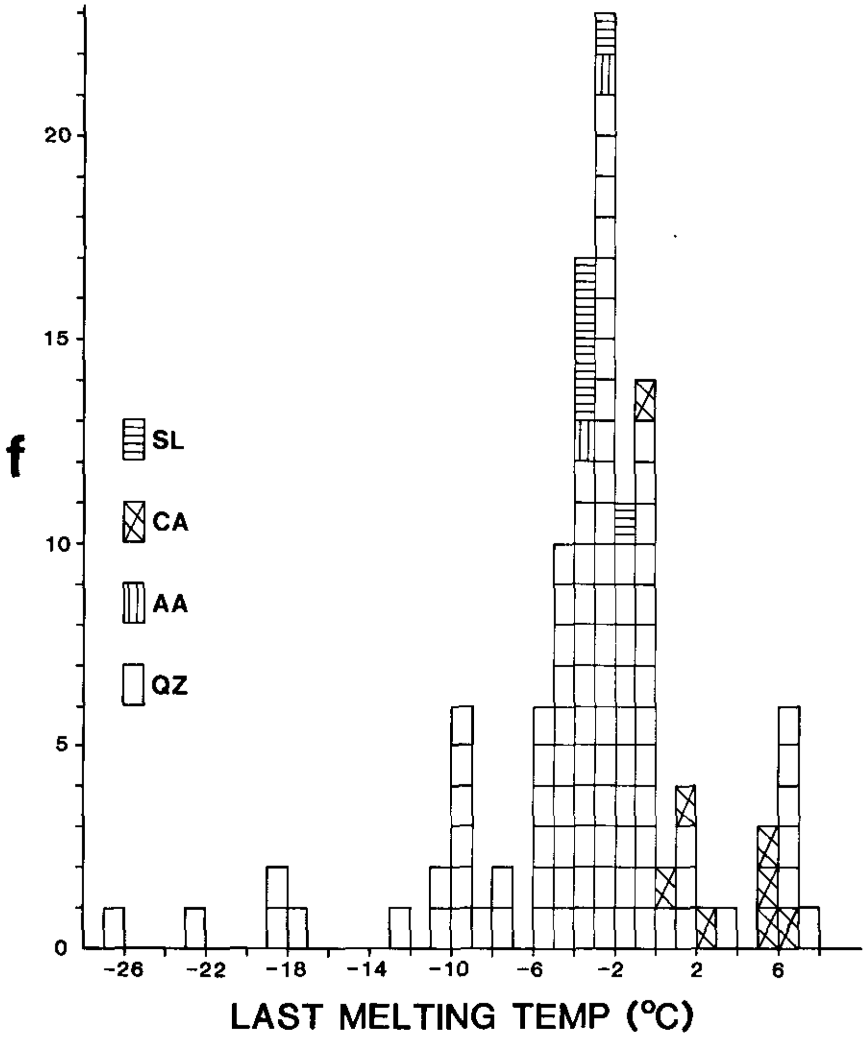

Figure 2. Freezing (last melting) temperatures for 115 fluid inclusions, Sam Goosly deposit.

Freezing data indicate high salinity for mineraliztion within the quartz monzonite stock, moderate salinity for mineralizing fluids of the Tourmaline Breccia zone and a range of lower salinities for the Main and Southern Tail zones. In the Wetherell model, the quartz monzonite is the centre of the mineralizing system. These salinity data indicate that high salinity fluids came from within the quartz monzonite stock, whereas a substantially more meteoric water component was involved elsewhere in the hydrothermal system.

CONCLUSIONS

A preliminary evaluation of fluid inclusion data for the Sam Goosly deposit suggests that all of the principal mineralized zones formed during a single episode of mineralization. The hydrothermal system was apparently centred on and driven by the quartz monzonite stock which lies just west of the two principal ore zones. Mineralization proceeded under conditions of gradually decreasing temperature and intermittent fracturing so a well-defined sequence of veining resulted. High salinity fluid inclusions that contain halite as a daughter product suggest that a very small proportion of the ore fluid had an igneous origin. Most of the ore fluid, however, was of relatively low cut variable salinity indicating that meteoric water was the dominant component in the hydrothermal system.

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