Structural Geology and Timing of Deformation at the Gibraltar Cu-Mo Porphyry Deposit: Controls on Mineralization, Cariboo Region, British Columbia

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The Gibraltar copper-molybdenum porphyry, near Williams Lake in south-central British Columbia, is hosted by the Late Triassic Granite Mountain batholith. The open pit mine is currently 25% owned by Cariboo Copper Corp. and 75% by Taseko Mines Ltd. Gibraltar has been in production from 1972 to 1998 and 2004 to present and has 802 million short tons of sulphide mineral reserves at 0.301% Cu and 0.008% Mo. The main ore zone, hosted within the mine series phase tonalite, has been structurally dismembered and the relationship between mineralization and deformation remains uncertain.

The objectives of this study are to (1) unravel the geometry and kinematics of deform-ation that have affected ore distribution, (2) place constraints on the timing of deformation, and (3) determine if batholith emplacement and mineralization were synkinematic with the earliest deformation structures, or if structural modification of the deposit occurred after emplacement and mineralization.

Deformation in the Gibraltar pits is complex because there are no true marker horizons; therefore, determining offsets and kinematics can be difficult. Hydrothermal alteration zones were assigned to distinguish different packages of rock and assist in structural mapping of various pits. Kinematics were ultimately verified through microstructural analysis, and aided by Leapfrog Geo® visualization tool.

A tectonic foliation tectonic (S_1), large ductile shear zones and smaller scale thrust faults (all dipping towards the southwest) are believed to all be part of a progressive deformation that occurred under the same stress regime. Discontinuous subhorizontal shear zones (DSSZ) that are common in all pits are not well understood, however, they are interpreted to be caused by instabilities arising from the flattening of foliation around large veins. North-striking oblique-slip faults contain foliated cataclasite that offset everything else and suggest formation in the upper levels of the crust. Shallowly southeast-plunging lineations, including intersections, fold axes and boudin necks, represent the last stage deformation: the cause of this late-stage flattening remains unresolved. The abundance of hydrous micaceous minerals in thrust faults, ductile shear zones and foliated cataclasites has facilitated higher grades of deformation in quartz through decreasing dislocation creep strength.

Ages for Ar-Ar (white mica) cooling ages of various structures at Gibraltar mine range from 54 to 38 Ma. We interpret these age results as follows: (1) north-striking oblique-slip faults are Eocene and related to the Fraser and Pinchi fault systems; (2) other structures may have (i) all formed in the Eocene, or (ii) S_1, thrust faults and DSSZ formed earlier than Eocene, but the Ar-Ar has been reset to Eocene ages. The range of Eocene ages obtained implies that resetting of Ar-Ar systematics have caused by episodic fluid flow, rather than by intrusive activity. Geometric and kinematic relationships of regional- and pit-scale faults suggest a possible right step-over strike-slip fault system with oblique-slip extensional bend.