Structural geology of the Mount Polley porphyry copper district: reconstruction of post-mineral fault displacement and tilting for the purpose of future exploration

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1. Introduction

The Mount Polley Cu-Au mine is located 56 km northeast of Williams Lake on the west side of Polley Lake, approximately 8 km southeast of Likely, BC. It is developed on multiple breccia-hosted, porphyry Cu-Au ore zones within monzonitic intrusions emplaced into the marine alkaline volcanic rocks of the Nicola Group (Logan et al., 2005).

The Mount Polley Igneous Complex is cut by steeply dipping faults, on which significant displacement is inferred from the geology. The structural block in the Southeast zone has a high temperature alteration assemblage and the highest Au:Cu ratio, implying relatively deep exposure. This is juxtaposed against the Northeast zone structural block, which comprises propylitic alteration and is stratigraphically nearest to a post-mineral unconformity, implying a relatively shallow level of exposure. Evidence of tilting is provided by a post-mineral conglomerate that unconformably overlies mineralized rocks and dips approximately 35° to the northwest. Collectively, the geologic data suggests significant post-mineral modification to the Mount Polley porphyry Cu-Au district.

2. Tectonic Setting

Mount Polley is located on the eastern margin of the Quesnel terrane, in the Intermontane Belt close to the tectonic boundary with the Omineca Belt (Logan et al., 2005) (Fig. 1). The Quesnel terrane is an island arc, fault bounded to the east by the pelagic Jurassic Coquihalla terrane and the oceanic Diablo Mountain terrane, and to the west by the oceanic Cache Creek terrane. Faunal evidence in the Cache Creek terrane suggests that the island arc formed in an eastward dipping subduction zone in the Paleozoic Ocean (Johnston and Borel, 2007), however it has also been suggested that the island arc formed allochthonous to the western margin of North America (Dostal et al., 2001). The formation of a westward subduction zone, consuming oceanic crust continuous with the North American continent, is thought to have occurred in the latest Triassic, approximately 205 Ma. The Nicola Group comprises a lower, continental volcanic sequence, and an upper, submarine volcanic sequence; the latter includes the Nicola Group (Logan et al., 2005).

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4. Preliminary Results

Unconformity and Tilting:

Examination of the contact between the Triassic monzonite and the Jurassic overlying conglomerate shows that it is an unconformity. There are abundant monzonite rip-up clasts in the conglomerate directly overlying the unconformity (Fig. 3), and the majority of clasts are angular to sub-angular. Stratigraphically higher the clast composition becomes more varied, containing pyroxene, feldspar, grained volcanics, and basalt clasts that are more distally sourced. Bedding is observed in drill core, and field measurements indicate a 207°/33 orientation (Fig. 3). Given that the Mount Polley Igneous Complex comprises numerous igneous bodies without foliation, the bedding is the sole constraint on tilting.

3. Research Objectives

Previous work at Mount Polley has focused on the brecciation, mineralization, and alteration style of the porphyry deposits, particularly in the Northeast zone. The structural geology of the deposit continues to be an enigma, which has strong implications for future exploration at the site. This project will look at the following problems:

(1) What is the nature of the contact between the overlying Jurassic conglomerate and the underlying Mount Polley Igneous Complex? Can the conglomerate provide a constraint on the timing of the deposit?

(2) What is the nature of the faults and deformation in the Northeast zone? Can these faults be used to understand the distribution of porphyry copper centers in the district?

(3) Are the augite porphyry dykes contemporaneous with the mineralization? Is there a preferential orientation in the dykes that relates to the strain orientation at the time of the porphyry intrusions?

These problems will be addressed by the means of fieldwork and mapping in the Northeast zone and Springer Pit, LIDAR analysis to locate additional outcrop exposure, and thermochronometry to help identify the location, and displacement, of fault blocks along the length of the deposit.

Dyke Orientation:

Summer field work will be spent mapping and measuring the exposed augite porphyry dykes in both the Northeast and Southeast, and in the actively mined Springer pit (Fig. 5). There are two models that could describe dyke emplacement during mineralization (1) the dykes emplace radially from the igneous intrusions, or (2) the dykes are planar and emplace in a conjugate orientation. Analysis of the dyke orientation may provide insight into the strain orientation at the time of dyke emplacement.

References Cited


