

Abstract ID: 157

Title: LOS PELAMBRES, CHILE: RECENT ADVANCES IN THE GEOLOGIC UNDERSTANDING OF A MAJOR CU-MO AND CU-AU PORPHYRY SYSTEM

Student: No

Topic: Economic Geology

Medium: Invited Oral Presentation

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Keywords: Miocene, potassic alteration, quartz diorite, zoning, Cu, Mo, Au

Abstract: Los Pelambres (3,300 million metric tons averaging 0.63% Cu; 0.016% Mo) evolved, between ~12.5 and 10.5 Ma, through several alteration-mineralization events associated with the emplacement of a kilometer-scale, composite quartz diorite stock and intermineral porphyry dikes into dominantly volcanic sequences of Late Paleozoic to Miocene age. Intrusion was accommodated by panels of high-angle reverse faults, some juxtaposing basement rocks over Miocene units. An on-going program of mapping, logging of historic core, and exploration drilling has revealed new aspects of the evolution of the system and discovered additional Cu-Mo and Cu-Au resources.

An early potassic alteration stage probably commenced soon after intrusion of the main quartz diorite stock. Earliest pulses were associated with emplacement of multiple centers of small (~200 m in diameter), vertically-zoned bodies of aplite, pegmatite, and hydrothermal breccia within quartz diorite, whereas later ones, invariably related to

intermineral dikes, extended into the volcanic country rock. Each center formed a bornite-rich core, and their coalescing halos produced a system-scale sulfide zoning from central bornite>chalcopyrite, through chalcopyrite, to external pyrite. Early veinlets of this stage (T4-type) are characterized by alteration halos of biotite, sericite, and andalusite with chalcopyrite and bornite. They are cut by conventional A- and B-type veinlets and related Cu-Mo mineralization. Cu-Au centers display similar veinlet styles which, in addition, possess appreciable hydrothermal magnetite. Younger porphyry dikes also show similar veinlet sequences, but introduced progressively lower Cu, Mo, and Au contents.

Later stages of alteration-mineralization were associated with transgressive, structurally-controlled veinlet panels, including (1) an early group of millimetric sulfidic veinlets with halos of muscovite, green sericite, chlorite, and minor biotite that introduced chalcopyrite and bornite in deeper parts of the system and pyrite at shallower levels; and (2) a late, crosscutting group of D-type veinlets with quartz-sericite halos, that contributed pyrite and Cu-As sulfosalts.

Thus, early establishment of a thermal regime characterized by a hot (and low sulfidation state) core zone, and a cooler (and higher sulfidation state) periphery, is apparent at Los Pelambres. This protracted event (~1.5-2.0 Ma), presumably sustained by the large size of the quartz diorite stock along with the continuous supply of intermineral magma, introduced the bulk of the Cu-Mo and Cu-Au mineralization in separate, although broadly simultaneous centers. The abundance of T4 veinlets within this stage, imply early input of a Cu-bearing fluid in disequilibrium with the quartz diorite. Later stages contributed progressively lower Cu, Mo, and Au, although elevated Cu, together with As, was again introduced by an end-stage, higher sulfidation state event.