EVOLUTION OF THE CHUQUICAMATA EOCENE-OLIGOCENE PORPHYRY COPPER SYSTEM, CHILE

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The Chuquicamata porphyry copper district in northern Chile represents a concentration of more than 11.4 billion tonnes of 0.76% Cu. A strong structural control of intrusion, mineralization, brecciation and dismemberment of the deposit has been exerted by the West Fault, the present expression of a long-lived trench-parallel shear (Domeyko Fault) system. The author has involved mine staff, graduate students, consultants and colleagues in the first comprehensive geological and geochronological study of this complex ore system, funded by Codelco. Emplacement of the Chuqui granodioritic porphyry complex was initiated in the Eocene (U/Pb zircon ages of ca. 39 Ma) followed by potassic alteration (K-feldspar, biotite), marginal propylitic alteration, and low-grade Cu mineralization. This event coincided with regional exhumation of the Domeyko Cordillera where the Palaeozoic crystalline basement yields cooling 40Ar/39Ar ages of ca. 300 Ma and apatite fission track ages of ca. 40 Ma. Active (dextral) shear controlled permeability since the early stages. The second mineralising stage formed discrete veins of quartz-molybdenite, which are older than the 40Ar/39Ar cooling age of potassic alteration minerals (ca. 34 Ma). After some exhumation, the main quartz-sericitic mineralising event developed, with high-grade Cu and As in the core of the deposit and against the bounding West Fault, peaking at ca. 31 Ma (Oligocene, 40Ar/39Ar on sericite). Most of the system cooled below 100oC by ca. 29 Ma (apatite fission track data). Supergene Cu (and Zn) enrichment and development of exotic Cu bodies occurred in the Miocene, still under the effects of active (now sinistral) faulting.