The Eocene Coroccohuayco and Tintaya Copper Porphyry-Skarn Deposits, Peru: 5 Ma of Favourable Tectono-Magmatic Evolution

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The Coroccohuayco and Tintaya porphyry-skarn Cu(-Au) deposits (>5 million tonnes of Cu) lie at the southern corner of the Eocene-Oligocene Andahuaylas-Yauri magmatic belt, southern Peru. The Eocene-Oligocene period is characterized by intense plutonism, by the deformation associated with the Incaic compressional event, and by the onset of the Bolivian orocline bending.

In the Tintaya district, diorite intrusion represents the main phase of the Andahuaylas-Yauri batholith. It is emplaced in deformed Cretaceous sediments, broadly following fold axis striking north-northwest–south-southeast (Fig. 1A). The diorite intrusion is followed by the emplacement of multiple stocks and dikes of monzonite porphyries and rhyodacite subvolcanics. These felsic rocks are commonly affected by hydrothermal alteration and may host porphyry type Cu(± Au) mineralization. Skarn alteration and mineralization are zoned around the monzonite porphyries and mainly developed in limestone of the Cretaceous Ferrobamba Formation.

The diorite has been dated by U-Pb laser ablation-inductively coupled-plasma-mass spectrometry (LA-ICP-MS) on zircon at 40.81 ± 0.18 Ma. High-precision chemical abrasion-isotope dilution-thermal ionization mass spectrometry (CA-ID-TIMS) dating of zircons from the felsic rocks showed the existence of two age clusters at 38 to 37 Ma and 35.6 Ma in each sample. We interpret the oldest cluster as the age of a protopluton construction at depth, of which no other evidence exists on surface. The youngest cluster is interpreted to date the emplacement of the felsic rocks. Time difference between the emplacement of successive monzonites at Coroccohuayco may be on the order of tens of k.y.

Geochemical data on the magmatic rocks suggest that the magmatic evolution toward high Sr/Y felsic rocks was due to hornblende and titanite fractionation. This assemblage is characteristic of deep and/or hydrous fractionation. Radiogenic isotope data further indicate that the diorite magma shows no clear sign of crustal assimilation, as opposed to the felsic rocks, which display increasing radiogenic signatures with time. It indicates that the magma increasingly interacted with the crust on its way to the surface.

At Coroccohuayco and Tintaya, felsic dikes strike northwest-southeast and northeast-southwest (Fig. 1A). Faults with the same orientations have also been recognized. Tectonic constraints at the time of monzonite emplacement are recorded by porphyry stage A and B veinlets. Three vein families can be recognized in stockwork developed in monzonite at Coroccohuayco (Figure 1B): N140°-striking veinlets showing dextral movement, N35-55°-striking veinlets, and veinlets oriented north-south. This arrangement is consistent with a dextral strike-slip fault system with simple shear characteristics and the development of synthetic shears, antithetic shears, and tensional fractures, respectively.

Structural data in the Tintaya district support the idea that the monzonite intrusions related to the mineralization were emplaced in synthetic and antithetic shears (dikes) and dilatational jog (stocks) developed during dextral NW-SE transtensional tectonics. These compressional conditions probably closed magma pathways to the surface and forced the magma to evolve at depth, thus becoming enriched in volatiles and metals prior to final emplacement in neoformed structures.

The data obtained during the present work suggest that the magmatic-hydrothermal system leading to the Tintaya mineralization took place in a period of compression from 38 to 35 Ma, during the Incaic compressional event.

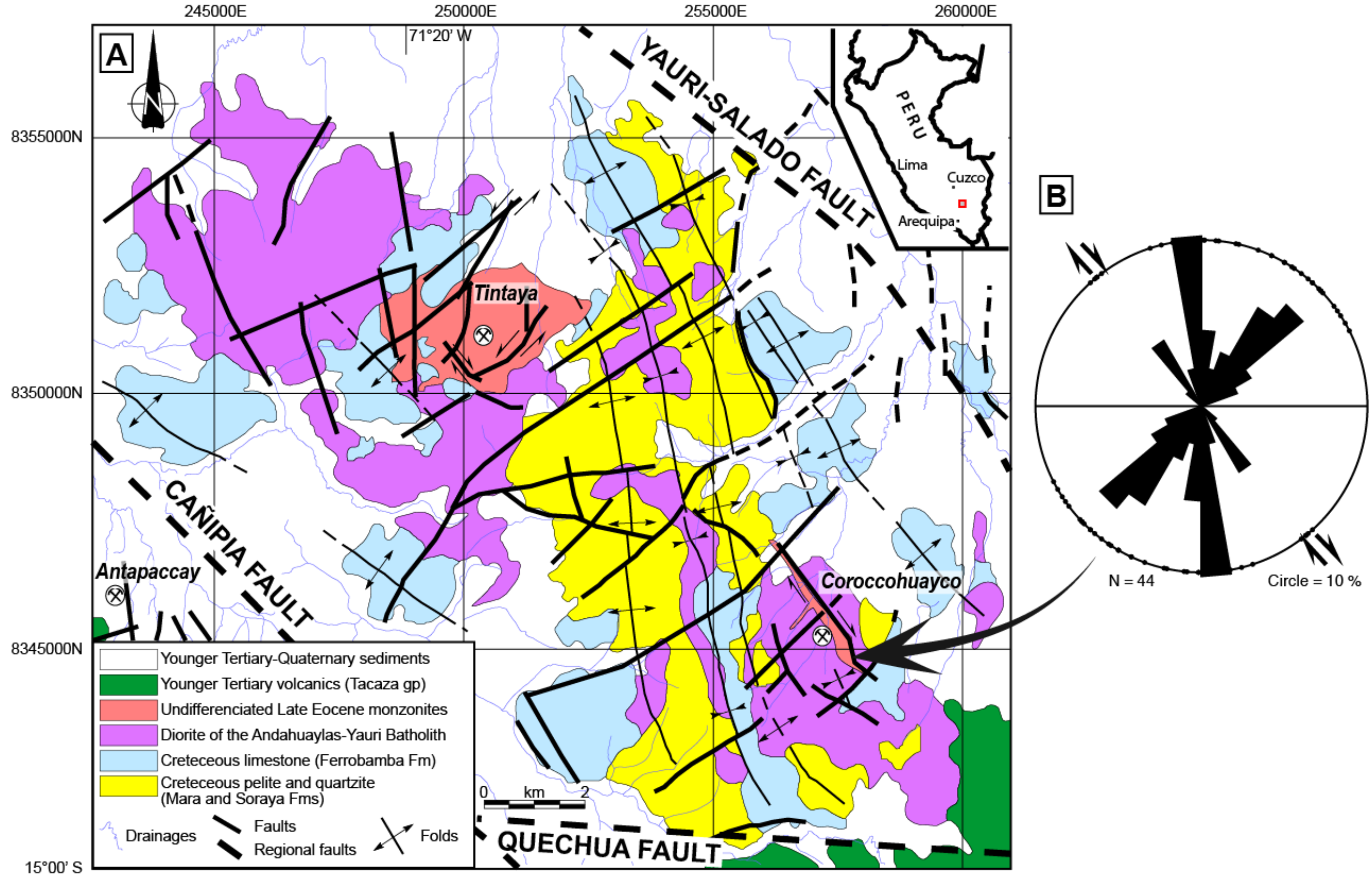

Fig. 1. (A) Geologic map of the Tintaya district and (B) rose diagram of hydrothermal porphyry A and B quartz veinlets at Coroccohuayco ("A" veinlets are sinuous but oriented at the meter scale).