IOCG-type deposits in north-central Chile: 
A case study and implications for exploration

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Introduction

IOCG-type deposits have been widely described for the Coastal Cordillera of northern Chile [1], where they appear to have a strong spatial and temporal relationship with the Atacama fault system [2, 3, 4, 5]. In contrast, only a few IOCG deposits have been reported and examined in detail south of La Serena, where there are a number of such occurrences [6, 7, 8]. This contribution presents and discusses the geology and structure of the Toro District, located east of the city of Illapel, in the internal domain of the Coastal Cordillera of this part of the Central Andes.

Geology

The Toro District emplaced within Early Cretaceous andesitic volcanic unit, interbedded with volcaniclastic rocks. This unit is part of the Cretaceous Quebrada Marquesa Fm., which, at the regional scale, is intruded by coeval/younger mid-Cretaceous plutonic rocks range from monzodiorite to tonalite, some of them magnetite-bearing [9]. Field mapping shows that the wallrocks strike NNW and dip shallowly to the east, exhibiting a minimum thickness of 350 m. The most important lithology corresponds to a 200 m-thick volcaniclastic breccia unit, which hosts most of the copper mineralization in the Toro area. Two regional, NS-striking, subparallel strike-slip faults flank the project area to the west and east respectively: the El Espino and Manquehua faults. These master faults are linked by a series of NW-striking, second-order, sinistral strike-slip faults making up a duplex structure that largely dominate the local structure (Fig. 1-a).

Mineralization and alteration

Copper oxide and sulphide mineralization and hydrothermal alteration are strongly spatially associated with the Las Lajas-Herminia fault-vein system (LHVS; Fig. 1-b); a
1.5 km-long by 0.2 km-wide structural mesh of NW-striking faults, fault-veins and hydrothermal breccia, located at a dilatational jog between two overstepping, NNW-striking, sinistral faults. Mineralization occurs as copper oxides, copper pitch/wad and limonite largely related with quartz and specularite; sulphide relics (chalcopyrite and minor pyrite, subordinate gold) are widely distributed at surface outcrops. Bornite has been locally recognized.

Main alteration paragenesis associated with mineralization breccias within the LHVS consists of strong, locally pervasive chlorite (±sericite±epidote±quartz). Quartz-sericite-clay associations occur marginally around the main mineralized breccia body, along with jarositic limonite suggesting shallow-level leaching. Surrounding the described mineralization and alteration there is a widespread epidote-chlorite-hematite (±albite±calcite) alteration all along the LHVS, fading away from it.

Chip sampling from mineralized and/or hydrothermally altered rocks of the Toro District consistently yields copper grades values over 0.1%, including numerous samples from apparently barren rock. About one third of the samples exhibit copper grades over 1% and as high as 5%; preferentially localized at both extremes of the target zone, as in Las Lajas and Herminia mines. These results, along with the field-supported structural model of a high-fluid-flow dilatational jog strongly suggest the possibility of having a sulphide-bearing mineralized breccia at depth (1-1.5% Cu). Significant gold contents, ranging from 0.1 to 0.7 g/ton have been found marginally around the main mineralized breccia body and along numerous peripheral veins and fault-veins.

Conclusions

Ore deposits at Toro District, consisting of veins-fault-veins, breccias bodies and widespread hydrothermal alteration zones are closely spatially and temporally associated with subvertical, NNW and NW-oriented second-and-third-order strike-slip faults that splay off regional NS-trending, sinistral master faults (Fig. 1). Mineralization was synkinematic with early to mid-Cretaceous (?) sinistral and sinistral-transtensional deformation. This tectono-magmatic setting is similar to that described for these type of deposits in the Coastal Cordillera of northern Chile and therefore has strong implications for exploration within a new Andean segment (e.g. IOCG: El Espino; Cu-Ag: Tres Valles).

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References


Figure 1: (a) Regional structural framework for the IOCG-type deposits along the Coastal Cordillera of north-central Chile south of La Serena. (b) Inset shows the LHVS within the Toro District, mineralized breccias bodies are represented in light green.