Mineralogy of the Chaparra IOCG deposit, southern Peru

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Introduction

The Chaparra Iron-oxide-copper-Gold (IOCG) type deposit is located in southern Peru, 150 km south to the giant Marcassa and Mina Justa IOCG deposits.

At present, it is mined for gold by small-scale miners. In spite of its economic importance, this deposit has not been reported until now. Here we present a preliminary Mineralogic and geochemical study of this deposit.

Geologica setting

The Chaparra deposit is hosted in magmatic rocks of the Arquean segment, in the Coastal Batholith. Host rocks belong to the Llaja Super-unit, of Upper Cretaceous age and are mainly constituted by monzonites, monzogabbros and diorites. In the area, in contact with the Llaja Super-unit also are present the belas Union Complex, and the Tupico Super-unit, also of Upper Cretaceous age (map).

Mineralisation occurs in quartz veins of less than 1m thick. There is a structural control of the mineralisation. Veins are filling fault systems, the main direction is NW-SW and veins dip 70-85°.

Major alterations are the propylitic (chlorite-actite-quartz), advanced argillic (jarosite-rutile-jarosite) and sericitic (muscovite-sericite-quartz). Gypsum and other alteration minerals such as potassium feldspar and phlogopitic, vermiculite and nustrolite are widespread.

Mineralogy

The ore minerals were studied by reflective optical microscopy and scanning electron microscopy. The mineral chemistry was established with a Cameca Electron Microprobe from the Service Centro de Geociencias of the University of Barcelona.

Quartz most abundant is the gangue mineral. Mineralization mostly consists of iron oxides, mainly magnetite and goethite, with minor amounts of magnetite. Sulfides are Cu, Fe-rich (pyrite, chalcopyrite and covellite, mainly). Gold is abundant, usually it has few microns in size but sometimes it can be observed at naked eyes (see image). Rare earth minerals, as monazite, and uraninite are also common.

Paragenetic sequence

A paragenetic sequence of the mineralization from the Chaparra deposit can be divided into three stages: (I) primary mineralization, (II) fracturing and filling, and (III) supergene alteration.

The sequence begins with the formation of quartz, magnetite, pyrite and pyrrhotite. Subsequently gold crystallization starts and Bismuth, while still forming the above minerals.. Uraninite also is included in the pyrite and quartz, while monazite only appears as crystals dispersed in quartz. Other sulfides as chalcopyrite, galena, sphalerite and arsenopyrite also precipitate, either included in the pyrite or outside. Next, the polycrystalline matrix of tetrahedrite and covellite is formed by recrystallization of Fe-Cu sulphides. Other sulphides, rich in Cu or Pb are generated within pyrite.

In the stage of fracture filling, these are filled by a second generation of tetrahedrite, tananite, annite, galvanite, Heyrovskyite, Lindströmite, native bismuth and uraninite.

Finally, supergene sulphates are formed by alteration of jarosite, and gypsum. Iodargite and scorodite also are common as the last products.

Mineral chemistry

Gold

The chemical composition of gold is quite uniform. Microprobe analyses show a range in silver content from 3.3 to 13.9 wt%, and As 72.0 to 94.74 wt%. Only one grain is electron (with 20.3 wt% Ag). Trace elements are 0-0.34 wt% Sr, 0.04-0.18 wt% Cu and 0-0.33 wt% Bi. Silver

Silver occurs as native silver and inaguid, argentite and freibergite.

Bi-rich sulphosalts

A high variety of Bi-rich minerals occur in this deposit. Bi occurs as native bismuth or as sulphosalts. Bi content can be up to 54.5 wt% in Bi-rich sulphosalts Mi-3[CoCuBi2O4]26 wt%, and Ag (up to 5.23% Ag), As (up to 27% As) or Fe (up to 26% Fe), some of the phases, in addition to bismuthinite, are argentiferous, lindströmite Pb,Sb,CuS,S, and Heyrovskyite Pb,Sb,CuS, Yeovinite (Bi,FesO3),TeO3, SbO6, 9H2O.

Sb-sulphides

Sakurite occurs in normal crystals. Its composition is Cu to 0.51 wt% In.

Whole-rock chemistry

Representative samples of the mineralization from the veins that are actually being exploited were analysed in the ACTLABS, Canada. Aqua regia-ICP to determine Au, Ag, Cd, Cu, Co, Mo, Pb and Zn. As and Sb were analysed by instrumental Neutron Activation (INAA).

Gold content in the veins is high; often it is >30 g.t. In addition in some veins Cu can reach up to 0.6 g.t. Silver contents always are lower, less than 3 g.t. Other metals, as Pb and Zn are always in small amounts.

Conclusions

The Chaparra ore deposit shows typical IOCG type characteristics. Mineralization is mainly constituted of hematite and minor magnetite. These oxides are accompanied by quartz and minor amounts of Fe-Cu sulphides. Native gold content is important, usually more than 26 g.t.

A wide variety of sulphosalts are abundant associated with covellite occur filling later fractures. Another characteristic of the IOCG deposits, and which is located at the site of Chaparra, is the presence of RREE minerals as monazite, and uraninite. Native bismuth and silver also occur. Silver also is as argentinite (Ag).

Sakurite, with more than 64 wt% As, also occurs in this deposit.

The high gold content make this deposit of economic interest. The high Ag and In contents in some minerals suggest that more detailed studies should be carried out to determine its possible economic value.

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