

# History

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## Conference

### The Marcona Iron Oxide-Copper Deposits, Peru

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Located approximately 400 km south of Lima, Marcona is the largest known iron deposit in the Pacific coastal belt of South America. Iron mining commenced at Marcona in 1953, and the mine is operated today by Shougang Hierro Peru. Estimated iron resources include 1400 Mt at Marcona and 1000 Mt at the nearby Pampa de Pongo prospect. Small-scale copper mining probably commenced several kilometres northeast of the Marcona iron mines near the present Mina Justa prospect in the late 1800s and informal mining continued sporadically to the early 1990s. In 1994, Rio Tinto commenced exploration in Peru for iron oxide-associated copper-gold and the same year discovered the Pampa de Pongo deposit. In December 2000, Rio Tinto formed a JV Agreement with Shougang Hierro Peru to explore for copper in the Marcona district and, in 2003, reported discovery of significant oxide and sulphide copper resources close to the Marcona mine. Most of the iron deposits in the district contain some copper, gold and silver.

The main rock units that host the magnetite and copper mineralization in the Marcona district are the Marcona and Rio Grande Formations. The Marcona Formation is dated as early Palaeozoic and must pre-date the ~420 Ma San Nicolas batholith that intrudes it along the western side of the district. The Rio Grande Formation is assigned to the mid- to Late Jurassic based on fossil content and limited radiometric dating. Minor iron bodies locally cut basement gneiss assigned to the Precambrian Lomas Formation. The nearby Pampa de Pongo iron (copper-gold) prospect is within the stratigraphically higher Jahuay Formation and is considered as a separate mineralized system to Marcona.

Phlogopite and sericite alteration associated with iron-copper mineralisation has been dated previously at ~155-160 Ma. Dolomite and limestone units in the Marcona and Rio Grande Formations are the principal host rocks for the magnetite deposits, whereas andesitic volcanoclastic rocks and an andesite porphyry sill in the Rio Grande Formation contain the newly discovered copper deposit at Mina Justa.

Previous studies in the district defined three main fault sets: the west-northwest-striking, 65°N-dipping Pista system; the northwest-striking, subvertical to 65°SE-dipping Huaca system; and the northeast-striking, 40-60°SE-dipping Repetition system. The Huaca Faults are considered part of the major Treinta Libras fault zone. Interplay of the Huaca and Repetition faults may have controlled mineralization. A shallowly southeast- to flat-dipping listric fault/fracture zone controls copper mineralization at Mina Justa and is probably part of the Repetition fault set.

The only plutonic complex in or near the Marcona district is the San Nicolas Batholith, which clearly has no genetic relationship to the copper-iron mineralisation because of its early Palaeozoic age. Other observed intrusions include several generations of dykes and sills, in particular the late- to post-mineral andesite (ocoitite) porphyry dyke swarm that is mostly controlled by the Huaca fault system. Minor dacite porphyry dykes containing quartz eyes are present at the Mina Justa deposit. 'Dacite' is also mapped near and within the main magnetite mines. However, recent observations suggest that some of the mine 'dacite' is highly altered equigranular diorite. The diorite and dacite are interpreted as pre- or syn-mineral intrusions based on the presence of strong pervasive albite and K-feldspar alteration, irregular veinlets and patches of actinolite and magnetite, up to 5 volume % disseminated pyrite and trace amounts of chalcocopyrite and molybdenite. A deep intrusive body is, therefore, interpreted as providing a source for the high-level intrusions, pervasive biotite hornfelsing of the Marcona Formation, widespread iron, calcium, sodium and potassium metasomatism, including magnetite-specularite, epidote-tremolite-actinolite, albite and orthoclase, and the copper-iron mineralization.

Reconnaissance observations in the Marcona Mine suggest mineralization in the largest iron bodies is associated with northwest-dipping mantos, in which breccia textures are common. The breccia matrices comprise mostly magnetite, amphibole, sulphides and chlorite-phlogopite-biotite. Sulphide minerals include pyrite, chalcocopyrite, pyrrhotite and lesser bornite, chalcocite, sphalerite, galena and minor carrollite. Pentlandite, mackinawite, molybdenite and gold have also been reported in lesser amounts.

The most significant copper deposit in the district is at Mina Justa, where the listric fault zone and its steep hanging-wall splays control patches, veinlets and breccia fillings of copper sulphides together with variable amounts of magnetite and actinolite. The sulphide assemblages are concentrically zoned outwards from bornite-chalcocite in the core through chalcocopyrite-bornite, chalcocopyrite>pyrite and pyrite>chalcocopyrite to peripheral pyrite. Coarse-grained diopside, actinolite and apatite occur in close proximity to the better copper values. Magnetite, in the form of mushketovite, is also observed replacing specularite at Mina Justa. Elsewhere in the district, copper concentrations are present in some of the magnetite replacement mantos, less commonly bordering the mantos and commonly in proximity to the Huaca faults. Supergene oxidation occurs locally to depths of >200 m, resulting in some locally minor copper depletion in the oxide zone and restricted copper enrichment immediately beneath the sulphide-oxide interface.