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The Patricia ore deposit: An economic Zn-Pb-Ag polymetallic sulfide mineralization in northeastern Chile

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The Patricia ore deposit represents a singular example of an economic Zn-Pb-Ag polymetallic sulfide mineralization located at the northernmost end of the Late Eocene-Oligocene metallogenic belt in Chile. The orebodies consist of subvertical E-W veins embedded by late Cretaceous volcano-sedimentary rocks, mostly andesitic breccias and tuffs. The deposit is divided into two blocks, eastern and western, by a set of NNW-ESE-trending reverse faults, which uplifted the eastern block exhuming thicker and deeper parts of the deposit. On the contrary, the western block exposes a shallower part of the mineralized system including cherts, amorphous silica and jasperoids. Three main stages of mineralization have been defined: (1) pre-ore stage, characterized by early quartz, pyrite and arsenopyrite, (2) base-metal and silver stage, characterized by Fe-rich sphalerite, galena, chalcopyrite and Ag-bearing minerals (freibergite, polybasite, stephanite, pyrargyrite, freieslebenite and acanthite), and (3) post-ore stage, characterized by late quartz, kutnohorite and minor sulfides. The hydrothermal alteration associated with the circulation of the mineralizing fluids is characterized by sericitic alteration which overlaps to the regional propylitic alteration. Fluid inclusions in sphalerite and quartz indicate that the base-metal sulfide ores were deposited from fluids at temperatures ranging from 280 to 170º C under moderate salinity conditions (1-9 wt % NaCl). The evidence of temperature, salinity and the absence of boiling point to the progressive cooling of the fluids as the most probable mechanism of mineral precipitation. Mineralogical, geochemical and fluid inclusion evidence suggest that the Patricia mineralization is a polymetallic epithermal deposit developed under intermediate sulfidation conditions, although the first and third stages were close to the limit with the low sulfidation field. Based on structural criteria (for example, vein orientations, presence of strike-slip faults and sigmoidal structures), the mineralized veins of Patricia seem to be the result of the progressive deformation of a block formed between two sinistral strike-slip faults with WNW-ESE orientations. This block probably could be part of a pull-apart structure on a larger scale and it could be genetically related to the Domeyko fault system.

From an exploration point of view, this study has highlighted that the western block of Patricia has potential to host at depth extensive mineralized bodies of sphalerite and galena similar to those appearing in the eastern block. In addition, our results also point to the extension of the mineralization both toward the south and to deeper levels in the eastern block of the deposit. Finally, their mineralogical and structure similarity with some polymetallic deposit in Peru and Bolivia may indicate the existence of a transition area between the typically Chilean metallogeny to the Bolivarian and/or Peruvian type