Composition, origin and time evolution of ore-forming fluids and trace element geochemistry of enargite in the Lepanto epithermal high-sulfidation deposit (Philippines).

Oliveras, M.¹, Kouzmanov, K.¹, Schlöglová, K.² & De los Santos, M.³

¹ Department of Earth Sciences, University of Geneva, rue de Maraîchers 13, 1205 Geneva, Switzerland
² Institute of Geochemistry and Petrology, ETH Zürich, Clausiusstrasse 25, 8092 Zürich, Switzerland
³ Lepanto Consolidated Mining Company, Manila, Philippines

The Lepanto-Far Southeast (FSE)-Victoria cluster in the Mankayan district, Philippines, offers an excellent opportunity to study fluid processes at the porphyry-epithermal interface (Tejada, 1989; Hedenquist et al. 1998). The district is centered on the FSE porphyry system and the Lepanto high-sulfidation epithermal ore body is developed outwards in NW direction. In the present study the Lepanto ore body has been subdivided into three main areas according to their distance from the FSE porphyry center – proximal, intermediate and distal.

The combination of near-infrared (NIR) microscopy and microthermometry with LA-ICP-MS analysis of enargite-hosted fluid inclusions (Kouzmanov et al. 2010) allowed studying composition, metal content, and P-T parameters of real ore-precipitating fluids at Lepanto. Such information is unique and can be used for a better understanding of ore precipitation mechanisms in the shallow epithermal environment. In addition, a detailed mineral geochemistry study of enargite from the three areas of the ore body has been performed in order to investigate the trace element pattern of the mineral as a function of distance to the supposed porphyry center.

Fluid inclusion microthermometry of enargite- and quartz-hosted fluid inclusions revealed a trend of decreasing temperature of formation from the proximal area (250°C) towards the distal areas of the deposit (125°C) and a slightly oscillating salinity of the mineralizing fluids (3.3 wt. % NaCl eq. on average for enargite-hosted and 0.88 wt. % NaCl eq. for quartz-hosted fluid inclusion assemblages), with no clear dilution pattern over the 2 km distance, as previously reported (Mancano and Campbell, 1995). Salinities measured for enargite-hosted fluid inclusions show a much wider range of values than previously reported for the deposit, with a maximum of 6 wt. % NaCl eq.

LA-ICP-MS analyses of enargite- and quartz-hosted fluid inclusions from the Lepanto ore body reveal high metal contents, especially in Pb, Zn, Ag, Bi and Au. Lead and zinc appear in anomalously high concentrations in fluid inclusions from the distal parts of the deposit and decrease towards the FSE porphyry center.
A combined NIR microscopy, electron microprobe and LA-ICP-MS study of enargite crystals from various parts of the ore body revealed a common oscillatory and/or complex sector zoning of the mineral. Systematic study of trace-element signatures of enargite along different sectors indicates a preferential incorporation of some trace elements in one specific sector with concentrations varying within several orders of magnitude. Therefore the potential of enargite trace element chemistry as a vectoring tool for porphyry-style mineralization (Deyell and Hedenquist, 2011) needs to be carefully reevaluated taking in account the complex internal growth features of the mineral.

REFERENCES