Origin of saline fluids in epithermal base metal deposits

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Certain epithermal base metal deposits have fluid inclusion salinities as high as 22 wt% NaCl equiv. [1]. Typical intermediate density fluids exolving directly from a magma have salinities between 3 and 8 wt% NaCl equiv. Fluid salinities above this values are generally explained by boiling and/or mixing with basinal brines. However, in some epithermal base metal deposits, neither boiling nor mixing with basinal brines could be evidenced [1]. Other studies [2, 3] suggest deep mixing of magmatic brines with meteoric water to explain the rise and recording of these “high salinity” fluids in the epithermal environment.

Based on fluid inclusion analyses from the early mineralizing stages at Cerro de Pasco, central Peru, we propose another mechanism to explain such “high salinity” fluids in the shallow epithermal environment. Early mineralization is characterised by an early stage of pyrrhotite-dominated pipes that grade outwards into massive Fe-rich sphalerite and galena rims. During a subsequent mineralizing event, a massive pyrite-quartz body was emplaced followed by a new stage of polymetallic mineralization.

In the present work, primary and pseudo-secondary fluid inclusion assemblages (FIAs) in quartz and Fe-rich sphalerite from the first stage and in quartz from the second one, have been studied. No evidence of boiling has been observed. FIAs show a progressive salinity decrease with time from 16.2 to 2.7 wt% NaCl equiv. at relatively constant homogenization temperature (280-220°C). Oxygen isotope analyses in quartz from the pyrite-quartz body revealed a strong magmatic signature of the fluids [4]. The results are compatible with mixing between two magmatic fluids, a brine previously exsolved from the magma and stored at depth, and a low-salinity one (~3 wt% NaCl equiv.), exsolving directly from a new magma batch. This mechanism, can explain the rise of fluids derived from magmatic brines, known to be rich in base metals and therefore explaining the high Zn-Pb-(Ag) grades of such deposits, whithout invoking mixing with meteoric fluids at considerable depth.

[1] Albinson *et al* (2001) *Econ. Geol.* **SP8**, 1-32. [2] Simmons (1991) *Econ. Geol.* **86**, 1579-1601. [3] Bendezu (2007), *Terre & environnmenent*, **66**, 167p. [4] Baumgartner *et al* (2008) *Econ. Geol.* **103**, 493-537.