Fluid origin of the Ixtacamaxtitlán kaolin and sinter deposit, Puebla State, Mexico

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The Ixtacamaxtitlán municipality is located north of the Puebla State in Central Mexico. The local geology comprises (1) Lower to Middle Cretaceous limestone formations of the Sierra Madre Oriental, and (2) igneous intrusive and extrusive rocks of Tertiary to recent age, of the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt (TMVB). The ore deposits of the area are hosted by pyroclastic deposits and the plutonic to sub-volcanic rocks that intruded them.

The Ixtacamaxtitlán hydrothermal deposit is made up by a succession, from bottom to top, of: (1) a porphyritic subvolcanic body crosscut by quartz veins and a stockwork with subordinate sulphides (pyrite and chalcopirite) showing propylitic alteration haloes and a former potassic alteration event (biotitization) preserved; (2) an overlying, kaolinitized rhyolitic tuff; and (3) a layered opal deposit with preserved sedimentary structures. This vertical arrangement, coupled with the distribution of the alteration assemblages, lead us to the interpretation of the whole as a porphyry copper-type deposit grading upwards to a barren, low-sulfidation epithermal system, with a partially preserved silica sinter on top.

Both the fluid inclusion study carried on the veins and the stockwork and the stable isotopic analyses of the kaolinitized bodies suggest the presence of two major hydrothermal events. An early event, characterized by hot, hypersaline fluids (up to 280ºC and 36 wt% NaCl eq.) likely of magmatic origin, closely associated with the emplacement of the underlying porphyry copper-type deposit. Their primary fluid inclusions recrystallized, showing hook-shaped morphologies, indicative of a decompression path probably due to the uplifting of the whole prior to the emplacement of the subsequent shallow hydrothermal system. This late event is characterized by the presence of cooler and dilute fluids (up to 150ºC and 4 wt% NaCl eq.) associated with propylitic and quartz-sericite alterations at depth, and acid-sulfate alteration close to the paleosurface. The calculated isotopic composition of water in equilibrium with the kaolinitic sequence, plot close and underneath to the meteoric water line, partially overlapping the Los Humeros geothermal fluids. These evidences coupled with the petrographic observations suggest that steam-heated phreatic waters altered the rhyolitic tuffs. This would have occurred when acid vapors exsolved from deeper hydrothermal fluids by boiling reached the local paleowater table and condensed.

Investigations on the behaviour of Re on the site of Maqarin (Jordan)

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Aim of the investigation

The site of Maqarin (Jordan), in which natural cements occur as a result of the combustion metamorphism of a biomicrite, is studied as a natural analogue for the long term evolution of a cementitious repository environment. The behaviour of Re, used as a chemical analogue for Tc, in this environment where hyperalkaline groundwater plumes develop due to cement alteration by infiltrating waters, has been explored by combining groundwater and rock analyses.

Results

Solid bulk analyses suggest that the combustion phenomenon led to a redistribution of Re (~0.15 ppm in the intact biomicrite, up to ~1.2 ppm in unaltered cement samples). Analytical techniques used in this study (SEM-EDX, PIXE, SIMS, ICP-MS LA) suggest that Re in the unaltered cement is located in submicronic Ca-Fe-S phases. Re is leached from the cements and marl by groundwaters and is found in a concentration range from 0.5 ppb to 10 ppb in water samples. Although Re and Mo show partially correlated concentrations in the waters (Fig. 1), they are spatially anticorrelated in the unaltered cement.

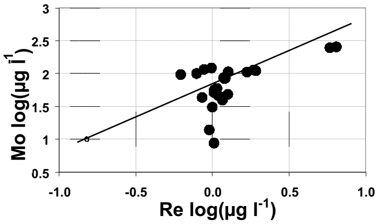

Figure 1: Re-Mo correlation in groundwaters. (solid line : Re-Mo stoichiometry in the biomicrite)

Conclusions and future plans

Results presented here suggest that redox processes are active in the mobilisation and transfer of Re at present conditions of leaching in the Maqarin site. Thermodynamic computations are in progress to identify possible controls on Re migration.

References

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