

3.6.P16**Experimental study of silica polymerization**

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In natural surface- and geothermal waters, dissolved silica occurs primarily as monomeric silica. When aqueous monomeric silica concentration exceeds that of amorphous silica solubility, the monomeric silica reacts to form polymeric silica. The rate of polymeric silica formation depends on the pH of the water, its ionic strength, temperature and the degree of over-saturation with respect to amorphous silica. In this contribution we studied experimentally silica polymerization rates at 80°C as a function of pH (2-10) and ionic strength (0.01-1.0) for varying degree of over-saturation with respect to amorphous silica. The formation of silica polymers was quantified by measuring molybdate active silica. Only monomeric silica reacts with the molybdate. Silica dimers and trimers may also contribute to molybdate active silica, if they break down to monomers during analysis, but this is not considered significant. The difference between molybdate active silica and total silica, as measured spectrophotometrically and with ICP-AES, was considered to be polymeric silica.

In the pH range 2-10, at initial monomeric silica concentration of 800 mg/kg, the silica polymerization rates increase with rising pH up to about 9, as measured at 25°C but at higher pH-values the polymerization rate decreases. Above pH 9, the ionized monomeric silica species becomes important, thus reducing amorphous silica over-saturation. Increased ionic strength increases the rate of polymerization. At the end of each experiment the concentration of monomeric silica was close to the solubility of amorphous silica.

Heating a solution containing silica polymers causes them to break down. This happens even if monomeric silica concentration is above amorphous silica saturation at the temperature of the experiment. The decrease in monomeric silica concentration in amorphous silica over-saturated solution is therefore considered to be controlled by the solubility of the silica polymers. Their constant growth during the experiments reduces their solubility as the surface energy becomes less important and the concentration of monomeric silica becomes stable when the polymers are so big that their surface energy does not contribute significantly to their solubility. It becomes the same as that of amorphous silica.

Knowledge of the rate of silica polymerization is important for the geothermal industry because one way of inhibiting silica scaling from spent high-temperature geothermal waters is to allow monomeric silica in excess of amorphous silica solubility to polymerize before the water is disposed of.

3.6.P17**Fluid evolution in the HS-epithermal Au-Te-As-Cu system at Famatina, Argentina**

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Significant element fractionation between brine and vapor fluids is widely quoted as a very important geochemical process that may generate specific metal enrichment in low-density fluids [1]. In this study, we want to evaluate the effect of fractionation of certain elements (e.g., Au, As, and Cu) into the low-density vapor phase during the process of epithermal ore formation. Furthermore, we try to reconstruct the evolution of the hydrothermal fluid in terms of pressure, temperature, and composition, using microthermometry and LA-ICP-MS. To address the above issues, we investigated the magmatic-hydrothermal system at Famatina, Argentina.

⁴⁰Ar/³⁹Ar studies at Famatina indicate that the high-sulfidation epithermal deposit formed roughly 1.4 Ma after the emplacement of shallow porphyritic bodies [2]. During this time span, the intrusion established a convective hydrothermal system, which resulted in a porphyry Cu-Mo-Au deposit adjacent to the intrusion and more distal high-sulfidation epithermal veins located in fault zones. Such long-lived hydrothermal activity normally suggests multiple pulses of intrusions associated with hydrothermal circulation. However, in rare cases where environments with permeabilities close to the conductive limit are intruded, long-lived hydrothermal systems can be sustained by a single intrusion event [3].

Our work suggests that the high-sulfidation epithermal deposit may owe its composition to the direct input of porphyry-derived vapor fluids. Fluid inclusion petrography of porphyry ore samples has shown that boiling produces a high-salinity brine phase and a coexisting low-density vapor phase. The element ratios of the latter are similar to low-salinity aqueous inclusions in the earliest epithermal ore stage and are probably derived through condensation. The element ratios of the latter are similar to low-salinity aqueous inclusions in the earliest epithermal ore stage and are probably derived through condensation. However, this low-salinity fluid is characterized by high concentrations in Cu, As, Te, and Sb and therefore, it might represent the ore-forming fluid at Famatina.

References

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