New insights into gold transport in HCl-bearing vapour at elevated temperatures

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Metal transport by vapour is an especially attractive hypothesis for explaining ore formation in shallow magmatic environments, where exsolution of fluid occurs in the stability field of vapour. Convincing evidence for the transport of high concentrations of metals by vapour in natural systems has been provided by quantitative analyses of fluid inclusions in porphyry Cu-Au deposists and associated epithermal Au-Ag deposits. Other evidence of metal transport by vapour in natural systems comes from metallic mineral deposits around high temperature fumaroles and in the pipelines from geothermal wells (scalings).

Experimental studies on metal solubility and speciation in water vapour at temperatures up to 400°C have emphasised the role of hydration in metal transport by vapour. These studies have shown that the concentrations of Ag, Au, Cu and Mo in vapour are comparable to those measured in hot fumarolic gas condensates. The high concentrations reported for fluid inclusions have not been observed experimentally. The current study was conducted for a range of fO_2 and at higher pressures than previous experimental studies, in order to approximate a little more closely the pressures of natural systems.

Experiments were carried out in batch-type Ti autoclaves at a temperature of 367°C and pressures up to 194 bars in HCl-bearing vapour. Oxygen fugacity was buffered either by the assemblage (MoO_2/MoO_3) or graphite. Gold concentrations ranged between 1.1 and 321 ppb in condensed samples of the reacted vapours. At pressures below 100 bar, gold concentration increased at a rate of 2-3 per log bar, similar to that observed previously. However, above this pressure, there was a sharp increase in the pressure dependency of gold solubility to approximately 8-14 per log bar. This suggests that at the lower pressures investigated, the hydration number was similar to that predicted by other studies, but increased sharply at higher pressure. Gold solubility increased with increasing fO_2 and was approximately one order of magnitude higher in the MoO_2/MoO_3 buffered system than in the system buffered by graphite.

Geothermobarometry of basaltic glasses from Tamu massif, Shatsky Rise oceanic plateau

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IODP Expedition 324 [1] recovered samples from Shatsky Rise oceanic plateau ranging from picritic basalts (15.6 wt% MgO) to more differentiated tholeiitic basalts (4.9 wt% MgO). In order to determine crustal magma chamber and magma evolution processes lava samples from several evolutionary stages should be investigated. We present results of the mineralogical study of lower MgO pillow and massive flow basalts (Site U1347). Major element glass and mineral compositions were analyzed by electron microprobe (JAMSTEC and University of Hannover). Glass H_2O and CO_2 determinations were performed by FTIR spectroscopy.

In general, basaltic glasses from Site U1347 are evolved tholeiitic basalts (5.2-6.8 wt% MgO), resembling typical EPR MORBs, located in the high-FeO and low-Al_2O_3 fields of EPR basalts. The CaO/Al_2O_3 ratios observed in U1347 basalts are amongst the highest known for all MORBs, probably indicating very low pressures of partial crystallization. H_2O contents in the glasses show MORB values, ranging from 0.18 to 0.6 wt%. CO_2 contents are usually below detection limit of the FTIR method (<50 ppm). The glass compositions and the H_2O concentrations were used to simulate conditions of multiply saturation [2]. Our calculations demonstrate that basaltic melts could have been last equilibrated with Ol-Pl-Cpx association at 1110 to 1170°C in the range of pressures between 1 atm to 3 kbar. These estimates represent the maximum values, since Ol is scarcely observed in natural Pl-Cpx-phyric lavas. The compositions of coexisting Pl and Cpx (~30 samples studied) show two compositional trends. One trend can be reproduced as a result of ideal fractional crystallization at pressures between (0.5-3 kbar). The second trend is the object for future investigations. Application of Cpx-melt and Pl-melt geothermobarometers [3] gives inconsistent results for the same samples and generally shows high P-T values using Cpx-melt (3.7-7 kbar, 1140-1220 °C) and low and negative pressure values using Pl-melt equilibria.

[1] Sager *et al*. (2010) *Proc. IODP*, 324: Tokyo. [2] Almeev *et al*. (2008) *JPet*, **49**, 25-45. [3] Putirka (2008) *Rev. Min. Geoch*. **69**: 61-120.