Phase equilibria constraints on the magma evolution of basanite-phonolite series of the Cumbre Vieja volcano (La Palma, Canary Islands)

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Eruptive products of the recent Cumbre Vieja volcano (La Palma oceanic island) cover a large spectrum of alkali-rich rocks ranging from basanites to phonolites. Current model of Cumbre Vieja plumbing system is based on cpx-barometry and xenoliths and includes three major intervals of magma stagnation and fractionation at mantle and crustal depths (430–780MPa, 180-420MPa and <150MPa) [1]. However, the relative influence of different thermodynamic parameters on stability fields of minerals is still unknown. We present first results of our experimental project aimed at evaluating p-T-aH_2O-fO_2 conditions in the course of basanite-tephrite-phonolite magma differentiation.

As a prerequisite study for these experiments phase equilibria simulations were conducted for a highly magnesian sample of Cumbre Vieja volcano (12.7 wt% MgO) utilizing the MELTs model [2]. Calculations were performed using solid phase fractionation mode, at QFM+1 oxygen buffer, in the pressure interval from 100 to 800 MPa (including both isobaric and polybaric simulations), and with various H_2O contents in parental melt (2-6 wt%). Good agreement between residual melt compositions and natural liquid lines of descent (LLD) were obtained only for the stage of "basanite to tephrite" magma evolution by crystallization of 25-30% ol+sp and subsequent ol+cpx+sp at pressures between 400 and 800 MPa and hydrous conditions. This stage is characterized by strong MgO depletion at nearly constant SiO_2 contents and proceeds until an inflection point at 5 wt% MgO (tephritic melt). Subsequently CaO, FeO and TiO_2 start to decrease and SiO_2 increases up to 58 wt% until the magma reaches phonolitic compositions. This strong change in melt composition is explained by appearance of kaersutite on the liquidus of tephritic melts, which has been so far impossible to reproduce in MELTs mainly due to the lack of kaersutite crystallization model. Thus, the conditions of kaersutite crystallization are crucial to understand the evolution of La Palma magmas from tephrite to phonolites. This problem is prioritized in our ongoing experimental investigations.

[1] Klügel *et al*. (2005) *EPSL* **236**, *211-226*. [2] Ghiorso & Sack (1995) *CMP* **119**, *197-212*.

The transport of gold in petroleum: An experimental study

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Although there is a close spatial association between gold and organic matter in intracratonic basins such as the Witwatersrand (South Africa), the role of the organic matter in the ore-forming process is not understood. One hypothesis is that the organic matter aids in the deposition of remobilized gold by reducing gold-bearing hydrothermal fluids. Another is that the organic matter represents hydrocarbon liquids, which acted as agents of gold transport. In the case of the Witwatersrand, the latter hypothesis would be consistent with the observation that organic-rich shales, which could have acted as source rocks, are present in the basin, that during burial these rocks passed through the thermal window for oil generation (90°C-160°C) and that structures (thrusts) and porous rocks (sandstones and conglomerates) were present, thereby facilitating hydrocarbon migration.

We report here the results of a study designed to determine the solubility of gold in crude oil and its refined fractions. The experiments were conducted in titanium alloy autoclaves at temperatures in the range 100°C to 300°C for 7-10 days. At the end of an experiment, the quenched oil was sampled. Gold that may have condensed on the walls of the autoclave was dissolved in aqua regia after heating the autoclave to 400°C. This washing solution and the crude oil were analysed using neutron activation to determine the solubility of gold in the crude oil. The results of these experiments show that gold solubility in crude oil reaches a maximum of 39ppb to 48ppb at 250°C. Below and above this temperature, the solubility of gold is significantly lower. Concentrations of gold in the refined fractions (distillates and residua) were significantly lower than in the crude oil. In the residual fractions, gold reached a maximum concentration at 150° (8 ppb), whereas in the distillates the maximum concentration occurred at 300°C (27 ppb). As large aromatic molecules were likely degraded during the refining process and the solubility of gold was low in all the refined fractions, we consider it likely that these molecules exercise an important control on gold solubility. The concentrations of gold in crude oil measured in this study are similar to or higher than those of epithermal ore-forming fluids, suggesting that petroleum can act as an agent for the transport of gold in environments such as the Witwatersrand basin