

Solubility of H₂O and CO₂ in low-K high-Al island-arc basalt from Mutnovsky volcano, Kamchatka

T. SHISHKINA^{1*}, R. BOTCHARNIKOV¹, R. ALMEEV¹,
F. HOLTZ¹ AND M. PORTNYAGIN²

¹Institute of Mineralogy, Leibniz University of Hannover
(*t.shishkina@mineralogie.uni-hannover.de)

²IFM-GEOMAR, Kiel, Germany

Subduction-related volcanism is an important source of magmatic volatiles, contributing to the overall volatile budget of the Earth. Since water and carbon dioxide are major volatile components of natural magmas, the concentrations of H₂O and CO₂ in melt inclusions can provide quantitative estimates of storage conditions and dynamic processes in magma chambers and conduits, if the solubility models of volatiles in silicate melts are available. The development of such models is based on experimental determinations of H₂O and CO₂ solubility in silicate melts of different compositions at geologically relevant conditions. The experimental data for basaltic compositions are scarce, limiting possibility to improve mixed volatile solubility models for mafic magmas.

In this study we present new experimental data on solubilities of H₂O and CO₂ in low-K high-Al tholeiitic basalt from Mutnovsky volcano. Solubility experiments were conducted in internally heated pressure vessel at 1250°C and 50, 100, 200 and 500 MPa and at redox conditions, corresponding to $\Delta QFM=+1-+3$ (QFM is quartz-fayalite-magnetite oxygen buffer).

The solubilities of both H₂O and CO₂ in the basaltic melt reveal non-linear dependence on pressure. H₂O concentrations increase up to 8.8 wt.% (with mole fraction of water in the fluid $X_{H_2O}^{fluid}=1$) with pressure increase up to 500 MPa. The maximum concentration of CO₂ determined in 500 MPa experiments was about 0.36 wt% CO₂ ($X_{CO_2}^{fluid}=0.82$). The results at 200 MPa are in general agreement with the available data on H₂O and CO₂ solubility in rhyolitic and basaltic melts [1, 2]. At pressure 500 MPa the concentrations of dissolved H₂O and CO₂ are closer to the solubility values determined for dacites and andesites.

The new experimental solubility data provide constraints on the magma degassing processes at Mutnovsky volcano.

[1] Tamic *et al.* (2001) *Chem. Geology* **174**, 333-347. [2] Botcharnikov *et al.* (2005) *Annals Geophysics* **48**, 633-646

Natural analogue of low pH/high CO₂ environment in the ocean at hydrothermal vents

KIMINORI SHITASHIMA

Central Research Institute of Electric Power Industry, Chiba
270-1194, Japan

At seafloor hydrothermal systems, natural CO₂ is diffused into the ocean as a hydrothermal plume and low pH/high CO₂ environment is appeared around natural CO₂ vents. Natural analogue of the hydrothermal CO₂ would provide an opportunity for understanding the mechanism, influence and recovery of low pH/high CO₂ environment for CCS [1]. In the Okinawa Trough and Mariana Trough, liquid CO₂ is emitted from hydrothermal vents at about 1500m depth. Even more, CO₂ gas bubbles are erupted from seafloor at 100-200m depth in the Kagoshima Bay and 20m depth in Taketomi Island.

Dissolution of liquid CO₂ during ascent of CO₂ droplet and diffusion of low pH seawater (pH 6.4 to 7.3) were observed at the Hatoma Knoll in the Okinawa Trough [2]. The CO₂ droplets emitted from the seafloor dissolve slowly into the ambient seawater while ascending, but changes in pH and pCO₂ near the rising CO₂ droplets are small. The *in situ* pH mapping revealed that the discharged liquid CO₂ does not cause widespread pH depression in the ambient environment. At the NW Eifuku submarine volcano in the Mariana Trough, the low pH plume (pH 6.7 to 7.4) derived from hydrothermal liquid CO₂ was detected in 100m high and 200m wide area above the summit of the volcano (Fig. 1). The result of mapping survey of CO₂ gas bubbles at the Wakamiko Caldera in the Kagoshima Bay indicated only localized pH depression (pH 6.4 to 7.7) below 120m depth because CO₂ in gas bubbles dissolved to seawater during ascent of the gas bubbles (Fig. 2). At shallow hydrothermal system off Taketomi Island, 10m x 10m area around CO₂ venting site showed low pH environment (pH 6.3 to 7.6).

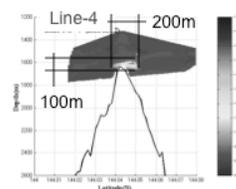


Figure 1: Diffusion of low pH seawater on the summit of the NW Eifuku SMt..

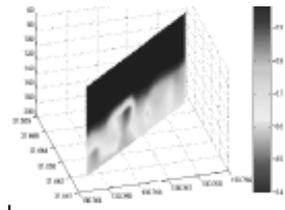


Figure 2: Diffusion of low pH seawater in the Wakamiko Caldera.

[1] Shitashima (1997) *Waste Management*, **17**, 385-390. [2] Shitashima *et al.* (2008) *IJGGC*, **2**, 95-104.