Water diffusion in a basaltic melt

LI ZHANG AND HUAIWEI NI

CAS Key Laboratory of Crust-Mantle Materials and Environments, School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, China

(zl12345@mail.ustc.edu.cn; hwni@ustc.edu.cn)

Water diffusion is an important microscopic mechanism that sustains bubble growth during explosive volcanic eruptions. Compared to felsic systems, water diffusivity in basaltic melt has not been thoroughly determined to a satisfactory precision despite the work by Zhang and Stolper (1991) and Persikov *et al.* (2010). Furthermore, the significance of the role played by OH relative to molecular H_2O is still not clear.

In this study, we have carried out hydration experiments for a Fe-free basaltic melt at 1 GPa in the temperature range of 1400 °C to 1550 °C in a piston-cylinder apparatus at USTC. The melt gained a significant amount of water after dwelling at high temperature for only a few minutes, with the water concentration at melt-platinum interfaces being more than doubled (from ~280 ppm to ~600 ppm). Experimental charges were doubly polished to sections of ${\sim}200~\mu m$ thickness, and diffusion profiles were measured by FTIR microspectroscopy along the cylindrical axis. The profiles can be well fit by error function curves, which are consistent with the idea that OH can also make a major contribtuion to water diffusion in depolymerized melts (Ni *et al.*, 2013). The obtained diffusivities line up nicely in Arrhenius plot and yield an activation energy of 203 kJ/mol. The new diffusivity data are useful for modeling explosive eruptions of basaltic magma and for developing a general water diffusivity model $D(T, P, H_2O)$, SiO₂) for calc-alkaline melts at subduction zone environments.

[1] Zhang & Stolper (1991). *Nature* **351**, 306-309 [2] Persikov *et al* (2010). *Chem Geol* **276**, 241-256 [3] Ni *et al* (2013). *Geochim Cosmochim Acta* **103**, 36-48