CO_2 degassing in a haplo-basaltic magma: An experimental approach

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Basaltic magmas carry huge amounts of volatiles (CO_2, H_2O, SO_2) from their sources in the upper mantle up to the Earth surface. The dynamics and efficiency of basalt degassing are fundamental parameters for eruption dynamics, the environmental impact of volcanism, and the global cycle of volatile elements. Some models of basalt ascent and degassing are purely based on equilibrium solubility laws while others take into account disequilibrium processes such as bubble nucleation and growth (e.g. [1]). Attempts to integrate these disequilibrium processes are hampered, however, by the lack of experimental data on major variables, such as the basalt-CO_2 surface tension.

We investigated CO_2 degassing in an ascending basaltic melt by performing decompression experiments in a piston-cylinder apparatus. Series of experiments were run at a constant decompression rate and quenched at different pressures in order to characterize the kinetics of bubble nucleation and growth. The main parameters of interest are the bubble nucleation pressure P_N, the critical supersaturation pressure ΔP_N (= P_{SAT} - P_N, where P_{SAT} is the volatile saturation pressure), the bubble number density, the bubble size distribution and the residual CO_2 supersaturation in the melt.

A CMAS-Na basaltic glass cylinder was loaded along with silver oxalate powder (the source of CO_2) into a Pt container. The melt was first saturated with CO_2 at 2 GPa-1500°C and then decompressed at 1 MPa/s. Homogeneous bubble nucleation was observed in the experiment quenched at 1.2 GPa, but not in the ones quenched above 1.5 GPa. This yields a ΔP_N for CO_2 bubbles in basalt of 0.5 to 0.8 GPa, thus larger than the values reported in the literature (0.2 GPa [2] or 0.4-0.5 GPa [1]). Quantification of CO_2 in the decompressed quenched glasses is in progress to quantify the residual volatile supersaturation.

[1] Bottinga and Javoy (1990) *Chem. Geol.*, **81**: 225-270. [2] Lensky *et al* (2006) *Earth Planet. Sci. Lett.* **245**: 278–288.

Simulating the role of extra-cellular DNA in cellular adhesion

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Bacteria produce a vast range of mineral deposits within the earth and are involved in the degradation of many materials. Experimental studies have demonstrated that extra-celluar DNA (eDNA) is a major component of the extra-cellular polymeric substance used to bind the bacteria to surfaces [1]. Understanding the mechanisms of eDNA attachment is necessary to understand biofilm development.

We have explored the mechanisms of attachment using molecular dynamics simulations that provide atomic-scale detail to analyse the interactions. We consider how eDNA binds at amorphous silica surfaces which provides an analogue to many geological and experimental systems. A range of different solvated cations is simulated to enable us to look at their effect on both the space-charge layer and on localised bonding. We discuss the implications of these results for bacterial attachment and the building of DNA based scaffolds on mineral surfaces comparing them with current experimental work where possible.

[1] J.S. Andrews, S.A. Rolfe, W.E. Huang, J.D. Scholes, S.A. Banwart, (2010) *Environmental Microbiology* **12**(9), 2496–2507