

# **Solubility, activity and phase relationships in silicate-H<sub>2</sub>O systems: insights from new hydrothermal experimental techniques**

N. TAILBY<sup>1</sup>, J. MAVROGENES<sup>1,2</sup>, J. HERMANN<sup>1</sup> AND H. O'NEILL

<sup>1</sup>Research School of Earth Sciences, The Australian National University; nick.tailby@anu.edu.au

<sup>2</sup>Department of Earth and Marine Sciences, The Australian National University; john.mavrogenes@anu.edu.au

The last decade has seen renewed interest in hydrothermal experimental petrology, particularly with regard to near- or complete miscibility between silicate melts and hydrous fluids at high-P conditions. Inherent quench problems associated with hydrothermal experiments require that rock-H<sub>2</sub>O behavior be either directly observed (e.g., hydrothermal diamond-anvil) or solubility relationships at run conditions be preserved (e.g., diamond trap).

This research project has seen the development of a cold-seal, thick-walled 6mm Ag-capsule, suitable for ½'' piston cylinder pressure vessels. The cold-seal technique has previously been tried and tested for the various parameters crucial to hydrothermal experiments (e.g., inertness, temperature gradients, H-diffusion and P/T-calibrations). Application of the cold-seal technique has, however, been restricted to 5/8'' pressure vessels. In order to approach conditions near the second critical end-point (a position in P-T-X space where the mutual solubility of silicate melts and hydrous fluids become unity), cold-seal experimental runs must be carried out at conditions beyond the 5/8'' working range (~25kb). Hence, the ½'' pressure vessel design is aimed at addressing rock-H<sub>2</sub>O relationships at P-conditions analogous to deeper subduction zone environments (i.e., up to ~45kb).

In addition to extending the cold-seal working range, this research has worked towards developing a technique whereby high-P rock-fluid interaction is monitored by water activity. By combining metal-metal oxide  $fO_2$  buffers (e.g., Re-ReO<sub>2</sub>) with sliding  $fH_2$  sensors (e.g., Ni-Pd noble metal alloy) it is possible to determine the water activity for a given rock-H<sub>2</sub>O system. If  $fO_2$  within the experimental charge is fixed by a MMO buffer, changes in  $fH_2$  (monitored by a H-sensor) reflect changes in  $aH_2O$  due to changes in silicate-H<sub>2</sub>O solubility.

Finally, this experimental setup may be used to study synthetic, high-P fluid inclusions, while also monitoring phase and trace element systematics with changing P-T-X conditions.