

Solubility of H₂O and CO₂ in trachytic melts (Campi Flegrei, Italy): an experimental study.

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Dissolved H₂O and CO₂ in silicate magmas affect the density, viscosity and the phase equilibria of these systems influencing their evolutionary history as well as their eruptive behavior. Although H₂O and CO₂ solubility was well studied in magmas with compositions ranging from basalt to tephrite, solubility data are still missing for Si- and alkali-rich magmas, producing some of the most powerful and destructive eruptions.

In this study, experiments were conducted to determine H₂O and CO₂ solubilities in an alkali-rich trachyte from the Campi Flegrei, Italy. A synthetic analogue of the natural trachyte was prepared by melting oxide and carbonate powder at 1600°C in a muffle furnace. The obtained glass, crushed to a grain size of 200-500 μm, was doped with distilled water and Ag₂C₂O₄ or CaCO₃ as sources for H₂O and CO₂, respectively.

The solubility of H₂O and CO₂ in equilibrium with H₂O-CO₂ fluids was experimentally investigated at 1100°C and at pressures of 100, 200 and 400 MPa. Capsules were prepared with an initial mole fraction of water (X_{H_2O}) of 0, 0.25, 0.5, 0.75 and 1. Experiments were conducted in an internally heated pressure vessel at intrinsic redox ($\log f_{O_2} = FMQ + 3$) conditions for 24h.

Infra-red spectroscopy was used to determine the speciation contents of H₂O and CO₂ in the experimental glasses and to check for their homogeneity. Bulk water content was also analyzed by Karl-Fisher Titration. The composition of the fluid-phase was determined by the weight-loss method. Microprobe analyses were performed on the experimental glasses to test the homogeneity of the major elements. To determine the redox state of the melts, the ferric/ferrous ratio was measured using a colorimetric method.

First results show that the solubility of water increases from 3.77 wt% to 9.30 wt% with increasing pressure from 100 MPa to 400 MPa. A pressure above 200 MPa trachytic melts dissolve more water than typical alkali-basalts. For instance, at 400 MPa and 1100°C trachyte dissolves 9.30 wt% H₂O, whereas a trachybasalt of Solchiaro eruption (Campi Flegrei, Italy) dissolves at 500 MPa only 9.15 wt% H₂O. At 200 MPa and 1100°C, the value of 5.24 wt% we found for trachyte is in a good agreement with the data on H₂O solubilities of 5.19-5.32 wt% and 5.46 wt% obtained at 1200°C for phonotephrite and tephrite by Behrens et al. (2009) and Lesne et al. (2011), respectively. On the other hand Di Matteo et al. (2004) reported higher water content (8 wt%) measured in trachytic melts at 850°C and at pressure of 200 MPa. Further investigation is needed to clarify whether this difference can be attributed to the temperature effect, or other parameters should be taken into account.

References:

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