Origin of Water in Miarolitic Cavities of the Ariskop Phonolite, Namibia

B. M. JOST[1]*, F. KOLLER[2], N. VOGEL[1], P. ULMER[1] AND T. DRIESNER[1]

[1]Institute of Geochemistry and Petrology, ETH Zurich, Clausiusstrasse 25, 8092 Zurich, Switzerland (*correspondence: benjamin.jost@erdw.ethz.ch)

[2]Department of Lithospheric Research, University of Vienna, Althanstraße 14, 1090 Vienna, Austria

Paleogene phonolites exposed near the village of Aris, central Namibia, are unique in that they contain macroscopic amounts of free water trapped in miarolitic cavities within the rock.

Strongly deformed schlieren associated with spherical (i.e. undeformed) cavities imply that bubble nucleation and growth occurred after emplacement of the phonolite. Elongated and aligned cavities suggest that late-stage differential shear was focused into localized zones.

The cavities are surrounded by white-coloured alteration halos that contain larger, more euhedral aegirine and sanidine crystals than the greenish-grey phonolitic groundmass. Natrolite after nepheline is the commonest replacement reaction observed in the halos ($2NaAlSiO_4 + SiO_2(aq) + 2H_2O = Na_2Al_2Si_3O_{10}{\cdot}2H_2O$). Water and SiO_2 are supplied from within the cavities, as the replacement decreases with increasing distance from the cavity. The replacement involves a 30% volume increase, reducing the rock's permeability and trapping the water within the cavities.

The occurrence of water-soluble minerals (villiaumite, makatite) in the cavities suggests the exsolution from the parental magma of: (1) a solute-rich aqueous fluid, (2) a hydrous sodium silicate melt, and (3) a sodium fluoride salt melt or brine. Noble gas analyses of the trapped water, however, show it to be a mixture of air-saturated water and a crustal component. Three models are proposed: (1) the water in the parental magma was meteoric *ab initio*; (2) the noble gas signature originates from boiling groundwater beneath the sill; (3) the percolation of meteoric water through the sill between its intrusion and final solidification. All models and the strongly radiogenic $^3He/^4He$ ratios in the cavities imply that the water is trapped since the emplacement and solidification of the Ariskop phonolite sill (i.e. ~32 Ma [1]).

[1] Burger & Walraven (1976) *Annals Geol. Surv. S. Afr.* **11**, 323–329