Volatile evidence for mantle metasomatism and source heterogeneity in the Auckland Volcanic Field, New Zealand

ELAINE R. SMID*, MICHAEL C. ROWE AND JAN M. LINDSAY

University of Auckland, Private Bag 92019, Auckland, New Zealand 1010 (*correspondence: e.smid@auckland.ac.nz) (michael.rowe@auckland.ac.nz, j.lindsay@auckland.ac.nz)

Lavas erupted in intraplate basaltic volcanic fields, wherein single magma batches ascend quickly to the surface, are widely regarded as comparatively simple 'windows' into mantle compositions and behaviour. Recent studies, however, have revealed complex geochemical trends in many of these fields, both within individual volcanic sequences and across whole fields, with much of this heterogeneity attributed to multiple mantle sources.

The Auckland Volcanic Field (AVF), New Zealand, is a dormant monogenetic field containing 53 volcanic centres with compositions ranging from subalkalic basalt to nephelinite. Recent interpretations of extensive isotopic and major and trace element data from bulk rock seek to explain this geochemical range through the melting of three source endmembers: metasomatised lithospheric mantle, eclogitic veins, and fertile asthenospheric mantle.

In this study, glassy, olivine-hosted melt inclusions (MIs) from 'endmember' whole rock compositions are used to constrain the volatile components related to changes in source chemistry. In particular, the alkalic and subalkalic magmas, most recently erupted in the AVF from Rangitoto Volcano, are ideal for this study due to the abundance of fresh, glassy material and the diversity of compositions available.

Volatile data from FTIR analyses of MIs indicate that the subalkalic magmas from Rangitoto best represent the postulated metasomatised lithospheric mantle source. These magmas contain up to 1.5 wt% H_2O and CO_2 concentrations up to 2100 ppm, as opposed to H_2O contents up to ~1 wt% and CO_2 concentrations up to 2600 ppm in the alkalic magmas. Crystallisation depths for subalkalic magmas cluster at ~9-11 km and at ~5 km and may indicate ponding at these depths. H_2O/Ce ratios from high pressure melt inclusions range up to ~600 for subalkalic magmas and ~140 for alkalic magmas. Subalkalic values are double that typically observed in MORB or OIB magmas (< 300 H_2O/Ce) but below that of most arc basalts (>~ 600 H_2O/Ce), consistent with a partially metasomatised lithospheric mantle source.