5.4.P06

Extreme geochemical heterogeneity in Indian Ocean tephra layers from Afro-Arabian silicic flood volcanism

I.U. PEATE[1,2], A.J.R. KENT[3] AND J.A. BAKER[2,4]

[1] Geoscience Department, University of Iowa, Iowa City, IA 52242, USA (ingrid-peate@uiowa.edu)
[2] Danish Lithosphere Centre, Øster Voldgade 10, 1350 Copenhagen K, DENMARK
[3] Department of Geosciences, Oregon State University, Corvallis OR 97330, USA
[4] School of Earth Sciences, Victoria University of Wellington, P.O. Box 600, Wellington, NEW ZEALAND

Four Oligocene tephra layers from the Indian Ocean (ODP Leg 115) have been linked to specific Afro-Arabian silicic eruptive units in Yemen [1]. The tephras preserve morphologic and geochemical diversity of shards not observed in on-land units. Tephra layers are 5 to 15 cm thick and composed of ca. 80% sand-sized shards in siliceous ooze. Shards exhibit a variety of colours and morphologies, from opaque black to transparent, with massive, pumiceous or angular shapes and tricuspate bubble junctions. Rare shards are banded, and occasional alkali clinopyroxene and feldspar crystals are also present.

Major and trace elements have been analyzed by EMP (n = 1000) and *in-situ* LA-ICP-MS (n = 300), on the full range of shard types. Compositional variations correspond to shard type and range from basaltic (opaque) to rhyolitic (transparent) (SiO_2: 43-81 wt%). The three lowest tephras have continuous variations from ~60-81 wt% SiO_2, while the uppermost tephra contains basaltic shards and a silica gap (43-54 & 59-79 wt% SiO_2). Co-variations with other major elements (e.g. TiO_2, K_2O) indicate fractionation of Fe-Ti oxides and feldspar. Continuous compositional variations from dacite to rhyolite, and curvilinear trends in plots of major vs trace elements, indicate tephra arrays result from extreme fractional crystallization of mafic magmas. Within the uppermost tephra, variations in highly incompatible elements (e.g. Nb: 32-196 ppm) require > 90% fractional crystallisation.

Nd-Pb isotope data for the tephras are similar to those determined on basalts that have assimilated only minor amounts of continental crust. Coupled with the large fractionation-generated chemical variations observed in the glass shards, the tephra layers and silicic volcanism in Yemen-Ethiopia can be considered to be the product of Plinian eruptions tapping strongly zoned silicic magma chambers, produced by extensive fractionation (90%) of basaltic magmas with little crustal assimilation.

Reference

[1] Ukstins Peate et al. (2003) *EPSL* **211,** 311-327.

5.4.P07

Depleted melt inclusions from the Southwest Indian Ridge: An example of melt productivity from an ultra-slow mid-oceanic spreading ridge

M.J. LUND[1,2], A.J.R. KENT[3], C.K. BROOKS[1,2], J. KONNERUP-MADSEN[1] AND M. WIEDENBECK[4]

[1] Danish Lithospherecentre, Øster Voldgade 10, 1350 Copenhagen K, Denmark (jakob_lund@hotmail.com)
[2] Geological Institute, University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen K, Denmark
[3] Department of Geoscience, 104 Wilkinson Hall, Oregon State University, Corvalis, OR97331, USA
[4] GeoForschnungsZentrum Potsdam, Telegrafenberg, D14473 Potsdam, Germany

Primary magmas produced in the mantle regime may undergo significant mixing and fractionation during melt transport to the surface, destroying much of their primary origin, especially if the erupted laves represent a mixture of several melt batches of different composition. To circumvent this problem, melt inclusions hosted in primitive plagioclase crystals from the Southwest Indian Ridge (SWIR; 32ºE-49ºE) have been chosen to explore melt production and melt diversity. Melt inclusions from each sample can be linked to the host lava by assuming up to 30% crystal fractionation of olivine and clinopyroxene, although some samples also require a componential plagioclase accumulation or fractionation. Modelling of SWIR melt inclusions reveals that the majority of inclusions have experienced post-entrapment secondary crystallisation of plagioclase, however amounts are on average less than 10%. Incompatible elements and especially incompatible element ratios will remain unaffected (e.g. K_2O/TiO_2, $[La/Sm]_N$, La/Yb, Zr/Nb). Trace element ratios reveal that different diffusion processes are not an important issue for the SWIR melt inclusions. The complex chemistry of SWIR melt inclusions is consistent with melt production from multi-component sources. Ultra-depleted SWIR melt inclusions, similar to those found at the Mid-Atlantic Ridge, are possible products of sources previously melted to high degrees of melting to the point or beyond where clinopyroxene is exhausted from the source. The results obtained are consistent with a scenario where hot melts of diverse composition produced at different depths travel independently through the melting regime to the upper crystal mush zone without undergoing homogenisation.