5.2.41

Origin of extreme $^3He/^4He$ signatures in Icelandic lavas: Insights from melt inclusion studies

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The variation in He-isotopes in many basaltic suites remains enigmatic and often difficult to link with lithophile chemical and isotopic tracers. One problem is that He-isotopes, commonly measured from crushing olivine separates, reflect the composition of fluids and melts trapped within the olivine grains, while the lithophile elements measured in glass or bulk rock reflect the composition of the host lava. Previous studies from NW Iceland have reported extreme $^3He/^4He$ [1], [2]. SEL97 (ankaramite) is suggested to provide the most precise estimate of the Sr-Nd-Pb isotopic ratios of a relatively undegassed (high $^3He/^4He$) mantle component (FOZO) [1]. To link He-isotope and lithophile element variations, we characterize major, volatile and trace element compositions of olivine-hosted melt inclusions from 3 ankaramitic lavas from Vestfirdir, NW Iceland. These samples exhibit amongst the highest $^3He/^4He$ observed in terrestrial rocks (42.9 and 34.8 R/R_a). Host lavas and melt inclusions are basaltic (Mg# 52-62). Melt inclusions have higher trace element concentrations than host lavas but parallel REE-patterns. ΔNb of the melt inclusions from a single lava spans a large range from -0.08 to 0.45 (most >0), with $(La/Sm)_N$ from 0.65 to 2.65. This contrasts with negative ΔNb and $(La/Sm)_N$ < 1 for the high-$^3He/^4He$ Baffin Island basalts [3]. Major and trace element systematics suggest that each melt inclusion population and their host lavas are related by a combination of accumulation and fractionation of olivine and clinopyroxene. Variations in incompatible trace element ratios within each melt inclusion population reflect variations in the degree and depth of melting. A lack of fluid inclusions in the olivine phenocrysts suggests that these melt inclusions are the major host of He, suggesting that the trace element signatures and He-isotopes in these lavas derive from the same mantle source. Strong links between melt inclusion and whole-rock chemistry could also imply that the extremely high $^3He/^4He$ and FOZO-like Sr-Nd-Pb isotopic compositions originate in the same lower mantle source.

References

[1] Hilton D.R., Gronvold K., Macpherson K., and Castillo P.R. (1999). *EPSL* **173**, 53-60.
[2] Breddam K. and Kurz M.D. (2001) *EOS* **82,** F1315.
[3] Stuart F.M., Lass-Evans S., Fitton, J.G., and Ellam R.M. (2003) *NATURE* **424,** 57-59.

5.2.42

A melt inclusion study in primitive olivines from Padloping Island, Baffin Bay

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Tertiary picrites from Padloping Island, Baffin Bay, are thought to be the result of early activity of the Iceland Plume. The olivines found in these lavas are primitive to very primitive with Fo-content ranging from 88 to 93. However, they are not in equilibrium with the liquid, suggesting that they have been derived from earlier cumulates. Therefore, by obtaining the composition of the melt inclusions in these olivines we might be able to gain some insight in the composition of, possibly primary, mantle derived melts.

We have optically evaluated a large set of olivines and it is clear that they all contain primary inclusions ranging in size from ~10 to ~100 micron in diameter. The inclusions are randomly distributed and not related to any fractures. They contain glass, daughter minerals and volatiles, suggesting relatively slow cooling after entrapment.

Electron microprobe analysis of daughter minerals has suggested a primitive composition for the initial trapped liquid, which has evolved into a residual Si-rich liquid after the growth of Al-rich clinopyroxene and Cr.

Currently, homogenisation experiments are carried out under ambient pressure using a heating stage under controlled fO_2 conditions. These experiments suggest that our liquidus temperature is higher than 1350°C. The fact that we are unable to complete our homogenisation, i.e. let the gas phase dissappear, suggests that the melt was either oversatured in CO_2-rich volatiles or that the entrapment has taken place at higher pressures than can be obtained by our experiments.

Our next aim is to obtain major element compositions for the homogenised inclusions by electron probe as well as trace element signatures using LA-ICPMS. Those results might reveal more about the mantle source that has contributed to these melts as well as the melting processes that have taken place.