Variable H and O isotopes in Tongan basaltic glasses: Source or degassing?

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New H and O isotope data are presented for submarine basaltic and basaltic-andesite glasses dredged from the Tongan arc (north of Tongatapu), the Fonualei Rifts (FR, a nascent backarc spreading centre) and the Mangatolu Triple Junction (MTJ). These data complement a comprehensive trace element and Nd-Sr-Pb-Hf isotope dataset.

The highest δD values (-50‰ to -30‰) occur in the MTJ and FR. There is a positive co-variation between δD and H_2O abundance, initially suggesting addition of a δD-rich H_2O component derived from the subducted slab to the upper mantle source. In this scenario, the most negative values ($\geq$-85‰), which have lower water contents, would represent uncontaminated mantle wedge. This is consistent with a MORB source component (typically -80‰ ± 10‰). However, H_2O concentration and δD also increase with depth of eruption, suggesting that degassing may explain the fractionation observed. In this scenario the highest δD (-40‰ to -30‰) may be typical of the whole arc-backarc mantle source, while the lower values are produced by degassing (whereby D is preferentially incorporated into H_2O rather than melt). Extrapolation to infinite water for the whole arc-FR dataset gives a δD value of ca. -26‰. Samples from the MTJ (n=2) are offset to more elevated δD at similar H_2O contents.

Ba/La ratios are highest at the central Tongan volcanoes, indicating that these have the greatest fluid-mobile trace element flux, but they do not possess complementary high δD. Thus, either the D-rich signature is masked by fractionation during degassing or the trace element flux is partially decoupled from the water flux.

$\delta^{18}O$ values range from 4.6‰ to 6.2‰. There is a poor negative co-variation of $\delta^{18}O$ and δD but this is most likely masked by the effects of H fractionation during degassing. Such a co-variation requires the transfer of an ^{18}O-depleted and D-rich fluid from high-T altered oceanic crust, rather than low-T altered crust or sediment.

Trace element analysis and petrology of Martian meteorite RBT04262

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Major and trace element analysis and element mapping of the newly discovered Martian meteorite RBT04262 reveal two main lithologies: a coarse pyroxene zone (lithology 1), and a finer-grained zone containing pyroxenes and olivine interspersed with shocked plagioclase maskelynite (lithology 2), with a reaction zone between them consisting mainly of Ca-rich pyroxene (lithology 3) [1]. Lithology 1 appears to be a basaltic (melt) cumulate, containing large phenocrystic Fo_{66} olivines within En_{65} pigeonites, as well as aggregates of these materials. Lithology 1 may represent a xenocryst set within lithology 2, composed primarily of maskelynite, Fo_{57} olivine, and high- and low-Ca pyroxenes with minor Ca-phosphates, ilmenite, chromite, and Fe-sulfides, which we interpret to represent the host basaltic magma.

Lithology 1 appears to represent earlier crystallized products based on their more primitive trace-element compositions obtained by LA-ICP-MS. Low-Ca pyroxenes in lithology 1 are depleted in REEs and strongly LREE depleted, whereas low-Ca pyroxenes of lithology 2 have slightly higher REE contents, and only slight depletions in LREE. The reaction zone (lithology 3) has a similar trace element composition to lithology 2 low-Ca pyroxenes. RBT04262 may represent a basaltic magma that has entrained earlier cumulate phases. Although the bulk rock composition has not been reconstructed yet, we find that all mineral phases containing significant amounts of REEs are LREE-depleted to flat (Ca-phosphates) when normalized to C1 chondrites. The lack of significant negative Eu anomalies in the pyroxenes, however, suggests relatively high oxygen fugacities, possibly not too different from what is seen on Earth.

[1] Dalton H. A. *et al.* (2008) *LPSC* **XXXIX**, Abs #2308.