Matrix effects and Hf isotope analysis of zircon by laser ablation MC-ICP-MS

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In the last decade there have been significant advances made in the *in situ* measurement of Hf isotopes in zircon and the application of the Lu-Hf isotopic system to help constrain the sources that contributed to zircon formation. The information obtained from the *in situ* Hf analysis of zircon has been used to monitor magmatic processes, to identify inherited and juvenile components in magmatic sources, and to evaluate models of crustal evolution. Despite the success of the technique, its application is still limited by the contribution to the total uncertainty by corrections for isobaric interferences, especially for zircons with high REE/Hf ratios. A significant effort has been devoted to demonstrating the robustness of correction methods for isobaric interferences of ^{176}Yb and ^{176}Lu on ^{176}Hf but little attention has been paid to the contribution of molecular interferences.

In this study the accuracy and precision of isobaric corrections and the contribution of REE-oxides on Hf isotopes are evaluated using a suite of synthetic glass beads doped with the JMC475 Hf standard and varying concentrations of Yb, Gd and Dy. The results demonstrate the robustness of the isobaric interference correction procedures for ^{176}Yb/^{177}Hf ratios greater than 0.8 (i.e. approx. three times that of ^{176}Hf/^{177}Hf ratio).

Theoretical calculations and measurement of Gd- and Dy-doped glass beads demonstrate that REE-oxides are also able to bias Hf-isotope data. Gd oxides can produce interferences on a number of Yb isotopes and Dy oxides overlap several Hf isotopes. The significance of these interferences depends on the oxide production of the mass spectrometer as well as the slope of the REE patterns (Gd/Yb) and REE/Hf ratios (Dy/Hf). The results can potentially explain a number of observed correlations between REE content of zircon and measured Hf isotope ratios. These 'matrix-effects' are most apparent in high REE zircons and in zircons with high Gd/Yb ratios and leads us to recommend monitoring of REE levels and oxide interference corrections.

Assimilation of lithospheric mantle melts by West Greenland tholeiitic magmas recorded by melt inclusions

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An issue in many flood basalt provinces is how to distinguish crustal assimilation from lithospheric mantle inputs. We have studied olivine-hosted melt inclusions in five high MgO samples (olivine separates from [1]) from the Paleocene picrite-dominated Vaigat Formation in West Greenland [2]. Melt inclusions can preserve a diversity of compositions that record petrogenetic processes taking place within the magmatic plumbing system. Inclusions were rehomogenized to glass in a 1-atm gas-mixing furnace prior to EPMA and LA-ICP-MS analysis. One sample (332788) has lower ^{143}Nd/^{144}Nd and higher ^{206}Pb/^{204}Pb than the other samples. Inclusions from the other four samples show limited compositional variability, limiting any role for crustal assimilation, and inclusions in rare high Fo% (~92) olivines are similar to inclusions in less forsteritic olivines in terms of incompatible element ratios, indicating that the high Fo% olivines are not xenocrystic. Whole rock data on more evolved flows [1] show isotopic evidence for assimilation by crust with low ^{143}Nd/^{144}Nd and low ^{206}Pb/^{204}Pb, different to the displacement trend of sample 332788. Inclusions in sample 332788 show significant compositional variability, with K/Ti varying from 0.14 to 0.33 (compared to 0.12 to 0.19 in inclusions from the other samples). Trace element data show that K/Ti in inclusions from sample 332788 correlates with incompatible element ratios such as Zr/Y and Zr/Nb but not with La/Nb and Ba/Nb that might have been expected for crustal assimilation. Small-volume, incompatible-element-enriched, alkali picrite flows, interpreted as melts of old metasomatized lithospheric mantle, are found at a similar stratigraphic level elsewhere in the province [3]. Their isotopic composition is consistent with the displacement of sample 332788 from the other samples, and their trace element composition can explain the variations in the inclusions. The presence of these melts near the surface suggests a shallow-level magma mixing model rather than assimilation during ascent through the lithosphere.

[1] Larsen *et al*. (2009) *JPet* **50**, 1667–1711. [2] Graham *et al*. (1998) *EPSL* **160**, 241–255. [3] Larsen *et al*. (2003) *JPet* **44**, 3–28.