Lithospheric mantle sources within the East African Rift, Tanzania

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Trace element and isotope compositions of inferred plume-derived basalts and carbonatites erupted through the East African Rift (EAR) have been ascribed to derivation from heterogeneous lithospheric mantle, asthenospheric or plume sources, or combinations thereof. Rifting in Tanzania occurs in different lithosphere domains: craton, reworked craton and mobile belt and a correspondence between these domains and magma types erupted through them has been recognised [1]. This is corroborated by data from peridotite xenoliths from three Tanzanian localities.

The deep mantle beneath Labait (craton) is strongly silicate melt metasomatised [2], with HIMU-like Sr and Nd. This component, also seen in erupted basalts, is ascribed to overprinting by sublithospheric melts. Remelting of metasomatised lithosphere prior to significant radiogenic ingrowth may yield compositions indistinguishable from plume-derived melts. Although the EAR plume source contains a small EM1 component, persisting old LREE-enriched lithosphere has lower ^{143}Nd/^{144}Nd and is recognised in some EAR lavas.

At Olmani (reworked craton), many peridotites have high Ca/Al and extremely homogeneous isotope compositions despite variable parent/daughter ratios, indicating recent overprinting of the lithosphere by ultimately sublithosphere-derived calico-carbonatite [3].

Lashaine peridotites (reworked craton) have extremely radiogenic Sr relative to Nd [4], high Na_2O contents and cpx Sr/Y that may reflect but do not require overprinting by a subducted (silicic) component [5], possibly related to ca 2 Ga subduction [6]. This signature is seen in some basalts erupted through the craton and craton margin, but not in carbonatites. As the inferred subducted component is located in the shallower mantle, this may indicate that, contrary to EAR basalts, carbonatites can penetrate upwards at these depths with little lithospheric mantle interaction.

[1] Macdonald *et al.* (2001) *J. Pet.* **42**, 877-900. [2] Lee & Rudnick (1999) *Proc. 9IKC*, 503-521. [3] Rudnick *et al.* (1993) *EPSL* **114**, 463-475. [4] Cohen *et al.* (1984) *EPSL* **68**, 209-220. [5] Rudnick *et al.* (1994) *Proc. 5IKC*, 336-353. [6] Möller *et al.* (1995) *J. Pet.* **39**, 749-783.

Mantle melting beneath island arcs: U-series constraints from Marianas

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U-series disequilibria of erupted lavas are a geochemical means to investigate the geodynamics of melting regimes. At destructive plate margins, U-series isotopes are controlled by two competing processes: i) fluid addition from the subducting plate; ii) melting of the mantle wedge. Depending on the nuclides half-lives and their mobility in the fluids phase, each parent-daughter pair responds differently to the two processes. (^{230}Th/^{238}U) is mainly affected by the fluid addition whilst (^{231}Pa/^{235}U) is more sensitive to melting and requires time-related processes to 'in-grow' the daughter nuclide. The combination of U-Th-Pa-Ra measurements on a single volcanic arc, and in particular the variation of (^{231}Pa/^{235}U) with (^{230}Th/^{238}U) allows investigation of the timing of slab dehydration and its affects on the melting process.

The Mariana arc provides the perfect location to study the behaviour of Pa in the arc environment. (^{230}Th/^{238}U) disequilibria suggest that U is fluxed into the mantle during dehydration of the altered oceanic crust inducing significant ^{230}Th-deficits in the most depleted (least sediment enriched) lavas [1]. The more sediment rich lavas are less affected by this U addition, and show minor ^{230}Th. All the measured samples display (^{231}Pa/^{235}U)>1, requiring sufficient ^{231}Pa in-growth during melting to overcome the initial deficit induced in the source by U-rich fluids. Moreover, the slope of the (^{231}Pa/^{235}U) vs. (^{230}Th/^{238}U) alignment of the erupted lavas, in comparison to that expected for the fluid-fluxed source, suggests that magmas more affected by fluids requires more ^{231}Pa-ingrowth during melting.

[1] Elliott *et al.* (1997) *J. Geophys. Res.* **102**, 14991-15019.