

## The environmental fate of depleted Uranium particulate after 25 years

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Between 1958 and 1984, depleted uranium metal was processed at a National Lead (NLI) plant in Colonie, NY, USA. Combustion of scrap metal resulted in emissions of uranium into the environment. Contamination is evident in a sediment core collected downstream of NLI [1].

Uranium contamination was from aerial deposition of episodic stack emissions prior to 1982, dispersed by prevailing winds. Existing survey data have been interpolated and integrated to estimate 5 tonnes of uranium contamination within 1 km<sup>2</sup> of the plant [2]. Analysis of soil samples by quadrupole mass spectrometry (ICP-MS) reveals contamination in soil profiles to at least 35 cm depth, at sites close to NLI. The contamination footprint has been mapped to at least 5 km, using isotope ratios from 250 soil samples.

The relationship between <sup>236</sup>U/<sup>238</sup>U and <sup>235</sup>U/<sup>238</sup>U appear to fit a single mixing line between natural and a depleted uranium endmember (estimated 0.2 % <sup>235</sup>U and 32 ppm <sup>236</sup>U). However, analysis of individual uranium-oxide grains by laser-ablation multi-collector ICP-MS (LA-MC-ICP-MS), reveals a spread of isotope ratios, representing differences in the composition of batches of feedstock handled at NLI.

Individual spheres of uranium-oxide, with diameters 30 - 60 µm have been isolated from soil and dust samples. These have been imaged and characterised by electron microscopy (SEM-EDX) and micro x-ray absorption spectroscopy (µXANES). Uranium-oxide contamination has survived in the terrestrial environment for more than 25 years and appears to have limited mobility in soil. Particulate recovered from wet environments show evidence of enhanced oxidation and dissolution, when compared to those from dry dusts. Bioaccessibility of uranium, which is significantly governed by oxidation, is being assessed by isotope dilution.

[1] Arnason & Fletcher (2003) *Environ Pollut* **123**(3) 383-391.  
[2] Parrish *et al.* (2008) *Sci Total Environ* **390**(1) 58-68.

## Hf isotopic insights into mantle source contributions in Turkana, East African Rift System

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The East African Rift System (EARS) provides a unique opportunity to observe the magmatic processes of crustal growth associated with plume-driven continental rifting. The Turkana depression within the EARS, a region of highly extended lithosphere located between the East African and Ethiopian Plateaus, has particularly favorable conditions to study these processes as basalts erupted there have primitive compositions. New Hf, Sr, Nd, and Pb isotopic data of Quaternary and Tertiary Turkana basalts, coupled with existing Pb, Sr, Nd, He, and major and trace element data [1], offer enhanced insights into the interplay of mantle sources.

The isotopic data indicate two distinct mixing trends. One trend includes all Quaternary samples and several Tertiary samples (most <3 Ma); the other trend consists of mostly older Tertiary samples (20-40 Ma). The older Tertiary basalts have <sup>206</sup>Pb/<sup>204</sup>Pb, <sup>207</sup>Pb/<sup>204</sup>Pb and <sup>208</sup>Pb/<sup>204</sup>Pb values overlapping the HIMU field [2]; younger lavas are less radiogenic. The Tertiary lavas in both trends have <sup>176</sup>Hf/<sup>177</sup>Hf (0.2828 to 0.2830) and <sup>87</sup>Sr/<sup>86</sup>Sr (0.7031 to 0.7047) that nearly overlap the HIMU field [2]; the Quaternary samples have more radiogenic Hf similar to C-component [3].

The major element (specifically Na, Ca, and Al) and trace element bulk rock concentrations of older Turkana samples, coupled with elevated Ni at a given forsterite composition in olivine [4], suggest that the HIMU signature is linked with a pyroxenite component [5], and the younger samples have major and trace element concentrations consistent with derivation from a peridotite component [5]. Ongoing studies, including trace element zonations in phenocrysts, may clarify source mixing timescales and further elucidate any lithospheric overprinting.

[1] Furman *et al.* (2004) *J. Petrol.* **45**, 1069-1088; Furman *et al.* (2006) *J. Petrol.* **47**, 1221-1244. [2] Stracke *et al.* (2005) *G<sup>3</sup>* **6**, 2004GC000824. [3] Hanan & Graham (1996) *Science* **272**, 991-995; Hanan *et al.* (2000) *G<sup>3</sup>* **1**, 1999GC000009. [4] Sobolev *et al.* (2005) *Nature* **434**, 590-597. [5] Kogiso *et al.* (2003) *EPSL* **216**, 603-617.