

## Apatite as a petrogenetic indicator for lamprophyres and carbonatites

R. KIETÄVÄINEN<sup>1</sup>\* J. WOODARD<sup>1</sup> O. EKLUND<sup>1</sup>,  
C.J. HETHERINGTON<sup>2</sup> AND BOETTCHER<sup>3</sup>

<sup>1</sup>Department of Geology, University of Turku, FIN-20014  
Turku, Finland (\*correspondence: rekiet@utu.fi)

<sup>2</sup>Department of Geosciences, University of Massachusetts,  
611 N Pleasant St., Amherst MA 01003-9297, USA

<sup>3</sup>Institut für Mineralogie, TU-Clausthal, D-38678, Clausthal-  
Zellerfeld, Germany

Apatite is an important host for incompatible trace elements (LREE, Sr, Th, P, F) in the mantle and plays an important role in the trace element signature of mantle-derived melts. For this study, we analysed fluorapatite from different textural settings in Palaeoproterozoic lamprophyres and carbonatites in the Fennoscandian Shield to gain information about their petrogenesis. The lamprophyre and carbonatite dykes represent low-volume partial melts derived from an enriched lithospheric mantle. Enrichment patterns (high Ba, Sr, LREE; low HFSE; [1]) are consistent with carbonatite metasomatism in the source. The P<sub>2</sub>O<sub>5</sub> content of the lamprophyres is around 4 wt%, consistent with the apatite saturation level of high temperature, low SiO<sub>2</sub> basic magmas [3]. This may indicate a P-rich residual phase remained in the mantle source.

Apatite macrocrysts in the lamprophyres are euhedral to subhedral and appear compositionally homogeneous in BSE images. Many grains also contain submicroscopic (<3µm) inclusions of monazite. The apatites are mildly enriched in Si and LREE and have positive Eu anomalies, typical for apatites from a metasomatised lherzolite [2]. Apatite macrocrysts in the carbonatites display alteration textures characteristic of autometamorphic reactions with the magmatic fluid, however unaltered domains are also enriched in Si and LREE with positive Eu anomalies. We therefore propose that the macrocrysts are mantle-derived xenocrysts.

Matrix apatite from the lamprophyres has a skeletal texture and shows a core-to-rim decrease in Sr and LREE content. These grains lack Eu anomalies, which supports our model both in that they are not genetically related to the macrocrysts and that they crystallised from P<sub>2</sub>O<sub>5</sub>-saturated lamprophyric magma during ascent and emplacement.

- [1] Andersson *et al.* (2006) *Lithos* **86**, 110-136. [2] Belousova *et al.* (2002) *Journal of Geochemical Exploration* **76**, 45-69. [3] Watson, E.B. (1980) *EPSL* **51**, 322 -335.

## Uranium isotope ratios in atmospheric deposits in Japan

Y. KIKAWADA<sup>1</sup>\*, K. ODA<sup>1</sup>, M. NOMURA<sup>2</sup>, T. HONDA<sup>3</sup>,  
T. OI<sup>1</sup> AND K. HIROSE<sup>4</sup>

<sup>1</sup>Sophia University, Tokyo 102-8554, Japan  
(\*correspondence: y-kikawa@sophia.ac.jp)

<sup>2</sup>Tokyo Institute of Technology, Tokyo 152-8550, Japan

<sup>3</sup>Atom. Energy Res. Lab., Musashi Institute of Technology,  
Kawasaki, Kanagawa 215-0013, Japan

<sup>4</sup>Meteorological Research Institute, Tsukuba,  
Ibaraki 305-0052, Japan

<sup>235</sup>U/<sup>238</sup>U ratios in atmospheric deposits in Japan, which had been collected with rainwater by Japan Meteorological Agency (JMA) and Meteorological Research Institute (MRI), were measured by ICP-MS after chemical separation of uranium using UTEVA resin.

The <sup>235</sup>U/<sup>238</sup>U ratios in the atmospheric deposits collected in March between 1963 and 2000 at Fukuoka, which is located at southeast Japan (Kyushu Island) and where Kosa events are observed in spring seasons, were slightly higher than the natural <sup>235</sup>U/<sup>238</sup>U ratio. No obvious secular change in the ratio was observed in those deposit samples through the period studied, while large amounts of anthropogenic radionuclides had deposited in the early 1960s because of nuclear test explosions.

Contrarily, the <sup>235</sup>U/<sup>238</sup>U ratio in the Reference Fallout Material (RFM) prepared by MRI, which is a mixture of atmospheric deposits collected at 14 monitoring stations of JMA located all over the Japanese Islands between 1963 and 1979, was significantly lower than the natural ratio. We conducted the HNO<sub>3</sub> extraction treatment for the RFM sample, and measured the <sup>235</sup>U/<sup>238</sup>U ratios in the leachate and in the residue separately. The ratio in the leachate (extracted part) was obviously lower than the natural ratio, whereas that in the residue (silicates part) was nearly the same as the natural ratio. This result suggested that uranium having the low <sup>235</sup>U/<sup>238</sup>U ratio, i.e., depleted uranium (DU), was not originally contained in mineral particles but was adsorbed on them secondarily. The <sup>235</sup>U/<sup>238</sup>U ratios in Japanese atmospheric depositions may show regional variation, since the <sup>235</sup>U/<sup>238</sup>U ratios in the Fukuoka deposits in the 1960s and 1970s were slightly higher than the natural ratio.

The present results suggest that DU had fallen in the 1960s or 1970s at some regions in Japan, and further indicate the possibility of the global fallout of DU in those times, although its origin is unknown.