Uranium enrichment in lithospheric mantle: Case studies from French Massif Central.

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Mantle xenoliths are often enriched in LILE relative to heavy REE. This feature is classically attributed to enrichment by melts/fluids infiltrated in the lithosphere. Moreover several recent papers have reported peridotite from world-wide continental occurrences characterized by selective U and Pb enrichment (e.g., Jochum et *al*., 1989; Ionov et *al*., 1995). However current interpretations of selective U enrichment in mantle xenoliths call upon post-eruption alteration involving U- and Pb-rich fluids.

Our ICP-MS study of a wide number of mantle xenoliths collected in various localities from French Massif Central confirms the widespread distribution of U-rich peridotites at the scale of this region (e.g., Alard et al., 1996). Virtually all the analyzed samples are selectively enriched in uranium with U_N/Th_N ratios as high as 60 in several samples. It is worth-noting that U- and Pb-rich xenoliths include peridotites which are otherwise depleted in highly incompatible elements, with compositions typical of unmetasomatized "Depleted MORB Mantle". The only noticeable exceptions are xenoliths characterized by overall enrichment of LILE and negative anomaly of HFSE, a signature which is commonly ascribed to mantle metasomatism by carbonate-rich melts. The U/Th ratio tends to be roughly correlated with Pb/Ce. In individual xenolith suit this ratio is well correlated with Sr/Ce and LREE/MREE.

In contrast with the conclusions of previous studies, our data indicate that the selective enrichment of uranium in mantle xenoliths is of primary origin. This is shown by (1) the absence of detectable alteration products in the studied samples, (2) the low U/Th values of the host lavas (≈primitive mantle values), (3) the fact that the elevated U/Th values of bulk rocks are also observed in separated minerals (olivine, cpx) analyzed after extensive acid-leaching, and (4) the absence of marked U anomaly in the samples affected by "carbonate-melt" metasomatism. Our data suggest that the U anomaly is not just overwhelmed by overall LILE but more likely erased.

On the basis of our results, we suggest that a considerable proportion of the subcontinental lithospheric mantle is characterized by U/Th ratio much higher than the primitive mantle value. Our data for acid-leached olivine separates indicate that fluid inclusions trapped in minerals have elevated U/Th value. Together with experimental evidence (Brenan et *al.*, 1995), this observation is consistent with uranium enrichment by water-rich small melt fractions (± Sr and LREE).These fluids might be either derived from subduction processes (e.g., Rosembaum et *al.*, 1997), or they may represent evolved liquids resulting from melt-rock reactions in the lower lithosphere, above a mantle plume (Bedini et *al*., submitted). The latter hypothesis is supported by 0D numerical simulation (Vernieres et *al.*, submitted) of reacting porous flow involving partition coefficient of water-rich small volume melts. This results -for the most soluble elements- from coupled chromatographic effect and source effects of reactions at decreasing melt-mass. If time-integrated, this U-enrichment could represent an efficient way for generate enriched isotopic reservoirs.

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