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U-Th-Nb-La Systematics of Archaean Komatiites from the 2.7 Ga Abitibi Sub-province: Implications for the Formation of Continental Crust and Lithosphere Recycling

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Hofmann and co-workers pioneered an elegant approach to addressing the inter-related questions of the source of oceanic basalts and crust-mantle separation. They showed that modern MORB and OIB have uniform ratios of Nb/U (47 ±10) and Ce/Pb (25 ±5), well above the ratios in either primitive mantle (30, 9) or continental crust (10, 4). They attributed the high Nb/U ratios in modern MORB and OIB to the formation of continental crust through subduction process which increases Nb/U in the subducted and recycled oceanic crust [1, 2].

There is increasing evidence that komatiites and spatially associated basalts from Archaean greenstone belts may have been generated in plumes originating from the deep mantle, with komatiites generated in the hot “plume tail” and the basalts reflecting upper mantle entrainment [3]. Accordingly, we extend the approach of Hofmann and co-workers to examine U-Th-Nb-REE systematics in Archaean komatiites, and to address the sources of Archaean mantle plumes and lithosphere recycling. New high precision trace element data for selected komatiites, screened for alteration and crustal contamination, from the Abitibi belt are reported. Samples were analysed using a high sensitivity VG PQ3 S ICP-MS, due to the extremely low concentration of these elements in komatiites.

The komatiites have Nb/U between 28-58 and Nb/Th between 8-20, extending from near to predominantly greater than the primitive mantle values (30, 8, respectively), but higher than continental crust (10, 3), and similar to values observed in modern MORB and OIB [Figure 1]. There is a good correlation between Nb/U and Nb/Th, suggesting that the large range of Nb/U in komatiites is not due to the mobility of U during secondary alteration [Figure 1]. In contrast, there is no correlation between Nb/U, Nb/Th and Eu anomalies which is generally considered an indicator of the degree of secondary alteration. The U-Th-Nb-REE systematics also rule out continental crust contamination as the cause of observed Nb/U and Nb/Th ranges in Archaean komatiites, as supported by depleted Sr, Nd and Pb isotope ratios. The Nb/U ratios of komatiites are in agreement with ratios (35-47) calculated in Kostomuksha komatiites based on Th-U-Pb relationships [4], and the higher ratios extend into the field of modern Icelandic plume basalts and picrites [Fig. 1; 5] The high Nb/U and Nb/Th ratios are interpreted as recycling of subduction processed oceanic lithosphere into the deep mantle source of komatiites. Given the formation of arc crust complementary (low Nb/U, Nb/Th) to the recycled subduction processed oceanic lithosphere, these results may signify early extraction of continental crust from the mantle. The trend in komatiites to larger values of Nb/U and Nb/Th than spatially associated tholeiitic basalts from the Yilgarn and Abitibi terranes [4, 5, 6] is consistent with the plume model in which komatiites are generated by deep melting of “plume tail”; containing a larger proportion of deep recycled oceanic lithosphere [3]. In contrast, tholeiites associated with komatiites are generated by shallower melting of the “plume head” which may contain less recycled oceanic lithosphere and some recycled continental lithosphere, as shown by Nb/U (26-48) and Nb/Th (8-14) ratios spanning lower ranges than komatiites, and extending below primitive mantle values [5, 6].

[1] AW Hofmann et al, *Earth Planet. Sci. Lett*, **79**, 33-45, (1986).
[2] AW Hofmann, *Science*, **275**, 498-499, (1997).
[3] IH Campbell et al, *Nature*, **339**, 697-699, (1989).
[4] IS Puchtel et al, *Earth Planet. Sci. Lett*, **155**, 57-74, (1998).
[5] PJ Sylvester et al, *Science*, **275**, 521-523, (1997).
[6] R Kerrich et al, *Earth Planet. Sci. Lett*, **168**, 101-115, (1999).