The origin of the REE-rich, Strange Lake A-type peralkaline granite, revealed by O and Sm-Nd isotopes

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Although it is well known that peralkaline granites commonly form in anorogenic tectonic settings, the processes controlling the concentration of the REE/HFSE are still under debate. The 1240 Ma Strange Lake peralkaline granitic pluton, located in northern Québec-Labrador, Canada, is an extraordinary example of hyper-enrichment of the REE, Zr, and Nb in an A-type granite. Quartz mineral separates from the unaltered hypersolvus and subsolvus granite units of the 6 km diameter cylindrical pluton were analysed for their oxygen isotope composition. The $\delta^{18}O$ values range from +8.16 to +8.93 ‰ (relative to VSMOV), which are within the range typical for A-type granites. These values are considerably higher than the mantle value (5.7 ± 2 ‰) and thus indicate a substantial crustal component in the magma. This interpretation is supported by the Sm-Nd data. The age-corrected εNd values range from -0.34 to -4.07 for arfvedsonite separates and from -0.62 to -3.53 for whole rock samples; the $^{143}Nd/^{144}Nd$ values range from 0.51192 to 0.51230 and from 0.51141 to 0.51202, respectively. The negative εNd and relatively low $^{143}Nd/^{144}Nd$ values also indicate an appreciable crustal component, with the relatively little range in εNd implying little variation in the proportions of the crustal and mantle components. Our results are very similar to those of Konnerup-Madsen (1980), Sheppard (1986a) and Marks et al. (2004) for the 1152 Ma Ilimaussaq alkali granite (Gardar province, southern Greenland), which we believe shares the same tectonic environment ($\delta^{18}O$ = +9.2 to +9.3 ‰ for quartz, εNd = -3.1 and $^{143}Nd/^{144}Nd$ = 0.51183 for arfvedsonite). These authors interpreted their data as indicating significant crustal contamination, while noting that the nearby related more mafic rocks have the isotopic signatures of uncontaminated mantle melts.