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Lithium abundance and isotope composition of Logudoro basalts, Sardinia : constraints on the EM1 source

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Li isotope ratio (7Li/6Li) in seawater altered oceanic crust is significantly higher than normal mantle material. The fate of the heavy lithium is still uncertain because it is not clear whether the heavy Li can survive throughout subduction processes. Several samples from mid ocean ridges, HIMU and EM-2 type oceanic island basalts (OIBs) have been analyzed and show slight Li isotopic range of variations. As to Li isotopic composition of EM1 sources, extremely light Li isotopic ratios were reported from clinopyroxene grains separated from mantle xenoliths which have similar Nd and Sr isotopic signatures with EM1 source. Basalts from the Logudoro, Sardinian island, Italy, with the EM1 signature, have been analyzed to provide data on so far an unknown reservoir.
The Li concentrations of the Logudoro basalts vary between 7.7 and 10.8 ppm, which is within the common range of Li contents in OIBs. Nevertheless, Li/Dy ratio of Logudoro basalts ranges from 1.9 to 2.9, with the average of 2.4, higher than those of most OIBs. The results of model calculations suggest that high Li/Dy ratios of Logudoro basalts are ascribed to partial melting processes occurred at pressure higher than those of ordinary OIBs, and result from the large amount of residue garnet during the partial melting compared to other OIBs. The Li isotopic compositions of Logudoro basalts range from delta7Li = + 1.5 to + 3.6 permil. These ratios are similar to or slightly lower than ordinary mantle materials, but no sample of Logudoro basalts shows extremely light Li isotope ratios. The observed isotopic compositions are similar to those reported for lower dyke complexes in the oceanic crust and are supports the hypothesis for which the Logudoro basalts were derived from recycling of the fresh lower part of the oceanic crust. The fast diffusion of Li in the mantle prevent the Li isotopic ratios of OIBs from preserving the original Li isotopic ratio of recycled mantle source, and Li isotopes of OIB is diffucult to constrain the specific source material recycled in the mantle. Nevertheless, Li isotopic ratios of Logudoro basalts are suggestive that highly altered oceanic crust of heavy Li can be excluded for the mantle source of EM1, including Pitcarin island.

Keywords: Li isotope, EM1, OIB, Sardinia, mantle heterogeneity