Ce-Nd isotopic composition of the continental crust: first data on middle and lower crustal rocks

CLAUDINE ISRAEL1, MAUD BOYET1, RÉGIS DOUCELANCE1, PIERRE BONNAND1, BRUNO DHUIME2, DMITRI IONOV2 AND MATTHEW G. JACKSON3

1Laboratoire Magmas et Volcans, Université Clermont-Auvergne
2Géosciences Montpellier, Université de Montpellier
3University of California, Santa Barbara

Presenting Author: claudine.israel@uca.fr

The accessibility of the continental crust (CC) sharply decreases with depth. The upper crust is relatively well-known but the geochemical composition of the deepest parts of the crust is harder to estimate. Our recent study combining the measurement of \(^{138}\)La-\(^{183}\)Ce and \(^{147}\)Sm-\(^{143}\)Nd systematics showed that the upper crust isotopic composition defined by loess measurements plots on the regression line that defines the mantle array [1]. Mass balance estimates for silicate reservoirs predict that (1) the bulk CC is off the \(\varepsilon\)Ce-\(\varepsilon\)Nd mantle array; (2) the lower crust plots in the lower left quadrant of the \(\varepsilon\)Ce-\(\varepsilon\)Nd diagram. The aim of this study is to better characterize the CC for the La-Ce systematics.

We analyzed Hf, Nd and Ce isotopic composition of upper to lower crustal rocks from four locations: xenoliths from the French Massif Central; uplifted crust from the Southern Ivrea-Verbano zone (Italy); Paleoproterozoic to Archaean xenoliths from Udachnaya (Siberian craton); and composite samples from the Precambrian Canadian upper crust. Most of the samples are located along mantle arrays in the \(\varepsilon\)Ce-\(\varepsilon\)Nd and \(\varepsilon\)Hf-\(\varepsilon\)Nd isotopic plots, except Siberian samples whose isotopic compositions plots well below the \(\varepsilon\)Ce-\(\varepsilon\)Nd array.

Siberian samples deviate from the mantle array as predicted in the calculations for the lower crust end-member. Such compositions have not been measured so far and contrast with results obtained on the Lu-Hf and Sm-Nd systematics for which all sub-crustal reservoirs plot on the mantle array alignment [2]. The mantle array deviation in \(\varepsilon\)Ce-\(\varepsilon\)Nd space reflects fractionation of La/Ce relative to Sm/Nd. The La-Ce systematics for Siberian samples has evolved in a closed system since 1.8 Ga that corresponds to large-scale delamination and rejuvenation of the Archean lower lithosphere [3]. A large database from the literature including Archean and post-Archean granulite samples from the lower crust will be used to better understand the parent/daughter fractionation processes through time and discuss the representativeness of our results at global scale.