

^{138}La - ^{138}Ce and ^{147}Sm - ^{143}Nd isotope composition of the main silicate reservoirs and implications for the rare earth elements pattern of the Bulk Silicate Earth

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Compositional and evolutionary models of the Earth need to constrain the chemical and isotopic compositions of its main reservoirs. For this purpose, we propose to combine the measurements of two isotope systems: ^{138}La - ^{138}Ce and ^{147}Sm - ^{143}Nd . Parent and daughter elements are from the rare earth element group (REE) and their behaviour are well-known during magmatic processes. Furthermore, chemical and analytical procedures recently developed allow us to further explore the domain of Ce isotope systematics in the context of planetary evolution.

We report high precision Ce and Nd isotope measurements of chondrites, mid-oceanic ridge basalts (MORB), ocean island basalts (OIB) and aeolian sediments. The mean value of 9 chondrites gives the reference for the CHondritic Uniform Reservoir (CHUR): $^{138}\text{Ce}/^{142}\text{Ce}_{\text{CHUR}} = 0.02256577 \pm 66$ (2 s.d.). MORB and OIB define a negative, linear correlation called the mantle array in the $\epsilon^{143}\text{Nd}$ vs. $\epsilon^{138}\text{Ce}$ diagram. The corresponding best fit is: $\epsilon^{143}\text{Nd} = -7.93 \times \epsilon^{138}\text{Ce} + 0.37$. The CHUR plots on the mantle array. This is also the case for two early-depleted reservoirs we modelled assuming Sm/Nd increases of 3.6% and 5.6% (relative to chondrites) in order to explain ^{142}Nd excesses of 10 and 16 ppm in modern terrestrial samples relative to chondrites. The precise determination of the mantle array does not provide any constraint on the La/Ce and Sm/Nd ratios of the Bulk Silicate Earth (BSE).

We went further by modelling a consistent Ce isotope composition for the continental crust (upper-middle-lower) assuming a BSE with chondritic REE ratios. Our isotopic values for the continental crust highlight a stronger fractionation of the La/Ce ratio between the crustal reservoirs than that observed for the Sm/Nd ratio.