Nickel isotope composition of the upper continental crust

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The Nickel (Ni) isotope composition of the Bulk Silicate Earth (BSE) has been estimated at the range of 0.05 ± 0.05‰ to 0.23 ± 0.06‰ for δ^{60}Ni values [1,2,3]. However, as one of the important reservoirs of Ni in Earth, the δ^{60}Ni value of the upper continental crust (UCC) is poorly constrained. Here, a suite of samples (n=60) including granites, loess, stream sediments and glacial diamictites were selected, and their Ni isotope compositions were accurately and precisely determined by double spike MC-ICP-MS, in an attempt to estimate the Ni isotope composition of UCC.

The average δ^{60}Ni values of granites are 0.07±0.08‰ (2SD reported for all data here, n=10) for I-type, -0.02±0.19‰ (n=3) for A-type and 0.23±0.17‰ (n=8) for S-type. The average δ^{60}Ni values of loess, stream sediments and glacial diamictites are 0.07±0.08‰ (n=22), 0.10±0.05‰ (n=5) and -0.02±0.13‰ (n=12), respectively. The δ^{60}Ni values in all these samples range from -0.16‰ to 0.31‰, demonstrating the slight fractionation of Ni isotopes in different geological endmembers on Earth surface. The weighted average, arithmetic average and median of δ^{60}Ni values (n=60) are 0.08±0.19‰, 0.07±0.18‰ and 0.07‰, respectively. These values are identical within error. Taken together, the weighted average, 0.08±0.19‰ (n=60) is chosen to represent the average Ni isotope composition of UCC.

Compared with river water (δ^{60}Ni = 0.88‰) and sea water (1.44‰) [4], UCC has lighter Ni isotope composition, indicating that there is obvious Ni isotopic fractionation during continental rock weathering and water-rock interaction. It is seen that the heavier isotopes of Ni are transported into the ocean from the upper continental crust via rivers. The results provide a benchmark for understanding the processes of the biogeochemical cycle of Ni on the global scale.

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