

Long-term preservation of early-formed silicate reservoirs in the deep mantle: New insight from ^{146}Sm - ^{142}Nd systematics in Hawaiian basalts

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The Hawaiian mantle plume rises from the northeastern edge of the Pacific LLSVP near the core-mantle boundary [1]. Geochemical studies of Hawaiian lavas revealed two distinct geochemical trends, Loa and Kea [2]. The heterogeneous nature of Hawaiian sources reflects the long-term recycling of surface material and the potential preservation of early-formed reservoirs in Earth's deep mantle. To provide new insight into the nature of deep mantle chemical heterogeneities, we present high-precision isotopic measurements of the short-lived ^{146}Sm - ^{142}Nd system in ~30 Hawaiian basalts from 12 different volcanoes.

Variations in $^{142}\text{Nd}/^{144}\text{Nd}$ (expressed in m^{142}Nd , the variation relative to the terrestrial standard JNdi-1 in parts per million) measured in terrestrial rocks are small and do not exceed ± 20 ppm. The largest variations are measured in Archean samples. However, in modern samples, the variations do not exceed ± 5 ppm and claimed resolved variations exist in very few ocean island basalts (OIBs) [3,4]. Resolving ppm-level m^{142}Nd variation is the next step toward better understanding the formation of early Earth reservoirs and their potential preservation in the convective mantle.

Samples in this study have been measured by thermal ionization mass spectrometry using two different dynamic routines (2- and 4-lines measurements) and long runs (up to 1080 cycles). The external reproducibility obtained on standards measured with the 4-lines dynamic routine equals 2.4 ppm (2sd, $n=12$). Statistical analysis of the results shows that Hawaiian lavas have m^{142}Nd similar to the composition of the terrestrial standard (weighted mean = 0.50 ± 0.55 , 95% confidence interval). We obtain a similar result when samples are subdivided into their Hawaiian geochemical group (e.g., Kea, Loa). These new results allow us to 1) discuss the source of the Hawaiian basalts and 2) re-evaluate the global dataset of m^{142}Nd anomalies measured in OIBs in light of the small difference proposed between mid-ocean ridge basalts and OIBs [5].

[1] Garnero et al., 2016. *Nature Geoscience*, 9(7). [2] Weis et al., 2011. *Nature Geoscience*, 4(12). [3] Horan, et al. 2018. *EPSL*, 484. [4] Peters, B. J. et al., 2018. *Nature*, 555(7694). [5] Peters, et al., 2024. *GPL*, 29.