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Constraints of barium isotopes on oceanic crust recycling in the mantle

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The mantle is geochemically heterogeneous on variable scales based on radiogenic isotopes (e.g., Sr-Nd-Pb-Hf). However, origin of the mantle geochemical heterogeneity has long been debated. A potential origin of such heterogeneities is subduction of ancient oceanic crust. Because barium isotopes are significantly fractionated during surface processes, and such fractionation may be preserved in the mantle after subduction. Thus, the barium isotopes may provide a novel perspective on the role of recycled oceanic crust in the mantle heterogeneity. The content of Ba in the oceanic crust (including igneous oceanic crust and sediments) is much higher than that in the mantle, and limited barium isotopic fractionation has likely occurred during mantle melting and mantle melting processes. In this study, we have analyzed samples of N-MORB, E-MORB, OIB (typical seamount chain and oceanic plateau) samples with variable low-temperature alteration degrees from the global oceanic settings for Ba isotopes. The results show that seafloor low-temperature alteration increases Ba content and lowers Ba isotopic ratios ($\delta^{138/134}$Ba, relative to SRM 915a). The $\delta^{138/134}$Ba of fresh E-MORB (average of 0.05 ± 0.03‰ (2SD, N = 5)) and OIB samples (average of 0.01 ± 0.03‰ (2SD, N = 17)) are between the altered N-MORBs. Our geochemical modeling indicates that the variability of Ba isotopes of the enriched mantle reservoirs can be explained by the addition of AOC into the mantle. We propose that recycling of altered oceanic crust with variably low $\delta^{138/134}$Ba in the mantle has potential to generate Ba isotopic heterogeneity in the mantle.