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Effect of chemical and isotopic variation of DMM and addition of sediments on the estimation of recycling ages of oceanic crusts

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To constrain a timescale of material cycling in the Earth, we propose a new method in which the recycling ages of oceanic crusts were determined by combining the Pb and Nd isotopic compositions of ocean island basalts (OIBs). This method is based on three assumptions: (1) source areas of OIBs of which $^{87}Sr/^{86}Sr < 0.704$ and $^{143}Nd/^{144}Nd > 0.5128$ consist primarily of recycled oceanic crust and DMM (depleted MORB mantle or surrounding upper-mantle peridotite); (2) the model age of recycled oceanic crust in an OIB source is identical to its recycling age; and (3) present-day oceanic crust compositions inferred from MORB compositions can represent those of the ancient oceanic crusts. Under these assumptions, each OIB source has two unknowns: (a) the model age (recycling age) and (b) the mixing ratio of recycled oceanic crust and DMM in the OIB source. Since there are two equations of the Pb–Pb and Nd model ages, these two unknowns, the recycling age of oceanic crust and the mixing ratio, are uniquely determined from a single set of OIB isotopic compositions. The advantage of this approach is that it enables the estimation of the age distribution of recycled oceanic crusts within each hotspot, as determined by the OIB isotopic diversity. The obtained recycling ages of oceanic crusts in HIMU sources were characterized by single peaks at 1.7 Ga for Pacific HIMU and 1.9 Ga for Atlantic HIMU. In contrast, the age distributions of non-HIMU hotspots ranged over 0.88 to 2.6 Ga and included multiple peaks. The issue of this method is the effect of sediment on the estimated recycling ages because the sediments are ubiquitously present on the top of oceanic crust. Another issue is that chemical and isotopic variation in DMM because DMM experienced melting event with different extent. In this presentation, the recycling ages of oceanic crust will be evaluated using selected OIBs. Furthermore, the effect of sediment contamination and chemical and isotopic variation of DMM on the recycling ages will also be discussed.