

# Petrogenesis of ocean island basalts: implications from major element and isotopic diversity

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Ocean island basalts (OIB) show large diversity in isotopic ratios, which have been attributed to involvement of recycled subducted crustal material in their source regions. Major element compositions of OIB are also diverse, and they can be classified to two types: silica-saturated tholeiites and silica-undersaturated alkali basalts. These two types of basalts can be produced by partial melting of variations of subducted basaltic crust, as demonstrated by recent high-pressure melting experiments. Thus, major-element and isotopic characteristics of OIB seem to be consistent with recycling of subducted crustal material into their sources. However, involvement of recycled subducted crust cannot thoroughly explain both the major elements and the isotopic ratios of OIB. In this study, I attempt to impose new constraints on petrogenesis of OIB in the context of recycling of crustal material, based on compilation of OIB geochemical data and experimental phase equilibria of mafic lithologies.

The isotopic diversity of OIB can be expressed by mixing of four end-member components: DMM, EM1, EM2, and HIMU. Among these components, EM1 OIB are found in hotspots where there are volcanoes predominated by tholeiitic lavas (e.g., Hawaii and Pitcairn-Gambier). The EM1 end-member tholeiites from Oahu Island (Hawaii) and alkali basalts from Pitcairn Island are richer in silica compared with lavas of their neighbor islands. Thus, EM1 OIB suites are closely associated with silica-rich tholeiites or silica-rich alkali basalts. On the other hand, HIMU basalts have most silica-undersaturated compositions among worldwide OIB.

Subducted basaltic crust has diverse lithologies through subduction-related processes. The uppermost part of subducted crust suffer from partial melting and/or dehydration upon subduction, forming silica-poor biminerale pyroxenite at high pressure, and the deeper part subducts with its original MORB-like composition, resulting in forming silica-excess pyroxenite. Melting phase equilibria of pyroxenites and behaviors of trace elements during subduction suggest that silica-poor pyroxenites can produce alkali basalts with HIMU-like isotopic ratios and that MORB-like pyroxenites can produce tholeiites with EM1-like isotopic ratios. In other words, variations in lithology and trace element composition of subducted basaltic crust could explain both major-element and isotopic diversities of OIB.