Geophysical Research Abstracts
Vol. 19, EGU2017-2467, 2017
EGU General Assembly 2017

Mantle Sources and Tectonic Affinities of the Accreted Basalts in Southern Taiwan

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Accreted basalts provide critical information on mantle nature, tectonic evolution, and mass transport in convergent boundaries. In this study, nineteen accreted basalts from southern Taiwan on the convergent boundary between Eurasia and Philippine Sea plates were analyzed for element concentrations as well as Sr, Nd, Hf, and Pb isotope ratios to investigate their petrogenetic and tectonic significance. All the samples contain $>$ 2% L.O.I., reflecting post-magmatic alteration. The invariability of REE and HFSE abundances relative to the L.O.I. content indicates that these two element groups remained intact after magmatic processes. In contrast, Rb, Sr, and Ba were relatively mobile as indicated by the scatterings in the concentration plots of La versus these three elements. Pb is also mobile but to a lesser extent; therefore, Pb isotope ratios generally reflect characteristics of mantle sources. The Pb and Nd isotope ratios and REE patterns classify the samples into derivation from the N-MORB, E-MORB, and OIB sources. REE simulations showed that the N-MOEB-like high-HREE samples were evolved melts after 30–40% crystal fractionation from a primary melt generated by $\sim$20% melting with residual spinel in a source having La and Ce abundances 1.33 and 1.23 times higher than those of the DMM-HS source, respectively. The N-MORB-like low-HREE samples were similarly generated, however, from a relatively depleted source with residual garnet, implying heterogeneity in the N-MORB source. The two E-MORB-like samples required high extents of LREE enrichment in their sources; specifically, 3.1 and 5.5 times for the La relative to the DMM-HS source for the flat and LREE-enriched patterns, respectively. They, therefore, cannot be derived from the N-MORB source by lower melting degrees, reflecting the role of enriched sources. If the OIB-like samples were generated by $\sim$10 % melting with residual garnet, their mantle source should have LREE and MREE concentrations higher than those of the DMM-HS source by factors of $\sim$9 and $\sim$2, respectively. There is no geochemical similarity between these accreted basalts and the ocean floor basalts from the so-called “Taiwan Sea” or “Huatung Basin” in the south and southeast of Taiwan. The OIB-like samples have Pb–Nd–Hf isotopic systematics showing an affinity to the overriding Philippine Sea floor, whereas all but one N-MORB-like samples, on the basis of the TiO_2–P_2O_5 discrimination plot, were considered as representatives of the subducting South China Sea basalts. The occurrence of hornblende phenocrysts and hornblende-containing nodules in the exceptional N-MORB-like sample is suggestive for an arc origin from the Philippine Sea plate. Accordingly, it is inferred that the dominance of an affinity to the subducting plate for the N-MORB basalts in the accretionary prism can be indicative of the subduction polarity.