Volcanism above a stagnant slab: Constraints from Cenozoic alkaline basalts in eastern China and Korea

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The late Cenozoic off-arc volcanism in eastern Eurasia is characterized by eruption of basalts with high alkalinity, especially after Japan Sea opening in the middle Miocene (~15Ma). Although large geochemical variation is observed in these alkaline basalts, we found two important geochemical end-members of the low-FeO and high-FeO basalts in terms of major and trace elements and isotopic compositions. The low-FeO alkaline basalts are depleted in FeO* and TiO_2, enriched in SiO_2, Al_2O_3, and fluid-mobile trace elements (e.g., Rb, Ba, K, and Pb), and show enriched Sr-Nd isotopic compositions. The geochemical study on the low-FeO basalts from Chugaryeong volcano in central Korean Peninsula shows a significant contributions of the fluid components to the basalts from a higher melting degree. These basalts have radiogenic Nd and ^{206}Pb with radiogenic Sr and ^{208}Pb, being plotted close to those in the subducted sediments. These lines of evidence suggest that the low-FeO basalts are strongly influenced by the sediment-derived fluid flux derived from the stagnant Pacific plate slab in the mantle transition zone (MTZ). The high-FeO alkaline basalts are extremely enriched in FeO* and TiO_2 and depleted in SiO_2, Al_2O_3, and fluid-mobile trace elements. The trace element compositions are similar with those in the ocean island basalts (OIBs) with HIMU isotopic signatures. The Shangdon high-FeO basalts in eastern China, however, show a depleted Sr-Nd and unradiogenic Pb isotopic compositions in contrast to the extremely radiogenic Pb in the HIMU OIBs. This suggests a young-HIMU source for the high-FeO basalts. Distribution of the high-FeO basalts is limited in the middle to eastern China in 119°E/30–40°N where the leaing edges of the stangant Pacific plate slab underies in the MTZ. None of the high-pressure melting experiment on a peridotite has reproduced melt composition with such the high-FeO, whereas partial melting of a carbonated eclogite with or without peridotite can generate a high-FeO basalt. These suggest that the high-FeO basalts have significant contributions from dehydrated carbonate-bearing oceanic crust of the stagnant Pacific plate slab. The young-HIMU signatures are also consistent with the short-term ingrowth of its isotope systems.