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Paleoproterozoic sediment recycling leads to LOMU signature in hydrous asthenospheric mantle

○Dey Bidisha[1], Shibata Tomoyuki[1], Yoshikawa Masako[1]
([1]Hiroshima University)

We present new geochemical and petrological data from Higashi-Matsuura alkali basalts that reveal the presence of a low-μ (LOMU) type mantle component beneath southwestern Japan. Radiogenic isotopic ratios, measured at Hiroshima University (TIMS MAT-262), suggest low $^{206}Pb/^{204}Pb$ values (ranging from 17.72 to 18.04) combined with moderate $^{87}Sr/^{86}Sr$ values (ranging from 0.7041 to 0.7044), indicating similarity to the low-μ type mantle component found in East Asia (e.g., Changbaishan, Wudalianchi, Xiaogulihe, etc.).

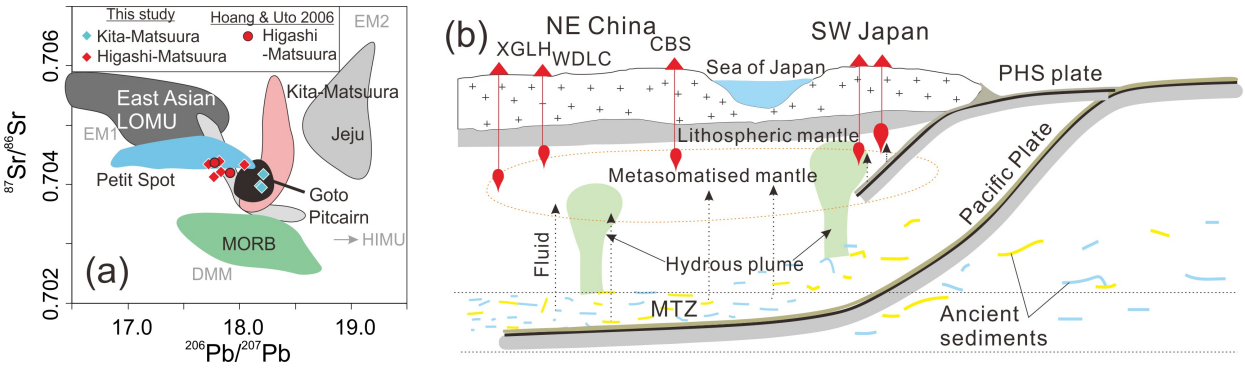

Fig. 1. (a) Pb and Sr isotopic ratios of measured alkali basalts from the Matsuura region with respect to reported data from nearby areas and other mantle components. Samples from Higashi-Matsuura show LOMU- like characteristics. (b) Schematic diagram of tectonic setting and magmatism for East Asian LOMU basalts.

The origin of these basalts has been investigated using petrologic and thermobarometric methods, which indicate that the primary magma was generated at a pressure of 1.9 to 2.1 GPa and a temperature of 1370 to 1400°C. The water content of the basaltic magma, corresponding to about 2.0 wt%, was determined using a pyroxene hygrometer (Perinelli et al., 2016), suggesting hydrous conditions during mantle melting with about 1700 ppm H_2O in the source mantle. Previously, a hydrous asthenospheric mantle (> 1.8 GPa) originating from the stagnant Pacific Plate had been suggested for northern Kyushu (Sakuyama et al., 2014; Kuritani et al., 2017). However, this model does not explain the LOMU type isotopic character of these basalts. To address this issue, we compare the radiogenic Pb isotope ratios of LOMU type basalts from East Asia and present a Pb isotope evolution model that explains the isotopic ratios of the East Asian LOMU basalts. The results of the model indicate that the LOMU end member was generated by mixing between two Paleoproterozoic subducted sediment components that evolved independently for 1.8 and 2.2 Ga with a low U/Pb ratio. The present-day East Asian LOMU basalts are the product of mixing between the LOMU end member and a MORB-like component that may have originated from the lithospheric mantle.