Isotopic and geochemical constraints on the origin of the Sea of Japan

S. OKAMURA[1], R.J. ARCULUS[2] AND Y.A. MARTYNOV[3]

[1] Sapporo Campus, Hokkaido Education University; okamura@sap.hokkyodai.ac.jp
[2] Department of Earth and Marine Sciences, Australian National University, rarculus@ems.anu.edu.au
[3] Far East Geological Institute; martynov@fegi.ru

Sikhote-Alin and Sakhalin (SAS) are located in the Russian Far East Flank of the northernmost part of the Sea of Japan. Magmatism in this region preceded, was concurrent with, and continued after the extension and sea floor-spreading that formed the Sea of Japan.

The Sr-Nd-Pb isotopic and trace element systematics between the Eocene-Oligocene basalt and Early-Mid Miocene basalt suggest that the sites of magma generation beneath the SAS region have moved from the subduction-related, EMII-like mantle lithosphere deeper into MORB-type asthenosphere as spreading progressed in the Sea of Japan.

The post-Sea of Japan opening Mid Miocene-Pliocene lavas exhibit wide ranges in trace element abundances that vary between two distinct end member types. The minor Mid Miocene-Pliocene alkali basalts have OIB-like trace element and Sr-Nd-Pb isotope compositions, similar to the Cenozoic alkali basalts from the Sino-Korean Craton, consistent with melting of asthenospheric mantle at depth. By contrast, the Mid Miocene-Pliocene tholeiites form the other extreme with HFSE concentrations that are much lower than those of elements of similar incompatibility. The wide range of incompatible-element abundances in the Mid Miocene-Pliocene basalts defines coherent trends consistent with a mantle mixing between an isotopically enriched FOZO-type asthenospheric mantle and an isotopically enriched EMI-type subcontinental lithospheric mantle.

The appearance of the FOZO- and EMI-type components in the post-opening Mid Miocene-Pliocene basalts may reflect mantle flow into the region through asthenospheric injection under the Sino-Korean Craton that led to thinning of the subcontinental lithosphere via partial delamination. It is likely that the Japan Sea opening and associated magmatism in the back-arc basin were triggered by lateral migration of the FOZO-type asthenospheric mantle from beneath northeast China toward the Japan arc during late stages of Tethyan closure by the India-Asia collision.