Li-Sr-Nd isotopic systematics of the mantle-derived xenoliths

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Isotopic signatures of mantle-derived xenoliths have provided much information on the evolution of their mantle source regions. A recently developed multiple-collector ICP mass spectrometry method that allows precise and accurate lithium isotopic determinations of Li-poor samples such as peridotites [1]. We present Li-Sr-Nd isotopic systematics of clinopyroxenes (CPXs) in mantle-derived ultramafic xenoliths. The results show that Ichino-megata (NE Japan) and Bullenmerri (SE Australia) samples have positive δ^7Li values (δ^7Li~ +4 ~ +7‰, δ^7Li= $[[^7Li/^6Li]_{sample}/[^7Li/^6Li]_{L\text{-}SVEC\ standard}$ -1] x 1000) common to values previously reported for terrestrial volcanic rocks. By contrast, unusually low δ^7Li values (δ^7Li ~ -17‰) are observed in many samples from Sikhote-Alin (the Far East of Russia) and Kurose and Takashima (SW Japan). The δ^7Li values of Sikhote-Alin samples vary widely from –17.1‰ to –3.1‰, while the δ^7Li values are positively correlated with ^{143}Nd/^{144}Nd, and negatively correlated with ^{87}Sr/^{86}Sr. On the other hand, the δ^7Li values of the Bullenmerri samples are essentially constant (δ^7Li = +5.0 ~ +6.0‰), while the ^{87}Sr/^{86}Sr and ^{143}Nd/^{144}Nd ratios vary widely. The Sr-Nd isotopic variation of both Sikhote-Alin and Bullenmerri samples can be explained by the results of binary mixing between a depleted component and an enriched component. It can be estimated that the enriched component (metasomatic agent) in the mantle beneath Sikhote-Alin area has extraordinary low δ^7Li value (<-17‰), whereas the metasomatic agent in the mantle beneath Bullenmerri area has positive δ^7Li value (+6‰). Based on the Sr-Nd isotopic systematics and coexistent hydrous mineral, metasomatic agents of the Sikhote-Alin and Bullenmerri samples are classified into anhydrous EM1-type and hydrous EM2-type, respectively. Therefore, we infer that anhydrous EM1-type metasomatic agent has a property of extremely low δ^7Li value, whereas hydrous EM2-type metasomatic agent has a property of positive δ^7Li value. Considering the Li isotopic fractionation model [2], the hydrous EM2-type metasomatic agent with a positive δ^7Li value may be attributed to dehydration fluids liberated from subducted slabs, whereas the anhydrous EM1-type metasomatic agent with an extremely low δ^7Li value may originate from the dehydrated slab residue.

References

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Coccolithophorids blooms and their chemical-controlling features in the Eastern Bering Sea

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After 1997, coccolithophorids blooms were frequently observed by research vessels and satellites in the Eastern Bering Sea shelf, where diatoms have had the most dominate distribution. Here, we present CTD, Chl-a, nutrient and phytoplankton data collected during cruises of the T/S Oshoro-Maru and R/V Mirai vessels in 2000, 2001 and 2002. Our goal is to refine the controlling features of coccolithophorids blooms by each species' composition of phytoplankton and water characteristics. Stations were mainly positioned at the 166°W observing line from 55°N to 59°N. For cell counting, seawater samples were filtered through a 25-mm Millipore HA (pore size: 0.45 μm) filter, and identification and counting of phytoplankton with a scanning electron microscope.

The scale of bloom and abundance of coccolithophorids were different in each year. The most dominant phytoplankton group was coccolithophorids in 2000, which agrees with the large bloom observed by satellite. In 2001, diatoms dominated at 70% and coccolithophorids accounted for 30% at 58, 58.5°N. In 2002, diatoms dominated at nearly 100% at all stations. Coccolithophorids abundance was nearly halted by pycnocline, since coccolithophorids existed in the middle shelf domain, which is known to be an area of cold-water pool distribution. The difference in density between the surface mixed layer and the cold-water pool gradually increased from 1980 to 2002, that is, seawater stratification in the middle shelf domain was strengthened as the result of the increased surface temperature and decreased salinity that have occurred recently. When stratification strengthens, the supply of nutrients to the surface from the cold-water pool is reduced. Consequently, coccolithophorids take precedence over diatoms in this condition. However, if the decreased salinity in the surface water depended on the increased river discharge, then the nutrients in the surface water would increase. River discharge has two peaks (spring and late summer) in one year (Chikita, 2001). Since river water contains high volumes of silicate and iron, an increase in river discharge would lead to the predominance of diatoms. The frequency and timing of storms, which influence the thickness of the surface mixed layer, may be another controlling factor of coccolithophorids blooms. In fact, there was a second peak in October 2000 and in August 2001. In 2000, the thickness of the surface mixed layer increased from July to September. Because the timing of storms and river discharges in summer controlled the stratification in the middle shelf domain, it greatly influenced the species' composition of phytoplankton.