Determination of lead isotopic ratios in ferromanganese crust by using MC-ICP-MS and NanoSIMS

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The isotopic compositions of such trace elements as Pb and Nd, which have short residence times in the ocean, are considered to be influenced by fluctuation of deep ocean circulation. Therefore, the isotopic compositions of those elements in seawater could be a sensitive tracer for investigation of deep ocean circulation.

Ferromanganese crusts are regarded as a natural archive of past deep ocean circulation. Because of quite low growth rates of crusts, a long range record of the fluctuation of deep ocean circulation is expected to be preserved in them. By using Pb, Nd and Hf isotopic compositions of crusts, intensive studies have been undertaken to reconstruct the past deep ocean circulation pattern [e.g., 1]. However, in those earlier studies, spatial resolution of determination spots for the isotopic ratios was ~1mm and it is equal to ~1Ma. Therefore, in order to improve the spatial resolution, we applied SIMS (NanoSIMS) analysis for determination of Pb isotopic ratios of crust. For evaluation of the data of NanoSIMS, the Pb isotope ratios were also determined by MC-ICP-MS method described in Tanimizu and Ishikawa [2].

We analyzed a ferromanganese crust collected at 19°N, 138°E in the Northwest Pacific Ocean. By using microdrilling technique (the spatial interval is ca. 1mm), we prepared the samples for MC-ICP-MS. The data obtained by MC-ICP-MS show a good agreement with in surface layer of other crusts collected in the Pacific ($^{206}Pb/^{204}Pb$; 18.67 for this study, 18.7 ± 0.1 by Klemm *et al*. [3]). However, in the bottom of the crust, our data are less radiogenic than those of layer with the same age (ca. 3Ma) for the other crusts ($^{206}Pb/^{204}Pb$; 18.48 for this study).

NanoSIMS analysis of Pb isotopic ratios of the crust sample was performed by a spatial resolution of 20µm. The data of NanoSIMS are lower than those obtained by MC-ICP-MS for the same layer. A possible cause of the difference between the data of NanoSIMS and those of MC-ICP-MS is the interference of ^{204}Hg on mass number 204 in NanoSIMS analysis. However, Hg concentration of the crusts is much lower than Pb concentration and cannot be a main reason for the discrepancy. Thus, there might be other unknown isobaric interferences or problems about sample preparations or analytical technique.

References

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Exsolution texture of alkali feldspar in a granite porphyry

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Microtextures of alkali feldspar are useful tool for petrologists to deduce the thermal history of felsic rocks. Exsolution texture is, for example, closely related to the cooling rate. In slowly cooled rocks the thickness of the exsolution is coarser than in rapidly cooled rocks. The relationship between the cooling rates and the wavelength of exsolution lamellae in alkali feldspars has for a long time been examined by many previous researchers, e.g., for rhyolitic lava flow [1] and for syenitic rock [2]. However, there are few studies on exsolution texture of alkali feldspar in porphyry with an intermediate cooling rate between volcanic and plutonic rocks. To examine the microtexture of alkali feldspar in felsic rock with the intermediate cooling rate, granite porphyry from the Kose granitic body was used in the present study.

The Kose granitic body is composed of cordierite-biotite granite and biotite granite porphyry [3] and located in the northern Omine acidic rocks which are one of Middle Miocene granites in the outer zone of Southwest Japan. In the granite porphyry, some phenocrysts of alkali feldspar can be clearly divided into textually-distinct two regions; in a presence and absence of the well-developed lamellar intergrowth in a microscopic scale. The latter regions look like 'homogeneous' by a petrographic microscope and SEM, but TEM observation proves a presence of the *fine lamellae* in a submicroscopic scale (hereafter, the lamellae observed in the former regions with a microscopic scale are denoted as the *coarse lamellae*). The chemical compositions of the latter regions without the coarse lamellae (Or54-63) are slightly lower Or contents than those of the former regions with the coarse lamellar intergrowth (Or60-64). Coarse lamellar intergrowth (1 µm in average) has an irregular periodicity and its interfaces between adjacent lamellae are straight and sharp, strongly indicating a formation due to the nucleation and growth mechanism. The wavelength of the fine lamellar intergrowth (40 nm in average), in contrast, is one order or more smaller than that of the coarse lamellar intergrowth. The fine lamellar texture has a regular periodicity and the interfaces are slightly waved and branched, indicating a formation due to the spinodal decomposition mechanism. The fact that these distinct types of exsolution lamellae each of which was formed by the different mechanism coexist in the same phenocryst can be explained by taking a kinetic effect into consideration even through the simple cooling process.

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