

Osmium isotopic composition of umbers in the late Cretaceous Japanese accretionary complex

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Submarine ferromanganese sediments (umbers) associated with *in situ* greenstones and red and black shales occur in the late Cretaceous Japanese accretionary complex (Shimanto Supergroup). The umbers exhibit remarkable enrichment of Fe, Mn, P, V, Co, Cu, Ni, Zn, Y, Mo and REEs. These elements/Fe ratios and PAAS-normalized REE patterns of the umbers are very similar to those of modern hydrothermal ferromanganese sediments that precipitated near mid-ocean ridges (MORs). These geochemical features suggest that a spectrum of sedimentary rocks (umbers and red and black shales) deposited near the trench where terrigenous materials from lands and hydrothermal ferromanganese suspended particulates from MORs were simultaneously supplied. This result supports that ridge-forearc collisions occurred near the late Campanian Japan (Kiminami et al., 1994). The umbers are considered to preserve original geochemical signatures of submarine hydrothermal sediments and suspended particulates that adsorbed various metals from pre-65 Ma seawater. Therefore, the Japanese umbers can be used as an excellent tracer of past seawater chemistry, like the Cyprus umbers (e.g., Ravizza et al., 1999).

Furthermore, it is very likely that the umbers record Os isotopic composition of late Cretaceous seawater. The ¹⁸⁷Os/¹⁸⁸Os ratios of the umbers range from 0.42 to 0.62. Our data do not agree with results obtained from the North Pacific pelagic clay core by using a hydrogen peroxide leaching procedure and ³He correction protocol (Pegram and Turekian, 1999). Pegram and Turekian (1999) reported an abrupt decrease in ¹⁸⁷Os/¹⁸⁸Os ratios at the K/T boundary (~65 Ma), which is ascribed to meteorite impact. However, our present measurement demonstrates this great excursion is most likely an artifact and that the short-term variation of ¹⁸⁷Os/¹⁸⁸Os due to the K/T impact is much more moderate.

References

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ATEM as a tool for the study of high pressure mineralogy

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Analytical transmission electron microscopy (ATEM) is a very powerful tool to study natural and synthetic ultrahigh pressure materials which are very small in amount and very fine in grain size, because ATEM provides us with both structures and compositions of those materials in a nano-meter scale. However, ATEM has several problems to be resolved. The first is that ultrahigh pressure materials are in general very weak against the electron beam and easily become amorphous. The second is that in widely used ion-thinning to make ATEM foils, elements are selectively removed from the surface area during ion-thinning.

We are trying to overcome the first problem by a high-sensitivity TV camera system for TEM. For the second problem, we examined ultramicrotomy to make ATEM foils. By an ultramicrotome with a diamond knife aggregates of submicron silicate perovskites synthesized by a multianvil cell or a laser-heated diamond anvil cell (DAC) could be sectioned into ultrathin foils down to 30 nano-meter thickness. However, some areas of the sectioned foils were often lost, and some deformation textures were introduced into the specimens.

With ATEM combined with a laser-heated DAC and synchrotron X-ray diffraction, we are studying cation solubilities and structure variations in silicate perovskites under the lower mantle conditions. The preliminary experiments revealed the following results. In the system CaMgSi₂O₆-CaFeSi₂O₆ at 30-80 GPa and 2000-2300 K, (Fe,Mg) solubility in CaSiO₃ perovskite significantly increases with the bulk Fe/(Mg+Fe) ratio and pressure, while Ca solubility in (Mg,Fe)SiO₃ perovskite remains very limited. In the system (Mg,Fe)SiO₃-Al₂O₃ at 35 GPa and 1800 K, Fe and Al solubilities in (Mg,Fe)SiO₃ perovskite have a positive correlation, indicating the formation of the Fe³⁺Al³⁺O₃ endmember in perovskite. In the system CaSiO₃-CaTiO₃, the perovskite phase in the intermediate composition has a double perovskite structure with a face-centered cubic lattice at 30 GPa and 1800 K, but it inverts to a lower symmetry phase during cooling.