

Geochemical and morphological features of manganese micronodules in REY-rich mud within the Minamitorishima EEZ, western North Pacific Ocean

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Manganese micronodules are small grains (< 1 mm) composed of manganese oxides, and constitute one of the important components of pelagic sediments. The micronodules show high contents of various heavy metals, especially of some redox-sensitive transition metals [1]. In addition to chemical compositions, the abundance and texture of micronodules can be affected by sedimentation rates and/or redox conditions of the sediment column [1, 2]. Therefore, the micronodules have been regarded as a useful indicator of the sedimentary environment.

Recently, deep-sea sediment extremely enriched in rare-earth elements and yttrium (REY) was discovered within the Japanese exclusive economic zone (EEZ) around Minamitorishima Island [3]. Previous studies reported that the extremely REY-rich mud contains significant amounts of biogenic calcium phosphate, which is a main host of REY, and phillipsite grains [3, 4]. In addition to them, manganese micronodules were also recognized in the sediment column, which were especially abundant in the extremely REY-rich layer [3, 4]. However, detailed features of the micronodules in the REY-rich mud within the Minamitorishima EEZ have not been investigated yet. Manganese micronodules in the REY-rich mud are about μm –mm ferromanganese oxides. Because their abundance and chemical compositions are considered to reflect respectively the sedimentation rate and redox conditions when they were buried [4], the micronodules can provide important constraints on the depositional environment of the REY-rich mud.

In this study, therefore, to characterize the manganese micronodules in the REY-rich mud within the Minamitorishima EEZ, we implemented (1) microscopic observations of the shape, surface texture, and relative abundance of the micronodules, and (2) bulk chemical analysis of them by using ICP-MS. We compared the geochemical features of the micronodules with those of macronodules both on the seafloor of the Minamitorishima EEZ, and also with those of macro- and micronodules in other areas.

The Minamitorishima micronodules are generally characterized by diagenetic features, although showing a compositional shift towards hydrogenetic features in some samples. Based on the integration of the observational and analytical results, we will discuss the possible changes in the sedimentary environment (e.g., sedimentation rates and redox conditions) involving the formation of the extremely REY-rich mud.

References

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