

Mineralogical Characteristics of Oceanic Polymetallic Nodules and the Activities of the Antarctic Bottom Water (AABW)

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Abstract: This paper has summarized the characteristics, such as the morphology, structural type, regional distribution and mineral assemblage, of ocean polymetallic nodules and their responses to the activities of the Antarctic bottom water (AABW). Scanning electron microscopy (SEM) was used to continuously observe the change of structural types during the growth of nodules, then Transmission electron microscopy (TEM) and X-ray powder diffraction (XRD) were used to analyze and further confirm mineral types of nodules. The results show that there are good responses among the morphology, structure type, and mineral assemblage of the polymetallic nodules, and those characteristics were influenced by the intensity of activities of the AABW. In the early stage of the formation, the core of the nodule was formed under conditions of strong activity of the AABW and relatively high oxidizability of the seawater. Thus the core has major manganese mineral of vernadite and major taxitic structure. In the middle and late stages, the shells of the nodule) were formed under conditions of relatively weak activity of the AABW and the relatively low oxidizability of the seawater. Thus, the shells have major manganese mineral of todorokite and structure types gradually transiting from the columnar structure to the lamellar structure. In addition, characteristics of the regional distribution and elemental variation of polymetallic nodules are closely related to the activities of the AABW. The strong activities of the AABW are often corresponded to the wide distribution of polymetallic nodules. The δCe_N and Ce / La values of the nodules in the active AABW area are obviously different to those of the nodules in the inactive AABW area.

Keywords: polymetallic nodules; mineralogy; Antarctic bottom water (AABW); oceanic environment; deep-sea mineralization