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Formation Patterns and Preservation Condition of Polymetallic Nodule

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ABSTRACT

The new concept of "structure layer unit" of polymetallic nodule is proposed based upon a great number of internal structure studies of nodules and their time-space relation to associated sediments. The growth and non-growth periods of the polymetallic nodule could be comparable respectively with depositional stages and sedimentary hiatuses of the sediments in the researching area. The whole formation process of the polymetallic nodule should take place in a certain environment that explained to be kinetic-static-progressive development. The condition for preservation of the polymetallic nodules depends on several factors such as biogenetic agency, intensity of bottom current, size of the nodules, static pressure from the overlay, sedimentation rate, tectonic environment and geochemical factor control. The polymetallic nodule nowadays occurred on the surface of sea bottom could be regarded as "survivors," because they will undergo to be dissolved away completely, if once deep buried by sediments.

KEYWORDS : polymetallic nodule, structure layer unit, formation and preservation of nodules

RAISING OF QUESTIONS

The polymetallic nodule is a very useful mineral resource formed in certain environment and occurred over the marine surficial sediments. Earlier investigation results indicate the sedimentation rates of associated sediments are more rapid than that of the nodules. But why did the nodules not be buried by sediments? Researchers have been interested in this question for a long time.

Another question is whether we can find relevant mineral beds of the polymetallic nodules in the marine of the ancient continents on the basis of the rule "present is the key of the past," since the polymetallic nodule is a geologic product over the long geologic history and distributed in world oceans.

Considering the data obtained from CP and CC blocks in Central Pacific Ocean during the three cruises of HY4-861, 871 and 881, the present paper considers that formation and preservation of polymetallic nodule are two aspects of the same question. So, well understanding of formation and preservation conditions of the polymetallic nodules are the key to reveal its distribution rule, and still further to forecast its enrichment areas.

FORMATION PATTERN OF POLYMETALLIC NODULE

It is well known that mineralization of polymetallic nodule is an extremely complicated process. It relies on many factors including material resources, element migration pattern, sedimentary environment, generation type, formation mechanism and pattern, etc.. The paper only discuss its formation pattern. Basically, the train of thought is to study the internal microstructure characteristics and the space-time relationship of the nodule growth to the associated sediments, which leads to the new concept – "structure layer unit" of the nodules. Finally, the author proposes a model of formation pattern of polymetallic nodule.

Internal Structure Characteristics of the Nodules

Examination of a number of polished sections under LM exhibited that the polymetallic nodule has greatly complicated textures. Ferromanganese minerals occur in form of noncrystalline, crypto- or microcrystalline aggregates.

According to the microtextures and assemblages feature, structures can be classified into 6 major types.

- Lamination structure: consists of low-reflectance ferromanganese clay and high-reflectance gray manganese-iron oxides or white ferromanganese oxides.
- Stromatolitic structure: comprises microlayers of anorphous ferromanganese oxides and clay minerals alternately, bending at large angle just like stromatolite. It is equivalent to what Marching et al. (1987) called Dendritic Zone.
- Columnar structure: consists of anorphous ferromanganese oxides and clay alternately, redially growing from core to surface toward the outer layers. The columnar type could be regarded as a variety of the stromatolitic structure, but differs from the following in having high peak and steep angle of micorlayer's flexion.
- Taxitic structure: contains two types. One is made up of dense, hybrid and discontinuous Laminations which grow around the porphyritic compositions. The other consists of one or more type structures irregularly.
- Dense massive structure: mainly comprises massive intergrowth of ferromanganese oxides.
- Concentric variolitic structure: consists of interlayers of clay microlayer with dark color and weak reflectance. Ferromanganese minerals show gray or gray-white color and stronger reflectance. Both two grow around one core.