Origin of Iron-Rich Montmorillonite from the Manganese Nodule Belt of the North Equatorial Pacific

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Abstract: Clay minerals in the upper 50 cm of sediment that surround the Cu- and Ni-rich manganese nodules in the North Equatorial Pacific form two fractions: terrigenous (mostly eolian) illite, chlorite, and kaolinite, and authigenic smectite. Smectite increases with depth in box cores from 26 to 39% and from 53 to 66% in the easternmost and westernmost areas respectively, and with distance seaward from the Americas from 26 to 53% in surface deposits. The change in the amount of smectite relative to other clay minerals is due to dilution by terrigenous debris; smectite probably forms at a uniform rate over much of the North Pacific deep-sea floor. The δO^{18} value for the smectite is +29.6‰ which suggests that it formed authigenically at a temperature characteristic of the deep-sea floor. The smectite is an Fe-rich montmorillonite that probably forms by the low-temperature chemical combination of Fe hydroxides and silica. Silica is derived from dissolution of biogenic debris, and the Fe hydroxide is from volcanic activity at the East Pacific Rise, 4000 to 5000 km to the east. Al in the authigenic montmorillonite may be derived from the dissolution of large amounts of biogenic silica or from river-derived Al that is adsorbed on Fe-Mn hydroxides in the oceans. The Fe-montmorillonite contains relatively abundant Cu, Zn, and Mn and is of possible economic importance as a source of these and other metals.

Key Words: Authigenic Formation • Deep-Sea Clay • Manganese Nodule Belt • Montmorillonite • Pacific Sediments • Smectite

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