Siliceous concretion in Miocene diatomaceous muddy rock, northeastern Noto Peninsula, central Japan

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Siliceous concretions called as "Koburi-ishi" are embedded in the diatomaceous muddy rocks from the Iizuka Formation of middle Miocene, the northeastern Noto Peninsula, central Japan. They have platy to ellipsoidal forms with 1-5 cm in diameter, are embedded in specific horizons or in association with faults, in the host diatomaceous muddy rocks which contain a large number of microfossils mainly of marine diatoms with radiolarians and sponge spicules. Here we describe the siliceous concretions mineralogically, and discuss their formative processes and environment.

Microscopic observation clarify that the siliceous concretions contain microfossils with hard matrices of siliceous phases and have concentric growth structure. This indicates that hard matrices phases were precipitated from interstitial solution. The XRD analysis for siliceous phases after the elimination of clay fraction indicates that both siliceous concretions and the host diatomaceous muddy rocks are composed of opal-A and opal-CT. The peak fitting assuming Gaussian distribution reveals that siliceous concretions contain more opal-CT than the host diatomaceous muddy rocks. The cristobalite in opal-CT from siliceous concretions has 4.121 ~ 4.137 Å, which is wider d-spacing of (101) than that from the host diatomaceous muddy rocks of 4.073 ~ 4.083 Å.

Original sediments of the host rocks from the Iizuka Formation were deposited under shallow marine environment. They were buried up to about 500 meters in depth of sedimentary sequences. Biogenic opal-A of diatoms in diatomaceous muddy sediments from the Iizuka Formation changed to opal-CT by the diagenetic phase transformation responsible for the burial depth. It is known that the sequences were uplifted repeatedly to the present location. The wider d-spacing of (101) of siliceous concretions suggests they were formed under shallower burial environment than host rocks. Considering that the solubility of silica in seawater is higher than that in meteoric water due to the contribution of Na-Si complex, the inflow of meteoric water by upheaval triggered the formation of the siliceous concretions. As the meteoric water invaded into a series of the sequences along permeable horizons or fault planes, mixing of interstitial seawater of the host diatomaceous muddy rocks and meteoric water took place at the permeable horizons or fault planes. As a result, dissolved silica in interstitial seawater was precipitated along the horizons or planes to form siliceous concretions.

Keywords: opal-CT, concretion, diagenesis, diatomite

