The occurrence of iron minerals in the Marble Bar chert, Pilbara Craton, Western Australia

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The Marble Bar chert in Towers Formation of 3460 Ma, located in the eastern part of Plibara Craton, Western Australia, is called as Jasper, and it shows rhythmical alternation of red and white chert. The Marble Bar chert is regarded as an analogy of the banded iron formation.

It has been debated among researchers whether banded iron formations formed under oxic or anoxic environments. Some scientists have interpreted that the hematite in the Marble Bar chert of 3460 Ma was produced by modern weathering, and other geologists emphasize the oxidation of aqueous iron by iron bacteria using photo energy without free oxygen. As some kinds of bacteria oxidize iron using free oxygen, the accurate description of the occurrence of iron minerals in the Marble Bar chert becomes very important, so We examined the mineral assemblages and textures of iron oxides in fresh cores of the Marble Bar chert from the ABDP#1 hole using petrographical and electron microscopes.

On the surface, the red chert contains numerous hematite grains of submicron size, and hematite is accumulated with quartz in a botryoid cell of 10 to 30 micrometer in diameter, although the boundary among the botryoid cells is not clear, and each botryoid cell can not be observed distinctly. The botryoid cells are heterogeneously distributed in the same bed. Many cubic shaped cavities are observed in red chert, and quartz grows and quartz grows inward from the cavity walls.

The ABDP#1 core of the Marble Bar chert is composed of organic-rich black chert, silicified white chert, and rhythmically banded chert composed of white, red and black bands, in order of sedimentation. The red and black bands show high magnetic susceptibility and consist of hematite and magnetite respectively.

The occurrence of the iron oxides in the core is quite different from the surface samples. The botryoid cells of hematite are also observed in the hematite bands, the boundary among the botryoid cells is clear, and each botryoid cell can be observed distinctly. Most of the botryoid cells are rounded, but some botryoid cells are slightly angular. Euhedral grains of pyrite of 10 to 50 micrometer in diameter are observed to be layered in hematite bands. The pyrite might be of syngenetic.

The magnetite band also contains botryoid cells that consist of magnetite grains. Comparing to the botryoid cell of hematite, magnetite grains compactly fill the botryoid cell.

The occurrence suggests that the hematite and magnetite bands have maintained their original textures, and that they have not been affected by hydrothermal alteration, metamorphism or modern weathering. The magnetic features well coincide with this observation. The texture suggests that iron bearing colloidal cells had been formed in seawater, and deposited on the sea floor. The kinds of iron oxides might reflect differences in environment of precipitation. The black chert is rich in organic carbons, which are also accumulated in a botryoid cell. But botryoid cells scatter throughout the black chert. Carbon isotopic ratios of organic carbon ranges from -39 per mill to -23 per mill, and n-alkane could be detected from the organic carbon. Euhedral grains of pyrite are also observed in the black chert. It is not clear whether the black chert was formed by the same mechanism.

Including the data of sulfur isotopic ratios, we will discuss on the biosphere and its environment of 3460 Ma.