Framboidal pyrite in the mudstones of the Hokuroku district, Akita prefecture and their indication for paleoenvironments

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Kuroko deposits in Akita, Japan, is overlaid by 'M2' mudstones. Kuroko was formed at 15 to 13 Ma by submarine hydrothermal activities which took place at the water depth of 3500˜4000m. M2 mudstones are the hangingwall of Kuroko deposits. Alteration by submarine hydrothermal activities associated with Kuroko formation extends widely to footwall and hangingwall. That means post-Kuroko hydrothermal activities continued after Kuroko formation and such submarine hydrothermal activities were most likely influenced to redox conditions of ocean waters and also microbial activities. Previous investigators suggested that the sizes of framboidal pyrite are sensitive to the redox change of ocean waters and change of microbial activities.

Samples from Ishinosawa(I section: Kuroko Horizon) and Daimyoujin(D section: above the Kuroko Horizon) were collected to examine the morphology, size and chemistry of pyrite. I and D sections were on the same section extended by the Fukazawa Mine. Collected samples were observed by the standard petrographic microscope. Amount of organic carbon and sulfur were determined by elemental analyzer with carbon isotope compositions. Morphology and chemistry of pyrites were examined using FE-SEM and EPMA.

Among I section samples, hydrothermally altered features were observed such as pyrite quartz vein and silicification, but framboidal pyrite were not observed. This suggests that activities of sulfate-reducing bacteria were limited during the deposition of I section sediments. In D section, hydrothermal vein was not observed but abundant framboidal pyrite were observed.

The size of framboidal pyrite were 1˜30 micro meters in diameter and size distribution imply that benthic ocean water were oxic, suggesting that the pyrite were formed in sediments by the action of sulfate-reducing bacteria.

From these results, it is implied that benthic ocean after Kuroko formation were oxic, not euxinic in this area, although submarine hydrothermal activities at the post-Kuroko stage may have influenced the flux of metals (Mn and Zn) into sediments.