Hydrothermal oceanic sedimentation in Middle Archean: Reconstruction of the sedimentary sequence from the DXCL drilling project.

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The 3.2 Ga Dixon Island-Cleaverville formations are a well-preserved submarine sequence; only affected by low-grade metamorphism (prehnite-pumpellyite facies) without intensive deformation (Kiyokawa et al., 2002). These formations composed of volcanic rock units and chemical-volcanosedimentary sequences which are identified as the accreted immature island arc setting (Kiyokawa and Taira, 1998). We carried out a scientific drilling, which is called DXCL drilling project, at 2007 summer. This drilling project selected two coastal sites; CL site at lower part of the Snapper Beach Formation and DX site at the upper Dixon Island Formation.

The ˜350m-thick Dixon Island Formation, is overlain by pillow basalt, consists mainly of highly silicified volcanic-siliceous sequences that contain apparent microbial mats and bacterial fossil-like structure within black chert and also includes a altered komatiite-rhyolite sequences. Well-preserved micro-fossil structures were identified at lower part of the black chert, which is just above the hydrothermal black chert veins bearing highly altered volcanics (Kiyokawa et al., 2006).

The approximately 300m-thick Cleaverville Formation, which conformably overlay pillow basalt, contains a thick unit of reddish shale, bedded red-white chert, and banded iron formation. It partly contains chert fragments-bearing pyroclastic beds (Kiyokawa et al., 2006).

In detail, lithology of the CL and DX contain show different types of organic rocks. The CL 1 and CL2 cores mainly consist of organic-rich massive black shale bed (20cm in thickness) with few cross-laminated fine volcaniclastic sandstone. On the other hand, the DX core shows thin alteration of very thin laminated black shale and thin pyrite lamination. These sulfide-containing black shales are not found in surface outcrops, and therefore this lithology is first geological discovery. Preliminary data from isotopes of organic carbon and sulfur in pyrite are as follows:d13C: -32 - -26 per mil (vs. PDB), TOC: 0.6-1.4 %, d34S: -1.9 - +4.4 per mil (vs. CDT).

The Dixon Island Formation is identified as more distal and deeper depositional environments than that of the Snapper Beach Formation. The depth, where the upper Dixon Island Formation deposited, is thought to be anoxic and very clam conditions. After the pillow basalt eruption, the Cleaverville Formation deposited slightly shallower condition. The thick black shale shows the many biogenic activity occurred before sedimentation of the Banded Iron Formation of the Cleaverville Formation. This sequence is resembled stratigraphy at the Hamersley iron formations. The shallowing upward sequence may show the buried history along the relatively deeper hydrothermal setting submarine floor in the immature island arc. This stratigraphy indicates that there is critical boundary of iron material sedimentation depth at Archean ocean.