Hydrothermal generated early life activity on the 3.2Ga oceanic island arc-Dixon Island Formation, Pilbara Craton, Australia.

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The Dixon Island Formation, the Cleaverville Group in the West Pilbara, is one of the best sequence preserved the Archean hydrothermal sequence and the bimodal volcanic sequence of immature island arc (Kiyokawa & Taira, 1998). 3.2 Ga black chert in the Dixon Island Formation of this sequence contains well preserved bacteria-shaped materials and dendritic filamentous microfossils. Here we will describe details of bacteria-shaped materials in well-preserved Archean hydrothermal system.

The Dixon Island Formation, which is approximately 400 m thick, is composed of Rhyolite Tuff, Black Chert and Varicolored Chert Members. The Rhyolite Tuff Member is composed of highly silicified greenish felsic tuff containing many veins and laminated coarse to medium-grained felsic tuff. The coarse-grained laminated felsic tuff includes well preserved cross laminations. Based on the petrographic observation, these felsic tuff contains many vesicular glassy texture, which shows shallow water sedimentary condition. The black chert vein contains many fine carbonaceous grains together with dark round particles.

The Black Chert Member is formed 10 ~15 m thick stratified sequence which composed of massive black chert, well-laminated black chert and tuffaceous laminated chert. The massive black chert has carbonaceous particles which are quite similar with them in the black chert veins. This suggests that the black chert originated from the black chert veins which throw up from the basement rhyolite to the surface of sea floor. Well-laminated black chert contains very fine lamination with small-scale stromatolite-like wavy fabrics. Total organic carbon (TOC) in the Black Chert Member varied within 0.05~0.16 % in the massive and laminated black chert layers (average 0.1 %). The carbon isotope (delta 13C) of these black chert are -3~ -1.6% (average 2.64%).

Many bacteria-shaped fossils occur in carbon-rich part of the massive and laminated black cherts. Here we define the description term of the carbon grains. The carbon grain is a black small carbon crystal which form 0.05~ 0.001mm. The carbon particle is identified as the concentrated carbon grains which formed rounded shape and 2 mm to 0.5 mm in diameter. Also carbon material defined as concentrated very fine black carbon grain which is less than 1mm in diameter. Each fossil shape fabric formed by concentrated fine carbon grains. In the carbon-rich chert matrix of the massive black chert, pipe-shaped filamentous structure preserved. It formed 0.005 mm wide and0.05 mm long with 0.001 mm thick film of black carbon materials.

The fine laminated black chert also contains unusual textures. Dendritic filaments form thick blanches of black carbon material, which are similar to filamentous microfossils from volcanogenic massive sulfide (Rasmussen, 2000). Under the SEM images, 0.001~0.003 mm diameter spherical shape carbon grain preserved all of the black chert beds and the black chert vein. These spherical carbon grains partly joined and formed donates shape and string shape. These texture may be related previous bacteria fossils.

The origin of the carbon of the Dixon Island is the hydrothermal related bacterial material which seems living along the hydrothermal mound on the relatively shallow water hydrothermal environments. Similar sequence of the other Archean BCB sequence may be similar situation to form the BCB sequence of the Dixon Island Formation. In addition, this sequence might be preserved or get a hint of formed the BIF.