The geological evidence of the 3.2Ga hydrothermal generated early life:Dixon Island Formation, Pilbara Craton, Australia.

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Bacteria-shaped materials and dendritic filamentous microfossils have been found from 3.2 Ga black chert in the Dixon Island Formation. The Dixon Island Formation, the Cleaverville Group in the West Pilbara, is one of the best sequences preserved the Archean hydrothermal sequence and the bimodal volcanic sequence of immature island arc (Kiyokawa & Taira, 1998). We did very detailed mapping, (1/500, 1/100 scales) in this microfossils bearing hydrothermal sequence. Here we will describe details of stratigraphic 2-dimengional Archean hydrothermal system with bacteria-shaped materials.

The Dixon Island Formation is composed of Rhyolite Tuff, Black Chert and Varicolored Chert Members. Total thickness of this formation is approximately 400 m. The Rhyolite Tuff Member iscomposed of highly silicified greenish felsic tuff containing many veins and laminated coarse to medium-grained felsic tuff. These volcanics had been affected by highly degree of silicification and changed greenish siliceous rock. Many black-chert vein swarms in the Rhyolite Tuff Member contains many fine carbonaceous grains together with dark round particles. Based on the mapping, well preserved hydrothermal veins which is more than 15m thick preserved in the boundary between the Rhyolite Tuff and Black Chert Members. The Black Chert Member 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. The Varicolored Chert Member is comprised of well-laminated fine iron formation, ferruginous-red chert, and well-bedded black-green chert. Partly preserved black chert layer contains bacteria-shaped fossils and stromatolite mat layer.

Under the petrographic observation and SEM images, bacteria-shaped fossils occur in carbon-rich part of the massive and laminated black cherts and black chert veins. The carbon particle is identified as the concentrated carbon grains which formed rounded shape and 2 mm to 0.5 mm in diameter. In the carbon-rich chert matrix of the massive black chert, pipe-shaped filamentous structure preserved. It formed 0.005 mm wide and 0.05 mm long with 0.001 mm thick film of black carbon materials. Dendritic filaments form thick blanches of black carbon material, which is 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.

The Dixon Island Formation preserved hydrothermal sedimentary system on and after the bimodal volcanism. Well preserved black chert - BIF sedimentary sequence formed above the rhyolite sequence with hydrothermal veins. The bacteria-like structure, stromatolite-like texture and other various biogenic structures occurred restrictedly in the black chert. The outcrop, microscopic and geochemical evidences strongly suggest that the microbial structures are well developed along the area of the paleo-hydrothermal system on the relatively shallow sea floor. This suggests that the microorganisms from the Dixon Island Formation were probably chemotropic microorganisms developed around hydrothermal environment.