Archean oceanic volcano-hydrothermal sequence: an example of living place of early life, Pilbara terrane, Australia

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The 3.2Ga Dixon Island Formation in the Cleaverville Group of the coastal Pilbara terrane, Australia, is one of the most complete and best-preserved examples of middle Archean oceanic stratigraphy and contains possible microbial material. Field observations and geochemical evidence suggest that this formation contains a low-temperature hydrothermal-vent system with a biogenic microbial colony from the Archean ocean. The similar sequences are well preserved in the 3.5Ga Marble ber chert and North pole chert. The absence of detrital sediment of continental origin and the many vein injections imply that these sedimentary facies represents a pelagic hydrothermal environment at about500-2000 m in paleodepth.

The massive black chert in each sequence have carbonaceous peloids (0.3-2.0mm in diameter) which are similar to those in the black-chert veins. Microbial material has been preserved well in the lower part of Black Chert Member in the Dixon Island Formation. The total organic carbon (TOC) value of massive black chert in the lower part of the Black Chert Member is higher (TOC 0.15-0.45per cent) than that of the overlying laminated chert section (TOC 0.02-0.15par cent). The carbon isotope (delta13C) values of this lithology (-33–27per mil) are also lighter than for the black chert veins (-29–26per mill) and the laminated black (-27–13 per mil).

These evidence suggests that the carbonaceous grains and bacteria-shaped material in the lower part are of biogenic origin and formed close to a low-temperature hydrothermal vent system. The microbial colony may have been rapidly fossilized by silicification related to hydrothermal activity. These environments may be first prospective living place of early life.