Organic Materials in the 2.7 Ga Mt. Roe Basalt Formation, Pilbara, Australia

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2.7 Ga Mt. Roe basalt in the Pilbara craton, western Australia, is mainly composed of vesicular and amygdaloidal lava flows, interstratified with tuff, crastic sediments (sandstone, conglomerate and mudstone) and evaporite of carbonate. A few occurrence of pillow lava and ripple mark on the sandstone suggest the environment of shallow sea. Two areas (Mt. Roe #1 and #2) of about 1.5 km along the strikes of the Mt Roe basalt are strongly sericitized and chloritized. It has been reported as a paleosol formed under an anoxic atmosphere, as the Fe was strongly depleted, compared to the parental rocks (e.g., Macfarlane et al., 1994; Rye and Holland, 1998, 2000; Yang et al., 2001). Recently, Nedachi et al. (2000, 2001) proposed that the Fe depletion has been caused by reduced hydrothermal fluid rich in methane. They observed also the Fe increase in the area from fresh basalt to chloritized zone, suggesting the possibility of rather oxic atmospheric environment if the profile would be a paleosol.

Rye and Holland (2000) have described the organic carbon from the crastic sediments in the Mt.Roe #2 area and estimated the carbon isotopic ratios. The carbon isotopic ratios from -33 to –51permil(PDB) suggest that methanotrophs once inhabited there under the anoxic atmosphere which has contained the methane gas. We also found the organic material from hydrothermal veins in the sericitized zone, as well as from sandstone in the Mt.Roe #1 area. In the hydrothermal vein, the organic carbon occurs as a fabric sheaf or flake in the grain boundary of sericite. However, we could not identify the carbonaceous material in the sandstone. It may be a component of the black colored sericite as pointed by Rye and Holland (2000). We extracted organic carbon into the organic solvents (di-chloromethane + methanol) from rock powder of the sandstone, and detected a sterane with the mass of 217 by GC-MS measurements, which might be regarded as a bio-maker. On the other hand, we extracted these carbonaceous materials from samples, using a mixture of hydrofluoric acid, nitric acid and hydrochloric acid, and measured carbon isotopic ratio. The carbon isotopic ratios of sandstone vary from -36 to –40permil, which suggest the existence of methanogens and/or methanotrophs, On the other hand, the carbon isotopic ratios of hydrothermal vein are slightly heavier (about 5permil) than those of sandstone. The fluid inclusions in the hydrothermal vein contain methane, of which the carbon isotopic ratios are not known yet. The evidence and carbon isotopic ratios suggest the following possibilities as the origin of organic carbon.

1) He life has already inhabited near or on the seashore at the late Archean (about2.7Ga).

2) The organic material in the veins might be transferred from the overlying sediments described above by hydrothermal circulation.

3) The methanogen has inhabited in the veins, converting the organic material to methane.