Early Archaean carbonaceous material from the Pilbara, Western Australia: Its nature, characteristics and possible sources

L.J. DUCK, M. GLIKSON, S.D. GOLDING AND R.E. WEBB

Earth Sciences, The University of Queensland, QLD, 4072, Australia (l.duck@earth.uq.edu.au)

The c. 3.49 Ga Dresser Formation, a lower member of the Warrawoona Group in the North Pole Dome region, Western Australia, is a barite/black chert dominated, mafic volcanic hosted, shallow water (<100m), seafloor exhalative hydrothermal deposit [1]. Carbonaceous matter (CM) aggregates, varying in size from 1µm to >20µm, have been isolated from black cherts in drill core from the Dresser Mine area.

With total organic carbon (TOC) contents from 0.19% to 0.31%, organic petrology and SEM-EDS studies of whole rock samples reveals the CM as aggregated forms around siliceous nuclei in the majority of samples. Transmission electron microscopy (TEM) of carbonaceous concentrates show this aggregate material to be composed of sub-micron sized granular-textured particulates. The observed morphology is suggestive of the remains of microbial clusters or colonies. TEM investigation of one sample, however, showed it to be dominated by soot particles such as have been reported from the Sudbury impact [2] and K-T boundary [3]. The presence of soot particles supports previous evidence of meteoritic impact in the Pilbara during the early Archaean [4]. Reflectance measurements (%Ro) of the CM have yielded three dominant groupings: 1) 0.5-1.5; 2) 2.4-2.8; and 3) 3.2-3.8. Different Ro populations in a single sample record several hydrothermal events, as well as relative proximity to a venting source.

These results, combined with the bulk C-isotope values of the CM ($\delta^{13}C$ -32.1 to -38.2‰ PDB, n=11), are suggestive of a biogenic source, and as such, may represent remnants of some of the earliest primitive life forms on Earth.

References

[1] Nijman, W., et al., 1999, *Precam. Res.*, **95**: 247-274.
[2] Bunch, T.E., et al., 1999, *Special Paper - Geol. Soc. Am.*, **339**: 331-343.
[3] Wolbach, W.S., et al., 1985, *Science*, **230**(4722): 167-170.
[4] Byerly, G.R., et al., 2002, *Science*, **297**(5585): 1325-1327.

Fractionation of carbon isotopes in biosynthesis of piezophilic bacteria

JIASONG FANG[1], OLIVIA CHAN[1], MARIA UHLE[2], DOUGLAS BARTLETT[3] AND CHIAKI KATO[4]

[1]Department of Geological and Atmospheric Sciences, Iowa State University, Ames, IA 50011, USA (jsfang@iastate.edu)
[2]Department of Earth and Planetary Sciences, University of Tennessee, 306 Geological Sciences Bldg, 1412 Circle Drive, Knoxville, TN 37996, USA (muhle@utk.edu)
[3]Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla CA, 92093, USA (dbartlett@ucsd.edu)
[4]Research Program for Marine Biology and Ecology, Extremobiosphere Research Center, JAMSTEC 2-15 Natsushima-cho, Yokosuka 237-0061, Japan (kato_chi@jamstec.go.jp)

Understanding the lipid biochemistry and carbon isotope fractionation of deep-sea piezophilic bacteria is of paramount importance because lipids and stable carbon isotopes are used extensively in marine biogeochemistry for defining the sources of organic matter and assessing preservation of organic matter in ocean sediments. However, our current understanding of microbial lipid biochemistry and carbon isotope fractionation is based on studies on lipid biosynthesis of surface bacteria at warm temperature and atmospheric pressure. The models and parameters of carbon isotope fractionation derived from surface bacteria may be significantly different from that of deep-sea piezophilic bacteria. In this study, we investigated carbon isotope fractionation in a piezophilic bacterium *Moritella japonica* DSK1. DSK1 was grown in natural seawater on glucose at atmospheric pressure (atm), 100, 200, and 500 atm. Phospholipid fatty acids were extracted and identified by GC-MS. $\delta^{13}C$ of individual fatty acids was determined by a GC-C-IRMS. Fatty acids detected include C_{12-20} saurated, monounsaturated and polyunsaturated fatty acuds. The fatty acids exhibited distinctly different isotopic composition. Fatty acids from cells grown at higher pressure were considerably depleted in ^{13}C. For example, fatty acids from cells grown at 100 atm displayed remarkably less negative $\delta^{13}C$ values (8.4 to 23.2‰), whereas fatty acids of cells grown at 200 and 500 atm showed much less variations (0.2 to 4.8‰). Our results suggest that hydrostatic pressure is an important factor in influening carbon isotope fractionation in marine bacteria and that caution must be exercised in using $\delta^{13}C$ of fatty acids to determine the soiurce of organic matter in marine environment.