GEOLIPIDS FROM CYANOBACTERIA: NEW STUDIES OF MATS & CULTURED ORGANISMS FROM THE HYDROTHERMAL ECOSYSTEMS OF YELLOWSTONE NATIONAL PARK

ROGER E. SUMMONS[1], LINDA L. JAHNKE[2], JANET M. HOPE[1] AND GRAHAM A. LOGAN[1]

1. Australian Geological Survey Organisation, GPO Box 378, Canberra,ACT 2601 Australia
2. Planetary Biology Branch, NASA Ames Research Center, Moffett Field, California 94035 USA

This paper reports new biomarker and carbon isotopic data for cultured cyanobacteria and cyanobacterially-dominated communities from the hydrothermal ecosystems from Yellowstone National Park. We compare this data from extant organisms with analyses of fossil hydrocarbons from Precambrian sediments and conclude that cyanobacteria were the dominant form of phytoplankton in the Proterozoic ocean.

Some filamentous cyanobacteria such as *Phormidium luridum, Anabaena cylindrica* and *Chlorogoeopsis* sp. synthesise branched hydrocarbons (monomethyl- and dimethylalkanes) under certain physiological conditions. Similar compounds are found in thermophilic cyanobacterial mats and are especially prominent in some we have studied in Yellowstone National Park. Similar kinds of branched hydrocarbons are unusually abundant biomarkers in Precambrian oil and sediments and we have speculated that, rather that being a product of conventional petroleum generation, this feature may be due to direct input of lipids from certain kinds of bacteria, including cyanobacteria.

A significant proportion (25%) of the cyanobacteria we cultured was found to contain 2β-methylbacteriohopanepolyols, another distinctive class of biomarker lipid. Analysis of Yellowstone hot spring mats shows that they invariably contain 2β-methylbacteriohopanepolyols and other 2-methylhopanoids. The specific origins of these biomarkers, and their fossil 2α-methyl counterparts, has been an enigma up until the present work. Since these compounds do not appear to have been found in any other class of bacteria, we now believe they may be a specific marker for cyanobacteria. A survey of hopanoids from Proterozoic (ie > 550Ma) oils and sediments shows that 2α-methylhopanes are always particularly abundant and generally in higher relative amounts than can be found in younger materials.
We conclude that the prominence of monomethylalkanes, dimethylalkanes and 2-methylhopanes in very old oils suggests that cyanobacteria made a significant contribution to preserved Proterozoic organic matter. The presence of these signals in sediments from deep water environments leads to the conclusion that cyanobacteria were a dominant component of the marine phytoplankton and not just restricted to stromatolites or benthic bacterial mats.