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Utilizing molecular biomarkers bound into kerogen to follow biological evolution and environmental change in the Precambrian ocean

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Molecular biomarker studies of Precambrian rocks are regularly compromised by the high thermal maturity of the host organic matter and the possibility of contamination. Extreme care must be taken in selecting appropriate sediments and cross-checking analytical protocols used to extract and detect biomarkers. Using the technique of catalytic hydropyrolysis (or *HyPy*, Love *et al.*, 1995) to fragment kerogen (the insoluble macromolecular organic matter in sediments) we can release genuine molecular biomarkers from Precambrian organic matter. By using sophisticated and sensitive GC-MS-MS detection of key homologous series of compounds in hydropyrolysates, some of our recent work has helped identify possible biosignatures for microbial life in the early Archean ocean as well as steroid markers which mark the earliest appearance of basal animals (sponges) in the Neoproterozoic.

Molecular profiles of bound polyaromatic hydrocarbons (PAH) generated from HyPy of overmature 3.43 Ga Strelley Pool kerogens exhibit very similar patterns to a range of mature biogenic Phanerozoic and Proterozoic kerogens. Furthermore, the molecular patterns are distinct from fragments generated from HyPy of the insoluble carbonaceous matter in the Murchison meteorite (Sephton *et al*., 2005; Marshall *et al*., 2007) We propose that kerogen-bound PAH patterns may be extremely informative in discriminating abiogenic from biogenic organic matter in highly cooked organic mat-

ter and should prove to be an important approach in Astrobiology for discriminating chemical biosignatures. While the PAH do not give information on source organisms, alkanes trapped in the microporous networks of these highly mature kerogens are also released by by HyPy and offer better potential in this regard.

The co-occurrence of distinctive free and kerogen-bound C_{26} and C_{30} steranes, the hydrocarbon remains of sterols produced by marine demosponges, record the presence of metazoa in the geological record sometime between the Sturtian (ca. 713 Ma) and Marinoan (ca. 635 Ma) glaciations in the Neoproterozoic Huqf Supergroup, South Oman Salt Basin. These sterane biomarkers are found in all formations of the Huqf Supergroup and constitute an apparently continuous 100 Ma record of demosponges beginning in the Cryogenian, through the Ediacaran and into the early Cambrian. These demosponge steranes are potentially the first evidence for the appearance of animals since they predate both the Marinoan cap carbonate (ca. 635 Ma) and the oldest Ediacaran microfossils from the Doushnatuo Fm. (Yin *et al*., 2007).

Enhanced 3-methylhopane indices ($>$5%) are detected in certain sulfate-depleted environments (marine sulfate concentrations of probably $<$0.2 Mm) such as in highly euxinic sediment facies of he Palaeoproterozoic (1.64 Ga) Barney Creek Formation and in Neoproterozoic interglacial rocks from the Ghadir Manquil Formation, deposited between the Sturtian and Marinoan glaciations in South Oman. 3-Methylhopanes are derived from methylo/methanotrophic and acetogenic bacteria and elevated levels of these suggests methane cycling occurred in the water column of these sedimentary environments as a result of methanogenenic archaea outcompeting sulfate reducing bacteria for common substrates such as acetate and hydrogen.

References

Love, G.D., Snape, C.E., Carr, A.D. & Houghton, R.C. (1995) Org. Geochem. 23, 981-986.

Marshall, C.P., Love, G.D., Snape, C.E., Hill, A.C., Allwood, A.C., Walter, M.R.,Van Kranendonk, M.J., Bowden, S.A., Sylva, S.P. & Summons, R.E. (2007) Precam. Res. 155, 1-23.

Sephton, M.A., Love, G.D., Meredith, W., Snape, C.E., Sun, C.-G. & Watson, J.S. (2005) Planetary & Space Science 53, 1280-1286.

Yin, L.M., Zhu, M.Y., Knoll, A.H., Yuan, X.L., Zhang, J.M. & Hu, J. (2007) *Nature* **446**, 661-663.