

Oil-bearing Fluid Inclusions: Biogeochemical Time-Capsules for >2.0 Billion Years

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The observation of oil inclusions in >2.0 Ga rocks [1] and the ability to obtain detailed molecular geochemical information from them [e.g. 2] provides a robust way for understanding the early biogeochemical evolution of the Earth. The abundance and widespread nature of oil inclusions suggests that oil generation, migration and accumulation processes were operative (complete petroleum systems), and that at least some environments were rich in organic matter. The aliphatic and aromatic biomarkers present in these oils can be related to the original organic matter deposited >2.0 Ga. Unlike shale-hosted hydrocarbons, oil inclusions are not as prone to thermal alteration, overprinting by later migrating fluids or anthropogenic contamination. The lack of mineral catalysts in inclusions likely helps prevent included oil from alteration during heating above 300°C.

In order to ensure reliable information from oil inclusions, a comprehensive series of outside-rinse blanks and procedural system blanks are analysed by gas chromatography-mass spectrometry. Quantitative amounts of the hydrocarbons in these blanks are compared to the inclusion extracts, so as to provide confidence limits on the experimental integrity of each compound class. The results will be illustrated using data from oil inclusions associated with the Oklo natural nuclear fission reactors in Gabon (ca. 2.1 Ga FA Formation, Franceville Basin). In this example, some hydrocarbons are also derived from co-occurring solid bitumen, but the initial outside-rinse blank enables these to be differentiated.

References

[1] Dutkiewicz A., Rasmussen, B., and Buick, R. (1998) Oil preserved in fluid inclusions in Archaean sandstones. *Nature* **395**, 885-888.

[2] Dutkiewicz, A., Volk, H., George, S.C., Ridley, J., and Buick, R. (2006) Biomarkers from Huronian oil-bearing fluid inclusions: an uncontaminated record of life before the Great Oxidation Event. *Geology*, in press.