Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 403

Constraints on the Paleoenvironement Interpretation of Steranes from Ancient Sediments

Stephanie Fleck (stephanie.fleck@g2r.u-nancy.fr), **Raymond Michels** (raymond.michels@g2r.u-nancy.fr), **Pierre Faure** (pierre.faure@g2r.u-nancy.fr), **Laurence Schlepp** (laurence.schlepp@g2r.u-nancy.fr), **Marcel Elie** (marcel.elie@g2r.u-nancy.fr), **Seyed Ashkan** (seyed.ashkan@g2r.u-nancy.fr) & **Patrick Landais** (patrick.landais@g2r.u-nancy.fr)

UMR G2R, Faculté des Sciences, BP236, 54501 Vandoeuvre les Nancy, France

Biomarkers analysis from ancient sediments, petroleum source rocks and oils is of uppermost importance for organic geochemists in order to characterize and identify oils, establish correlations and develop paleoenvironmental interpretations. For the most common sterane markers used in studies dealing with ancient sediments, four major classes of sterols are considered as precursors and derive from eukaryotic organisms. They contain 27 carbon atoms (e.g. cholesterol found in animals, algae or plankton), 28 carbon atoms (e.g. ergosterol found in fungi), 29 carbon atoms (sitosterol, stigmasterol found in vascular plants and some algae) and 30 carbon atoms (sterols from marine derived biomass). In addition to the variability in the organic sources, transformation of the biomass in the water column and the sediments as well as early diagenetic processes modify the initial structure of the precursor molecules, leading to the formation of steranes. Among them, the regular steranes are the most widely used in organic geochemistry. Especially the relative proportions on the C27, C28, C29 steranes are used for the assessment of organic input to the sediments and of paleoenvironmental conditions of deposition. Because sterols are widespread in sediments and connected to the biological sources, Huang and Meinschein (1976) proposed to use sterol analysis to define ecosystems. They extended this approach to the steranes, suggesting that the C27, C28 and C29 relative contributions provide valuable information on ancient ecosystems (Huang and Meinschein, 1979). However, the use of this diagram to assess the depositional conditions has been particularly open to discussion (Volkman, 1988). In this study, the analysis of the regular steranes content of sediments is combined with geological and sedimentological data in order to constrain the paleoenvironmental interpretation. Samples from very different environmental settings (marine, lacustrine, terrestrial, mixed) were analyzed for their steranes content. A majority of samples, essentially from marine sediments, exhibit the sterane ratios expected in partial accordance with the Huang and Meinschein (1979) diagram. However, other series of sediments of strictly terrestrial origin fall into unexpected parts of the diagram. Especially the presence of higher C27 sterane content is noticed suggesting a marine influenced system. Two combined explanations can be considered: 1) in addition to the C29 steranes inherited from terrestrial higher plants, some C28 and C27 steranes may derive from fresh water plankton and/or algae, as noted in lacustrine environments (Nishimura, 1977). The lacustrine environment is usually characterized by a higher relative concentration in C28 steranes (Huang and Meinschein, 1979). The low concentration of this steranes in our "anomalous" sample sets suggests the absence of typically fresh aquatic organisms (the absence of a true lacustrine environment is also supported by geological evidences), this probably because of shallow fresh water conditions (in opposition to deep lacustrine), related to swamp type environments. 2) Foliage fall and turn over of plants are the dominant source of plant debris. These are utilized in the food web by heterotrophs. C27 sterols can thus originate from organisms living onto the plant debris, e. i. variable invertebrates, Huang and Meinschein (1979), and/or from the microbial degradation of C28 and C29 sterols side chains (Murohisa and Iida, 1993). In order to unravel all these possibilities and improve the paleoenvironmental assessment, correlation of organic information with the geological and biological context is necessary. For each case study, especially for exceptional cases like those presented by Volkman (1988), it is necessary to adjust the paleoenvironmental interpretation of steranes by considering geological and biological information.

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