24-isopropylcholestanes: possible sponge biomarkers in sediments and petroleum

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24-propylcholesterols, a class of C_{30} sterols, are rare lipids found mainly in marine chrysophyte algae and in some sponges. In the chrysophytes (order Sarcinochrysidales) which have been examined to date, there is a strong preference for the straight chain i.e. 24-*n*-propylcholesterol. In sponges *(Trachyopsis* sp., *Dysidea* sp., *Pseudaxinyssa* sp. and *Druinella* sp.) with C_{30} sterols, a branched chain at C-24 is found to be predominant.

C_{30} steranes, the fossil analogues of the above sterols, have been synthesised chemically and can now be detected using GC-MS-MS analysis. The biomarkers occur ubiquitously, although only in trace quantities, in oils and sediments where they are generally accepted as unambiguous markers for marine or mixed marine/terrestrial sedimentation (Moldowan et al. 1985). They are present for most of the Phanerozoic where the preference is overwhelmingly in favour of 24-*n*-propylcholestane (I), the algal biomarker. Only minute traces of these steroids are found in the Cambrian and in the Proterozoic (McCaffrey et al. 1993) and again (I) is the preferred structure ($i/n \leq 0.4$). A striking exception occurs in bitumens and oils derived from carbonates of Neoproterozoic and Cambrian age. Here, the preference is strongly ($i/n \geq 1$) in favour of the 24-isopropylcholestane (II). Examples are the Neoproterozoic source rocks and oils of Oman, India, Siberia and the Urals, and in Australia the Ouldburra Formation of the Officer Basin. Shales such as those in the Rodda Beds of the Officer Basin, and older carbonates such as the Bitter Springs Formation (Amadeus Basin), Yalco Formation and Barney Creek Formation (McArthur Basin) have low ratios ($i/n \leq 0.4$).

These observations suggest that the ratio of i/n in C_{30} steranes may be a useful signature for constraining source rock age and lithology in old oils. In looking for a viable explanation, based on the known distribution of sterols in extant organisms, it seems possible that the $i/n \geq 1$ preference in the Neoproterozoic and Cambrian could be connected to the radiation of the sponges, and particularly the early calcareous forms, that is the archaeocyaths and their (presently unrecognisable) Neoproterozoic ancestors. A concerted study of the occurrences of these compounds in the sediments of the Centralian Superbasin where there are continuous and well-dated sections of fossiliferous shales and carbonates should enable these initial observations to be verified or disproved. Simultaneous studies of the distributions of C_{30} sterols in extant sponge taxa should shed further light on the issue.

References

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