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NEWS

WRITING GEOLOGICAL HISTORY

A molecule of biological origina extracted from an ancient rock is just as much a fossil—a molecular fossil—as a familar mineralised shell from the same rock is a macro or microfossil. In the same way that time sequences of fossils from superimposed layers of rocks (strata) can be used to date them and determine the conditions under which they were deposited-the science of stratigraphy or historical geology—so molecular fossils may be used to develop a discipline of molecular stratigraphy. Recently, Geoff Eglinton, Simon Brassell, and their coworkers have been showing how lipid molecules from one particular alga can be used in this exciting new way as an addition to long-established methods of historical geology.

'The premise is that water temperature affects the production of lipids by microorganisms', Eglinton explains. 'So, in a given unicellular alga grown at 5, 15 or 20°C, the relative abundances of certain molecules will change systematically. We've demonstrated this in conjunction with Dr John Green and his colleagues at the Marine Biological Association in Plymouth. A particularly abundant and wide-ranging marine alga called *Emiliana huxleyi*, produces certain C_{37} alkenoes, with two, three and even four double bonds. It's the ratio of the two-to the three-double bond molecules that changes with growth temperature.

'So we have hypothesised that this sort of record, if it were contributed to the growing sedimentary pile, would enable us to plot water palaeotemperatures [ancient temperatures] against time. We've chosen to test this against an established indicator of water palaeotemperature—the obvious one was δO^{18}, that is, the ratio between O^{16} and O^{18} in carbonate shells from small marine animals called foraminifera'. Two complementary temperature-related effects alter δO^{18} for CO_3^{2-} deposited in foraminiferal shells; the availability of O^{16}, which depends on the amount of water tied up in the polar icecaps (lighter water is preferentially evaporated from the oceans to come down later as snow and then be held as ice), and the differential uptake of the isotopes by the growing forminifera at different water temperatures.

'Michael Sarnthein, a sedimentologist from Kiel University, selected a suitable site where drilling would give us about the last million years of sediment undisturbed. We sampled the drill core for our compounds, he sampled it for O^{16}:O^{18}— and lo and behold, in the upper part of the core (the past 700000 years or so) the correspondence is really quite startling, but there are some intriguing differences. It may be that these differences will help us to disentangle the two effects [polar ice cap size and tropical water temperature] belived to determine the O^{18} isotope record

The technique should help geologists to build up a more complete environmental picture for the sediments, and also to fill in gaps in their knowledge. For instance, carbonate shells are dissolved below the calcite compensation depth, so sediments laid down below this level in deep oceans preserve no δO^{18} signal; however, the molecular record of the alkenones is still present. *Chemistry in Britain*, Vol. 23. No. 4, April 1987, p. 304. Published by the Royal Society of Chemistry, Burlington House, London.