Steroidal ketones as measures of redox conditions during OAE1a

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A critical objective in efforts to understand the nature of Oceanic Anoxic Events (OAE) is assessment of the prevailing levels of O_2 in the water column and redox conditions in sediments during such episodes of enhanced sequestration of organic matter (OM). Various proxies have been proposed as measures of paleo-oxygenation levels in ancient sediments, including biofacies [1], concentrations of redox sensitive metals [1,2], and molecular biomarker distributions [3], although none of these indicators is unequivocal. Studies of the complex compositions of molecular biomarkers in sediments deposited during OAEs have tended to focus on the characterization and distributions of aliphatic hydrocarbons, although their concentrations in some sequences are greatly exceeded by those of aliphatic ketones [4].

Sedimentary ketones can originate from direct inputs of biolipids, such as sterones from dinoflagellates [5], and can also form by oxidation of sterols in particulate OM during settling [6]. However, for sediments rich in OM deposited at Shatsky Rise during OAE1a the predominance of steroidal ketones (5α-, 5β-stanones; Δ^4-stenones) among the biomarker distributions suggests that they derive from post-depositional oxidation of precursor sterols. The occurrence of sterols in trace concentrations suggests their extensive oxidation to Δ^4-stenones, which, in turn, can be converted to stanones by hydrogenation [7]. In sediments from the OAE1a interval, the proportion of Δ^4-stenones relative to 5α-stanones correlates well ($r^2 = 0.951$) with their C_{org} contents. Thus, it appears that depositional conditions were oxic, at least intermittently, with O_2 levels sufficient to convert sterols to stenones, and evoking the possibility that this reaction perhaps reflects preferential oxidation of specific biomarkers relative to OM. Yet, the limited extent of hydrogenation of stenones relative to stanones in sediments more enriched in OM suggests that the early diagenetic, abiogenic production of hydrogen, likely from S-species, in these sediments is insufficient to obscure evidence of oxidative processes in the ketone distributions.

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Contemporary versus long-term weathering rates in Tropics: Mule Hole , South India

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The contemporary and long-term weathering rates for tropical shield landscapes were assessed in the steep climatic gradient and associated geomorphic features of the Kabini river basin, Peninsular India. The initial focus was on the pristine forested experimental watershed of Mule Hole (4.3 km^2) developed on Precambrian gneiss and located in the sub-humid zone of the gradient.

The combination of geophysical, mineralogical and geochemical studies in soil profiles, rock outcrops and boreholes with Electrical Resistivity Tomography facilitated the assessment of the average regolith thickness and the long-term chemical mass balance at the watershed scale. TCN study (^{10}Be) in streambed sediments were used to estimate the long-term denudation rates integrated over the last 100 kyr. The input-output budget of solutes and particles in both surface and ground water enabled the assessment of the contemporary denudation rates.

At Mule Hole the regolith was immature and its average thickness was 17 m (15 m of saprolite, 2 m of red and black soils) [1]. According to the long-term erosion rate [2], the time span to form this saprolite would be at least 1.1 Ma. The contemporary denudation rate is 28 mm/kyr, which is significantly higher than the long-term one (10 mm/kyr). In this region of rather quiet tectonic activity, such difference may be explained by the large variations of the SW monsoon strength, observed in oceanic and continental records for the last climatic cycle. This study has important significance in terms of quantification of the amount of weathered material at the small watershed scale and hence of the assessment of the impact of silicate chemical weathering on atmospheric CO_2 consumption.

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