

MINERAL PROTECTION SELECTIVELY PRESERVES SOIL ORGANIC MATTER IN OXIC MARINE ENVIRONMENTS

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Burial of organic carbon (OC) in marine sediments is one of the major sinks for carbon on geological time scales, thereby having important effects on atmospheric CO₂ and O₂ concentrations. Most of this burial takes place in continental margins where both marine and terrestrial, mainly soil derived, OC is deposited. Generally, terrestrial carbon is selectively preserved in (sub)oxic environments compared to marine organic matter (e.g. Burdige et al., 2005). However, it is unclear if this is due to intrinsic chemical resilience of the terrestrial organic matter, e.g. *n*-alkanes and lignin which are relatively resistant to microbial degradation, or because the mineral matrix to which the organic matter is absorbed protects it from degradation (Keil et al., 1994).

Here we analyzed bulk OC, long-chain alkenones and glycerol dialkyl glycerol tetraethers (GDGTs) of the f-turbidite deposited at the Madeira Abyssal Plain (de Lange, 1998). The f-turbidite sediments were originally deposited on the anoxic African shelf and, subsequently, due to slope instability, deposited in the oxic deep sea as a well mixed and fine-grained OC-rich distal turbidite. This resulted in oxygen diffusion into the top of the turbidite leading to oxic degradation of organic matter (de Lange, 1998). The oxidation front can be established visually and is also apparent from the substantially lower OC content and $\delta^{13}\text{C}_{\text{org}}$ (Fig. 1). Quantitative analysis of GDGTs shows the abundant presence of isoprenoidal GDGTs from marine crenarchaeota with TEX₈₆ values of ca. 0.52 and relatively small amounts of branched GDGTs derived from soil bacteria with BIT values of ca. 0.02 in the unoxidized part (Fig. 1). Concentrations of GDGTs in the oxidized turbidite section were two orders of magnitude lower, suggesting substantial degradation of GDGTs, similar to what is observed for OC and alkenones. However, while the U^k₃₇ index remains unchanged, the TEX₈₆ and BIT index substantially increase with oxic degradation (Fig. 1). Other turbidites show a similar pattern with respect to the BIT: increased BIT indices in oxidized parts compared to the unoxidized parts. In contrast, TEX₈₆ values increased or decreased with oxic degradation depending on the turbidite analysed.

These results can be readily explained if we consider that branched GDGTs are exclusively derived from soil organic matter whilst the isoprenoidal GDGTs are predominantly derived from the marine environment with minor contributions from soils (Weijers et al., 2006). Depending on the environment, TEX₈₆ values in soils can be substantially higher or lower than those in marine sediments (Weijers et al., 2006). Hence, the strong shifts towards higher BIT indices and varying shifts in TEX₈₆ values upon oxic degradation can be explained by a strong relative increase in soil-derived GDGTs compared to the marine-derived GDGTs. This selective preservation of soil-derived lipids, which are chemically nearly identical to those of their marine counterpart, strongly suggests that the mineral matrix to which soil organic matter is attached enhanced its preservation. To test this hypothesis we will now perform hydrodynamic particle separation of the turbidite sediments to establish whether the soil-derived GDGTs are attached to different mineral matrices than marine-derived GDGTs.

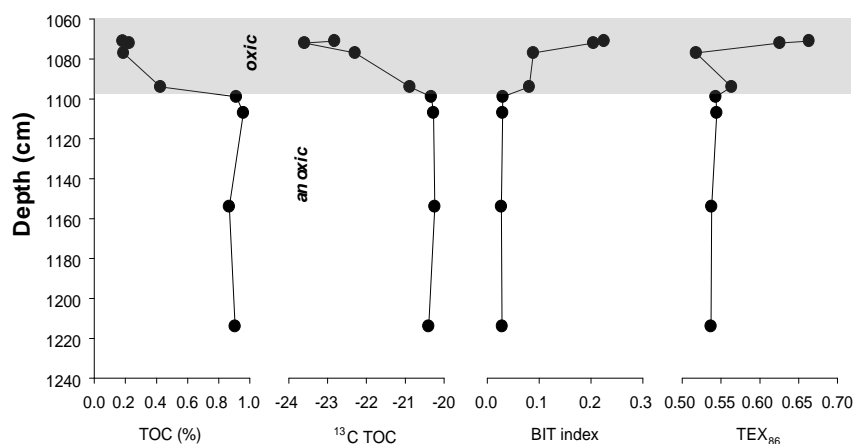


Figure 1. TOC, ¹³C TOC, TEX₈₆, BIT index in oxic and anoxic parts of Madeira Abyssal Plain turbidites.

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