Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31440

Preservation of Land-Derived Organic Matter in Ultra-Deep Ocean Sediments

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The majority of terrigenous organic carbon (terrOC) is recycled after its introduction into the marine environment; however, its fate in the ocean remains a longstanding mystery due to the complex chemical and biological processes that terrOC undergoes prior to its ultimate burial in ultra-deep ocean sediments. In this study, we conducted a comprehensive analysis of terrestrial biomarkers' distributions, alongside their influencing factors in surface sediments collected along the Japan Trench axis (>7000 meters depth). Our findings suggest a common factor influencing terrOC distribution along the Japan Trench axis, which we interpret as enhanced transport efficiency of terrOC along the landward slope of the trench, likely enhanced by frequent earthquake-induced sediment remobilization and downslop transport events. Molecular dynamics simulations indicate that long-term transport of terrOC from land to the ultra-deep ocean can lead to the formation of large terrOC aggregates with variable properties, which in turn reduces microbial activity associated with different terrOC inputs. This suggests a negative priming effect of terrOC input, resulting in the enhanced co-preservation of both terrOC and marine organic carbon in the Japan Trench axis, where carbon export to subduction zones may be accelerated.