Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37561

Investigating clay mineral controls on organic carbon sequestration in tropical coastal settings

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Coastal ecosystems are among the most efficient natural carbon sinks on Earth, contributing a significant proportion of global marine sedimentary organic carbon (OC) burial despite covering less than 2% of the ocean surface. Organo-mineral interactions with clay minerals are widely recognized as a primary mechanism for long-term OC stabilization over geological timescales. However, the efficacy of clay mineral assemblages for OC sequestration in tropical coastal settings remains poorly constrained, and the depositional and geochemical factors that modulate the expression of mineralogical controls on OC accumulation have not been quantitatively resolved. Here, we present a multi-proxy study of long sediment cores (1.5–6.3 m) from Hong Kong, Palawan (Philippines), Puerto Rico, and Panama. We combine sedimentology, radiocarbon dating, X-ray diffraction, physical and chemical fractionation of sediment, stable carbon and nitrogen isotope analyses, and Rock-Eval pyrolysis to characterize depositional facies, stratigraphic chronology, clay mineral assemblages, fraction and features of mineral associated organic matter and particulate organic matter. Our results constrain the differential OC sequestration potential of clay mineral types in sediments and highlight the coupled influence of catchment lithology and depositional environment on coastal carbon preservation. These findings improve our ability to assess coastal carbon sink sustainability at a global scale.