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Influence of mineral associations on terrestrial particulate organic carbon preservation and transport in the northern Gulf of Mexico

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River-dominated continental margins receive large inputs of terrestrial organic carbon (TerrOC). This TerrOC can potentially form a long-term sink for atmospheric CO_2 upon burial in continental margin sediments, thereby forming a key part of the global carbon cycle. Only part of the TerrOC that is delivered to the coastal zone is deposited on the seafloor and its sequestration efficiency depends on its type and composition. However, the composition and quality of TerrOC on the seafloor is usually not determined, hampering estimates of its contribution to carbon sequestration on the continental margin. Moreover, TerrOC is thought to form associations with mineral surfaces, protecting it from degradation, but it is not fully known to which extent these associations persist in the marine realm and if TerrOC types preferentially bind to certain minerals.

Here, we investigate the TerrOC composition in different grain size fractions (>250, 250—125, 125—63, 63—30, 30—10 and <10 µm) of surface sediments along a land-sea transect (15—600 m water depth) in the northern Gulf of Mexico, using bulk properties (TOC, TN, $\delta^{13}C_{org}$) and lipid biomarkers for plant- (long-chain *n*-alkanes) and soil-derived OC (branched glycerol dialkyl glycerol tetraethers; brGDGTs). In addition, we use mineral surface area analysis and X-ray diffraction to assess whether different TerrOC types have an affinity for certain minerals. We found that concentrations of lipid biomarkers are highest in the smaller (<30 µm) size fractions. In particular, concentrations of *n*-alkanes are consistently higher in the smaller fractions, suggesting that they form associations with clay minerals. While brGDGT concentrations also increase towards smaller grain sizes, their molecular signature is constant among size fractions at each site, suggesting that they are well mixed within the sediment. Furthermore, an increase in the degree of cyclisation of the brGDGTs between 50 and 150 m water depth indicates that the initial soil-derived signal is strongly overprinted by an *in situ* marine contribution in this zone.

Our results show that plant OC is more likely to remain associated with mineral surfaces than soil OC, thereby facilitating its transport further offshore through hydraulic sorting and preferential burial on the shelf.