The Preservation of Organic Carbon in a Tidal Mudflat Through Time

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The Willapa Bay estuary system records modern and Pleistocene sediment from intertidal mudflat deposits. The modern deposits and Pleistocene outcrops allow for a detailed study on the sedimentary organic matter preservation of tidal mudflats through varying degrees of diagenesis, using source rock and biomarker analyses. The conditions that modern mudflat are deposited in mesotidal tidal range with fully marine salinities, oxygenated bottom waters and oxygen depleted sediment less than 1mm below the sediment water interface. Both the modern and Pleistocene deposits are characterized by nearly 100 % bioturbated sediments of fine to medium silt with disrupted coarse silt to fine sand horizons. Discreet traces of Skolithos-, Gyrolithes-, Helicodromites-, Planolites-, Palaeophycus-, Thalassinoides-, Diplocraterion-, Arenicolites-, Siphonichnus-, and Conichnus-like structures can be observed. Both the modern and Pleistocene deposits record total organic carbon (TOC) values from 0.59 to 1.45 %wt TOC with similar biomarker signatures of mixed origin. Despite the mixed origin, the quality of the carbon is of Type 4 kerogen (oxidized) with only top surface of the modern mudflat containing Type 3 kerogen (humic). Indicating that the only change in the quality, type, and amount of organic carbon happens initially after deposition as the carbon passes from the sediment water interface to 40 cm depth. To be preserved in the rock record carbon must pass an immense biomass of macro-fauna reworking the sediment and recycling the carbon back to the surface to be degraded by the micro-fauna. In the case of the mudflats of the Willapa Bay estuary system the labile carbon is quickly consumed and only refractory oxidized carbon passes into the rock record.