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Carbon diagenesis in different sedimentary environments of the subtropical Beibu Gulf, South China Sea

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Abstract: The depositional environment in the subtropical Beibu Gulf area is highly complex, and the sediments accumulate under specific combinations of hydrodynamics, physiography and sediment sources. In the present study, six sedimentary gravity cores were collected from three different depositional zones of the Beibu Gulf. We measured the geochemical and carbon isotopic compositions of pore water and solid sediments to characterize the benthic early diagenesis of carbon. Our results indicate that marine organic matter is rapidly remineralized in delta deposits and the Central Beibu Gulf. Terrestrial organic matter, however, seem to be more important at the bottom of the Central and Northern Coastal Beibu Gulf, which probably formed in an estuarine or fluvial environment before the Holocene or Pleistocene transgression. Organic matter degradation via microbial sulfate reduction is the most important source for isotopically light DIC (dissolved inorganic carbon) added to the pore waters at most sites. In the Central Beibu Gulf, however, the carbon isotope signatures of DIC indicate an additional source of light carbon and pore water profiles exhibit a characteristic pattern reflecting the occurrence of the anaerobic oxidation of methane. Moreover, we find that the pore water $\delta^{13}C_{added}$ is greater than the $\delta^{13}C$ of total organic carbon net loss in solid sediments in the zones with relatively strong current environments. This result hints that the frequent physical reworking and reoxidation of bottom deposits are likely key factors controlling carbon isotopic fractionation between the sedimentary organic carbon and DIC. Overall, our results further reveal that carbon sources and transformations in the sediments sensitively respond to changes in depositional conditions. Pore water modeling give strong hints for non-steady state processes impacting diagenesis at several sites.

Key words: Carbon diagenesis, Dissolved inorganic carbon, Sulfate reduction, Carbon isotope