Carbon Processing in Aquatic Critical Zones: A Source-to-Sink Perspective

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The majority of organic carbon (OC) in the global ocean is buried in the coastal margin. In particular, river delta and non-deltaic shelf regions bury an estimated 114 Tg C $year^{-1}$ and 70 Tg C $year^{-1}$, respectively, with only ca. 6 Tg C $year^{-1}$ buried in the open ocean. While there has long standing general agreement that continental selves represent the largest sink of both terrestrial (OCterr) and marine (OCmari) OC in the global ocean, our understanding of the spatial and temporal complexity of this region continues to evolve. For example, fjords are now more recognized as “hotspots”of carbon burial with recent estimates suggesting fjord surface area-normalized OC burial rates are at least five times greater than other marine systems and one hundred times greater than the entire ocean average. Here, I will compare and contrast some of the key molecular biomarkers that have been used to date to track OC across different depositional environments (e.g., large river deltas and fjords) and explore how margin-type, residence time of transport, reservoir dams, redox, priming effects, and molecular stability, impact the utility of using different biomarkers in coastal OC cycling. Finally, I will focus on important critical zones within the aquatic continuum from land-to-sea and examine how more attention is needed better understand OC cycling in these new dynamic interfaces in the Anthropocene.