Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33954

Blue Carbon sequestration by alkalinity production and pyrite burial in seagrass sediments

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"Blue carbon" (BC) sequestration is typically thought of in terms of organic carbon (OC) burial in salt marsh, seagrass or mangrove sediments. However, processes in these sediments can also result in an intertidal "pump" in which DIC, alkalinity, and/or DOC, that are all derived from the remineralization of plant-derived OC, are exported to the coastal ocean. This export may be comparable in magnitude to OC burial in BC systems, particularly as a long term (> centuries) BC sequestration process, given that the residence time of alkalinity in the oceans is many thousands of years. This alkalinity production is generally linked to bacterial sulfate reduction of plant-derived OC, and in siliciclastic sediments where reactive iron is available, the sulfide that is also produced can result in the precipitation of sedimentary pyrite. Pyrite burial therefore becomes a proxy for sediment alkalinity production, or this BC alkalinity pump. However, the efficiency of this alkalinity pump is also a function of this pyrite burial. Furthermore, in estuarine settings pyrite formation and the BC alkalinity pump are a strong function of salinity since sulfate is ~200-250 times more abundant in seawater than in freshwater.

We are examining these processes in a range of seagrass environments across a salinity gradient from freshwater wild celery meadows in northern Chesapeake Bay to dense eelgrass beds in the oceanic coastal lagoons on the eastern side of the Delmarva Peninsula (Virginia). Preliminary results from four relatively high salinity sites (S>15) show inverse non-linear relationships between salinity and total alkalinity in the pore waters and also between salinity and sediment OC content. Thus we are exploring how sulfate and/or carbon availability control alkalinity production in these sediments. Future work includes pyrite analyses of the sediments at these sites and studies of additional, lower salinity (freshwater) seagrass sediments.