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Groundwater-derived alkalinity exports as an overlooked component of carbon sequestration in blue carbon ecosystems

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Mangroves and saltmarshes have elevated groundwater-surface water connectivity due to effective tidal pumping in and out of animal burrows. These blue carbon habitats also have high rates of organic carbon burial due to the anoxic nature of their soils, high sedimentation rates, and high primary productivity rates. Here, we assess whether submarine groundwater discharge and/or porewater exchange may release some of the soil carbon, and whether groundwater-derived alkalinity fluxes may rival carbon sequestration in intertidal wetlands. Seasonal observations were performed in an Australian estuarine tidal creek surrounded by mangrove and saltmarsh vegetation. We used radon to quantify porewater exchange and detailed time series observations to quantify outwelling and outgassing rates of all the key carbon species. Organic carbon burial derived from the 239+240Pu soil dating method were 63±26 and 11±5 g C m-2 yr-1 in the mangrove and saltmarsh, respectively. A radon mass balance model implied tidally-driven porewater exchange rates ranging from 7.3±4.8 in the winter to 20.2±10.7 cm d-1 in the summer. These porewater exchange rates released about 400 g C m-2 yr-1 from soils to surface waters, an order of magnitude greater than soil carbon burial rates. About 65% of the porewater-derived carbon fluxes were DOC, while 24% were alkalinity. The porewater-derived alkalinity fluxes from the soils were greater than the organic carbon burial rates. Therefore, porewater derived alkalinity exports to the coastal ocean may represent an important, but largely unquantified mode of long term carbon sequestration. Much research has already focused on quantifying carbon burial rates in blue carbon habitats. We suggest that groundwater and porewater alkalinity fluxes should also be considered when determining the carbon sequestration potential of mangrove and saltmarsh systems. The ability of these coastal blue carbon ecosystems to produce large amounts of alkalinity associated with porewater flushing may more than double their total carbon sequestration capacity.