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Impacts of Enhanced Olivine Weathering in Nearshore Marine Environments

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Coastal enhanced weathering (CEW) of olivine sand is being explored as one possible strategy for mitigating ocean acidification and anthropogenic CO_2 emissions. The weathering of forsteritic olivine releases alkalinity and potentially sequesters up to 0.93 tons of atmospheric CO_2 as DIC in seawater per ton of olivine. Olivine sand—produced by mining and milling dunite deposits—can be used to replace a portion of the native sand in beach nourishment projects, providing a carbon sink as the olivine sand dissolves over a period of several decades. At scale, the overall life cycle analysis (LCA) on this process is more than 90% efficient.

However, prior to field-based trials of CEW, it is critical to explore the potential geochemical and ecological impacts of olivine CEW in shallow marine environments. To this end, we have developed a new 1-D reaction transport model (RADIO) designed to simulate weathering of olivine in coastal sediments. This model allows the assessment of likely *in situ* weathering rates, biogeochemical changes in porewater and seawater chemistry, and the fate and transport of weathering products including alkalinity, silica, iron, and trace metals such as chromium, nickel, and cobalt.

In this presentation, we will introduce the RADIO model and illustrate some of the key considerations regarding controls of olivine weathering and biogeochemistry in shallow marine systems. Examples of these interactions include: (1) the interplay of olivine weathering rates with microbial respiration rates and sediment pH; (2) linkages between sediment redox conditions and the speciation and transport of trace metal species, and (3) the potential impacts of secondary mineral formation on the fate of newly produced alkalinity. We will compare these predictions with newly obtained experimental and ecotoxicology data as a first step towards assessing the potential safety and efficacy of olivine CEW as a real-world climate mitigation technology.