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From eruption to sequestration: How tephra impacts marine biogeochemistry and carbon cycling

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Abstract - Volcanic eruptions are widely recognised as sources of atmospheric CO_2, yet their indirect effects on the marine carbon cycle may partly counteract this warming signal. Tephra, particulate material ejected during volcanic eruptions, is deposited across large areas of the global ocean, where it initiates a range of biogeochemical reactions with consequences for ocean chemistry and Earth's carbon cycle.

In this talk I will discuss how our work has contributed to our understanding of the role of tephra as a driver of marine biogeochemical cycling. Upon deposition, tephra rapidly releases bioavailable iron, phosphorus, and silica into surface waters, stimulating primary productivity and perturbing nutrient cycles. At the seafloor, diagenetic reactions between tephra and sediment porewaters drive enhanced burial of organic carbon through association with reactive iron phases, alter alkalinity, and promote the formation of authigenic minerals. Together, these processes link explosive volcanism to the long-term cycling of carbon, nitrogen, and trace metals across a range of timescales.

Drawing on evidence from marine sediment records and geochemical analyses, I will discuss how tephra represents an underappreciated but significant forcing on marine biogeochemistry, with implications for our understanding of past climate change, ocean productivity, and Earth system feedbacks.