Redox cycling control on the Cadmium-isotope composition of waters, porewaters, and sediments in the Saanich Inlet

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Cadmium (Cd) isotopes have provided insights into the bigeochemical cycling of Cd in the modern oceans, and may be used to provide information about past ocean chemistry. Cadmium is removed from seawater into marine sediments, but the isotopic composition of this output flux, and the processes that control the isotope composition of marine sediments, are not well understood. The precipitation of Cd-sulfides is a potential controlling mechanism on sediment Cd-isotope compositions, and those of dissolved Cd in low oxygen settings.

This study investigates the role of redox conditions as a control on the Cd-isotope composition of marine waters, porewater and sediments in an oxygen-depleted setting (Saanich Inlet, Vancouver Island). Saanich Inlet experiences an annual transition from oxic conditions in early autumn to anoxic conditions in late summer with detectable hydrogen sulfide in the deep waters. Our results support a link between redox state at the water-sediment interface and the degree of Cd-isotope fractionation of the core-top sediments and porewaters relative to the overlying waters. The Cd concentration and isotope composition in core-top sediments and porewaters at sites with anoxic deep waters indicate near quantative removal from the waters and a decreased magnitude of isotope fractionation compared to sites with fully oxygenated water columns. The most significant variability in Cd concentration and isotope composition down-core likely coincides with changes in redox conditions, suggesting precipitation of Cd as Cd-sulfides as the controlling mechanism for Cd removal from the porewaters. These observations indicate the important role of redox cycing in controlling Cd isotopes in marine sediments, and support the use of sedimentary Cd-isotopes as a tracer for past ocean Cd cycling.