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Unexpectedly heavy ^{51}V on an oxygenated continental margin: distinguishing between terrigenous inputs and marine elemental cycling

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The continental margin is the primary depocenter for terrigenous particulates and dissolved ions entering the ocean. Because of these inputs, margin sediments host high concentrations of authigenic Fe and Mn-(oxyhydr)oxide minerals and organic matter. These authigenic phases may scavenge trace metals dissolved in seawater as they accumulate in sediments, imparting enrichments and isotopic fractionations for some metals distinguishable from the terrigenous background. However, large sections of the continental margin remain scarcely sampled for their elemental contents, preventing their incorporation into models of metal cycling in the ocean. Indeed, some oxic margin sediments host large enrichments of the redox sensitive element vanadium[1], with potential significance for the marine V mass balance.

Current studies on V isotope geochemistry[2] only constrain sediments on the oxic continental margin with a low V enrichment. Authigenic V in these sediments, and in sediments on the pelagic seafloor, is more fractionated from seawater ($\Delta^{51}V_{Oxic}$ = -1.1±0.1 ‰) than in sediments underlying anoxic waters ($\Delta^{51}V_{Anoxic}$ = -0.7±0.1 ‰). This difference in the fractionation of V isotopes allows for their use as a sensitive paleo-redox proxy. However, so long as the isotopic composition of V at enriched oxic-margin sites remains unmeasured, the impact of the continental margin on the V isotopic composition of modern and ancient seawater remains uncertain.

In this presentation, we provide isotopic measurements from authigenic V, enriching sediments underlying the oxic water of the continental margin Skagerrak strait. In the most enriched samples, $\Delta^{51}V$ values are significantly less fractionated from seawater than in other oxic sediments. In order to verify that these heavy values are not caused by terrigenous inputs, we also present sequential extractions that distinguish between V bound to authigenic Fe-(oxyhydr)oxides and Mn-oxides, and terrigenous clays. From this analysis, we evaluate the ocean processes fractionating V during sequestration and diagenesis, with implications for the global mass-balance of V and its isotopes.

[1] e.g. Li et al. 2021. Enrichment of trace metals in Arctic sediments: From Siberian Arctic shelves to the basin. https://doi.org/10.1029/2020JC016960

[2] Wu et al. 2020. Sedimentary vanadium isotope signatures in low oxygen marine conditions. https://doi.org/10.1016/j.gca.2020.06.013