Understanding molybdenum and uranium isotope systematics in continental margin sediments

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The abundance and isotope composition of molybdenum (Mo) and uranium (U) in ancient sediments are promising tracers of the redox state of the past ocean. Their application generally relies upon the unique environmentally dependent Mo and U isotope signatures in modern oceanic settings [1, 2]. To date, however, the impact of early diagenesis on Mo and U isotopic fractionations in continental margin sediments has not been fully understood. Here we explore this issue through paired measurements of δ^{98}Mo and δ^{238}U together with concentrations of trace metals in both solid phase and pore water samples from a set of short sediment cores collected along the shelf-to-slope transect on the Namibian margin.

For all sediment profiles from different stations Mo and U contents increase with depth, in general agreement with previous findings that authigenic accumulation of Mo and U occurs under reducing pore water conditions at depth [3, 4]. The sedimentary δ^{98}Mo show systematic variations, ranging from 0.28‰ to 2.03‰, with the highest δ^{98}Mo values in the core top layers, and show a decreasing trend with depth. The sedimentary δ^{238}U show a narrower range, between -0.34‰ and 0.03‰, with an overall increase with depth. Notably, we observed a pronounced anticorrelation between δ^{98}Mo and δ^{238}U for most sediment samples. The pore water data also display clear systematic trends with depth but with more dynamic behaviour and a larger range in isotope composition, between 0.90‰ and 2.79‰ for δ^{98}Mo and -1.74‰ and 0.26‰ for δ^{238}U. Together, the sediment and pore water data suggest that early diagenetic processes have a strong influence in controlling the authigenic Mo and U isotope signatures of continental margin sediments.

[1] Poulson *et al.* (2006), *Geology* 34, 617-620; [2] Andersen *et al.* (2014), *EPSL* 400, 184-194; [3] Zheng *et al.* (2000), *GCA* 64, 4165-4178; [4] Anderson *et al.* (1989), *GCA* 53, 2215-2224.