Uranium and Mo isotopes record a slowdown of the E. Mediterranean overturning during the last interglacial period (~125 ky)

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The astronomically-paced formation of organic-rich sediments (sapropels) in the Eastern Mediterranean (EM) has been linked to deep-water stagnation and/or enhanced biological productivity. The preservation of organic carbon in sediments requires anoxia in pore-waters, but not necessarily the water column. The enrichments of redox-sensitive elements and their isotope systematics provide further information on the chemical evolution of overlying waters through time.

Here we focus on Mo and U isotopes in sapropel S5 from EM core 967 (2550 meters depth), deposited during the last interglacial period at 125-120 ka. Both Mo and U show strong authigenic enrichment throughout S5 sediments, while their isotope systems evolve from start to end. δ^{98}Mo evolves from ~1.2‰ to ~2.3‰, suggesting gradual build-up of euxinic conditions and near-quantitative Mo removal in the water column with δ^{98}Mo near seawater (2.3‰) at the end of sapropel formation. Uranium isotopes (δ^{238}U) evolve from +0.1‰ to -0.1‰, suggesting U removal into S5 sediments that are isotopically fractionated from seawater (-0.4‰) but with a trend towards more quantitative U uptake at the end of the sapropel.

The observed Mo and U isotope systematics, particularly toward the end of S5, are very similar to those of the modern Black Sea: a semi-restricted basin characterised by slow overturning, euxinic conditions at depth, and strong Mo-U removal into the sediments. Using the U isotope systematics in the Black Sea sediments and waters, a simple mass balance model can be constructed to quantify U removal from deep-waters, based on the rate of U supply from above and U removal into the sediments. Application of this model to the Black Sea sediments gives a best fit for the deep-water mixing/exchange time of ~700 years. Applying this framework to the EM during S5, the U isotope systematics suggest a water mixing exchange time that increased 10-fold from ~100 to ~1000 years at the end of S5. Thus, the combined Mo and U isotopes provide evidence for significant restriction of the EM basin as a driver of sapropel S5 formation.