

Heavy cadmium isotope signatures in the Late Cambrian Alum Sea – implications for organic carbon burial trends.

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Understanding the evolution of the organic carbon cycle throughout Earth's history is crucial to addressing the challenges of modern-day climate change. Marine organic carbon burial represents one of our planet's largest natural carbon sinks, and has the potential to act as an important feedback response to climate and carbon cycle perturbations. However, many estimates of past organic carbon burial fluxes rely on the $\delta^{13}\text{C}_{\text{org}}$, total organic carbon records or modelling of C_{org} -marine nutrient cycles, which are the result of multiple co-occurring and interdependent processes. Stable cadmium isotopes (^{114}Cd) have potential as an independent paleoproxy for global marine organic carbon burial, due to the fractionation of Cd in association with organic carbon. Therefore, the generation and evaluation of ^{114}Cd records in sedimentary successions encompassing periods of climatic and/or environmental change in the geological past are likely to be a useful tool in quantifying organic carbon burial trends during such events.

Here we present Cd isotope analyses from the Albjära-1 core of the Alum Shale Formation, spanning ~16 million years from the Middle Cambrian Guzhangian through to the Early Ordovician Tremadocian stages (500 – 484 Ma). The data show that Late Cambrian seawater cadmium was remarkably heavy, with $\delta^{114}\text{Cd}_{\text{NIST3108}}$ up to 0.58‰ throughout the late Cambrian following the SPICE event, a period of known enhanced C_{org} burial and ocean anoxia (compared to the modern ocean signature of ~0.25‰). We interpret this signature as a product of a higher relative removal flux of organic-bound Cd into Cambrian marine sediments compared to today perhaps with a lower (and heavier overall) oceanic cadmium inventory. We suggest that the late Cambrian oceans were a significant sink for organic carbon during the many environmental changes occurring during that time, and that our data show a close coupling between the marine cadmium cycle and organic carbon fluxes during the Alum Shale deposition.