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The DISTILL project: A $\delta^{114/110}$Cd paleo-proxy record for changes in the Earth's ancient marine organic C cycle

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The $\delta^{114/110}$Cd of suboxic-euxinic shales can approximate the $\delta^{114/110}$Cd composition of the seawater in which they were deposited, due to the assumed quantitative dominance of Cd-S species. Therefore, variations in $\delta^{114/110}$Cd in these rocks can be ascribed to processes which change the $\delta^{114/110}$Cd of the seawater in which they formed. Of the major burial pathways of Cd into marine sediments (the others being carbonate formation, adsorption to Fe-Mn oxyhydroxides, and CdS precipitation), organic matter burial is currently the primary flux of marine Cd able to move the deep ocean Cd isotopic composition up and down across geological time. Thus, the temporal $\delta^{114/110}$Cd record can, in principle, be used to constrain changes in the Earth's ancient marine organic carbon burial flux.

The UKRI-funded DISTILL research program aims to exploit the potential of Cd isotopes as a tracer of Earth's ancient organic carbon cycle. We aim to produce new data that will place important constraints on first-order Cd and C cycle interactions with long-term biosphere reorganisations and changes in continental weathering rates, atmospheric O_2, and organic C weathering and burial rates. We will also characterise for the first time the natural variability in seawater compositions across a continuous multimillion-year interval of time, and the response of the Cd isotope system to natural 'background' variability in the C cycle. We also aim to produce shorter-term, higher-resolution records for time periods covering different episodes of significant global environmental change. These data will provide us to with new constraints for C-P-N-O-S models configured to predict the rise of early Phanerozoic atmospheric O_2, and help determine C sources and the processes responsible for removing it back into the lithosphere during these perturbation events.