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Redox-sensitive metals and $\delta^{238}U$ in red and grey shales: Exploring a new archive for palaeo-redox studies

SOPHIE K. GANGL[1], CLAUDINE H. STIRLING[1], CHRIS M. MOY[1], HUGH C. JENKYNS[2], JAMES S. CRAMPTON[3], DR. MATTHEW O. CLARKSON[4] AND DON PORCELLI[2]

[1]University of Otago
[2]University of Oxford
[3]Victoria University of Wellington
[4]ETH Zürich

Presenting Author: sophie.gangl@otago.ac.nz

The investigation of past ocean redox conditions is crucial for understanding the mechanisms leading to extreme peturbations of the ocean–atmosphere system, which in turn will have a direct bearing on predicting the nature of future climate change. Reconstructions based on the measurement of metals and their stable-isotope systems in marine sediments have emerged, providing new information on past environmental changes. The majority of these records, however, are based on organic-rich black-shale and carbonate archives, which primarily form in low-latitude regions, leading to incomplete geographic coverage that complicates the global-scale interpretation of the results.

In this study, the potential of oceanic red and grey shales as new archives of past environmental conditions are investigated to complement the datasets derived from other lithologies. Our records originate from open-marine shales from two sedimentary sections spanning Oceanic Anoxic Event 2 (OAE 2; (~94 Ma) in New Zealand, originally deposited at high southern latitudes.

A series of leaching experiments using reagents of progressively increasing strength was conducted to determine the optimal method for isolating the authigenic Fe- and Mn-(oxyhydr)oxide fraction from the shale lithologies, which have proven to be difficult to unambiguously chemically separate. Chemostratigraphic records for the concentrations of a suite of redox-sensitive metals (Fe, Mn, Co, Ni, Mo, Cr, V and U), as well as the U-isotope ($\delta^{238}U$) palaeo-redox tracer, have been generated. These records imply that leaching with room temperature HCl is the optimal method for the selective extraction of the Fe- and Mn-(oxyhydr)oxide phase from red and grey shale lithologies. As a continuation to earlier work, methods to correct for detrital contributions to elements occurring in low concentrations are being explored and the degree of regional and global water-column oxygenation during OAE 2 is being re-evaluated.