# Advances on the paired use of Mo and U isotope data from organic-rich mudrocks to infer ancient ocean redox conditions

B. KENDALL[1], X. LU[1], S. YANG[1], J. WANG[1], S. WANG[1], F. ZHANG[2], S. ROMANIELLO[2]

[1]Dept. Earth & Enviromental Sciences, Univ. of Waterloo, Waterloo, Ontario, Canada (bkendall@uwaterloo.ca)

[2]School of Earth & Space Exploration, Arizona State University, Tempe, Arizona, U.S.A.

The Mo ($\delta^{98}$Mo) and U ($\delta^{238}$U) isotope compositions of euxinic organic-rich mudrocks (ORM) are used to reconstruct the global extent of ancient ocean oxygenation. However, both isotope systems are affected by local depositional conditions. Inferring global ocean redox conditions using Mo isotopes relies on direct capture of the global seawater $\delta^{98}$Mo by euxinic ORMs, but isotope fractionation sometimes occurs between seawater and euxinic sediments. Inferring the $\delta^{238}$U of global seawater relies on an assumed isotope fractionation factor between seawater and euxinic sediments, which is affected by multiple factors, including the degree of basin restriction. Hence, using both $\delta^{98}$Mo and $\delta^{238}$U from ORMs yields more robust inferences of global ocean redox conditions compared with individual use of these isotope systems. We are applying this approach to many Precambrian and Phanerozoic euxinic ORMs. The late Ediacaran Doushantuo Formation (Member IV) is dominated by high $\delta^{238}$U, suggesting widespread ocean oxygenation. In contrast, high Mo concentrations and low $\delta^{98}$Mo in most samples indicates that pronounced isotope fractionation occurred between seawater and sediments, possibly due to weakly euxinic conditions and/or a Fe-Mn particulate shuttle. The $\delta^{98}$Mo and $\delta^{238}$U of the Late Ordovician Fjäcka Shale and early Mesoproterozoic Velkerri Formation are consistent with appreciable ocean oxygenation, albeit less than that of today. The $\delta^{98}$Mo from these two Mo-rich units are probably at least slightly lower than coeval seawater $\delta^{98}$Mo because of non-quantitative Mo removal from bottom waters. Post-depositional hydrothermal fluid flow may have shifted the $\delta^{238}$U and $\delta^{98}$Mo of the late Paleoproterozoic Wollogorang Formation to higher and lower values, respectively. Ongoing studies are exploring the paired Mo-U isotope systematics of other Neoproterozoic and Paleozoic ORMs.