

## **Volcanoes, methane and weathering: Accessing the global record of environmental change during the Toarcian Ocean Anoxic Event of the Jurassic**

The geologic record contains many examples of rapid climatic and environmental perturbations that are linked to significant changes with the biosphere. Not only can we use the records of these events to understand the dynamics of the Earth system, but they also provide context for the changes presently occurring on our planet. One of these events is the Toarcian Oceanic Anoxic Event or T-OAE of the Early Jurassic Period (~183 Ma). During this time it is thought that the emplacement of the Karoo-Ferrar large igneous province injected large quantities of greenhouse gases into the atmosphere triggering a cascade of environmental feedbacks including: climatic warming, large-scale perturbations to the carbon cycle, an accelerated hydrologic cycle, widespread ocean anoxia, and marine extinctions. However the nature of the T-OAE record has been heavily debated. Much of this discussion has centered on global nature and magnitude of the biogeochemical perturbations that occurred during this event. This debate has persisted because the majority of the studies on the T-OAE have been primarily on European sedimentary successions. In order to test these competing ideas and gain a more global perspective on this event, our team is investigating the Early Jurassic sedimentary successions from multiple locations from western hemisphere.

For this talk I will focus on the carbon and osmium isotope records derived from Fernie Formation of western Alberta and eastern British Columbia. We have identified the large negative carbon isotope excursion that has been associated with the T-OAE elsewhere and linked to outgassing from the Karoo-Ferrar and other carbon cycle feedbacks. We have also identified high-frequency oscillations within the carbon isotope excursion that are also observed at other locations in Europe. We propose that these high-frequency carbon isotope excursions reflect an important climatic feedback mechanism: periods of enhanced production and release of methane gases from terrestrial wetlands. The T-OAE interval in western North America is characterized by more radiogenic osmium isotope ratios ( $^{187}\text{Os}/^{188}\text{Os} = \sim 0.6$ ), whereas the pre- and post-T-OAE intervals are characterized by less radiogenic values ( $^{187}\text{Os}/^{188}\text{Os} = \sim 0.25$  and  $\sim 0.4$ , respectively). We interpret this osmium isotope excursion as a transient increase in the contribution of continental-derived osmium to the oceans. Provocatively, our data suggest that on short timescales ( $\sim 10^4 - 10^5$  years), continental weathering rates may act as a control on atmospheric carbon dioxide concentrations. Taken together, these geochemical data from western North America and elsewhere support the hypothesis that the changes to these biogeochemical cycles are in fact global phenomenon and reveal a clearer picture of global environmental change during this dynamic event.