Evaluating the role of oxygen in Ordovician biodiversity events

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There is growing evidence linking many biotic events in the marine fossil record to changes in ocean oxygenation. This evidence is persuasive for several major and minor extinction events in the late Paleozoic and Meso-Cenozoic, but the potential role of oxygen in driving early Paleozoic biotic events is less well understood. Ocean redox changes are hypothesized to have been critical drivers of the Ediacaran-Cambrian radiation of crown metazoa, Cambrian-Early Ordovician biomere events, the Great Ordovician Biodiversification Event (GOBE), and the Late Ordovician Mass Extinction (LOME), but much uncertainty remains and many other potential drivers for have been suggested for these events. Uncertaintly arises in part from the lack of unambiguous redox proxies that can be reliably applied in ancient, often altered sediments. Even when the temporal pattern of redox changes is well established, however, it is not always clear whether there was a causal link between redox changes and macroevolutionary events. Hypotheses about causality can be tested by examining selctivity patterns – differnces in extinction and origination rate among taxa with different physiologies, ecologies, and geographic distributions and hence different predicted responses to a given environmental perturbation. I will examine origination and extinction selectivity patterns during the GOBE and during the LOME to evaluate relative support for a variety of different models of the drivers of biodiversity change. Preliminary analyses suggest that: (1) Although the pattern of redox change during the Early and Middle Ordovician is poorly established, origination patterns are consistent with rising oxygen levels as an important driver of the GOBE (2) Selective extinction of deeper-water taxa during the first pulse of the LOME suggest that redox changes in shelf and slope habitats were a critical aspect of this event. Due to a lack of direct constraints on starting state, observed extinction patterns can be reconciled with either expansion or contraction of oxygen minimum zones as a driver of extinction. Integration of fossil databases with new proxy datasets and with spatially explicit climate and biogeochemical models will allow more powerful and nuanced tests of specific extinction scenarios in the near future.