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Presentation Title:
Investigating redox conditions of the early Paleozoic Ocean: Isotopic and elemental constraints from the Middle Ordovician Argentine Precordillera

Abstract:
Greenhouse conditions of the early Paleozoic contributed to increased ocean stratification and the development of widespread deep-water anoxia. An expanding geochemical dataset from marine sedimentary rocks from the Argentine Precordillera suggests changing nutrient availability under fluctuating climatic conditions during the Middle Ordovician. Changes in ocean circulation patterns resulting from global cooling in the Middle-Late Ordovician would have led to the disruption of stratified ocean waters characteristic of early Paleozoic greenhouse environmental conditions, upwelling of nutrient-rich deep water, and perturbations in oceanic nutrient budgets. Evidence for such oceanographic change is found worldwide in the C- and S-isotope records of marine carbonate in the Middle Ordovician as the Middle Darriwilian isotope carbon excursion (MDICE) and large changes to the marine sulfur cycle recorded in carbonate associated sulfate (CAS) and pyrite (PY).

Carbon isotope compositions of early Darriwilian strata from the Argentine Precordillera suggest differentiated surficial and deep-water reservoirs characteristic of greenhouse environmental conditions. This is consistent with previously reported $\delta^{34}S$ patterns observed in early Ordovician strata suggesting growth of the marine sulfate reservoir and the persistence of deep-water anoxia. The S-isotope compositions of CAS and pyrite in the Ordovician has been explained by a dual reservoir model with oxidized surface and deep-water (anoxic) reservoirs that permit isolation of redox reactions between reservoirs. Disruption to stratified ocean conditions associated with progressive ventilation of deep-water environments via enhanced ocean circulation should be reflected as a stepwise change in the $\delta^{34}S$ values of coeval pyrite and sulfate between shallow and deeper water environments. Further constraints on the redox conditions during the middle Ordovician are provided with Fe-speciation and trace metal data from basinal black shale.