Lateral Sulfur Isotope Variability in Carbonate Strata on the Micron to Meter Scale

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Sulfur isotopes from carbonate-associated sulfate (CAS) and pyrite in ancient sediments are used to reconstruct marine sulfur cycling. Sulfur isotope data sets are most often obtained from vertical stratigraphic sections, with one data point equating to one laterally continuous bed. Each bed is assumed to be isotopically homogenous laterally and thus the resulting isotopic trend is read as a time-series record of ancient sulfur cycling. Yet as the record of ancient oceanic conditions becomes better resolved, it is increasingly apparent that sulfur isotopic records have more stratigraphic variability than expected and their mean values differ with location.

Here we present sulfur isotope data collected from early Ordovician strata in the Franklin Mountains and surrounding ranges near El Paso, Texas. We sampled both beds characterized by laterally homogenous facies (e.g., mudstone or grainstone) and laterally heterogeneous facies (e.g., bioturbated mudstone or thrombolite/grainstone-fill complexes). Individual carbonate hand samples were collected at a horizontal spacing of 0.5-1.0 meters through single, laterally continuous beds. We present the observed variability expressed in the sulfur isotopes of both CAS and pyrite sulfur, as a function of facies composition, lateral homogeneity/heterogeneity, and lateral distribution. These data sets are complemented by ongoing stratigraphic and bulk isotope analyses.

In addition, select samples from similar data sets were analyzed for micron-scale variance of sulfur isotopes. These samples can be characterized for sulfur abundance and speciation using synchrotron-based X-ray spectromicroscopy and for their sulfur isotopic compositions by secondary ion mass spectrometer (SIMS). These paired data sets can be used to inform future studies on the viability of assuming that sulfur isotopes are homogenous throughout single beds, ultimately improving our ability to extract environmental information from chemostratigraphic records and our understanding of the evolution of the global sulphur cycle over Earth's history.