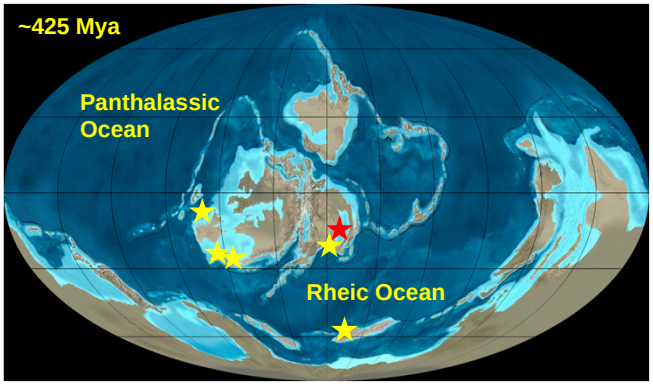
# Discerning Mechanisms of Environmental and Climatic Changes Associated with the Late Silurian (Ludfordian) Extinction Event

***Overview***: The Late Silurian was a period of widespread environmental, oceanographic, and biotic change associated with one of the largest perturbations of the global carbon cycle in the Phanerozoic. The Lau/Kozlowskii extinction event, although of lesser magnitude than the "big five" Phanerozoic mass extinctions, has strikingly similar sedimentary architecture and faunal changes. Causal mechanism(s) linking this Late Silurian extinction event to the large positive carbon ($\delta^{13}C$) isotope excursion, paleoceanographic change, and climate remain poorly understood. One potential mechanism that could link the carbon cycle perturbation to biotic, sedimentologic, environmental fluctuations is large-scale expansion of oceanic anoxic and sulfidic conditions in the Ludfordian. The research proposed within will establish/evaluate causal mechanisms, feedbacks, and controls of this well-established Silurian biotic and $\delta^{13}C$ events, using an integrated high-resolution geochemical, sedimentological, and paleobiological approach. This study will produce a detailed and quantitative reconstruction of the paleoredox conditions through the late Ludfordian and provide important insights into the relationships between water-column chemistry, sea-level, weathering, and global carbon and sulfur cycles during this Paleozoic global climatic event.

Forthcoming research proposals to NSF-SGP panel will be focused on determining causal mechanism(s), controls, and feedbacks on late Ludlow biogeochemical cycles through the Lau/Kozlowskii extinction event and associated positive $\delta^{13}C$ excursion (Lau CIE). We will collect samples for geochemical analyses from late Ludfordian carbonate-dominated sequences in North America and shale-dominated sequences in Europe (Fig. 1).

## *Late Silurian Paleogeography*

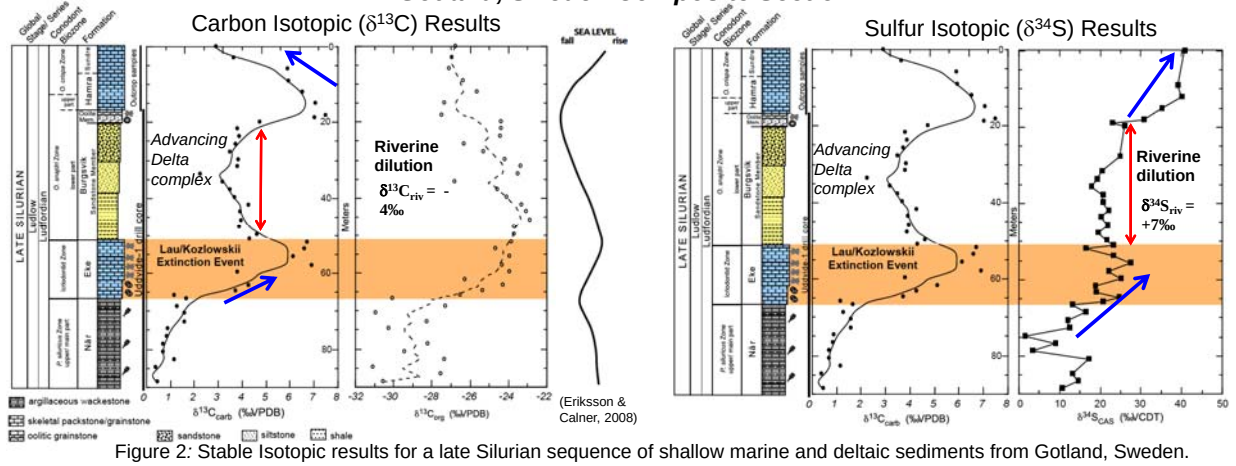



★ • This Study: Gotland, Sweden (Baltic Basin)

★ • Future Studies: Tennessee, Nevada, Virginia, East Baltic Area, Czech Republic

Figure 1: Paleogeographic reconstruction with study localities shown (modifed from Ron Blakey at http://jan.ucc.nau.edu/~rcb7/index).

## *Gotland, Sweden Composite Section*




(Eriksson & Calner, 2008)

Figure 2: Stable Isotopic results for a late Silurian sequence of shallow marine and deltaic sediments from Gotland, Sweden.

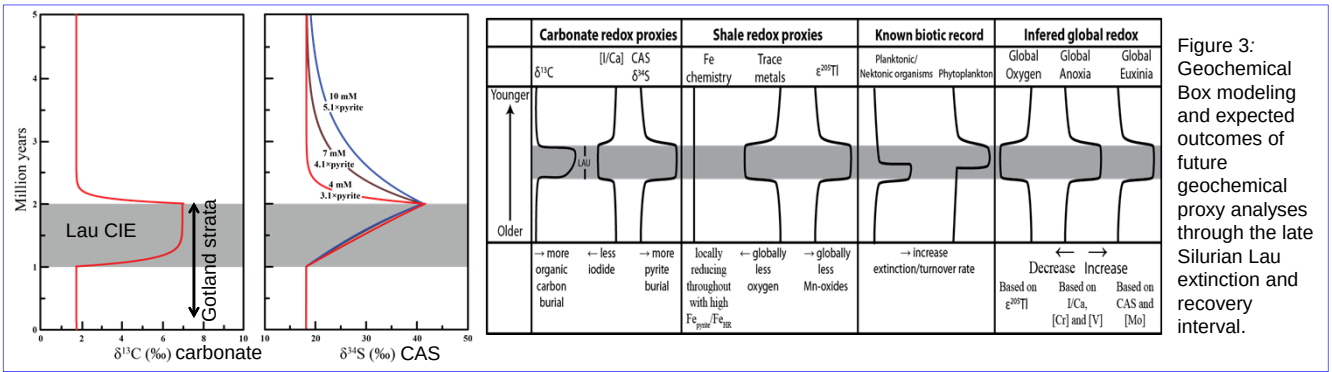



Figure 3: Geochemical Box modeling and expected outcomes of future geochemical proxy analyses through the late Silurian Lau extinction and recovery interval.

***Summary & Future Directions***

- This preliminary project has already fostered a new exciting collaboration between myself and another new EOAS faculty member, Dr. Jeremy Owens.
- As a result of this collaboration has yielded one NSF grant submission and one national conference talk.
- We plan on resubmitting a new NSF proposal for next January 2017 NSF-SGP panel deadline.
- First detailed $\delta^{34}S_{CAS}$ record through the Lau CIE and associated biotic events, documented a large magnitude (+25‰) positive shift that parallels $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$
- Shoaling of chemocline provides a unique mechanism to tie the biotic turnovers to the trends in stable S &C isotopes [deeper-water settings effected first then expansion into parts of photic zone
- Focus on other carbonate sections that contain significant pre- & post-Lau CIE strata to capture all S & C isotope dynamics (better constraints on late Silurian [$SO_4$])
- Investigate shale-dominated sections (Baltic Basin) to document $\delta^{34}S_{pyr}$ (constrain $\Delta^{34}S$) and other local/global metal redox proxies through the Lau CIE interval


***Contant Information***
Dr. Seth A. Young
Department of Earth, Ocean & Atmospheric Science
Email: sayoung2@fsu.edu