Dr. John Senko, Associate Professor in the Department of Geosciences and Biology at the University of Akron, and Dr. Chelsea Monty-Bromer, Associate Professor in the Department of Chemical and Biomedical Engineering at Cleveland State University, completed an Ohio Water Resources Center funded project via 104(b) USGS. The project, titled "**Electrochemical sensors for microbial activities in benthic sediments: A sentry for lacustrine P biogeochemistry,"** aimed to investigate how electrical current measurements using sensors positioned in lake sediments could serve as an early warning system for harmful algal blooms (HABs) resulting from internal phosphate loading.

HABs form when there are high levels of nutrients, such as phosphorus and nitrogen, in a body of water. A relatively unstudied source of phosphorous in water is internal phosphorus loading—the release of phosphorus (generally as phosphate) from sediments on a water body's floor—because the potential for and extent of it is difficult to monitor. The research team set up experiments where they mimicked different processes in lake sediments by placing sediments from Old Woman Creek estuary on Lake Erie in separate chambers with a synthetic Lake Erie water and Fe(III) minerals. The team utilized a split-chamber zero resistance ammetry (SC-ZRA) technique, a relatively inexpensive and low-power approach, to detect varying microbiological activities in benthic sediments.

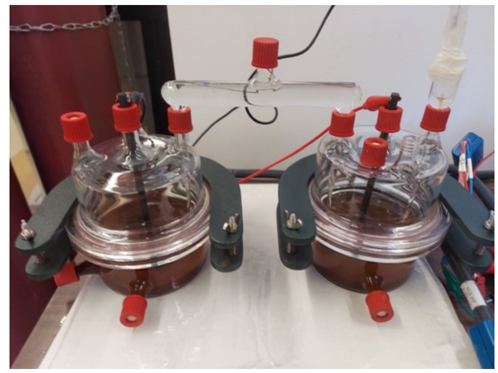

Figure 1. SC-ZRA setup with the Old Woman Creek sediments.

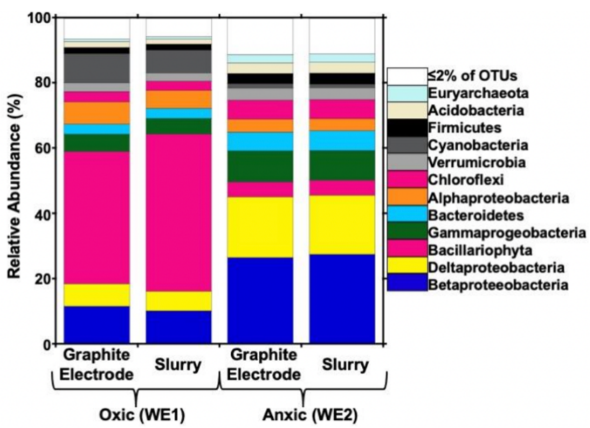

Figure 2. Relative abundances of taxonomic groups (based on 16S rRNA gene sequencing) ZRA electrodes and OWC sediment-SLEW slurries in the oxic and anoxic sides of SC-ZRA incubations amended with 50 mmol/L $Fe(OH)_3$.

The team was able to electrochemically detect the Fe(III) reducing microbiological activities using the SC-ZRA approach, where electrodes were deployed in sediments with contrasting terminal electron accepting regimes (oxic/aerobic and anoxic/Fe(III) reducing). These contrasting conditions gave rise to contrasting microbial communities. Comparison of current and voltage patterns between Fe(III) (hydr)oxide and Al (hydr)oxide amended SC-ZRA incubations indicates that Fe(III) reduction may give rise to a unique current and voltage pattern. Results indicate that ZRA-based approaches might be used to detect microbiological activities in sediments. The use of ZRA sensors could predict phosphate solubilization in the sediments. Importantly, the microbial communities associated with the electrodes were similar to those of the bulk sediments, indicating that the electrochemical phenomena were not an artifact of the electrodes, but reflective of overall processes in the sediments. Additionally, ZRA could be used to detect fine-scale contrasts in terminal electron accepting processes that might not be detected by bulk sediment analyses.

Researcher Profiles: Dr. Senko is an Associate Professor in the Department of Geosciences and Biology at the University of Akron. He studies how microorganisms influence the prevailing chemical conditions of a variety of "natural" and man-made systems. Dr. Monty-Bromer is an Associate Professor in Chemical and Biomedical Engineering at Cleveland State University. Her research focuses on using electrochemical techniques and novel nanocomposite biomaterials to better understand biological processes at a variety of spatial scales.