

PROJECT SUMMARY

Overview. Stable isotope data have made pivotal contributions to nearly every discipline of the physical and natural sciences. The isotopes held within organic and inorganic substrates integrate across broad spatial and temporal scales -- from individual organisms to the global geo-ecosphere and across ancient to contemporary timescales. While the pace of growth in the generation of isotopic data rivals that of genetics no centralized database exists for isotope data. This has hindered the development of “omic”-based approaches (e.g., genomics, proteomics, metabolomics) and the ground-breaking discoveries that they provide in other fields. The limited examples that do exist point to the huge potential of such work, particularly in studying processes at large spatio-temporal scales, including pressing global change questions. Our proposed project will bring together a diverse team of analytical experts and scientists who produce and interpret isotope data with database architects and website developers in a series of workshops that will culminate in the creation of an IsoBank, a web-accessible repository serving an interdisciplinary research and education community.

Intellectual Merits. We propose IsoBank, a centralized database of stable isotope data. This resource will enable a diverse and rapidly growing scientific community to harness the advantages of big data analytics. At the same time, it will support and increase the efficiency of a wide range of existing isotope-based applications, which generally require reference data to support data interpretation. We envision that IsoBank will foster interactions among disciplines that speak a common chemical language and the fusion of diverse perspectives, a process that has resulted in some of the biggest and most creative advances in science. We anticipate that our project will catalyze the overdue conversation among disciplines regarding the standards that constitute sufficient isotope metadata, which is likely the reason why a large openly accessible isotope database does not currently exist. We also envision that IsoBank will enhance the standards for data quality assurance and control by creating a network among core isotope laboratories in the U.S. that are currently producing nearly a million new datapoints per year, and networking these labs with individual PIs that rely on portable laser-based spectrometers to rapidly measure the isotopic composition and abundance of inorganic molecules (e.g., H₂O and CO₂). Lastly, IsoBank is poised to address growing initiatives of publication and funding agencies for data accessibility and transparency.

Broader Impacts. Our project will enhance research infrastructure while promoting the education and training of graduate students and postdoctoral scientists. We anticipate that IsoBank will become a major cyberinfrastructure resource for the diverse and growing community of scientists that use stable isotope data. IsoBank will be integrated into two interdisciplinary two-week short courses taught annually at the University of Utah (SPATIAL and IsoCamp) to graduate students and postdocs from around the world. PI Newsome is an instructor at IsoCamp, Co-PI Bowen is the course director for SPATIAL, and several members of the sub-committees identified in this proposal are instructors at these courses. Each short-course is taught by a team of ~15 instructors that cover a broad range of topics and applications in biology, geosciences, ocean sciences, archaeology, and forensics. These courses will also provide our team with the opportunity to test and improve IsoBank via direct feedback from course students and instructors. With these hands-on opportunities, the ability to store and disseminate educational materials alongside data directly in IsoBank, and the open nature of IsoBank as a publically accessible web resource, a fully realized IsoBank will be poised to have impacts across numerous biological and non-biological fields as well as enhancing the understanding of this area of research among the public.