JPUR
JOURNAL OF PURDUE
UNDERGRADUATE RESEARCH

SCIENCE

Vertical and Lateral Variation of Carbonate Isotope Ratios within Paleosol Profiles of the Willwood Formation, Wyoming

Student researcher: Vishnu Srinivasaraghavan, Senior

This project aims to identify and understand spatial variability of stable carbon and oxygen isotopes preserved in fossil soil profiles (paleosols). Isotope values preserved in paleosols can record paleo-climate and paleo-environmental information that helps us understand Earth's history. Models predict that isotope ratios should vary vertically and perhaps laterally within paleosol beds due to chemical and physical processes. Many studies have reconstructed carbon and oxygen isotope ratios by measuring carbonate mineral formed in ancient soils; however, most only obtain a small sample set per bed and assume isotope ratios are constant across the profile. Few studies have actually documented isotopic variability or its effect on paleo reconstructions.

I collected 170 paleosol carbonate nodules from 9 different fossil soils in the Bighorn Basin, Wyoming, which formed during a profound period of global warming approximately 56 million years ago. The position of each nodule within the soil was recorded, and samples of the paleosol matrix were collected. Samples representing the calcite mineral formed in the soil and after burial were analyzed for carbon and oxygen isotopic composition. Carbon and oxygen isotope ratios show horizontal and vertical patterns of variation within the beds. I applied quantitative models describing isotopic fractionation in soils to constrain potential mechanisms controlling the observed patterns. The results indicate the variation correlates with diffusion and temperature gradients in fossil soils. These results show isotope fractionation is not always consistent across individual paleosol beds, demonstrating the importance of analyzing multiple samples when using soil carbonate nodules for paleo-climate work.

Research advisor Gabriel Bowen writes, "As humans continue to perturb Earth's climate and environment, we will increasingly need to look to the past for examples of how the world works under conditions drastically different from today. This work contributes to that vision by enhancing our understanding of ancient soils, important archives documenting past continental change."

Srinivasaraghavan, V. (2012). Vertical and lateral variation of carbonate isotope ratios within paleosol profiles of the Willwood formation, Wyoming. *Journal of Purdue Undergraduate Research,* 2, 95. doi:10.5703/1288284314718