



The Biology of Geology: Reconstructing tropical variability using biological proxy evidence

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Abstract: Paleoclimatologists reconstruct past climate states using various types of proxy evidence. The information used to generate these reconstructions often comes from the chemical signals produced by living things that, through their biology, record the physical processes occurring in their environment. Understanding the biology and ecology of these organisms is essential to properly interpreting the geo- and bio-chemical data they produce. Here I will discuss the use of such data to reconstruct the variability and dynamics of the tropical oceans at different times in Earth's recent past, including reconstructions of tropical Pacific variability at the onset of the Holocene (some 10,000 years ago) and tropical Atlantic variability during the mid Holocene about 5,000 years ago. Using a variety of evidence including organic biomarkers found in ocean sediments and stable isotopes and trace elemental abundances from marine organisms, we are able to infer various changes in the ocean over time, including changes to surface and subsurface temperature and temperature variability, the structure and stratification of the upper ocean, and changes in tropical dynamics and wind fields. Leveraging the ecology of marine plankton called foraminifera, we are able to reconstruct temperatures at different depths using species with varying depth habitats, revealing changes to the thermal vertical gradient of the tropical Pacific across the Holocene-Pleistocene boundary suggestive of alterations to tropical dynamics. By using organisms from upper mixed layer, we can reconstruct surface variability in the Atlantic Ocean that reflects changes in the Atlantic Niño at the end of the mid-Holocene "Green Sahara", where multiple lines of evidence record a climatic shift in Northern Africa from a mesic grassland to the desert conditions we know today. These results demonstrate the confluence of Biology and Geology in reconstructing past climate conditions.

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