Ancient clams yield new information about greenhouse effect on climate

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Ancient fossilized clams that lived off the coast of Antarctica some 50 million years ago have a story to tell about El Niño, according to Syracuse University researcher Linda Ivany. Their story calls into question contemporary theories that predict global warming could result in a permanent El Niño state of affairs.

"The clams lived during the early Eocene, a period of time when the planet was as warm as it's been over the last 65 million years," says Ivany, a researcher in the Department of Earth Sciences in SU's College of Arts and Sciences. "We used growth rings in their shells to analyze changes in year-to-year growth rate, and linked that to changes in climate that are characteristic of El Niño today."

The research, "El Niño in the Eocene Greenhouse Recorded by Fossil Bivalves and Wood from Antarctica," is published online in *Geophysical Research Letters* and is forthcoming in print. Ivany's research team included Thomas Brey of the Alfred Wegener Institute for Polar and Marine Research in Germany as well as researchers from Perdue University, the University of Hawai'i, and the University of Mainz, Germany. The study was funded in part by the National Science Foundation.

The El Niño phenomenon, which occurs every two to seven years, is characterized by unusually warm ocean temperatures in the eastern Equatorial Pacific. El Niño can cause torrential rainfall in Peru, devastating drought in Australia, and generally wreak havoc on global

weather. El Niño is the warm phase of a large oscillation in which the surface temperature of the tropical Pacific varies, causing changes in the winds and rainfall patterns. The complete phenomenon is known as the El Niño Southern Oscillation (ENSO). The prevailing theory predicts that rising global temperatures could cause the ENSO to collapse, resulting in permanent El Niño conditions, which could have a major impact on socioeconomic and ecological systems worldwide.

One way to predict the future is to examine past geologic records. The species of clams Ivany's team studied lived to be more than 100 years old during a time when the Antarctic was as warm as modern-day Virginia. Their shells provide a long, continuous record of climate during their lifespan. "Clams, like trees, respond to changes in climate by growing faster or slower," Ivany says. "Therefore, the width of the annual growth rings correlates with environmental variables like temperature or precipitation. We measured the distances between consecutive bands and found two-to-seven-year periodicity in them, which is typically described for El Niño."

The researchers compared the results they obtained from the clams to a similar analysis they did of tree rings from fossilized driftwood they found buried in the same sediments as the clams. "We found the same pattern," Ivany says. "While it might sound counterintuitive, it turns out that the inter-annual climate variations seen in the tropical Pacific today are strongly teleconnected to the Antarctic. This seems to have also been the case 50 million years ago. The good news is that despite the very warm temperatures during the Eocene, the evidence from the clams and tree rings shows that the ENSO system was still active, oscillating between normal and El Niño years. That suggests that the same will be true in our future as the planet warms up again."

Provided by Syracuse University