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## *Cal Poly Math Students Analyze Ancient Climate Change*

SAN LUIS OBISPO -- Cal Poly mathematics students are part of a group cracking the mysteries of climate changes that happened 1.2 million years ago.

Cal Poly is one of only a few undergraduate members of the Mathematics and Climate Research Network (MCRN). Funded by the National Science Foundation, MCRN brings together top scientists and mathematicians to explore how mathematics can contribute to climate research.

Cal Poly belongs to a group within MCRN that is investigating the Milankovitch Cycles. Milankovitch's theory proposes that changes in Earth's orbit around the sun cause changes in the planet's climate, such as the ice ages.

The students are focusing on the Pleistocene era, the time period spanning 2.5 million years ago to 11,700 years ago. In the middle of the Pleistocene, climate cycles that had been occurring at regular, 41,000-year intervals appear to have shifted to 100,000-year intervals. The variations in Earth's climate also became more extreme, with greater amounts of ice and more rapid periods of melting.

Using a new mathematical analysis technique, the MCRN group is trying to figure out when exactly the transition occurred and why. This information might help scientists understand what happens when the climate shifts radically, which hasn't happened for more than 10,000 years.

"We don't have a good understanding of why or how large changes in climate occur," said Charles Camp, mathematics professor and leader of the research group. "Paleo records provide the only evidence we have for how the climate drastically changes regimes."

The students have mathematically broken apart data sets taken from ocean sediment cores that contain soil formed in the mid-Pleistocene. These samples provide a snapshot of the distant past's climate. The group is searching for correlations, or lack thereof, between Earth's orbit at that time and the climatic evidence in the cores. "They're involved in active research on a topic of current interest to the science climate community," Camp said.

"I have been able to get a hands-on feel of what climate and climate change really is," said Tanner Gibson, a student who has been working on the research for more than a year. "It's nice to dive into something new, completely free of guidelines, and discover for yourself what is going on in a mathematical model or in the climate up to 70 million years ago."

So far, the group's calculations show that the surface picture isn't quite accurate. The 40,000-year cycles continue throughout the Pleistocene, but they're harder to see when the more extreme 100,000-year cycles become established. While the shorter cycles are dependent on Earth's relationship to the sun, the longer cycles do not appear to be related to the planet's orbit. If confirmed, these calculations could help revise Milankovitch's theory.

Because MCRN is a large, virtual network, students interact weekly with research groups composed of scientists across the country. "You have to learn how to communicate your work with your peers," Camp said. "The network provides opportunities for that."

"I have learned the value of communicating between fields," Gibson said. "There are a lot of mathematical techniques that oceanographers and other scientists can't necessarily bring to the table, and vice versa, so it's important to communicate and work together. Being able to give immediate feedback and contribute to the discussion was extremely valuable."

