

Sierra's current height goes back 50 million years, study finds

The finding adds to a growing body of evidence that the mountain range is much older than previously believed, and has implications for evolutionary studies.

Amina Khan, Los Angeles Times, 1-9-10

The Sierra Nevada reached their present height 50 million years ago -- 30 million years earlier than geologists once believed, according to a new study.

The research, part of a growing body of evidence that the Sierra Nevada are far older than once thought, has implications for understanding the evolution of the plants and animals in the West, as well as the likely climate of ancient North America.

The study, by scientists at Yale University and the Berkeley Museum of Paleontology, used 50 million-year-old chemical traces left on ancient leaves by microbes and raindrops to calculate the new height estimate for the Sierras at that time.

The western United States would have looked very different then, filled with lush forests of vines and magnolias. The Pacific Ocean would have lapped the foot of the Sierra.

"This is a time period where there would have been crocodiles in Wyoming," said lead author Michael Hren, a University of Michigan postdoctoral fellow who did the research while at Yale.

Sampling ancient flood-plain sites, the researchers found leaves preserved in the oxygen-poor sediments. They analyzed the waxes on the surface of those ancient leaves, measuring levels of normal hydrogen and its slightly heavier isotope, deuterium. This gave them an estimate of the elevation at which the leaves grew.

As clouds rise up the side of mountains, water droplets containing the heavier deuterium fall first, and droplets containing the lighter hydrogen later. The lower the proportion of deuterium on a leaf, the higher up the mountain that leaf must have been, the scientists surmised.

Hren also looked at soil carried down from the mountains to the ancient flood plains, checking for chemicals left by microbes that lived in the sediments. Cell membranes in these microorganisms changed composition depending on whether it was cool or hot -- providing a kind of ancient biological thermometer.

Using those data, the scientists estimated that the temperature had been 6 to 8 degrees Celsius warmer than today.

The idea that the Sierra Nevada were sitting at their current height 30 million years earlier than anticipated has implications for studies on the evolution of plants and animals, scientists said.

For example, with the mountains already in place so long ago, "how could animals migrate from California into the Great Basin?" asked Paul Koch, chairman of the Earth and Planetary Sciences Department at UC Santa Cruz, who was not involved in the research.

For understanding evolution of U.S. flora and fauna, "it matters a lot," he said.

The finding also has implications for historical climate estimates across North America. "Climate models require that you understand elevation," Koch said. "In Kansas it matters for you to get the topography of the Sierra Nevada right. In Florida it matters."

The study, published in the journal *Geology*, also provides a more accurate tool for exploring the elevation of ancient landscapes, said Diane M. Erwin, a study coauthor from the UC Berkeley Museum of Paleontology. In the past, such estimates have been made by studying leaf shapes. Such estimates can be less accurate than the deuterium method.

Putting together different pieces of data to create a coherent picture of the past is what drew him to the work, Hren said.

"It's amazing to break open a rock and look at these amazingly preserved leaves that can tell you a story from 50 million years ago."