

Sierra Nevadas still reaching for the sky

David Perlman, San Francisco Chronicle, 5-8-12

The mountains of the Sierra Nevada are still rising, and they're a lot younger than most scientists previously thought.

That's the conclusion of Earth scientists in Nevada who have used space-based radar and the most advanced GPS measurements to conclude that the entire range is now rising at a rate of one to two millimeters a year - less than an inch a decade - and in its modern form could be less than 3 million years old.

And scientists who have long held very different views about the age of the Sierra Nevada concede the mountains may have undergone a more recent pulse of upward growth, but still maintain they reached their present height many millions of years ago.

William C. Hammond, of the University of Nevada's Geodetic and Seismological Laboratories in Reno, and his colleagues have been measuring movements along all 400 miles of the Sierra and its spectacular peaks for more than 10 years to back their conclusions.

In Hammond's view, the mountains of the High Sierra that now range upward to Mt. Whitney's official summit of 14,494 feet were originally a long volcanic arc some 60 million years ago, when constant eruptions, powerful earthquakes and giant landslides marked their rise, Hammond said.

Even before that time, he said, when dinosaurs were walking across what would become California and southwestern Canada more than 65 million years ago, a vast slab of the Earth's crust beneath the Pacific called the Farallon Plate was diving under the western part of North America.

The ponderously diving plate crumpled up the western continent like wrinkles in a rug and began the rise of the volcanic arc that included what would become the Cascade volcanoes and the earliest rocks of the Sierra range, Hammond said.

Seismic intrusions of granite welled upward in California and built up the Sierra range that began rising some 40 million to 60 million years ago, according to Hammond's history of the mountains.

They are still rising - and have been for at least the past 3 million years or so, he said.

For their measurements, Hammond and his colleagues used data from a network of more than 1,000 Global Positioning System instruments, and from seismic detectors and other instruments now deployed across California and western Nevada by Earthscope, the continental earthquake research project maintained by the National Science Foundation and the U.S. Geological Survey.

The space radar data came from two European Earth-observing satellites, ERS-1 and ERS-2, in orbit now for more than 20 years. Instruments aboard the satellites can measure the most precise vertical motions of the Earth's surface from orbit.

The age of the Sierra Nevada has long been debated by scientists. Two of them, Stephan A. Graham and C. Page Chamberlain of Stanford, are leading advocates of the theory that the mountains rose to their present height between 75 million and 40 million years ago.

In a joint e-mail, they said "we are left with an interesting paradox" that there is abundant evidence for Hammond's conclusions, despite their own earlier evidence for a much more ancient Sierra Nevada uplift.

Graham and Chamberlain suggested that although they would still hold that the Sierra summit was as high "in ancient times" as it is now, they suggested that faulting and topographic collapse could have lowered the summit of the range before it began uplifting again more recently.

In other words, Graham and Chamberlain said, "the two views of the history of the uplift of the Sierra Nevada are not necessarily incompatible."

Hammond and his Nevada colleagues, together with Zhenhong Li, a specialist in remote sensing systems at the University of Glasgow, report their findings in the current on-line issue of the journal *Geology*, to be published in July by the Geological Society of America.