Palmdale Bulge: It Stretches, but Does it Bulge?

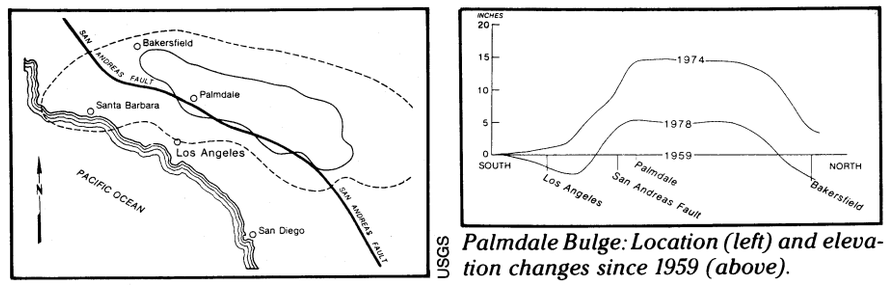
The Palmdale Bulge, a strangely behaved piece of earth astride the San Andreas Fault near Los Angeles, has baffled scientists who have warily watched it as a possible earthquake precursor since its discovery in early 1976. And, at the American Geophysical Union meeting last week in San Francisco, it continued to live up to its billing: Two independent groups of researchers reported that the area is unexplainably rapidly expanding horizontally, while another group suggested that it never bulged vertically.

According to scientists at the U.S. Geological Survey in Menlo Park, Calif., and at NASA's Jet Propulsion Laboratory in Pasadena, the region expanded about 22 centimeters in a northeast-southwest direction between April and November. Says one researcher: "It looks like Pasadena moved west," in effect adding a quarter-acre of land to the area in six months. Scientists can't fully explain the rapid stretching, but "it seems likely that it means ... a large earthquake sooner than earlier observations indicated," says Barry Raleigh of the USGS.

At the same time, but unrelated to the horizontal expansion, David D. Jackson and Wook Lee of the University of California at Los Angeles, have data indicating that most of the vertical swelling carefully recorded for years is due to a calibration error. "We can't say that there haven't been any uplifts, just that the bigger ones are explained in part by a systematic error," says Jackson.

These recent observations follow years of extensive study of the Palmdale region. The uplift, which covers about 32,400 square miles, is centered in the Mojave Desert about 40 miles north of Los Angeles. According to the Survey, the bulge rose more than 12 inches between 1959 and 1974, before generally deflating and tilting to the north. Since 1974, the USGS has observed a gradual north-south contraction in the region, as well as changes in radon emissions in the past year.

But none of the bulge's stirrings in the seismically suspect area have startled scientists the way recent events have. "The idea that such a large change could take place that fast is foreign to geophysicists," says Peter F. MacDoran of JPL. "It should take years and years." In April, MacDoran and co-workers, who operate a surveying system that uses radio astronomy to precisely measure changes in the earth's crust, noticed changes in their measurements of the distance between Pasadena and Goldstone, about 120 miles northeast. In October, using ground-based laser measurements, the USGS found similar changes.



USGS

Palmdale Bulge: Location (left) and elevation changes since 1959 (above).

The two teams agree on the existence and magnitude of the stretching, but no one seems to know what it portends. "It may be just the way nature behaves in that part of earth," says MacDoran, noting that JPL recorded similar activity in 1975, which was not confirmed by the USGS. Raleigh suggests an earthquake might occur sooner than expected because an expansion, particularly in the east-west direction, may "unlock" the fault, he says.

In the meantime, Jackson and Lee compared several studies of the survey line, San Pedro-Los Angeles-Saugus-Palmdale, and noted that the elevation changes seen in the large-scale features, such as mountains, were echoed in the small-scale features, such as ridges and small canyons. If tectonic forces were at play, changes in the large-scale features would stand out from changes in the small-scale features, Jackson says. Because they appear to change with the same magnitude at the same time, Jackson proposes a systematic error in the calibration of the leveling rods used during the surveys. When refigured, the rises and falls — with the exception of a rise after the 1971 San Fernando quake — melt into the margin of error, says Jackson. "Rather than a step backward, this is a step forward ... and it in no way decreases the risk of an earthquake," he says.

Other researchers suggest, however, that Jackson may be premature in his conclusions. Raleigh notes, for instance, that survey lines elsewhere do not show the behavior Jackson sees. But no researchers dismiss his work. Says one: "It looks damaging for the accuracy. ... But he's a bright guy ... you gotta listen to him." □

Earth tides help trigger volcano

When La Soufrière erupted last April on the Caribbean island of St. Vincent (SN: 5/12/79, p. 314), it was more than just random crustal grumblings, says University of Michigan's Frederick J. Mauk. It was earth tides. In fact, says Mauk, La Soufrière's eruptions were so well synched with earth tides that he was successfully able to pinpoint the most likely time of its final explosion.

In 1972, Mauk and M. J. S. Johnston showed that solid earth tides — deformations of the earth caused by the pull of the sun and moon — correlate quite well with most known volcanic eruptions (SN: 10/21/72, p. 261). Earth tides, which occur in cycles of 12 and 24 hours and 14.7 days, do not cause eruptions, but seem to contribute the "final bit of stress" to an already explosive situation, Mauk says.

Such a situation apparently existed on St. Vincent last April, Mauk told the American Geophysical Union last week in San Francisco. Based on Soufrière's past, Mauk found that the volcano has a tendency to erupt at the time of the maximum amplitude of the fortnightly tide. When he examined the reported times of the eight explosions at Soufrière up to April 22, he found they also matched the fortnightly tide maximum; 80 percent began within one day of the maximum. The probability of such a correlation occurring by chance is less than 0.01 percent, Mauk says.

In addition, because the time of Soufrière's explosions were so precisely known, Mauk was able to compare the activity with the more frequent diurnal and semi-diurnal tides. He found that 70 percent of the explosions occurred when the direction of acceleration of the semi-diurnal tide was upward.

Moreover, Mauk found that the next tidal maximums after the April 22 event — and the most likely times for another eruption — would occur within the 24 hour period of April 25 and 26. (According to researchers at the Smithsonian, Mauk had similarly accurately forecast the most likely time of the eruption of Alaska's St. Augustine in 1976.) "I called the [Smithsonian Event Alert Network] and told them, though I wouldn't hang my hat on it, that given the previous sequence, I suspected the 25th and 26th ... and it went off within 15 minutes of the diurnal tidal maximum [at 11:45 pm EDT April 25]." All in all, Mauk says, "the probability that earth tides trigger ... Soufrière is better than 99.5 percent." □