EARTH SCIENCES

From papers presented at the American Geophysical Union meeting in San Francisco

Rootless ranges and the Palmdale bulge

Normally mountain ranges have deep granite "roots" supporting their weight. The roots of the Sierra Nevada, for instance, go down about 30 miles. But analysis of seismic and gravity data by two California Institute of Technology geophysicists shows no evidence of roots for southern California's transverse ranges, composed of the San Gabriel and San Bernardino mountains. This leads them to conclude that these mountains are large folded, faulted and uplifted sections of the earth's crust, probably caused by a growing bend in the San Andreas fault.

The "Palmdale bulge," a 10-inch rise that extends across a 100-mile-wide area north of Los Angeles, may be a continuation of the same mountain-building processes that lifted the two ranges up to 10,000 feet, seismologist David Hadley reported. He and Caltech professor Hiroo Kanamori reported the results.

The Palmdale bulge has been much in the news since its discovery earlier this year. Many consider it a sign of increasing strain that could lead to a large earthquake. An entire symposium devoted to studies of the bulge was held at the AGU meeting.

But the Hadley-Kanamori concept of the area's tectonics predicts an uplift north of the San Bernardino mountains, and Hadley says he believes the Palmdale bulge may be part of this uplift.

"The bulge has been isolated for study, rather than being considered as part of the overall geologic activity in the area," says Hadley. "It's important to understand the uplift that's occurred over all the transverse ranges in recent geologic time."

The seismic data used by Hadley and Kanamori suggest that the San Andreas fault is offset between the crust and mantle. In the Imperial Valley the boundary between the North American and Pacific plates (the San Andreas fault) is the same for both the crust and the mantle beneath it. But farther northwest, the crustal segment of the fault may be offset to the west of the mantle segment of the fault. Near Gorman, Calif., the crust and mantle segments are many miles apart. At one time the two parts of the fault were probably lined up.

The great bend in the fault, between San Fernando and Bakersfield, is caused by something pushing the southern California portion of the earth's crust in a southwesterly direction, seismic data indicate. This push possibly originates in Nevada and Utah, a region that has undergone major crustal extension in recent times.

Quakes and the West China miniplate

China, with its history of devastating earthquakes, is also a treasure trove of earthquake documentation. Historical documents extending back almost 3,000 years describe the effects of earthquakes. One result of the analysis of these records is the preparation of estimates of local intensity of quakes and the construction of isoseismal maps—showing lines of equal intensity—based on them. Intensity, as opposed to magnitude, is a description of a quake's effects at a given location based on first-hand observation. An earthquake has only one magnitude; it can have many intensities.

Harsh K. Gupta and Jim Combs of the University of Texas at Dallas have analyzed available isoseismals for a number of great earthquakes in China from Sept. 17, 1303, to Jan. 25, 1972. Isoseismals for several of the quakes, they note, cluster around the margins of the West China miniplate. The data help define a miniplate boundary running almost north-south between longitudes 102° and 105°E and extending from about 23° to 36°N. They say these isothermal geometries, combined with the observed left-lateral faulting on the western side of the boundary and rotation measured by Chinese scientists near Shan Tan during a 1954 earthquake, indicate a clockwise rotation of the West China miniplate.

The wind-blown trails of meteors

For the past three years a radar with a pulse power of 10 million watts has been sending a beam upward from Urbana, Ill., scanning sections of sky 1,000 square miles in area and 25 miles deep. Its target has not been aircraft or satellites or anything else so tangible. Instead, it has been tracking the transient trails of meteors through the earth's upper atmosphere as part of an effort to trace variations in high-altitude winds.

The trails of ionized particles left by the passage of meteors drift in winds 50 to 70 miles above the earth and serve as ideal reflective tracers of wind patterns, according to Marvin Geller of the University of Illinois at Urbana-Champaign. The radar at Illinois, 10 times as powerful as any other being used for meteor trail study, observes 5,000 trails a day. Most of the meteors are as small as a grain of sand.

The research has shown that high-altitude winds affect the density of electrons in the D region of the ionosphere, 50 miles above the earth. These in turn, of course, affect long-distance radio reception. Winds from the north polar regions increase electron density at latitudes of the United States and Europe, hampering long-distance radio communications, while winds from the south decrease the electron density.

Climate, ice and navigability

How much difference can a 1°F drop in average temperatures make in the navigability of Arctic waters? Plenty, according to Jeffery C. Rogers of the University of Colorado's Institute of Arctic and Alpine Research. Comparing temperature and ice-severity records since the mid-1950s for the Beaufort Sea coast of Alaska and northwestern Canada, Rogers has found that a decline in summertime "thawing degree days" since the early 1950s "has had dire consequences along the northernmost part of the sea route between Pt. Barrow and Prudhoe Bay. From the 1920s to the early 1950s, he says, more than 80 percent of the summers had favorable ice conditions; since then slightly less than 50 percent of the summers have had favorable ice conditions. "This reduction," he says, "was brought about by a 0.6°C drop in the average daily summer temperatures along that sea route. A further decline in average temperatures would make light ice summers a rarity while an amelioration could lead to conditions resembling those of the 1920-50 period."

Magma body beneath El Paso

A variety of recent studies have produced evidence for the existence of one or more chambers of magma beneath the earth's surface near Socorro, N.M., in what has become known as the Rio Grande Rift zone. Now Jens Pedersen and John F. Hermance of Brown University find evidence for a similar magma body in the southern part of the rift zone near El Paso, Tex., 160 miles to the south.

Geomagnetic variation data from 17 sites near El Paso plus gravity data show quite clearly an anomalous conducting zone beneath the southern Rio Grande Rift, they say. Based on these data and the associated high heat flow of the rift, they infer the presence of a magma body thicker than 10 kilometers located in the crust at shallow to intermediate depth.