

## Do recent L.A. quakes herald larger shock?

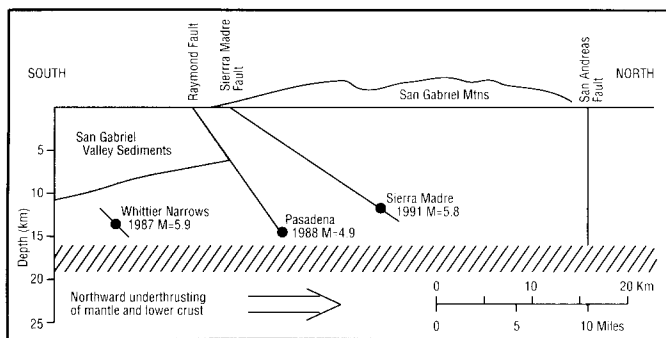
Three Los Angeles seismologists have some mixed news for their 12 million neighbors. On the positive side, these researchers have developed a theory to explain a puzzling spate of moderate-sized quakes that has rattled the San Gabriel Valley, east of Los Angeles. The bad news: Their theory may prove correct.

At a meeting of the American Geophysical Union in San Francisco last week, the scientists suggested that a surge of six moderate quakes since 1987

that the lower crust and the mantle beneath are sliding northward under the upper crust. According to this model, the lower crust has not moved all at once. Rather, a patch in the south slipped northward at first, and that movement has slowly crept forward, like a person trying to smooth away a ripple in the center of a rug. Such a pulse would trigger earthquakes as it passed faults with a particular orientation and a sufficiently high level of stored energy, Jones says.

She and her colleagues propose that by

*Vertical slice shows northward progression of three of the six quakes that have struck the area since 1987. The lower crust may be slipping beneath the upper crust, triggering the quakes.*



was triggered by a pulse of movement pushing slowly northward through the deep crust. That idea raises concern because the hypothesized pulse appears headed toward the main Sierra Madre and San Andreas faults — two structures with potential for unleashing earthquakes comparable to or even larger than the magnitude 7.1 Loma Prieta temblor, which devastated parts of the San Francisco Bay region in 1989.

"We've seen the earthquakes moving north-northeast at about 6 kilometers per year. So we're proposing essentially a pulse coming along that's setting off these earthquakes," says Lucile M. Jones, a seismologist with the U.S. Geological Survey in Pasadena. She developed the theory with Egill Hauksson and Hiroo Kanamori, both at the California Institute of Technology in Pasadena.

The recent cluster of quakes, ranging in magnitude from 4.5 to 5.9, has attracted attention because it occurred in a region that had gone 50 years without any recorded shocks of that size. The last major jolt in the series, a magnitude 5.8, originated on part of the Sierra Madre fault under the San Gabriel Mountains, a region nearly devoid of earthquakes over the past 20 years (SN: 7/13/91, p.27).

Adding to the intrigue, four of the quakes started 12 kilometers or more below the ground surface — an unusually deep level for California quakes. That depth lies just above the transition between the hard upper crust and the more ductile lower crust, where rock is too hot and soft to allow the fractures that generate earthquakes.

To explain the deep, northward-moving quakes, the three scientists propose

last June, the pulse reached a small portion of the Sierra Madre fault that bends to the south, setting off an earthquake there. To the north of that section lies the main Sierra Madre fault, which has remained quiet for decades, apparently storing up considerable energy. As the pulse moves onward, it could trigger a shock on this still-locked section of the fault or a later shock on the San Andreas fault farther to the north, Jones suggests. On the other hand, she says, the pulse could turn downward and travel deeper into the Earth without ever sparking a magnitude 7 quake.

The researchers say they cannot predict how this period of enhanced earthquake activity will end. In the Bay area, a cluster of moderate earthquakes foreshadowed the Loma Prieta quake. In other locations, clusters have died off without any grand finale.

"Just the fact that we're seeing anomalies does not mean that [the earthquakes] are precursors," Jones says.

After examining the work of Jones and her colleagues, a board of California scientists charged with overseeing earthquake predictions concluded last week that "the data show a pattern suggesting the possibility of increased seismic activity for the Los Angeles Basin," according to Richard Andrews, director of the California Office of Emergency Services.

Roughly translated, that statement warns Los Angeles residents to expect more of the tremors they've been feeling over the past several years. At this point, that's about as specific as seismologists can get. "Earthquake prediction is where weather prediction was a hundred years ago," laments Jones. — R. Monastersky

## Stroll for health, boogie for fitness

"Walking is man's best medicine," wrote Hippocrates, the ancient Greek physician. It may be woman's best medicine, too. A new study shows that regular hour-long strolls — which do little to improve cardiovascular fitness — can nevertheless reduce a woman's heart disease risk by boosting her blood levels of high-density lipoproteins (HDLs), which help remove cholesterol from the body.

"We found that even low levels of activity are beneficial," says study leader John J. Duncan of The Cooper Institute for Aerobics Research in Dallas. "We're telling people if the shoe fits, start walking."

This is the first clinical study to show that exercise need not be vigorous to lower a person's risk of cardiovascular disease, Duncan and his coauthors write in the Dec. 18 *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION*. Indeed, they say, the findings confirm epidemiologic evidence suggesting that HDL levels increase across a spectrum of exercise intensities.

To find out how a walker's pace affects cardiovascular health, the researchers recruited 59 healthy, sedentary, premenopausal women and divided them into four groups: aerobic walkers, who exercised at 86 percent of their maximal heart rate; brisk walkers, exercising at 67 percent; strollers, exercising at 56 percent; and a sedentary control group. The three walking groups traversed 4.8 kilometers per day, five days a week. Before and after the 24-week program, the researchers measured each woman's maximum oxygen consumption — an indicator of lung capacity and cardiovascular fitness — and assayed her blood-lipoprotein levels.

While fitness increased in direct relation to walking pace, HDL levels rose the same 6 percent whether a woman strolled leisurely or "power walked," the team found. This HDL increase should slash a woman's cardiovascular disease risk by 18 percent, Duncan estimates.

Peter D. Wood, who studies the health effects of exercise and diet at Stanford University's Center for Disease Prevention, cautions that the new findings don't belittle the value of vigorous exercise. Lean, muscular athletes enjoy additional health benefits from their low percentage of body fat, he notes. "Within reason, the more exercise you do, the better," Wood says.

All the same, he adds, the new data should convince people — especially sedentary women — that even mild activity is better than none. — K. Schmidt