Bay area quake fails to fit textbook model

In the wake of last week's earthquake, experts on the San Andreas fault find themselves alternately patting each other's backs and scratching their heads. The quake confirmed several of their predictions, but left scientists with many surprising details.

Records from distant seismic stations led the U.S. Geological Survey (USGS) this week to upgrade the quake magnitude from 6.9 to 7.1.

Last week's temblor ruptured a section of the San Andreas that runs through mountains east of Santa Cruz. Scientists named it the Loma Prieta quake for a nearby mountain peak. Historical records suggest this segment fractured during a jolt in 1865 as well as during the great San Francisco quake of 1906, and several signs indicated it was again near breaking. A 1988 report issued by the USGS calculated a 30 percent chance that a magnitude 6.5 shock would hit this fault section within 30 years.

"It worked out so well, almost unbelievably well," says Allan G. Lindh, a USGS seismologist in Menlo Park, Calif., who has long discussed the quake potential of the fault near Santa Cruz. But Lindh worries, "This will leave a lot of people feeling that we know more than we do."

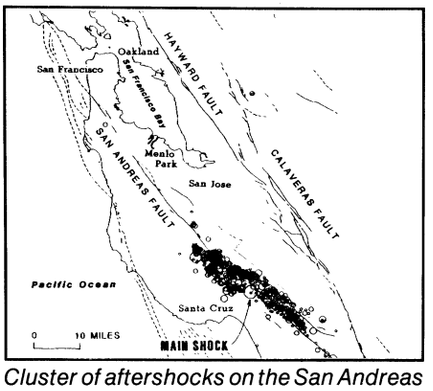
As scientists study the Loma Prieta shock, the cause of more than 60 confirmed deaths, an unusual portrait is emerging. Searches above the quake center have failed to find any sign the jolt ruptured the surface along the San Andreas fault. During a temblor this size, opposite sides of the San Andreas normally slip apart by a meter or two, and geologists usually find evidence of the displacement at the surface.

Geologists have found cracks in the ground, but none that match the way the fault moved underground, says USGS geologist David P. Schwartz. The San Andreas forms the border between the northwest-moving Pacific plate and the southeast-heading North American plate. Because the plate motion drives earthquakes along the San Andreas, the ocean side of the fault always moves to the northwest, relative to the continental side. For a person facing the fault, the other side should always slip to the right. Schwartz says investigators have not located such offsets at the surface.

What geologists seek may not exist. After the 1906 quake, researchers could not find the expected surface ruptures along this segment, and perhaps it does not normally exhibit the ground offsets that appear on most other sections of the San Andreas, Schwartz says.

Seismologists, who analyze earthquake waves traveling through the ground, may have an explanation for the lack of ground rupture. The main shock struck about 18 kilometers down, unusually deep for San Andreas earthquakes, which normally occur about 10 km below the surface, Lindh says. The rupture spread upward, but apparently did not break the surface. By measuring changes in the distance between reference stations, geophysicists have detected another unusual characteristic of this fault section. William H. Prescott of the USGS reports the Loma Prieta quake produced about 1.5 meters of horizontal slip and about a meter in the vertical direction. This is the first time that scientists have seen significant vertical movement on any section of the San Andreas. They say a local bend in the fault may explain the vertical slip.

Kerry E. Sieh, a geologist who studies rock displacements and other physical evidence of past earthquakes along faults, finds the absence of surface rupture troubling. Geologists often rely on the rupture history of a fault segment to assess the chances of a future shock. Sieh, of the California Institute of Technology in Pasadena, says if some damaging quakes do not manifest themselves at the surface, that could cause underestimates of the seismic danger.



USGS

Cluster of aftershocks on the San Andreas fault surrounds the Oct. 17 main shock.

Other scientists sound less concerned. When studying past quakes, geologists usually pick areas where the geology is less complex than the Santa Cruz mountains. These spots probably provide a true picture of the earthquake history, Lindh says. — *R. Monastersky*

Revised RDAs add a few good nutrients

The National Research Council issued new guidelines this week for the daily consumption of essential nutrients — the first such revisions in nine years. The updated Recommended Daily Allowances (RDAs) include "important changes" for several key nutrients, notes Richard J. Havel at the University of California, San Francisco, who chaired the panel that revised the guidelines.

One notable change extends the adolescent RDA for calcium of 1,200 milligrams (mg) to age 25. Previous guidelines initiated the adult RDA of 800 mg at age 19, when individuals reach full adult stature. But data now show that another 5 to 10 percent of one's calcium-rich bone mass gets deposited between ages 19 and 24. Since vulnerability to osteoporosis — a degenerative bone disease — depends on bone mass, Havel's panel reasoned that a little more calcium early in life could help stave off crippling bone breaks in old age.

Several RDAs decreased — including those for iron in adolescent and premenopausal women, folate, vitamin B6 and vitamin B12. Havel says these changes — sometimes a halving or more — reflect new data showing that the body stores more of these nutrients than was previously thought, or that the body needs less to maintain good health.

Though vitamin C's RDA didn't change, the new guidelines recommend smokers increase their intake by two-thirds — to 100 mg daily — because data now indicate those smoking a half pack of cigarettes or more daily use up this vitamin 40 percent more rapidly than nonsmokers.

Vitamin K and selenium gained their first RDAs. Found in green, leafy vegetables, vitamin K aids in the production of several important proteins and in blood clotting. The RDAs now suggest men consume 80 micrograms (μg) daily and women 65 μg. RDAs for selenium — found in seafood, liver and grains — are 70 μg for men and 55 μg for women. This element helps the body disarm dangerous chemical oxidants.

The RDA for what is generally considered the body's premier antioxidant, vitamin E, did not change. However, new animal and human data now strongly suggest consuming levels up to 10 times the current RDA of 8 to 10 mg, says William A. Pryor of Louisiana State University at Baton Rouge. Though Pryor acknowledges human studies have not yet provided conclusive proof of benefits from upping the vitamin's RDA, he contends this would cause no harm, since vitamin E is nontoxic up to 100 times the current RDA.

Leslie M. Klevay, at the Agriculture Department's nutrition research center in Grand Forks, N.D., frets that copper — an essential mineral — still lacks an RDA. The new guidelines loosely advocate levels up to 3 mg daily. But less than half the U.S. population consumes even 1.5 mg, Klevay's data show, and one-third of Americans eat less than 1 mg daily, a level studies indicate can foster dozens of changes linked with heart disease, including elevated cholesterol and blood pressure. Until it gets an RDA, he argues, consumers and the food industry "will continue to ignore copper" — in labeling, research and their menus. — *J. Raloff*