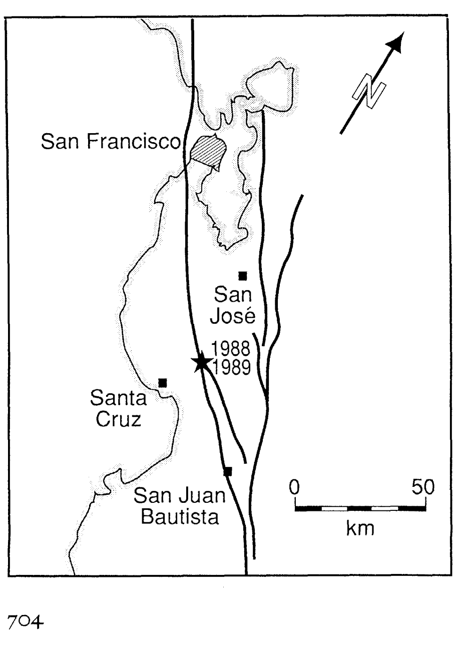
Another California Seismic Hot Spot

The house creaked, doors swung open and shut, and everyone woke with a start last week at Allan Lindh's home south of San Francisco. "It was the best earthquake we've felt yet," says Lindh of the Lake Elsman temblor. For seismologists such as Lindh, this magnitude 5.2 earthquake and its near twin that struck nearby last year are also the most intriguing earthquakes to have shaken that particular portion of the San Andreas since the great San Francisco quake of 1906.

"I've always taken that segment of the San Andreas a little more seriously than other seismologists," says Lindh, who lives a half kilometer off the fault, 60 kilometers south of San Francisco and 20 kilometers to the north of Lake Elsman. "Now we've had two of these magnitude 5's where we didn't have anything. I thought it was a dangerous segment before anything happened; I can only be reinforced in that feeling now."

The danger is that these events may be a sign that a damaging magnitude 6.5 quake will rupture a 45-kilometer section of the San Andreas south of Lake Elsman. This part of the fault runs through the southern Santa Cruz Mountains, a sparsely populated area, but it lies just to the south of Silicon Valley between San Jose and Santa Cruz.

Several characteristics of the southern Santa Cruz segment have alerted researchers to yet another California seismic danger. The first is the segment's role in the great San Francisco earthquake. It was here that the southward-propagating rupture of the San Andreas ran out of steam and came to a stop in 1906. The amount of slippage between opposing sides of the fault during the rupture decreased from more than 4 meters in the north to 2.5 meters in this section to zero at its southern end, near San Juan Bautista. But every part of the fault must slip several meters every few hundred years on average; the drifting of the continents requires it. So, seismologists expect one or more moderate earthquakes on such terminal segments to make up for the shortfall in fault slip in 1906.



Another worrisome circumstance is the length of fault that would break in any quakes that help the slippage catch up. If the southern end of the 1906 break were subdivided into a series of segments, each only a few kilometers long, the quakes would be small and relatively harmless. But in 1983 Lindh, who works at the U.S. Geological Survey office in Menlo Park, decided that the entire 45 kilometers of fault south of Lake Elsman was a single segment that would break all at once. If so, a respectable earthquake of magnitude 6.5 would result.

Then there are the Lake Elsman quakes. They are two of the three largest earthquakes since 1914 on the 420 kilometers of the northern San Andreas. Each broke about a 1-kilometer patch of fault at depths of 14 kilometers within a kilometer or two of the intersection of the San Andreas and a side fault called the Sargent, right at Lake Elsman. That puts these quakes precisely at one end of Lindh's segment. Often a fault section first shows signs of imminent rupture at its ends.

With more and more signs that the southern Santa Cruz Mountains segment is dangerous, seismologists are starting to give it the attention an immediate threat deserves. A USGS working group estimated last year, before the first Lake Elsman earthquake, that the southern Santa Cruz section has about a 30% probability of breaking sometime during the next 30 years (*Science*, 22 July 1988, p. 413). No one is formally raising that probability, but Lindh's seismological intuition tells him they better assume the worst. ■ RICHARD A. KERR

Exxon Bets on Bugs in Alaska Cleanup

In the largest experiment of its kind, Exxon Corporation is trying to feed native Alaskan bacteria. The hungry microbes slurp oil and, if Exxon can grow lots of them, they'll help clean up beaches that were stained with the crude oil dumped by the company's tanker, the *Valdez*, last April.

By September, says Bob Mastracchio, who heads Exxon's cleanup program, the company intends to coat 70 miles of shoreline with two kinds of nitrogen- and phosphorous-bearing fertilizers to boost the indigenous bacterial populations. Exxon is so confident about the potential of the approach that it is gambling $10 million on the effort.

But Exxon's confidence rests on a limited experimental base. The company, in conjunction with the Environmental Protection Agency (EPA), began experiments with the fertilizers in early June on four test plots measuring 30 meters by 12 meters. Two more plots were used as controls and were not treated. "Within 10 days a clear rectangle appeared against a background of oil-contaminated beach material," says Hap H. Pritchard, a microbial ecologist in EPA's Office of Research and Development.

But Pritchard, who normally is stationed at EPA's Gulf Breeze, Florida, research laboratory, says it is hard to quantify just how effective the fertilizer really is. Even without chemical treatment, "there is significant biodegradation going on," he says. Another variable, he adds, is the uncertainty about how long elevated bacterial populations will be sustained with just one application. A reduction in air and water temperatures also is expected to reduce bacterial activity.

Curiously, neither EPA or Exxon have done much work to identify the different species of bacteria at work on the beaches. Nor have they sought to gauge their appetite for oil. With a narrow time frame for executing the plan before winter closes in, Mastracchio says there has not been time for such basic research.

One of the chemicals to be used is "Inipol EAP 22," a special fertilizer created for the very same purpose in the early 1980s by the French petroleum concern, Elf Aquitaine. But the chemical's only major deployment occurred in 1985 to help mop up a far smaller spill of refined marine oil.

The use of the fertilizers, EPA and Exxon officials acknowledge, may pose a risk to some sea life. Lab studies suggest that, where tidal flushing is minimal, nitrogen-leaching fertilizers could be toxic to the larvae of sea urchins, oysters, and mussels. For this reason, EPA is monitoring shellfish, but so far there is no evidence that they are being affected.

Even if there were some damage, experts view the risk as small relative to the potential benefit. Pritchard says that it could take 5 to 7 years for oil on beaches to break down under natural conditions. With the fertilization program that time could be reduced to 2 to 5 years. ■ MARK CRAWFORD