Earth Science

Richard Monastersky reports from San Francisco at the annual meeting of the American Geophysical Union

Radio hints precede a small U.S. quake . . .

After a 5-year wait with radio receivers pressed firmly to the ground, Antony Fraser-Smith captured electromagnetic premonitions of a California earthquake a month before it struck last year. The finding offers the hope that scientists may one day predict some quakes by listening for electromagnetic pulses and other types of signals emanating from faults as they prepare to give way.

An atmospheric physicist at Stanford University, Fraser-Smith grew interested in seismology when one of his ultra-low-frequency radio receivers happened to record unusual electromagnetic emissions just before the 1989 Loma Prieta earthquake south of San Francisco. In hopes of catching another quake, the physicist set up two receivers over the San Andreas fault near the tiny town of Parkfield, where seismologists believe a magnitude 6.0 quake is imminent. He also stationed instruments near the San Andreas fault in Southern California and in the Bay Area.

In November 1994, one of the Parkfield instruments started showing electromagnetic pulses 10 times the size of typical atmospheric signals. At around the same time, seismometers and other types of monitoring devices stationed at Parkfield also began picking up unusual signals, convincing Fraser-Smith that "things were heating up down there." He drove to Parkfield to repair his other receiver, which had stopped working. A week later, a magnitude 5.0 earthquake struck.

His instruments in Southern California did not, however, pick up changes before the disastrous Northridge earthquake on Jan. 17, 1994.

Fraser-Smith's modest success at Parkfield and other findings around the world have convinced skeptical seismologists to take a new look at electromagnetic monitoring of faults (SN: 10/21/95, p.260).

. . . and a devastating Japanese jolt

Astronomer K. Maeda normally studies high-frequency radio emissions from Jupiter. But in the predawn hours of Jan. 17, 1995, his antennas picked up some pulses that could not have come from that distant planet. Forty minutes later, a magnitude 6.9 earthquake devastated the town of Kobe, Japan (SN: 1/28/95, p.54).

A researcher at the Hyogo College of Medicine in Nishinomiya, Maeda points to several pieces of evidence that link the radio emissions to the earthquake, which started 77 kilometers from his observatory. Unlike the Jovian signals, which vary continually because of Earth's rotation, the signals recorded on Jan. 17 were constant, indicating that they came from Earth. Maeda could also tell that the emissions came from the general direction of the earthquake's epicenter on the Nojima fault. He suggests that stress variations in the ground before the quake caused the radio emissions. Earlier this year, other researchers reported that changes in water chemistry preceded the Kobe quake (SN: 7/15/95, p.37).

Mountains frozen in time

Using explosive blasts and large vibrating trucks, an international team of seismologists has peered far below Russia's Ural Mountains to find out why they resemble no other mountain chain. Reaching unprecedented depths of 150 to 200 kilometers, the seismic imaging experiment illuminated structures all the way down to the base of the lithosphere—Earth's stiff outer shell.

"This is certainly the most ambitious effort ever undertaken in terms of imaging the lithosphere," says James H. Knapp of Cornell University. The project teamed U.S. researchers with scientists from Germany, Russia, and Spain.

To peek under Earth's skin, Knapp and his colleagues created small artificial earthquakes. The seismic waves raced down into the lithosphere and bounced off hidden structures, such as faults or folds.

The seismologists focused their study on the Urals because the 3,000-kilometer-long chain is frozen in midevolution. The range formed when Asia smashed into Europe between 600 million and 300 million years ago, at about the same time that North America collided with Africa, building the Appalachian Mountains.

The Appalachians entered old age when North America separated from Africa, tearing apart the lithosphere and causing the once-towering mountain range to collapse. Most other mountain chains evolve through the same pattern of growth and collapse. The Urals have remained intact because Asia never separated from Europe. "This is an important time to reexamine how mountain belts evolve, because we see in the Urals an example of one that didn't," says Knapp.

The experiment ended 3 weeks ago, so researchers have only begun to analyze the tremendous volume of data. Judging from a preliminary look at the recordings, Knapp and his coworkers can see structures potentially as deep as 200 km below the surface, nearly twice the depth of features seen in previous studies.

Cornell Univ.

Region of seismic experiment.

Sahara dust blows over United States

Summertime haze over the eastern United States often contains bits of the Sahara Desert blown clear across the Atlantic Ocean, report researchers from the University of California, Davis.

When Thomas A. Cahill and his colleagues started studying microscopic dirt particles in the atmosphere, they believed that dust storms from the Great Plains supplied much of the dirt in the air over the Midwest and the East. But the proportions of various elements in the airborne soil did not match those of U.S. dirt.

The floating dust particles did, however, resemble samples of dirt collected from air filters in the Virgin Islands. This led Cahill and his colleagues to suspect a Saharan source, because previous research indicated that air over the Virgin Islands contains African dust.

In fact, Cahill calls the Virgin Islands the dustiest place in the United States, judging from the concentration of fine particles less than 2.5 micrometers in diameter. "The Virgin Islands have more dust than the Grand Canyon, the Badlands, or Death Valley," he says.

The tiny Saharan dirt particles may reduce visibility in normally clear places, such as the Virgin Islands or South Florida. But most eastern states cannot blame their perpetual summer haze on the African dust, says Cahill. Rather, their air pollution comes from burning sulfur-rich coal and other fossil fuels, which creates tiny sulfuric acid droplets.

Cahill warns that the African dust could confound efforts by the Environmental Protection Agency to limit pollution from airborne fine particles. The agency is considering setting standards for particles below 2.5 micrometers in size. Natural sources could violate such standards on days when air currents carry large amounts of Saharan dust, says Cahill.

"It just shows that when it comes to fine particles, we're all one world," he says. Indeed, researchers from Mauna Loa Observatory on Hawaii find that dust storms from China and Mongolia reach Hawaii about 20 times a year, cutting down on visibility there.