Seattle's soft spot boosts power of quakes

Seattle enjoys a buzzing reputation for its coffee culture, but the city faces the threat of a caffeine-free jolt in the future. Seismologists this week report that the thick foundation of sediments underlying Seattle is less rigid than previously thought and will amplify shaking during earthquakes.

Much of the new information about the city's seismic risk comes from a large project launched in March 1998 to explore the hidden geologic structure of the region surrounding Seattle and Vancouver, British Columbia. The $3 million effort sent ships with airguns throughout Puget Sound and connecting waterways, where they fired 33,000 volleys of sound through the water and into Earth's crust.

Seismologists recorded the vibrations that bounced off buried structures or bent back upwards by refraction. Recordings of these waves provided the first clear picture of the Seattle Basin—a 10-kilometer-deep oblong bowl filled with sediments. As the vibrations passed through the basin beneath Seattle, they traveled much more slowly than expected, says project leader Michael Fisher of the U.S. Geological Survey in Menlo Park, Calif.

"We're finding that the velocity of sound in these sedimentary rocks is very low, which means, probably, that the sediment is going to shake severely during a major earthquake. . . . So it's probably heightened the threat to the city of Seattle," says Fisher. He discussed the findings at a meeting of the Seismological Society of America in Seattle.

The low velocities indicate that the sediments beneath Seattle are softer than expected. At a depth of 5 km, sound waves rippled at a speed of 4 km per second, roughly four-fifths of the typical value seen in sedimentary basins in California, says Fisher.

When seismic waves from an earthquake travel upward and enter the basin, the sediments intensify the shaking. "Think of it like you have a plate with a chunk of Jell-O on it and you shake it. The thing wobbles all over the place, and you wouldn't want a house on that," he says.

One possible source for an earthquake in this region is the Seattle fault, a major fracture in Earth's crust that cuts in an east-west direction across the southern part of the city. Geologists discovered it only 7 years ago, when they found evidence of a strong earthquake about 1,100 years ago that ripped the southern edge of the city, where the Kingdome arena now stands.

At the meeting, researchers showed that the Seattle fault is not dead. Craig Weaver of the USGS in Seattle discussed a magnitude 4.9 quake that struck west of Puget Sound in June 1997. Weaver and his colleagues linked the quake to a recently identified strand of the Seattle fault, indicating that the fault is more active than thought.

"It's getting to be compelling evidence that this is a major actor here in Puget Sound," he says. At present, though, researchers can't say how often destructive earthquakes emanate from the fault.

When the fault does unleash a strong shock, the shape of the basin could give Seattle a double shot of trouble, according to new studies. In a computer simulation of a magnitude 6.5 earthquake deep down on the Seattle fault, two different sets of seismic waves ganged up on the city, reports Arben Pitarka of URS Greiner Woodward Clyde, a geological consulting firm in Pasadena, Calif.

As seismic waves radiated up and out from the fault, some bent when they entered the edge of the basin and then traveled along the surface toward downtown Seattle. Other waves took a more direct route. When these two sets collided, they intensified the shaking in some regions—an effect seen in Kobe, Japan, in 1995. Pitarka cautions, however, that this simulation relies on assumptions about Seattle's underground geology, which scientists are only starting to map out. *—R. Monastersky*

Land mines may set off little buzzers

As a flower's scent lures bees to collect pollen, the aroma of TNT or other explosives might soon entice the insects to join a humanitarian mission against land mines. TNT, or trinitrotoluene, is the main ingredient of an estimated 100 million typically plastic land mines in the world that are a legacy of various wars. Each day, these hidden weapons kill or maim some 60 people.

Researchers at the University of Montana in Missoula and numerous U.S. government labs plan to start tests with honeybees later this month. They hope to determine whether it's possible to train and monitor the insects in ways that might lead to safer, quicker detection of land mines.

The Montana researchers had found that bees foraging in chemically contaminated areas accidentally pick up sufficient pollutants to reveal the presence of such substances within a half-mile or so of a hive (SN: 5/24/97, p. 324). Preliminary studies have since found that bees can bring home traces of explosives as well.

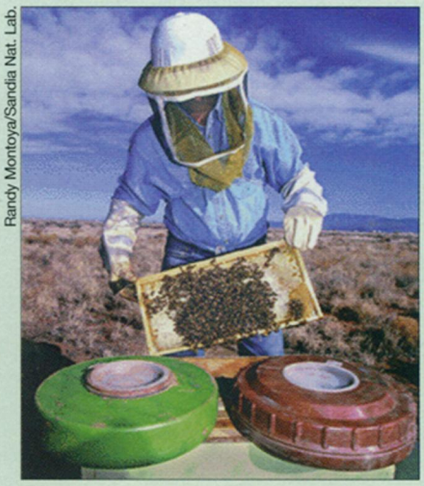
In the new tests, researchers hope to find out whether plants incorporate residues from leaky mines into pollen and nectar. They also plan to determine how much bomb residue bees might bring into hives from minefields and whether the chemicals taint the dust and pollen stuck to bee bodies, the fluids that bees ingest, or both.

Researchers will also try to train bees to seek out explosives by associating the compounds' scents with hives or food. To keep track of individual bees' comings and goings, engineers at Pacific Northwest National Laboratory in Richland, Wash., have shrunk electronic identification tags, readable via radio, to weigh less than a rice grain and fit on a bee's back. Another device, also to be glued on bees, may allow researchers to track the insects with hand-held radar guns, says Montana's Jerry J. Bromenshenk.

Similar techniques might also transform bees into scouts for illegal drugs or nuclear-bomb ingredients.

If the strategy works, "it's a cheap, nondestructive way to characterize a land mine site," says Susan Bender, leader of a group of researchers at Sandia National Laboratories in Albuquerque, N.M., that is involved in the project.

Nonetheless, convincing the people now clearing minefields to take up a technique "that frankly sounds a little farfetched" may bedevil the project, says Col. George Zahaczewsky, who runs the Pentagon office that oversees the U.S. military's humanitarian demining research.



Randy Montoya/Sandia Nat. Lab.

Metal detectors can't sense plastic land mines (shown foreground, without fuses), but bees might.

In recent years, scientists around the world have been developing new mine-detection schemes, ranging from better sensors to bacteria that glow when they contact explosives (SN: 3/28/98, p. 202). Exotic approaches have been "poohpoohed by the demining community," says Zahaczewsky. Most deminers continue to find mines at great risk to themselves by cautiously prodding the soil with pokers. *—P. Weiss*