American plate shows its edge in Japan jolt

The large earthquake that struck off the west coast of Japan's Hokkaido Island last week is helping earth scientists piece together the complex plate tectonic puzzle in this part of the world. The emerging picture indicates that western Japan faces a greater threat of quakes and accompanying large waves, called tsunamis, than previously recognized, according to Japanese seismologists.

The tremor, measuring magnitude 7.8 on the Richter scale, emanated from 30 to 40 kilometers below the ocean floor, just north of the small island of Okushiri. It fits in with a string of earthquakes that have occurred along the west coast of Hokkaido and Honshu islands during the last half century, says seismologist Katsuyuki Abe of the University of Tokyo.

The most recent of these was a 1983 earthquake, similar in size to last week's, that hit 300 kilometers south of Okushiri, also causing destructive tsunamis. That earlier tremor rattled standard theories about the local arrangement of tectonic plates – the large patches of Earth's outer shell that are in continuous motion. Four such plates butt heads in the vicinity of Japan. The Eurasian plate lies to the west, the North American plate extends down from the north, the Pacific plate bulldozes in from the east, and the Philippine plate pushes up from the south.

Around much of the world, the boundaries between plates are marked by clear geological features, such as mountain ranges or deep ocean trenches. But scientists have had trouble defining where the North American and Pacific plates meet. Traditional theory has held that the two collide in the center of Honshu Island, creating the central mountain range there. The 1983 quake, however, supported a rival idea, that the two plates collide farther to the west.

The orientation of the fault that produced the 1983 temblor suggests that the Eurasian plate is plowing underneath the North American plate just off the west coast of Honshu and Hokkaido islands. In other areas of the world, this type of motion, called subduction, carves a deep ocean trench. But the subduction here seems to have started within the recent geologic past and has yet to create a prominent trench, says Seiya Uyeda of Tokai University in Shimizu.

Last week's quake supports the idea of subduction off western Japan, says Abe. Quite similar to the 1983 jolt in orientation, this quake also occurred on a fault dipping east beneath Japan – an arrangement that suggests it too stemmed from the Eurasian plate diving beneath the edge of the North American plate.

Japanese seismologists expected the recent shock to some degree, because it fell in a seismic gap, a relatively quiet region sandwiched between the 1983 jolt to the south and a 1940 shock to the north. Yet they did not think a quake would fill the gap so soon, because the rate of seismic activity on this side of Japan is low. The Eurasian and North American plates are colliding slowly, so researchers expect that it takes about a thousand years to store enough energy to trigger an earthquake along a particular patch of the subduction zone, says Abe.

The tsunamis unleashed by last week's shock caused much of the destruction related to the quake. While the east coast of Japan has a long history of earthquakes and tsunamis, the west coast has experienced far fewer, and people there have been less aware of the danger, says Hiroo Kanamori of the California Institute of Technology in Pasadena.

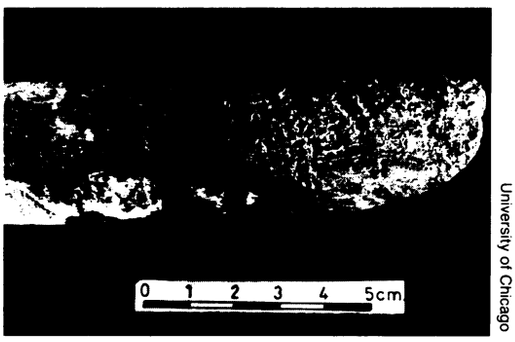
The growing evidence that a subduction zone lies just off the west coast of Japan indicates that this area will face more unrest in the future. But because the tremors originate so close to the coast, it takes only minutes for a tsunami to hit land, leaving precious little warning time – a fact made clear last week.

"In a way, it's really a worrisome situation," says Kanamori. "In the past, we've always argued that if we had a better warning system, we could have saved some lives. This time, it would have been very difficult." *– R. Monastersky*

Site surrenders fabric of prehistoric life

Archaeologists excavating an ancient Turkish site in 1988 found a puzzling, calcium-encrusted piece of material clinging to what was probably the handle of a bone tool. Microscopic analysis of the find, which measures about 3 inches by 1.5 inches, now identifies it as the earliest known fragment of cloth, scientists announced last week.

A team of archaeologists directed by Robert Braidwood of the University of Chicago and Halet Cambel of Istanbul (Turkey) University recovered the partially fossilized cloth at Cayonu in southeastern Turkey.



University of Chicago

Close-up of 9,000-year-old cloth fragment found in Turkey.

Several radiocarbon dates obtained from artifacts found near the cloth place it at around 9,000 years old. Previously, the oldest examples of prehistoric cloth – ranging from 8,000 to 8,500 years old – came from another Turkish site and an Israeli cave.

"The uses of textiles are innumerable, and it's hard to say how the Cayonu people employed cloth," says Gillian Vogelsang-Eastwood of the National Museum of Ethnology in Leiden, the Netherlands. Vogelsang-Eastwood, one of the few archaeologists who specialize in the study of ancient textiles, identified the Cayonu find as cloth.

She suspects the fabric served as a grip for the bone handle, which was fashioned out of an antler.

Vogelsang-Eastwood plans to use a scanning electron microscope to determine the nature of the fabric. Other early cloth specimens have been made of linen, which displays a characteristic polygon pattern when greatly magnified, she explains.

Cayonu residents probably produced cloth on a four-sided wooden frame, the Dutch archaeologist proposes on the basis of her examination of the new find. It appears, she says, that weavers interlaced pairs of threads horizontally around single vertical threads held in place on a frame.

This method derived from the already well-established practice of basket weaving, Vogelsang-Eastwood holds. It remains unclear when and where people first applied basketry techniques to weaving, although such innovation probably arose independently in several parts of the world, she argues.

Inhabitants of Cayonu may have developed a method of soaking the stems of flax plants and then beating them to loosen linen fibers for weaving, Vogelsang-Eastwood suggests. Investigators had previously found large flax seeds at the site that appear to belong to a domesticated version of the plant, Braidwood points out. Ancient residents may also have produced oil from flax seeds, he says.

Cayonu's early citizens moved from a hunting and gathering life to farming in a year-round settlement, according to Braidwood. Sedentary activity in an arid region may have sparked the replacement of animal-skin clothing with lighter, cloth apparel, he contends.

Vogelsang-Eastwood expects the Cayonu discovery to invigorate the study of ancient textiles.

"People now realize that textiles can be found at archaeological sites," she remarks. "I expect to see more examples of ancient cloth uncovered in the near future." *– B. Bower*