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Tidal Waves Called Threat to East Coast

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Geologists have long viewed the West Coast as the dynamic side of North America, the shore where earthquakes, tidal waves and other potentially dangerous geological forces are most likely to strike.

But there are increasing signs that the outer sloping edge of the continental shelf along the East Coast has the potential to cave in, possibly abruptly enough to send destructive tidal waves, or tsunamis, speeding toward shore.

The latest evidence comes in a study being published today in the journal Science, which found that rock buried nearly 2,000 feet under the seabed off New Jersey is so porous that it is actually mostly water.

The new research, and similar recent findings, do not suggest that strollers on the Atlantic City boardwalk are in imminent danger of being swept away by a tidal wave. But the findings do suggest that the East Coast is far more geologically active than had been thought.

Just as stepping on a water-filled balloon can cause its sides to bulge and burst, so too could the weight of rock over the soggy sediments cause the water to blow out the side of the continental slope, potentially causing an underwater landslide and subsequent giant waves, the authors say.

The report says the area studied, about 100 miles east of Atlantic City, is particularly waterlogged, and thus particularly unstable, because the deep layers of the shelf were formed in the last Ice Age, when the Hudson River was a turbid torrent, laying down enormous amounts of silt that trapped water as successive layers accumulated.

"It's a system that's in a critical state because of those fluid pressures," said Dr. Peter B. Flemings, a geologist at Pennsylvania State University who wrote the paper with Brandon E. Dugan, a doctoral candidate at the university. What is not yet known, Dr. Flemings said, is if this condition will result in a succession of small crumbling failures or in occasional canyon-carving, wave-spawning collapses.

Using computer models, the scientists calculated that the pressure built up in deeply buried layers of porous rock is more than sufficient to drive the water sideways until it breaks out the side of the slope where the continent descends toward the deep ocean bed. The pressure could explain muddy underwater geysers found in some places along the deepest parts of the continental slope, the scientists said.

The findings mesh with other research, including past surveys from submarines of other parts of the Eastern continental slope that found large "slump scars," areas where the bottom had slid away, leaving gaping concavities like those of an ice-cream scoop.

"Whether it generates a tsunami or tidal wave, we're not able to say," said Dr. Peter Rona, a Rutgers University geologist who first reported this condition when he explored the depths off the East Coast in a research submarine 30 years ago. He said the new analysis of fluid-filled rock layers off New Jersey provides a possible explanation, but more work needs to be done to determine the level of risk.

"All I can say is there is evidence that this has happened in the past," Dr. Rona said, "and some of these scars look fairly fresh."

Last April, another research team found cracks in the continental slope off Virginia that also signaled the potential for large submarine landslides, which are thought to spawn waves as the water above suddenly sinks to fill a gap in the sea floor, sending a pulse of energy shoreward.

The new findings come on the heels of other work showing that the threat from tsunamis comes not just from earthquakes, as has long been thought, but also from underwater landslides that can occur quite close to shore and can either be triggered by a small quake or happen spontaneously.

The last large destructive tidal wave, which killed more than 2,200 people along the northern coast of Papua New Guinea two years ago, was apparently the result of a large underwater landslide that was triggered by a moderate earthquake, scientists now say. The earthquake alone was calculated to have only one-fifth the power needed to cause the 50-foot-high waves that swept the coast.

The authors of the new study and others involved in similar work stressed that there is not nearly enough evidence to predict that something like the New Guinea tsunami could someday sweep the boardwalk of Atlantic City.

But the Penn State team and other marine geologists said the East Coast should no longer be considered a static place where the only potential oceanic disasters are storms.

"The literature of geology has called this area a passive margin," Dr. Flemings said. "There are no plates colliding or anything like that. But the reality is that the rapid sedimentation here created an environment where dynamic things are happening."

The analysis was done on a core of rock taken by an international oceanographic drilling ship in 1997. In successively deeper, and older, layers of compressed clay and sand, the rock becomes denser, but then -- nearly 2,000 feet down and a million years back in time -- the rock becomes a soggy sediment that contains up to 65 percent water.

The only explanation for the sponginess at such depths is that water, which cannot be compressed, is filling the pores and supporting the rock above, Mr. Dugan said.

Dr. Costas Synolakis, an engineering professor and tsunami expert at the University of Southern California who studied the New Guinea disaster, said the lesson being learned in all this research was that tsunamis were not nearly as well understood as scientists had thought.

Referring to the discovery of soggy rock near New Jersey, he said: "I concur that this is kind of a textbook scenario. The only thing is, we haven't written the textbooks yet."