OCEANOGRAPHY_HAZARD PREDICTION

Killer Waves on the East Coast?

Underwater landslides off the mid-Atlantic could trigger a tsunami, but the likelihood appears slim

If you perused any of several metropolitan newspapers along the Eastern seaboard this summer, you might have imagined a disaster of hurricane proportions striking the coast on a clear, blue day. With a sudden crumbling of the seafloor, the Atlantic Ocean would rise up and flatten Virginia Beach and Cape Hatteras. Giant waves might even surge up the Potomac River and flood the U.S. capital.

The notion of a tsunami striking the mid-Atlantic coast is startling—those disasters tend to hit earthquake-prone locales of the Pacific Rim, where land slipping along underwater faults sloshes the sea into threatening swells. But despite the breathless news reports, a long string of ifs and buts stretches between an imminent threat of an East Coast tsunami and its newly discovered potential cause: underwater landslides.

The landslide concern stems from new indications of looming instability atop the slope between the shallow continental shelf and the deep sea, off the coasts of North Carolina and New Jersey. Enormous cracks northeast of Cape Hatteras could be an underwater landslide in the making, three scientists suggested in the May *Geology*. Mud suddenly breaking loose and tearing downslope could displace enough water to swamp the nearby coastline with tsunami waves some five meters (15 feet) high—an event comparable to the storm surges of Hurricane Fran, which ravaged North Carolina in 1996.

The day after the media caught wind of the report, television helicopters were landing on the lawn of the Woods Hole Oceanographic Institution in Massachusetts, the workplace of the report's lead author, Neal W. Driscoll. Elsewhere, Driscoll's colleagues Jeffrey K. Weissel of Columbia University's Lamont-Doherty Earth Observatory and John A. Goff of the University of Texas at Austin were also fielding calls from eager reporters. "We underestimated the excitement the paper would cause," Weissel says.

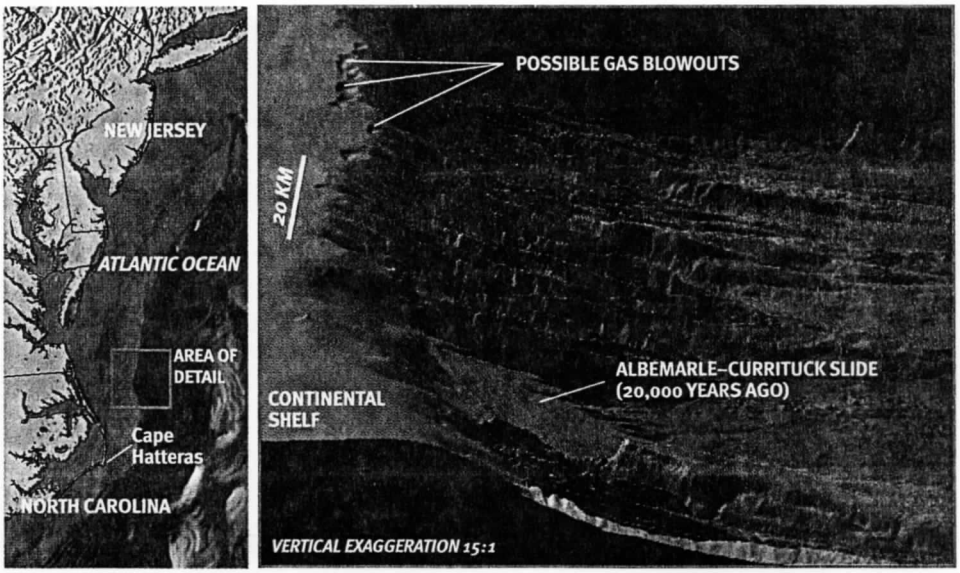
What the scientists knew—and what many news accounts failed to emphasize—was that although a tsunami would be devastating, the potential risk was remarkably unclear. At the time, the researchers had no idea when a landslide might occur (if ever), no mathematical predictions of the waves that might be generated and no evidence of a tsunami ever having struck the mid-Atlantic coast in the past. Still, Weissel maintains that "the paper would have been incomplete without a portion on tsunamis." At the heart of the scientists' concern is the growing evidence that underwater landslides—not earthquakes alone—pose a tsunami threat [see "Tsunami!," by Frank I. González, Scientific American, May 1999].

Oceanographers conducted the first intensive investigation of this theory after the 1998 Papua New Guinea tsunami. At least 2,200 people died—drowned, impaled on mangrove branches or bludgeoned by debris—when waves up to 15 meters high struck the country's north coast. A magnitude-7.1 earthquake had rocked the area only minutes before, but the waves were up to five times larger than expected for a quake that size. When oceanographers inspected the nearby seafloor, they found evidence of a landslide that could have enlarged the tsunami.

Two rare landslides in the western Atlantic also fuel the tsunami concern. In 1929 an earthquake-triggered landslide off Newfoundland's Grand Banks spawned a tsunami that killed 51 people. A similarly massive slide occurred some 20,000 years ago just to the south of the cracks discovered off the North Carolina coast.

Had scientists detected those cracks 10 years earlier, before underwater landslides were a suspected cause of tsunamis, their interpretations might have been different, Weissel says. But in light of this new historical evidence, his team couldn't ignore the possibility. Frank I. González, leader of the National Oceanic and Atmospheric Administration's tsunami research program in Seattle, agrees: "I think these guys were right on to call attention to the potential tsunami risk."

Based on sonar images, the cracks have



GIANT GAS BLOWOUTS, which may have cratered the seafloor off the North Carolina coast, could presage underwater landslides. Potential blowouts (*not shown*) also lie off New Jersey.

JOHNNY JOHNSON (*map*); BATHYMETRY IMAGE COURTESY OF JEFFREY K. WEISSEL *Lamont-Doherty Earth Observatory*

turned out to be giant craters—some five kilometers long and two kilometers across—that the team now thinks formed from eruptions of gas trapped in the sediments. What's more, additional gas is still waiting to blow. The researchers don't know when the past blowouts occurred, but they have reason to think they could have been explosive: such eruptions have destroyed oil rigs that penetrated gas deposits in the Gulf of Mexico and the North Sea.

In the July 14 *Science,* a second team reported another potential cause of seafloor blowouts. Peter B. Flemings and Brandon Dugan of Pennsylvania State University noted that explosions of waterlogged sediments could have carved several mysterious submarine canyons about 150 kilometers east of Atlantic City, N.J.

During an Ocean Drilling Program research cruise in 1997, Flemings and the crew drilled into one-million-year-old mud that contained up to 65 percent water. The soggy sediments were buried so fast that the water had nowhere to go. But the pressure caused by being buried 600 meters below the seafloor means that deep erosion could unleash the water with a bang. Flemings and Dugan didn't mention tsunamis in their journal article, but the media didn't miss the connection. "I just continually remind people that we haven't done any work on whether a tsunami would be generated," Dugan says.

Such a prediction would be difficult to make, anyway. It takes a sudden flow of a large volume of mud to create a tsunami; the scientists don't know whether the canyons formed quickly—in one explosive event—or eroded over tens of thousands of years. Even today, muddy seeps and geysers bleed off trapped water little by little.

Nor is it clear whether gas blowouts farther south would stabilize the slope by reducing the pressurized gas or destabilize it by rendering the shelf edge more precariously balanced than before, Weissel says. The fact is that landslides may never occur in either region. And until scientists can estimate the frequency of landslides—whatever the cause—it will be impossible to calculate the probability of a future tsunami. From Dugan's perspective, the bottom line is this: "Are these blowouts preventable? No. Should people be worried? No."

—*Sarah Simpson*

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Date:_____ Period:____

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Article questions

1. Where do tsunami waves normally occur?

2. Why is there a concern about a possible tsunami on the east coast?

3. When was this theory first investigated?

4. Describe the 1998 Papua New Guinea tsunami.

5. When did the landslide off the North Carolina coast occur?

6. What is a potential cause of seafloor blowouts?

7. "Should people be worried?"