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Highly Pressurized Ocean Water Could Cause Undersea Landslides, Tidal Waves

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21 July 2000 Water trapped under high pressure in sediment on the continental slope about 100 miles off New Jersey could, if expelled violently, cause undersea landslides and tidal waves, according to two Pennsylvania State University scientists who are affiliated with the Ocean Drilling Program.

The findings have worldwide implications, the scientists said in a statement releasing their study.

The continental slope is a narrow region of steeply angled sea floor that connects the U.S. Continental Shelf, where the water is hundreds of feet deep, to the deep ocean floor, where the depths exceed many thousands of feet.

Findings of the study, which was initially conducted aboard the Ocean Drilling Program's (ODP) research ship, *JOIDES Resolution*, will be published in the July 14 edition of Science. ODP is an international research program that is funded by the National Science Foundation and international partners.

"Our analyses focused on the layered sediments and we found a potential for water trapped there (in the sediments) under pressure to surge out and cause landslides or to seep out slowly," Dr. Peter B. Flemings, associate professor of geosciences and director of the research team said in a statement.

"We have not calculated the probability of tidal waves. However, undersea landslides are known to cause tidal waves and we agree with recent reports from other researchers that there is potential for expulsive events in the continental slope along the East Coast. We offer a new, alternative explanation for the cause of expulsive events not only off New Jersey, but also around the world, Flemings said. "

Analyses by Flemings and Brandon Dugan, a graduate student, showed that the slope off New Jersey may be only marginally stable due to water trapped under high pressure in the layered sediments there. Even small shaking from a mild earthquake, for example, could trigger release of the pressurized water and produce significant landslides.

More importantly, the possibility exists that the water trapped under high pressure could trigger landslides independently, without an earthquake, and without warning, the researchers concluded.

Other researchers recently identified cracks in the continental slope off the Maryland, Virginia and North Carolina coast and cautioned that the faults there could set off undersea landslides and subsequent tidal waves. In newspaper interviews, these researchers attributed the cracks to violent expulsions of gas trapped under layers of sediment on the continental shelf. The Penn State researchers offer another possibility - water trapped under high pressure.

Flemings and Dugan detailed their methods and results in a paper, "Overpressure and Fluid Flow in the New Jersey Continental Slope: Implications for Slope Failure and Cold Seeps," in the July 14 issue of the journal Science.

Dugan, is a doctoral candidate in the Department of Geosciences geosciences. Flemings also serves as director of both the Penn State GeoFluids Consortium and the Penn State Petroleum GeoSystems Initiative.

The authors used a computer simulation model that is commonly used to help the oil industry predict the location of overpressured zones, where water is trapped under high pressure in undersea sediment layers. When crews conducting undersea oil drilling sink a well into one of these areas, the high pressure can cause "blow outs" that send water and sediment up to the sea floor and even on to the overlying drilling platform.

Flemings and Dugan used the sediment data from a 1997 ODP expedition and their computer simulation to estimate how the pressures evolved over the last million years. The simulation showed that water under high pressure in some of the deeper lower layers of sediments could suddenly force its way out, laterally, through the slope face, creating undersea vents, cracks or landslides in the process. The same high-pressure zones that cause drilling problems for the oil industry could also unleash a landslide on the slope.

On the other hand, Dugan notes that the water trapped in the high pressure zones can also seep out slowly rather than exit forcefully. These seep fluids, he said, "may be rich in nutrients and provide energy for a variety of undersea life."

The Penn State researchers have not done calculations to predict when the high-pressure zones could cause failures off New Jersey. Flemings said, "our contribution here is to recognize high fluid pressures in offshore New Jersey and present a quantitative model that describes how these fluid pressures could contribute to slope instability and fluid expulsion."

"We have not tried to predict the probability of a significant failure but recognize that further research is warranted," he added.

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For more information and to view the computer simulation, you can go to http://hydro.geosc.psu.edu/Geofluids/scipaper.html.