SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

Press Release

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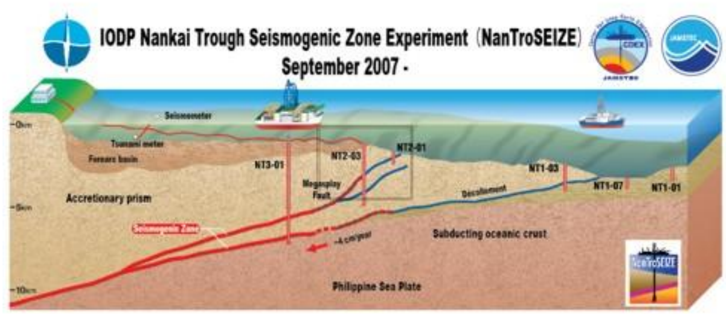
'Ultrasound' of Earth's Crust Reveals Inner Workings of a Tsunami Factory

Research announced this week by a team of U.S. and Japanese geoscientists may help explain why part of the seafloor near the southwest coast of Japan is particularly good at generating devastating tsunamis, such as the 1944 Tonankai event, which killed at least 1,200 people. The findings will help scientists assess the risk of giant tsunamis in other regions of the world.

University of Hawaii at Manoa Professor Gregory Moore along with Geoscientists from the Japan Agency for Marine Earth Science and Technology (JAMSTEC) and The University of Texas at Austin used a commercial ship to collect three-dimensional seismic data that reveals the structure of Earth's crust below a region of the Pacific seafloor known as the Nankai Trough. The resulting images are akin to ultrasounds of the human body.
The results, published in the journal Science, address a long standing mystery as to why earthquakes below some parts of the seafloor trigger large tsunamis while earthquakes in other regions do not.



Cross section illustration of the structure of the crust below the Nankai Trough.
Locations of seismometers and drill hole locations are also indicated.
High resolution image available, contact Tara Hicks Johnson.

The 3D seismic images allowed the researchers to reconstruct how layers of rock and sediment have cracked and shifted over time. They found two things that contribute to big tsunamis. First, they confirmed the existence of a major fault that runs from a region known to unleash earthquakes about 10 kilometers (6 miles) deep right up to the seafloor. When an earthquake happens, the fault allows it to reach up and move the seafloor up or down, carrying a column of water with it and setting up a series of tsunami waves that spread outward.

Second, and most surprising, the team discovered that the recent fault activity, probably including the slip that caused the 1944 event, has shifted to landward branches of the fault, becoming shallower and steeper than it was in the past.

"That leads to more direct displacement of the seafloor and a larger vertical component of seafloor displacement that is more effective in generating tsunamis," said Nathan Bangs, senior research scientist at the Institute for Geophysics at The University of Texas at Austin who was co-principal investigator on the research project and co-author on the Science article.

The Nankai Trough is in a subduction zone, an area where two tectonic plates are colliding, pushing one plate down below the other. The grinding of one plate over the other in subduction zones leads to some of the world's largest earthquakes.

"The tectonic setting is much different than Hawaii, so although the work has no direct impact on understanding Hawaiian tsunamis, our work will provide insights that will be useful for our colleagues studying convergence processes in the Sumatra-Java, Aleutian, and especially Cascadia (offshore Washington-Oregon) margins," says Greg Moore, lead author on the Science paper and co-principal investigator on the overall research project. "All have experienced great earthquakes that generated large and destructive tsunamis."

In 2002, a team of researchers led by Jin-Oh Park at JAMSTEC had identified the fault, known as a megasplay fault, using less detailed two-dimensional geophysical methods. Based on its location, they suggested a possible link to the 1944 event, but they were unable to determine where faulting has been recently active.

"What we can now say is that slip has very recently propagated up to or near to the seafloor, and slip along these thrusts most likely caused the large tsunami during the 1944 Tonankai 8.1 magnitude event," said Bangs.

The images produced in this project will be used by scientists in the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE), an international effort designed to, for the first time, "drill, sample and instrument the earthquake-causing, or seismogenic portion of Earth's crust, where violent, large-scale earthquakes have occurred repeatedly throughout history."

"We are now in the "ground truth" stage in which we are drilling deep into the splay fault region to test the physical properties of the rocks in this environment," says Moore. "The 3D seismic data allowed us to pick the best sites for drilling and will now allow us to extrapolate the drilling results away from the drill holes. The drilling phase in Nankai is scheduled to last for at least 5 years. We also plan to conduct a seismic experiment next year or the year after in which we put seismic sensors down a drill hole and record surface seismic energy in the vertical array along the borehole. This will give us a much more detailed picture of the rocks around the borehole, especially deeper in the hole where we hole to drill at the end of our drilling project (perhaps as much as 6000 m (20,000 ft) below the seafloor."

"The ultimate goal is to understand what's happening at different margins," said Bangs. "The 2004 Indonesian tsunami was a big surprise. It's still not clear why that earthquake created such a large tsunami. By understanding places like Nankai, we'll have more information and a better approach to looking at other places to determine whether they have potential. And we'll be less surprised in the future."

The other co-authors are Asahiko Taira and Shin'ichi Kuramoto at JAMSTEC, Emily Pangborn at the Institute for Geophysics at The University of Texas at Austin and Harold Tobin at the University of Wisconsin, Madison. Funding for the project was provided by the National Science Foundation, Ocean Drilling Program and Japanese Ministry of Education, Culture, Sports and Technology.

Release by J.B. Bird at the Jackson School of Geosciences, University of Texas at Austin, with additional information by Tara Hicks Johnson, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa

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Paper: Three-Dimensional Splay Fault Geometry and Implications for Tsunami Generation G. F. Moore, N. L. Bangs, A. Taira, S. Kuramoto, E. Pangborn, H. J. Tobin
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http://www.sciencemag.org/cgi/content/abstract/318/5853/1128