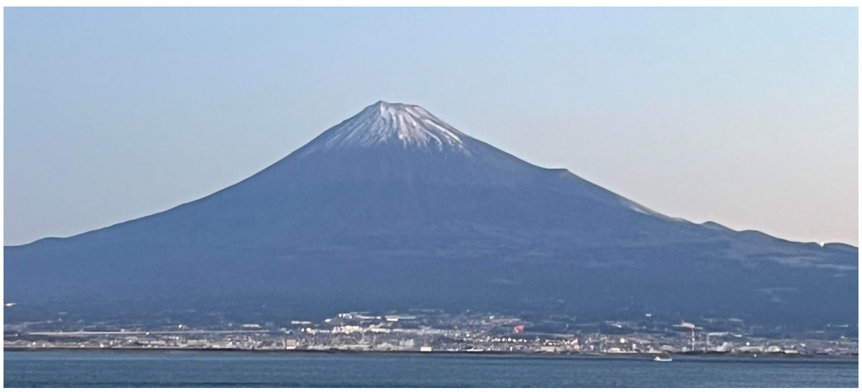
Stony Brook University

GEOLOGY OPEN NIGHT

DRILLING IN THE JAPAN TRENCH: EXPLORING THE RECURRENCE RATES AND REASONS FOR TSUNAMIGENIC EARTHQUAKES

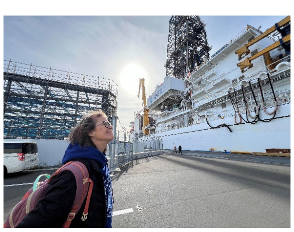
Dr. TROY RASBURY

Professor, Department of Geosciences



February 28, 7:30pm, Earth & Space Sciences 001

The 2011 Tohoku-Oki magnitude 9.0 earthquake and resulting tsunami resulted nearly 20,000 deaths and billions of dollars of property loss. The Japan Trench was not considered to be capable of an earthquake of this magnitude. While seawalls are built along the Japan coast to prevent tsunamis from pummeling infrastructure, these 18-meter walls could not withstand the Tohoku-Oki earthquake tsunami. Besides deaths and property loss, the Fukushima nuclear plant was breached, sending radioactive elements into the ocean, perhaps around the globe. One reason the tsunami was so devastating is that the fault ruptured all the way to the trench with some 50 meters of horizontal and more than 4 meters of vertical offset at the trench. It's like the entire fault was lubricated. Numerous international scientific expeditions have sailed since the earthquake and I have had the privilege to directly participate in two of these, as well as to collaborate on several others. Expedition 386, which sailed in 2021, focused on the sedimentological record for earthquake recurrence, drilling 15 sites in 11 basins in approximately 8000-meter water depths along 650 km of the Japan Trench. As a geochemist, my work has focused on the interstitial waters from the cored intervals. Particularly, I am using lithium, boron and strontium concentrations and isotope ratios to understand the origins of the interstitial waters. Concentrations change in a step-like way with depth, which is typically recognized as non- steady state behavior. The concentrations and isotope ratios are mostly unlike seawater, and based on patterns seem to require multiple sources of fluids to these trench basins. Alongside this observation, we also recognize evidence for mud diapirs and volcanoes, physical features that reflect destabilization of fluids and associated sediments from depth. Combined we have evidence for destabilization of fluids along the entire Japan Trench that must be recent because it is not possible to maintain stepped patterns due to diffusion. Work on earthquake hydrology suggests that only a magnitude 9+ earthquake could produce such widespread fluid destabilization, and thus we suggest that this widespread fluid mobility most likely resulted from the Tohoku-Oki earthquake. I will review the plate tectonic setting, the details of the fault movement, as well as this evidence for multiple fluid sources and possible pathways.



Troy Rasbury is a professor of Geochemistry in the Department of Geosciences. She runs the Facility for Isotope Research and Student Training (FIRST) lab at Stony Brook. Her research focuses on U-Pb dating of carbonates and other minerals that reflect the fluids they formed from. More recently, she has turned to working on the fluids themselves here on Long Island as well as from interstitial waters from ocean drilling expeditions.

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