

The 2011 M9.0 Tohoku (Japan) Earthquake: Insights from Drilling the Megathrust

Christie Rowe
McGill University

On March 11, 2011, the subduction plate boundary under northern Japan ruptured in a M9.0 megathrust earthquake. The earthquake rupture displayed some very unusual characteristics. The offset between the overriding and subducting plates was measured as ~60 m at the seafloor, more than twice the previous record for displacement in a single event! This great displacement, along with slowing of the rupture as the earthquake grew toward the surface, contributed to the production of a very large tsunami.

One year after the earthquake, the drilling vessel Chikyu sailed to the Japan Trench with 27 scientists from 14 countries to drill through the seafloor to sample the plate boundary fault (International Ocean Discovery Program Expedition 343). We recovered geophysical logs, thermal measurements, and core samples of the accretionary wedge, the downgoing Pacific Plate sediments, and the amazingly thin and slippery megathrust clays. My role on the expedition was “XCT Watchdog”, examining X-ray CT scans of the core as it came on board the ship to identify important deformation structures and distribute samples to the other specialist teams.

In this talk I will describe the M9.0 earthquake and explain how it was different than most of the M9 earthquakes of the 20th and 21st centuries. I will show some of the laboratories on D/V Chikyu and explain how science is done at sea on a big drilling vessel. Finally, I will show the data collected on the expedition and present our explanation for the unusual Tohoku Earthquake.