The NanTroSEIZE Project After Ten Years: Drilling to the Megathrust is More Important Now Than When We Started

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The Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) is the largest undertaking in the history of scientific ocean drilling. Conceived in the early 2000s, operations began with Expeditions 314 –316 in 2007. Between that year and 2016, there have been 11 IODP expeditions drilling at 13 main sites, with multiple holes to depths from 100s of meters to more than 3000 meters below the seafloor (the deepest scientific borehole in the ocean floor). More than 195 scientists have participated and close to 100 results papers have been published. The transect of boreholes, in concert with three-dimensional seismic reflection imaging and other geophysical studies, has sampled the inner and outer wedge extensively, and two state-of-the-art real-time downhole monitoring systems are now streaming data. This is now the best-known subduction zone forearc and plate boundary complex in the world.

However, the primary objective of drilling –to access, sample, log, and instrument the main plate interface at depth –has still not been achieved. The rapid scientific advance in understanding of the mechanics of faulting in general and subduction zone megathrust processes in particular of the past decade demands renewed efforts to complete this project. Discovery in NanTroSEIZE Stage 1 by 2011 suggested that rapid, seismic slip all the way to the frontal thrust must have occurred in the past, contrary to most accepted concepts at the time, and then the Tohoku-oki M9 earthquake demonstrated that does occur, causing devastating tsunamigenic displacements. The Kumano-nada area was the location where shallow plate boundary VLFE, tremor, and transient slow slip all have been discovered, just up-dip of the 2016 M6 normal earthquake region, dramatically showing the diverse strain accumulation and release activity of the region formerly though to be aseismic. Despite this wealth of geophysical information, we still do not have a clear understanding of the thickness, material properties, or state of stress in a megathrust fault system and surrounding wallrock, and what controls the presence or absence of slip to the trench. For all these reasons, drilling, sampling, and near-field measurements in the 5000 m deep fault at Site C0002 is even more justified than when it was first proposed and approved for drilling.

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