

# Understanding seismogenesis of subduction megathrusts through in-situ sampling, measurement and observatory -IODP NanTroSEIZE-

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Shallow earthquakes on subduction zone plate interfaces account for ~90% of global seismic moment release, resulting in devastating effects on heavily populated coastal areas from both ground shaking and tsunami. Improving our understanding of when, where, and how great earthquakes and tsunami occur is among the most urgent tasks of modern earth science.

The Nankai Trough region is among the best-studied subduction zones in the world. It has become a focus for investigation of the seismogenic zone because it has a 1300-year historical record of recurring and typically tsunamigenic great earthquakes, including the 1944 Tonankai (M=8.1) and 1946 (M=8.3) Nankaido earthquakes [Ando, 1975]. The rupture area and zone of tsunami generation for the 1944 event in particular are now reasonably well understood [Kikuchi et al., 2003; Tanioka and Satake, 2001]. Recent land-based geodetic studies suggest that the plate boundary thrust here is strongly locked [Miyazaki and Heki, 2001]; similarly, the relatively low level of microseismicity near the updip limits of the 1940s earthquakes [Obana et al., 2001 and unpub. data] implies significant interseismic strain accumulation on the megathrust.

NanTroSEIZE proposal, as a Complex Drilling Project (CDP), describes the rationale and scientific objectives for an integrated program of geophysical and geologic studies, non-riser drilling, and riser drilling designed to investigate the aseismic to seismic transition of the megathrust system and the processes of earthquake and tsunami generation at the Nankai Trough subduction zone. Our fundamental goal is the creation of a distributed observatory spanning the up-dip limit of seismogenic and tsunamigenic behavior. This will involve sampling and instrumenting key elements of the active plate boundary fault system at several locations off the Kii Peninsula, where the plate interface and active mega-splay faults &#8211; implicated in tsunamigenesis &#8211; are accessible to drilling within the region of coseismic rupture in the 1944 Tonankai M8 great earthquake. The most ambitious objective is to access and instrument the Nankai plate interface within the seismogenic zone to advance our knowledge of fundamental aseismic and seismic faulting processes and controls on the transition between them.

We propose 3 distinct phased IODP drilling efforts: Phase 1 &#8211; Inputs to the seismogenic zone system, investigating variations in the sediments, oceanic crust, and fluids input to the plate boundary system; Phase 2 &#8211; Mega-splay (OOST) fault drilling to sample and instrument thrusts which splay from the basal d&eacute;collement up through the forearc, in order to characterize fault properties transecting the aseismic to seismic transition from 1 to 3.5 km depth shallow; and Phase 3 &#8211; Sampling and instrumenting the plate interface (d&eacute;collement) at ~ 6 km below seafloor, in a region predicted to be within both the zone capable of generating seismogenic behavior and in the zone of co-seismic slip in the 1944 great earthquake. Long-term monitoring of a wide range of phenomena will be a major part of the effort, to detect signals of fault zone processes in the near-field. In addition, ongoing seismological and geodetic arrays in the vicinity as well as in the deep boreholes, geologic studies, laboratory and modeling efforts are all integral components of the NanTroSEIZE project, essential to success in achieving project objectives.