



A Plate Too Far: Lessons Learned and Insight Gained from scientific and operational achievements during IODP Expedition 358 in the Nankai Trough.

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IODP Expedition 358 planned to access and sample the subducting plate boundary at the Nankai Trough, Japan, and commenced on 7 October 2018, and ended on 31 March 2019, marking the ultimate stage of the NanTroSEIZE project. The goal was to drill down to the plate boundary fault, about 5 km below the ocean floor, where >8M earthquakes occur regularly at every 100–150 years. The successful completion would have represented the deepest borehole in the history of scientific ocean drilling and ultimately greatly deepen our understanding about fault mechanics, earthquake inception and tsunami generation processes.

The IODP Expedition 358 intended to access the plate boundary fault zone system through deepening the previously drilled and suspended C0002P hole. The original operational objective of the Exp 358 was to reach a total depth of 7267.5 mbrt (+/- 5200 mbsf) in 4 drilled sections. Previous major riser drilling efforts during the IODP Expeditions 338 and 348 advanced the main riser hole at Site C0002 (Hole C0002F/N/P) to 3058.5 mbsf meters below sea floor (mbsf). Extensive downhole logging data and limited intervals of core were collected during those expeditions.

Due to the nature of the drilling operation and the anticipated challenges ahead, JAMSTEC adopted oil & gas industry drilling standards and performed two detailed Drilling Well on Paper (DWOP) workshops as part of the very rigorous preparatory stage. Great deal of time was spent on selecting new and state-of-the-art drilling/circulating techniques, logging tools, bits and drilling

fluid formulation including a new mud sealant additive "FracSeal" to make sure borehole integrity issues can be minimized as much as possible. Drilling stages seen implementation of a novel concept of near real-time geomechanics to continuously monitor and assess borehole integrity.

The challenges born from side-tracking near the bottom of the previously drilled Hole C0002P (2014 Exp. 348), proved greater than the multi-disciplinary teams expected and the overall objectives set for Exp.358 were not achieved. Nevertheless, despite the significant problems seen during several attempts, the hole was deepened 204 m. This is a minor success and it is believed, once away from the highly damaged area of the C0002P hole, drilling can produce a high-integrity hole following excellent communication and recommendations between drilling and scientific teams during complex drilling operations, especially in complex environments such as the Nankai Accretionary Prism.

Despite not achieving the ultimate goal of the expedition, the implemented industry drilling standards, real-time surveillance system, real time geomechanics, improved and strict communication protocols, and integrating both scientific and drilling teams have demonstrated their value and should become standard practice during future IODP/ICDP operations.