

# Successful completion of first riser-drilling operations in earthquake zone

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Despite harsh weather and ocean conditions, and complex geological characteristics of its drill site, the deep-sea drilling vessel CHIKYU, for the first time in the history of scientific ocean drilling, conducted riser-drilling operations to drill successfully down to a depth of 1,603.7 meters beneath the seafloor (at water depth of 2,054 meters).

Engaged in the Integrated Ocean Drilling Program (IODP) Expedition 319, the CHIKYU is drilling deep into the upper portion of the great Nankai Trough earthquake zone to gain insights into geological formations and stress-strain characteristics. The CHIKYU is operated by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) a partner in the IODP. The Kumano Basin drilling and sampling operations began on May 12; the science party, which includes Co-Chief Scientist Lisa McNeill of the National Oceanography Centre, Southampton (UK), is expected to complete the first drill site on or about August 1.

Riser-drilling technology was used from about 700 meters below the seafloor to the bottom of the hole. Riser-drilling involves the circulation of drilling fluid that helps maintain pressure balance within the borehole. Cuttings were recovered from the circulated drilling fluid and analyzed to gain a better overall picture of downhole changes in lithology and age. Core samples also were collected between depths of 1,510 and 1,593.3 meters below the seafloor.

Co-Chief Scientist Lisa McNeill, a member of the University of

Southampton's School of Ocean and Earth Science based at the National Oceanography Centre, states: "This state-of-the-art technology enables scientists to access an unknown area. It will provide a lot of important information about what has happened in the seismogenic zone in the past and its present condition." She adds, "I'm very pleased to be a member of the science party conducting the first riser-drilling operation in the Nankai Trough."

Following drilling operations that included 'measurement-while-drilling' to obtain real-time geophysical characteristics, wireline logging instruments were lowered into the borehole to measure formation temperature, resistivity, porosity, density, gamma ray, and borehole diameter. The riser-drilling technology enabled dynamic formation testing using the logging instrumentation for the first time during IODP scientific ocean drilling operations; this instrumentation is designed to measure stress, water pressure, and rock permeability.

Co-Chief Scientist Timothy Byrne of University of Connecticut emphasises the importance of the Nankai Trough experiment results. "These two parameters , stress magnitude and pore pressure," he says, "are both important to understanding earthquake processes."

In addition, vertical seismic profiling was conducted from July 24<sup>???</sup> to obtain accurate details of the geological structure of the plate boundary system. The activity involved an array of 16 seismographs vertically lowered into the borehole and eight ocean-bottom seismographs placed on the seafloor. An air-gun array on the JAMSTEC research vessel KAIREI generated elastic waves, which traveled through the formation to be recorded on the borehole and seafloor instruments.

"The seismic sensor array was installed in this hole below the thick sediment layer," says Co-Chief Scientist Eiichiro Araki of JAMSTEC: "It acts like a telescope exploring the structure of faults in detail, which

are responsible for causing large earthquakes such as the one that occurred here in 1944."

Operations at this drill site are expected to conclude after casing the borehole to the bottom of the hole and capping it with a corrosion cap for future installation of a long-term borehole monitoring system (LTBMS). After completion of this task, the CHIKYU will move to its next drill site, where riserless drilling will be employed to penetrate the shallow portion of the megasplay fault branching from the seismogenic zone. Logging-while-drilling (LWD) will be conducted to measure rock properties, geological formation, and geophysical characteristics of the area. As a preliminary operation for LTBMS scheduled in the future, observatory instruments will be installed inside the hole to measure borehole temperature and pressure over the next few years.

Further analyses by scientists are expected to generate significant scientific knowledge of past earthquake activities and development processes of the Nankai Trough accretionary prism, as well as the mechanism of occurrence of large earthquakes and tsunamis.

Co-Chief Scientist Demian Saffer of The Pennsylvania State University notes, "With the efforts of the drillers and operations groups, we succeeded in conducting several very challenging experiments, many of which can only be achieved by riser drilling. The results provide important information about conditions within the rocks above zones where earthquakes occur. Ultimately, we plan to install long-term observatory systems in these boreholes that will allow us to continuously monitor the geologic formation during the earthquake cycle."

More information: Daily reports, photos and video from the CHIKYU are available online at: [www.jamstec.go.jp/chikyu/eng/E...roSEIZE/special.html](http://www.jamstec.go.jp/chikyu/eng/E...roSEIZE/special.html)

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