SCIENTIFIC OCEAN DRILLING

CREDIT: Chris Lyons & IODP

Digital Newsletter

# the Drilling Dispatch

November 2024

SCIENTIFIC OCEAN DRILLING

## In This Issue

# Happening now...
# Expedition 405: Tracking Tsunamigenic Slip Across the Japan Trench (JTRACK)


## Expedition 405 Co-Chief Scientists
Shuichi Kodaira, Marianne Conin, Patrick Fulton, Jamie Kirkpatrick, Christine Regalla, and Kohtaro Ujiie

## Expedition Project Managers
Natsumi Okutsu, Lena Maeda, Sean Toczko, and Nobu Eguchi

*written by Callan Bentley, Expedition 405 Onboard Outreach Officer*


On Friday, March 11, 2011, the world changed. That day, an enormous section of the Japanese lithosphere slipped eastward, releasing an enormous amount of pent-up energy. East of Sendai, the Pacific Plate dives westward beneath Japan at a subduction zone. The subduction zone's edge is the deep cleft called the Japan Trench. From the trench, a megathrust fault dips down and westward beneath Honshu. It was along this fault that the Great Tōhoku Earthquake occurred. At a magnitude 9.1, it was the largest earthquake to strike Japan in recorded history, as well as the fourth-largest earthquake ever recorded. Northern Honshu jumped 2 meters (6.5 feet) to the east. Adjacent to the trench, far beneath the sea, motion on the megathrust fault was even greater—in places it reached up to 60 meters (almost 200 feet). In a violent pulse, the overriding plate shoved a staggering mass of seawater out of the way. The ocean bulged upward and radiated outward, generating a huge tsunami.

Tsunami waves generated by the Tōhoku earthquake were much higher than infrastructure anticipated (Credit: Headquarters for Earthquake Research Promotion).

The tsunami inundated the coastal plain adjacent to Sendai, flooding its airport. Many coastal towns were destroyed as the huge waves overtopped seawalls designed for smaller tsunamis. A total of 561 $km^2$ (217 $mi^2$) of eastern Japan were inundated. The Fukushima Daiichi Nuclear Power Plant's backup generators were destroyed by the tsunami, resulting in several explosions and a release of radioactive material. More than 19,000 Japanese people lost their lives in the earthquake, tsunami, and nuclear accident.

It was a very dark day for Japan.

How can we better understand the geologic processes at subduction zones so that we build our coastal cities and infrastructure to be resilient to tsunami risk? As it turned out, scientists had met to discuss this very issue in November 2008, at a workshop entitled "Rapid Response Fault Drilling: Past, Present, and Future," sponsored by the International Continental Scientific Drilling Program (ICDP) and the Southern California Earthquake Center (SCEC). The report from this workshop and subsequent papers "enabled us to both prepare and convince the science community that we had thought this through," said Patrick Fulton of Cornell University, referring to Expedition 405, "that it was something of broad interest and desire within the earthquake physics world, and that it just might work."

After the Great Tōhoku Earthquake, the scientists knew they needed to quickly drill down to the source of the megathrust earthquake to take its temperature. Funding was quickly secured, and a rapid response expedition was spun up with very little lead time.

With their Rapid Response blueprint in hand, the scientists were able to move with extraordinary speed for the expedition that became known as JFAST, IODP Expedition 343: Japan Trench Fast Drilling Project. Aboard the D/V *Chikyu* in 2012, JFAST scientists drilled through the plate boundary at Site C0019, collecting core down to 854 meters (2800 feet) below the seafloor. The core showed a striking lithologic change at the plate boundary fault, a 4-meter thick zone of scaly rock fabric—a network of millions of tiny slick surfaces wrapping around slivers of rock. Additionally, this core showed scientists that the slip leading to the megathrust earthquake extended all the way to the trench, a finding which not only helped scientists interpret the conditions leading up to the Tōhoku earthquake, but also to reevaluate other at-risk locations such as the Nankai Trough.


A core collected during Expedition 343 shows the characterisitc scaly rock fabric at the plate boundary fault (Credit: JAMSTEC / IODP).

The JFAST team also installed a temperature observatory, a string of 55 high-resolution temperature loggers (devices that record temperature changes through time). It was recovered after nine months, and the story these sensors told was striking. After the rocks recovered from the initial cold-water perturbation of drilling the borehole, the temperature sensors at the plate boundary showed a pronounced signature of frictional heat: warmth left over from the Great Tōhoku Earthquake's grinding along the megathrust fault. In addition, a major aftershock occurred while the temperature observatory was recording data, and this showed a major reworking of the plate's internal "plumbing system," where hot water stopped circulating on some fractures, and then started flowing through new fractures.

That was twelve years ago.

Now, many JFAST alumni and a new generation of geoscientists have teamed up for IODP Expedition 405: Tracking Tsunamigenic

TOP: JTRACK scientists pose on the catwalk with the first core of the expedition. BOTTOM: Scientists discuss a recently split core in the lab. (Credit: Doriane Letexier & JAMSTEC / IODP).

Slip Across the Japan Trench, nicknamed JTRACK. Like any good sequel, JTRACK is returning to the original source material in a fresh and expansive way, and probably will change the way we think about JFAST, taking the story even deeper.

On September 6, 2024, the *Chikyu* embarked, carrying Expedition 405 scientists back to the Japan Trench. This expedition has two targets: Site C0019, which was originally drilled during JFAST, and Site C0026, composed of seemingly undisturbed sedimentary rocks on the overriding Pacific Plate. One of the first goals of the expedition was to revisit the observatory installed at Site C0019, to see if anything had changed in the past dozen years. Of particular interest was the question of whether the hole still crossed the plate boundary, or whether slipping movement had moved the lower Pacific section of the borehole relative to the Japanese section above. This first phase of Expedition 405 was completed on September 13th.

After revisiting the temperature observatory (Phase 1), operations aboard the *Chikyu* shifted to Logging While Drilling at both sites (Phase 2). During this phase, scientists ran logging tools down boreholes to measure various properties of the ocean floor in these two locations. Once logging was completed on October 1st, the drill string was outfitted with coring tools, so that scientists could begin to recover cores from the seafloor down to the basalt of the subducting plate boundary. The samples collected during this phase (Phase 3) will help scientists understand the lithological conditions that can generate destructive megathrust earthquakes. After coring is completed at both sites, the final phase (Phase 4) will involve the installation of a new subseafloor observatory at Site C0019.

As with JFAST, this expedition is operating under extraordinary conditions. The *Chikyu* is drilling in almost seven kilometers of water above the accretionary prism, and aiming again for the plate boundary hundreds of meters below the seafloor. The ship is operating at the limits of what is possible for oceanic scientific drilling. In fact, with a total pipe length of 7,906 m, Expedition 405 set a record for the longest drill string used in a scientific drilling expedition on September 21st.

Though the expedition has already reached its halfway point, the data and samples it will provide to the scientific community will make long lasting contributions. JTRACK is producing scientific results that will change the way we think about subduction zones and the risk their faults carry for humanity.

# How to...

# Apply for funding from the U.S. Science Support Program

In line with its goal to advance scientific ocean drilling data collection and research, the U.S. Science Support Program offers funding to exceptional candidates in two categories: Workshop Proposals and Schlanger Ocean Drilling Fellowships.

### Submit a Workshop Proposal (deadline: 4 December 2024)

Proposed workshops should promote the development of new ideas and strategies related to the study of the Earth's processes and history using scientific ocean drilling. The workshop program encourages wide scientific community involvement to bring a broader and multidisciplinary approach to standing hypotheses and to explore new directions for scientific ocean drilling research and communication.

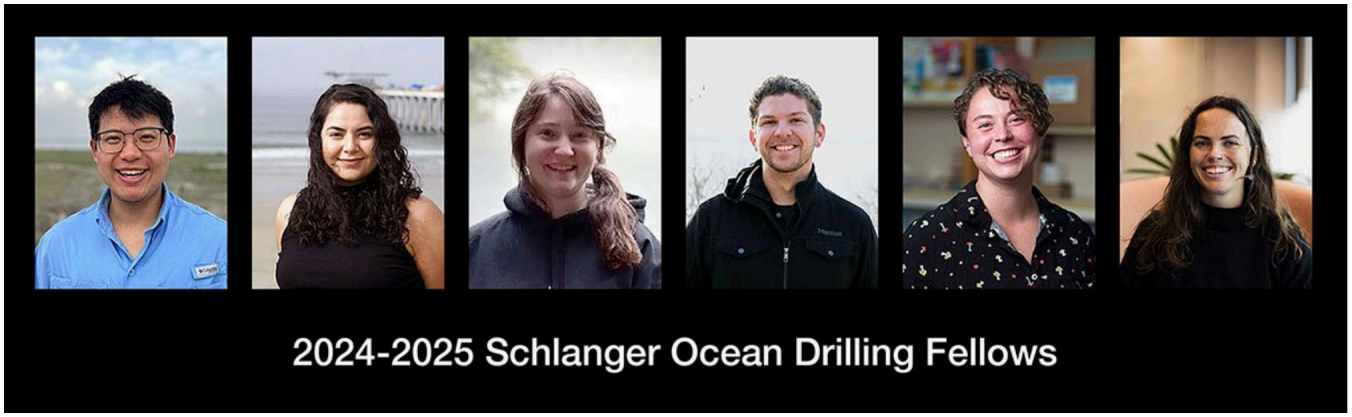
Workshop topics should be clearly relevant to the future of scientific ocean drilling, detailed in the 2050 Science Framework, Exploring Earth by Scientific Ocean Drilling. Workshops may focus on a specific scientific theme or geographic region; they may serve to develop drilling objectives and plans for future target areas; or they may facilitate the synthesis and advancement of scientific results from past expeditions. Although proposals are not limited to these topics, successful proposals will clearly state how they will advance knowledge within the field of scientific ocean drilling. Funding may be requested for virtual meetings, U.S.-based meetings, or to support U.S. participants at larger international workshops. Broad-based scientific community involvement, co-sponsorship by related programs, and the active participation of early career researchers and those from diverse communities are strongly encouraged.

Workshop proposals are submitted online, through the USSSP Application Portal. The submission process includes several online forms and documents, including:

1. Workshop Proposal Cover Sheet
2. Application Form
3. Workshop Proposal
    a. Scientific Motivation and Workshop Goals
    b. Workshop Format and Agenda
    c. Participants
    d. DEI and Communications Plans
    e. Travel and Location
    f. Budget and Budget Justification
    g. Summary of other relevant current support and prior work
4. Curriculum Vitae
5. Demographic Information Form
6. Conflict of Interest Disclosure Form

Workshop proposal PIs must have a primary affiliation with a U.S. institution or organization. To learn more, visit the USSSP website. Proposals should be submitted to the Workshops Program through the online USSSP Application Portal by December 4, 2024.

### Apply for a Schlanger Ocean Drilling Fellowship (deadline: 20 December 2024)




The Schlanger Ocean Drilling Fellowship Program offers merit-based awards for graduate students enrolled in a Ph.D. program to conduct research related to scientific ocean drilling. Research may be related to the objectives of past expeditions or it may address broader science themes. Selected fellows will receive an award of $30,000 for a 12-month period that can be used for research, stipend, tuition, or other approved costs.

Schlanger Fellowships are open to all graduate students enrolled at U.S. institutions in full-time Ph.D. programs. Applications require reference material from two referees, one of which must be the student's faculty advisor.

Schlanger Fellowship proposals are submitted online, through the USSSP Application Portal. The submission process includes several online forms and documents, including:

1. Application Form
2. Recommendation Letters
3. Research Proposal
4. Proposal Implementation Form
5. Curriculum Vitae
6. Demographic Information Form

To learn more, visit the USSSP website. Applications should be submitted to the Schlanger Fellowship Program through the online USSSP Application Portal by December 4, 2024.

# FEATURED VIDEO

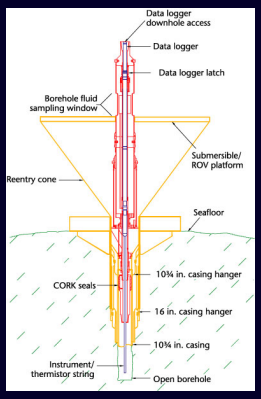

## JTRACK Expedition Targets

IODP Expedition 405 is drilling into the Japan Trench subduction zone with the goal of finding out what controls shallow slip during great earthquakes.

# For your calendar

- **Request for proposals: Novel Projects in support of Scientific Ocean Drilling**
  (deadline: 1 November 2024; learn more)
- **Request for proposals: Workshops in support of Scientific Ocean Drilling**
  (deadline: 1 December 2024; learn more)
- **American Geophysical Union Annual Meeting**
  (9-13 December 2024; Washington, D.C., USA; learn more)
- **Apply for a Schlanger Ocean Drilling Fellowship**
  (application deadline: 20 December 2024; learn more)
- **Autonomous Investigation during Drilling workshop**
  (15-17 January, 2025; Massachusetts, USA; learn more)
- **Provide input on Future Ocean Drilling in the U.S. (FOCUS)**
  (open deadline; learn more)

# SCI COMM RESOURCE OF THE MONTH




Aboard the D/V *Chikyu*, Expedition 405 scientists prepare to install a subseafloor observatory to measure high-resolution temperature over time at multiple depths within the fault zone. In this activity, students learn about CORKs, another type of observatory.

**Corks in the Crust**

# Spotlight on...

## Zenzoh Kitagawa

Zenzoh Kitagawa is a Mantle Quest Japan Toolpusher from Kanagawa, Japan. Zenzoh has been woring on *Chikyu* for 12 years, since 2012. Zenzoh enjoys seeing DV *Chikyu* mature in terms of equipment, knowledge, safety & people.

WATCH THE VIDEO!

## Maria Jose Jurado

Dr. Maria-Jose Jurado is geologist, and part of the downhole logging team for IODP Expedition 405. Based at Geociencias Barcelona CSIC in Spain, she has sailed many times on DV *Chikyu*, starting with IODP Expedition 314 in 2007.

WATCH THE VIDEO!

## Erwan Le Ber

Dr. Erwan Le Ber is one of three Logging Staff Scientists for IODP Expedition 405. Based at the University of Montpellier in France, he previously sailed aboard *Chikyu* for IODP Expedition 358 in 2018-2019.

WATCH THE VIDEO!

# Call for contributions

If there's one thing that can be said about the International Ocean Discovery Program (and the Integrated Ocean Drilling Program, and the Ocean Drilling Program, and the Deep Sea Drilling Project), it's that we are a tight-knit community. Just as much as this newsletter is for you, we want it to be from you, too! In future editions we will highlight our readers by featuring the following community contributions:

- **From the Field** - Have you had an experience with scientific ocean drilling that you want to share? Write a piece to tell us your perspective "from the field" for our next edition. Bonus points if you include some pictures!
- **Scientist Spotlight** - Do you know someone who's making waves in the ocean drilling scene, whether it's a grad student or accomplished scientist? Send us a nomination! Briefly tell us why this person deserves a shout-out, and ideally how to get in touch with them. Self-nominations are also accepted.
- **Photo Montage** - We'll take any photos you want to share!
- **Creative COREner** - Scientists are creators too! Send in your paintings, drawings, digital designs, poems, short stories, sculptures, or any other ocean science art you've made.

Send your contributions (and questions and concerns) to **mpincus@ldeo.columbia.edu** no later than **November 20, 2024** to be featured in next month's newsletter.

# See you next month!