FY24 Annual Report

International Ocean Discovery Program

JOIDES Resolution Science Operator

FY24 Annual Report

International Ocean Discovery Program

JOIDES Resolution Science Operator

National Science Foundation

Cooperative Agreement OCE-1326927

1 October 2023–30 September 2024

Publisher's notes

This publication was prepared by the International Ocean Discovery Program *JOIDES Resolution* Science Operator (JRSO) as an account of work performed under the International Ocean Discovery Program. Funding for the program is provided by the following agencies:

- National Science Foundation (NSF), United States
- Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan
- European Consortium for Ocean Research Drilling (ECORD)
- Ministry of Science and Technology (MOST), People's Republic of China
- Australian Research Council (ARC) and GNS Science (New Zealand), Australian/New Zealand IODP Consortium (ANZIC)
- Ministry of Earth Sciences (MoES), India

Cover photograph shows the *JOIDES Resolution* sailing away under the rainbow. Photo credit: Chris Lyons and IODP JRSO.

Citation

International Ocean Discovery Program *JOIDES Resolution* Science Operator, 2024. FY24 Annual Report. **http://iodp.tamu.edu/publications/reports.html**

Disclaimer

Any opinions, findings, and conclusions expressed in this publication are those of the author(s) and do not necessarily reflect the views of the participating agencies or Texas A&M University.

http://iodp.tamu.edu
Texas A&M University
1000 Discovery Drive
College Station TX 77845 USA
Tel: 979.845.2673
Fax: 979.845.1026

Mitch Malone

Director
International Ocean Discovery Program
***JOIDES Resolution* Science Operator**
Texas A&M University

Mitch Malone was appointed Director of the International Ocean Discovery Program at Texas A&M University in 2021. Malone began working for the Ocean Drilling Program as a Staff Scientist in 1995, and after transitioning into the Integrated Ocean Drilling Program as a Staff Scientist in 2003, he held the positions of Supervisor of Science Support (2004–2006), Manager of Science Operations (2006–2011), Acting Director (2008), and Assistant Director and Manager of Science Operations (2011–2021). During Malone's tenure, he has sailed on 10 Ocean Drilling Program and Integrated Ocean Drilling Program expeditions. Malone earned his B.A. in Geography from the University of Texas at Austin (1986) and his M.S. (1989) and Ph.D. (1995) in Geology from Duke University. He is on the Graduate Faculty at Texas A&M University in the Department of Geology and Geophysics and the Department of Oceanography. Malone was an Associate Editor of the *Journal of Sedimentary Research* from 1999 to 2004.

Gary Acton

Assistant Director and Manager of Technical & Analytical Services
International Ocean Discovery Program
***JOIDES Resolution* Science Operator**
Texas A&M University

Gary Acton was appointed Assistant Director of the International Ocean Discovery Program at Texas A&M University in 2021 and Manager of Technical and Analytical Services in 2017. Acton worked for the Ocean Drilling Program as a Staff Scientist (1995–2003), University of California-Davis as a Research Scientist (2003–2013), and Sam Houston State University as an Associate Professor at (2013–2017). He has sailed on 14 scientific coring expeditions. Acton earned his B.S. in Geology from Indiana University (1984), M.S. in Geophysics from University of Arizona (1986), and Ph.D. in Geosciences from Northwestern University (1990). He has served on the ODP Site Survey Panel, the US Advisory Committee for Scientific Ocean Drilling, and the IODP Science Evaluation Panel, and was selected as an IODP US Science Support Program Distinguished Lecturer (2014–2015). Acton served as Secretary of the Geomagnetism-Paleomagnetism Section of the American Geophysical Union from 2008 to 2010 and was elected a Geological Society of America Fellow in 2016.

Historical perspective

From October 2023 through September 2024, the international marine research collaboration called the International Ocean Discovery Program (IODP) continued to explore Earth's history and dynamics as recorded in seafloor sediments and rocks and to monitor subseafloor environments. IODP built on the earlier successes of the Deep Sea Drilling Project (DSDP), Ocean Drilling Program (ODP), and Integrated Ocean Drilling Program, which revolutionized our view of Earth's history and global processes through ocean basin exploration.

The Integrated Ocean Drilling Program and IODP expanded on the predecessor programs through the use of multiple drilling platforms operated by three implementing organizations (IOs) to achieve the Program's goals. The riserless research vessel *JOIDES Resolution*, a research facility managed for IODP by Texas A&M University (TAMU) as the *JOIDES Resolution* Science Operator (JRSO), continues to expand the global sampling coverage and disciplinary breadth that were characteristic of DSDP and ODP. The riser drilling vessel *Chikyu*, operated by Japan's Institute for Marine-Earth Exploration and Engineering (MarE3), allows extended drilling for several months at a single location. Mission-specific platforms operated by the European Consortium for Ocean Research Drilling (ECORD) Science Operator (ESO) allow drilling in environments unsuitable for either the *JOIDES Resolution* or the *Chikyu*, such as locations near the shoreline in shallow-water areas and in climatically sensitive or ice-covered regions. Consistency from one expedition to the next is ensured through provision of an Expedition Project Manager/Staff Scientist from the IO responsible for operating the expedition's platform.

Each IODP platform provider utilizes a Facility Board to make decisions on the effective use of its drilling facility in fulfilling the objectives of the IODP Science Plan, "Illuminating Earth's Past, Present, and Future," and each of the IOs provides liaisons with appropriate expertise to interact with the Facility Boards and other Program working groups and task forces. The *JOIDES Resolution* Facility Board (JRFB) is informed by advisory panels—the Science Evaluation Panel (SEP) and the Environmental Protection and Safety Panel (EPSP)—to evaluate the science, sites, environmental protection, and safety of hypothesis-driven science expedition proposals aligned with principal research themes outlined in the IODP science plan.

IODP facilities are funded by three platform providers (the US National Science Foundation [NSF], Japan's Ministry of Education, Culture, Sports, Science and Technology [MEXT], and ECORD) with financial contributions from the People's Republic of China Ministry of Science and Technology (MOST); the Australian and New Zealand IODP Consortium (ANZIC) funded by the Australian Research Council (ARC) and GNS Science (New Zealand); and the Ministry of Earth Sciences (MoES), India. Together, these agencies represent 20 participating nations whose scientists are selected to staff IODP research expeditions conducted throughout the world's oceans.

On the ship's bow, the 2024 ball drop is ready to welcome the new year.

Contents

1. Executive summary

Texas A&M University (TAMU) acts as manager and science operator of the research vessel *JOIDES Resolution* as a research facility for the International Ocean Discovery Program (IODP). Administrative services in support of *JOIDES Resolution* Science Operator (JRSO) activities are provided by the Texas A&M Research Foundation (TAMRF) through the TAMU Sponsored Research Services (SRS).

JRSO scope of work

As the science operator of the *JOIDES Resolution* research facility, JRSO provides wireline coring and logging services along with technical, science, operations, engineering, and information technology (IT) support; curates core materials; develops data applications and manages digital databases; and publishes preexpedition and postexpedition reports and results. In addition, JRSO produces and publishes technical documentation and program plans, completes legacy work (e.g., producing scientific publications), conducts long-lead planning work in preparation for expeditions scheduled for future fiscal years, and provides all necessary clearances and environmental assessments for IODP expeditions conducted by JRSO. All of these Program activities are conducted in accordance with direction provided by the Program's advisory panels and the *JOIDES Resolution* Facility Board (JRFB), as outlined in approved Annual Program Plans.

On behalf of JRSO and as outlined in this Annual Report, TAMRF contracted with ODL AS for the services of *JOIDES Resolution* and with Schlumberger Technology Corporation (Schlumberger) for the provision of downhole logging equipment and engineering support.

FY24 overview

During fiscal year 2024, JRSO successfully completed three expeditions, followed by demobilization of the *JOIDES Resolution*. Postexpedition research on the collected cores from the completed expeditions will improve our understanding of (1) the Atlantic–Mediterranean exchange before, during, and after

IODP JRSO FY24 expedition summary

Expedition	Operational days on site (days)	Distance traveled (nmi)	Sites (number)	Holes (number)	Meters cored	Meters recovered	Cores recovered (number)	Core recovery (%)	Holes logged (number)
Expedition 401: Mediterranean-Atlantic Gateway Exchange	47.44	2,778	4	7	3,166	2,605	408	82	3
Expedition 402: Tyrrhenian Continent–Ocean Transition	50.86	526	6	14	2,560	1,153	291	51	5
Expedition 403: Eastern Fram Strait Paleo-Archive	40.50	2,057	7	22	5,382	5,343	753	99	3
Totals	**138.80**	**5,361**	**17**	**43**	**11,108**	**9,101**	**1,452**	**82**	**11**

Note: Operations time = time on site (does not include transits, waiting on weather, or breakdown time).

the Messinian Salinity Crisis and its impact regionally and globally; (2) the history of magma generation in the mantle peridotites, the chemical interactions between seawater and the mantle rocks, and the deformation processes that unroofed the deep mantle and led to the formation of the continent–ocean transition; and (3) the dynamic history of ocean-ice interactions during global climate transitions, such as the onset of Northern Hemisphere glaciation, and past periods of rapid warming and higher CO_2 levels than today. Several outreach activities took place during expeditions and transit/tie up periods in between expeditions.

This IODP JRSO FY24 Annual Report details these accomplishments and other activities undertaken in support of National Science Foundation (NSF) Cooperative Agreement OCE-1326927 during the period from 1 October 2023 through 30 September 2024.

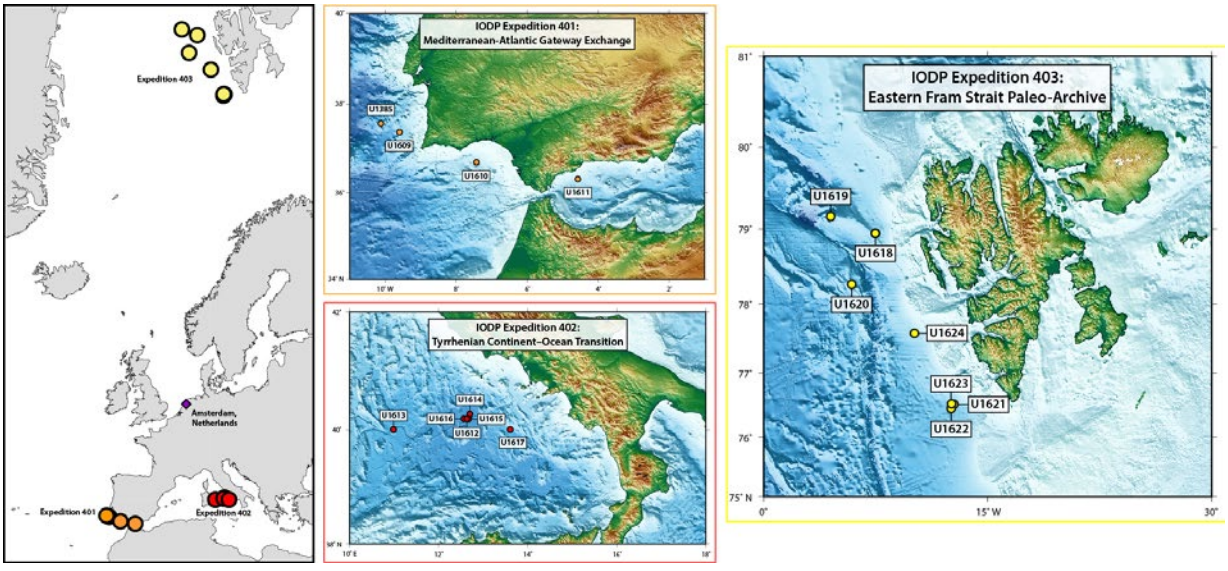
2. Expedition operations

Expedition 401: Mediterranean–Atlantic Gateway Exchange

Marine gateways play a critical role in the exchange of water, heat, salt, and nutrients between oceans and seas. Changes in gateway geometry can significantly alter both the pattern of global ocean circulation and climate. Today, the volume of dense water supplied by Atlantic–Mediterranean exchange through the Gibraltar Strait is among the largest in the global ocean. For the past 5 My, this overflow has generated a saline plume at intermediate depths in the Atlantic that deposits distinctive contouritic sediments and contributes to the formation of North Atlantic Deep Water. This single gateway configuration only developed in the Early Pliocene. During the Miocene, two narrow corridors linked the Mediterranean and Atlantic: one in northern Morocco and the other in southern Spain. Progressive restriction and closure of these gateways resulted in extreme salinity fluctuations in the Mediterranean, leading to the precipitation of the Messinian Salinity Crisis “salt giant.”

IODP Expedition 401 (10 December 2023–9 February 2024) is the offshore drilling component of a Land-2-Sea drilling proposal, Investigating Miocene Mediterranean–Atlantic Gateway Exchange (IMMAGE). Its aim is to recover a complete record of Atlantic–Mediterranean exchange from its Late Miocene inception

FY24 expedition sites.



to its current configuration by targeting Miocene offshore sediments on either side of the Gibraltar Strait. Miocene cores from the two precursor gateways now exposed on land will be obtained by future International Continental Scientific Drilling Program (ICDP) campaigns.

The primary objective of Expedition 401 was to document the time at which the Atlantic first started to receive a distinct overflow from the Mediterranean and to evaluate quantitatively its role in Late Miocene global climate and regional environmental change. Core was recovered from seven holes at four different sites (U1385 and U1609–U1611). Splices were constructed at Sites U1385 and U1609, where two holes were cored at each site and the physical properties data showed regular cyclic patterns. The core recovery at Site U1609 was much better than expected (>82% overall), and the 8 Ma target was not buried as deeply as expected, allowing for more coring time and the creation of a nearly complete splice. In addition, an almost complete record recovered at Site U1385 can be correlated peak-to-peak to adjacent records obtained from deeper waters at Sites U1586 and U1587 during IODP Expedition 397 (Iberian Margin Paleoclimate).

Another objective of Expedition 401 was to recover a complete record of Atlantic–Mediterranean exchange before, during, and after the Messinian Salinity Crisis and to evaluate the causes and consequences of this extreme oceanographic event locally, regionally, and globally. Cores recovered at Site U1611 in the Alborán Sea record a thick succession of organic-rich laminated fine-grained sediments interbedded with turbidites, debrites, and slumps, overlain by Pliocene contourites. The fauna and ichnofossils identified in the Miocene sequence indicate that subaqueous deposition occurred throughout but that the water mass was highly stratified with low oxygen or anoxic conditions at the sediment/water interface. The record from the Miocene/Pliocene boundary downward (with the exception of a 2 m gap just below the boundary) is close to continuous. At Sites U1385, U1609, and U1610, physical properties records (e.g., natural gamma radiation) show changes in siliciclastic deposition at times consistent with major changes in the Mediterranean gateway changes. Exploration of the mechanisms for achieving these synchronous changes can now be implemented through postcruise empirical and modeling studies.

The final Expedition 401 objective was to test our quantitative understanding of the behavior of ocean overflow plumes during the most extreme exchange in Earth's history. Testing physical oceanography hypotheses will require detailed physical and chemical analysis and modeling. This is only possible

From left: Preparing a whole-round core for interstitial water extraction. Sea 1 rig floor crewmembers disassembling logging tools. Applying acetone to an endcap to adhere to the end of the core liner.

because of the high core recovery rates and clear and tunable cyclicity enabling site-to-site correlation along the Mediterranean overflow plume on a precessional timescale. The cores we recovered will permit us to test whether the representations of overflows within general circulation models are effective when overflow density is higher than the range of validation provided by the modern ocean.

Expedition 402: Tyrrhenian Continent–Ocean Transition

In the classical view of tectonic rifting, divergent lithospheric plates cause the asthenospheric mantle to ascend, decompress, and melt, producing new magmatic crust. This view has been updated by drilling results that found exhumed mantle at the continent–ocean transition (COT), leading to the definition of magma-poor continental margins. Obtaining samples and data from drilling in magma-poor COTs is a challenge because the exposed mantle is typically buried under a thick sediment cover. The Tyrrhenian Sea provides an optimal location to test COT formation models by drilling because it has a comparatively thin sediment cover, allows for studying a conjugate pair of COT margins in a single drilling expedition, and has been mapped in unprecedented detail with recent geophysical measurements.

The key objective of IODP Expedition 402 (9 February–8 April 2024) was to determine the nature of the geological basement in the central Vavilov Basin, where exhumed mantle peridotites were expected, and of the conjugate margins to the west (Cornaglia Terrace) and east (Campania Terrace). Sites U1614 and U1616 in the Vavilov Basin recovered an exceptional variety of mantle rocks, including lherzolites, harzburgites, plagioclase-bearing lherzolites and harzburgites, dunites, and occurrences of pyroxenites and mantle intrusions. The mantle peridotites are variably hydrated and weathered, resulting in the formation of low-temperature serpentine and carbonate veins. Site U1612 recovered an unconsolidated breccia with clasts of basalt, peridotite, and granite at the sediment/basement interface, followed by variably deformed mylonitic gneisses that transition downhole to granitoid quartz-diorite rocks. On the western Tyrrhenian margin (Cornaglia Terrace), Site U1613 sampled a sediment sequence dating to the Messinian (late Miocene), resting on much older sedimentary rocks correlated to units outcropping in Sardinia, supporting the hypothesis that the margin consists of extended continental crust. On the conjugate margin to the east (Campania Terrace), Site U1617 recovered a complete sequence of Messinian evaporites, including halite. Although Site U1617 drilling did not reach basement, the material recovered nonetheless provides insight into the rifting process.

From left: Working halves of hard rock cores sprinkled with sampling labels. A stunning view of sunrise through the derrick.

The samples and data collected during Expedition 402 provide an extensive new data set to determine the heterogeneity of the mantle, the nature and history of melt production and impregnation, and the extent and evolution of serpentinization and carbonate formation; to constrain the geometry and timing of the deformation that led to mantle exhumation; to study the fluid-rock interactions between seawater, sediment, and the serpentinizing mantle; and to constrain geodynamic models of rifting and COT formation.

Expedition 403: Eastern Fram Strait Paleo-Archive

The North Atlantic and Arctic Oceans are unquestionably major players in the climatic evolution of the Northern Hemisphere and in the history of the meridional overturning circulation of the Atlantic Ocean. The establishment of the modern North Atlantic Water (NAW) transporting heat, salt, and moisture to the Northern Hemisphere has been indicated as one of the main forcing mechanisms for the onset of Northern Hemisphere glaciation. NAW controls the extent and dynamics of circum-Arctic and circum-North Atlantic ice sheets and sea ice in addition to deep water and brine production. How the ocean system and cryosphere worked during past warmer intervals of high insolation and/or high atmospheric CO_2 content is still largely unknown and debated. The required information can only be attained by offshore scientific drilling in high-resolution, continuous, and expanded sedimentary sequences identified on the western continental margin of Svalbard (and eastern side of the Fram Strait) along the main pathway and northern penetration of the NAW flowing into the Arctic Ocean. The area around Svalbard is very sensitive to climatic variability and can be considered a sentinel of climate change. Furthermore, the reconstruction of the dynamic history of the marine-based paleo-Svalbard–Barents Sea Ice Sheet is important because it is considered the best available analog to the modern, marine-based West Antarctic Ice Sheet, for which the loss of stability is presently the major uncertainty in projecting future global sea level rise in response to the present global climate warming.

The overarching scientific goal of IODP Expedition 403 (4 June–2 August 2024) was the reconstruction of the West Spitsbergen Current (WSC) variability; its influence on climate changes, particularly during established key climate transitions occurring since the cold late Miocene/warm early Pliocene (~5.3 Ma); and its impact on the Arctic glaciations, ice shelf development and stability, and sea ice distribution through heat transfer from low to north high latitudes and the Arctic Ocean. Expedition 403 was

From left: Observing sea ice from the bridge. A puffin soars near the ship. Setting up the pumps for the microbial contamination tracers.

designed to optimize recovery of expanded deposition sequences from sediment drifts along the western margin of Svalbard.

To generate the most complete stratigraphic record and to address the expected high-resolution sampling demands, at least two holes were drilled at each site, except for Sites U1619 and U1622, to obtain multiple, correlatable records, especially of the younger time intervals. At the two Bellsund drift sites, this operational success was amplified by drilling three good recovery holes of a highly expanded sequence at Site U1621 and five good recovery (and deeper) holes at nearby Site U1623. Additionally, planning aimed to drill at least one very deep hole at several sites to provide long-time series records. This goal was largely met by obtaining >600 m records from both the western Vestnesa Ridge (Site U1619) and Svyatogor Ridge (Site U1620) drill sites. The recovered core records span the intended geographic extent, including a south–north transect within the modern flow direction of the WSC and east–west transects that span proximal to distal settings relative to the Svalbard continental margin.

Expedition 403 successfully recovered highly promising sedimentary records, in total over 5,300 m long, dating back to the late Miocene (~5.3–6.0 Ma). A good preliminary age model for all sites was established by combining the magnetostratigraphy and biostratigraphy through the identification of main paleomagnetic reversals and nannofossils biomarkers and biozones, in places corroborated by the occurrence at depth of typical age-diagnostic diatom assemblages, foraminifera, and dinocyst biomarkers. The preliminary age models confirmed the presence of expanded sequences suitable for high-resolution paleoceanographic reconstructions. In particular, Site U1619 on the west termination of the Vestnesa Ridge contains the most expanded full Pliocene depositional record ever recovered on Arctic margins (~350–360 m), and Site U1621 on the upper reaches of the Bellsund drift contains a very expanded Quaternary sequence, having an overall sedimentation rate of ~245 m/My. Preliminary biostratigraphic analyses on the recovered record allowed for the identification of main Pleistocene warm interglacials (e.g., Marine Isotope Stages 5, 11–13, and 31) as well as warm events that occurred during the Pliocene time. The age model will be refined during postcruise analyses.

From left: Operations Superintendent at the drillers' console. Analytical gas bottle storage on *JOIDES Resolution*.

3. Management and administration

JRSO's organizational structure directly reflects the responsibilities specified by NSF for technical and scientific management, administration, and operation of *JOIDES Resolution*, including planning, coordinating, overseeing, reviewing, and reporting activities. The TAMU portion of the organization consists of four departments: Science Operations (SciOps), Technical & Analytical Services (TAS), and Publication Services (Pubs) whose managers report to the JRSO Director. A fourth department, TAMU Technology Services, is part of a consolidated TAMU IT services division, which is a dotted line reporting to the director. Curation services is part of the Director's Office.

On-site administrative staff members dedicated to JRSO support are overseen by a General Manager who reports to the Executive Director of TAMU SRS. This separate reporting chain ensures that the administrative unit retains the independence to ensure regulatory compliance while working directly with JRSO staff to efficiently implement the Program. The Director's Office and the Administrative Services group combined provide Management and Administration services for the award.

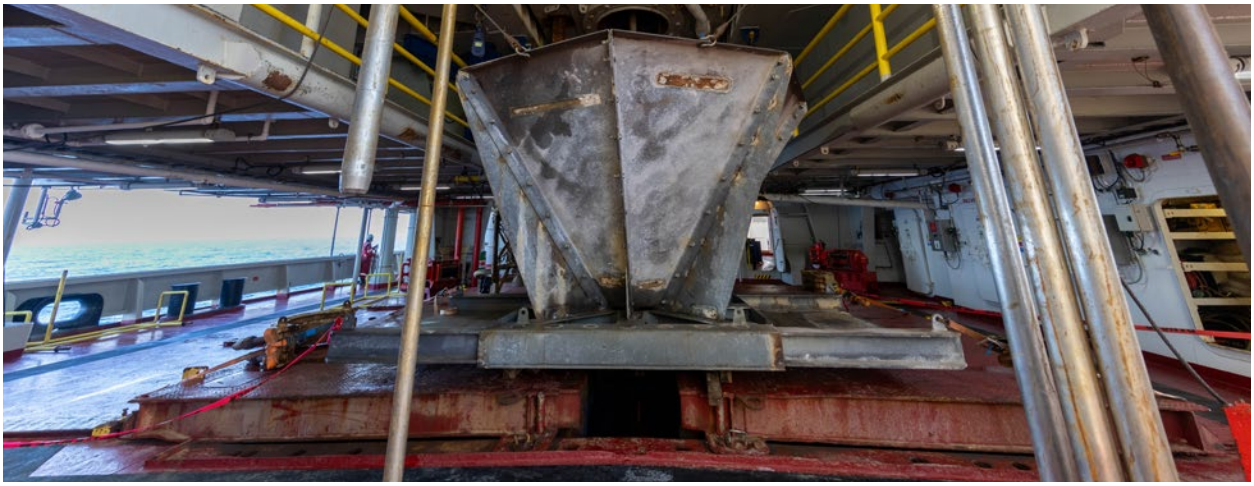
Reporting and liaison activities

JRSO reports to and liaises with funding agencies and IODP-related agencies (e.g., JRFB, JRFB advisory panels, Program Member Offices [PMOs], and other national organizations and facility boards) and participates in facility board, advisory panel, and IODP Forum meetings. Minutes from the facility board meetings are available online (**http://iodp.org/facility-boards**).

The JRFB includes liaisons from the European Consortium for Ocean Research Drilling (ECORD) and the Institute for Marine-Earth Exploration and Engineering (MarE3), and the *Chikyu* and ECORD Facility Boards each include a JRSO liaison.

Project portfolio management

M&A managed large cross-departmental tasks and projects through teams using a formal project portfolio management approach to identify, categorize, review, evaluate, select, and prioritize proposed projects. During FY24, JRSO staff completed work on the new Rig Instrumentation System (iRIS) and continued work on the Hyperspectral Line Scan Logger (HyperScan) and Google Migration projects.



Reentry cone for Site U1616 waiting for deployment in the moonpool.

4. Subcontractor activities

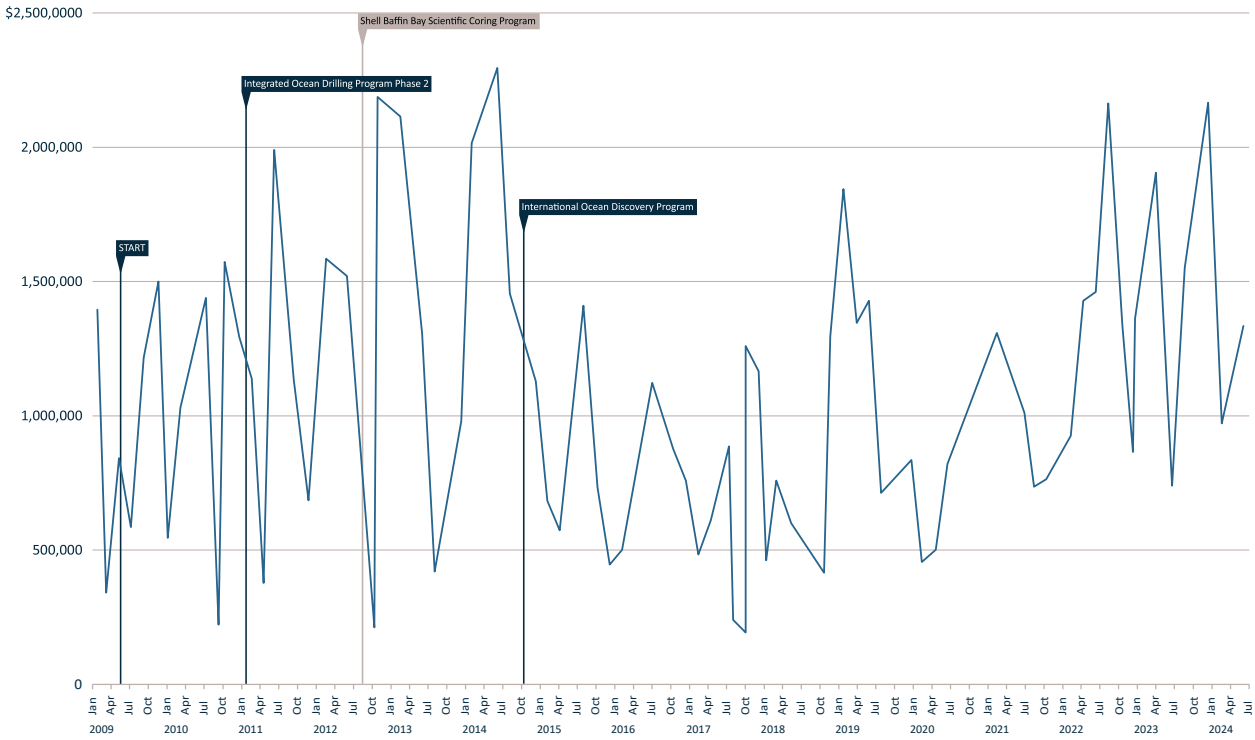
The Administrative Services department managed subcontracts with ODL AS for ship services and Schlumberger for wireline logging services. Administrative Services staff reviewed subcontractor invoices prior to payment and ensured financial compliance with cost allowability and other contractual requirements.

JRSO continued to interact with ODL AS to ensure efficient and compliant operations of *JOIDES Resolution*. JRSO management met with ODL AS frequently to discuss operational and logistical issues. JRSO continued to interact with Schlumberger to ensure that wireline logging operations aboard *JOIDES Resolution* continued in an efficient and compliant manner. JRSO and Schlumberger worked successfully to streamline travel, shipping, and tool maintenance activities. Three faulty Accelerator Porosity Sonde (APS) tools were removed from the vessel during the tie up before Expedition 401. A new Ultrasonic Borehole Imager (UBI) tool was sent to the ship for use during Expedition 402, and a new APS tool was sent to the ship for use during Expedition 403. Schlumberger tools and equipment were removed from the ship during the August–September demobilization period.

5. Science operations

The SciOps department provides scientific, operational, engineering, and logistical planning and implementation for *JOIDES Resolution* drilling expeditions in response to the IODP science planning structure. JRSO is responsible for scoping, planning, managing, and implementing science expeditions; providing services and materials for the platform and oversight to drilling and logging contractors; and utilizing IODP resources to oversee engineering development projects.

Actual ship fuel costs FY09–FY24.



Expedition planning

Expedition Project Managers (EPMs), Co-Chief Scientists, curators, and technical staff held virtual meetings to review laboratory measurements, engineering plans, and sampling plans for Expeditions 401, 402, and 403. A stratigraphic correlator meeting was held on 22 January, and GEODESC training was held on 13 February for Expedition 403. An Expedition 403 science party meeting was held during the American Geophysical Union (AGU) 2023 Fall Meeting for all those who attended the conference,.

Expedition staffing

All three expeditions were successfully staffed during FY23. Three scientists and an outreach officer withdrew from Expedition 402 with three of those positions being restaffed. One scientist from Expedition 403 withdrew and was replaced. Coastal observers from Morocco, Portugal, and Italy were added to Expeditions 401 and 402 in FY24. A scientist already invited on Expedition 403 was identified by Norway to act as its observer.

Logistics support

Logistical support for each expedition went smoothly without complications. Support was provided for vessel demobilization, which included surface and airfreight shipments back to TAMU (described below) as well as three flats of Schlumberger equipment and infrastructure that were sent to Louisiana.

Clearance/Environmental permitting/Risk management

Authorizations were needed from Spain, Portugal, Morocco, Italy, and Norway for the three FY24 expeditions.

The process to obtain clearance for Expedition 401 started in FY23. Spain issued their authorization on 30 November but restricted some activities at the single primary site in Spanish territory. Portugal issued their authorization on 5 December after confirming that the recommended observer had been invited. Finally, we had requested Moroccan authorization at the advice of the State Department because two alternate sites were in Spanish waters but too close to the marine boundary between Spain and Morocco. Because of a ~4 month delay caused by the US Embassy in Morocco not forwarding critical communication from the Moroccan government, we were unable to receive consent from Morocco.

IODP JRSO FY24 expedition science staffing breakdown

	Expedition			
Member country/consortium	**401**	**402**	**403**	**Total**
United States Science Support Program (USSSP)	14*	12	13*	**39**
Japan Drilling Earth Science Consortium (J-DESC)	2	3	3	**8**
European Consortium for Ocean Research Drilling (ECORD) Science Support and Advisory Committee (ESSAC)	7*	8**	7*	**22**
IODP-China	2	2	2	**6**
Australia/New Zealand IODP Consortium (ANZIC)	1	1	1	**3**
India Ministry of Earth Science (MoES)	1	1	1	**3**
Total Science Party Participants	**27**	**27**	**27**	**81**

Notes: * = includes one Co-Chief Scientist. ** = includes two Co-Chief Scientists. Observers: 401 (2), 402 (2).

However, the expedition's scientific success was not impacted. Because of the Land-2-Sea nature of the drilling proposal and the contributions of Moroccan scientists to this project, we did sail a Moroccan scientist as an unofficial observer. This was the first time Morocco participated in IODP.

The process to obtain clearance for Expedition 402 started in FY23. JRSO obtained authorization from Italy on 11 January to conduct research. In the authorization, Italy requested two observers. Both were invited and accepted the invitation to sail. In the weeks preceding the expedition, JRSO worked closely with the Italian Co-Chief Scientist and hydrographic agency to understand the locations of newly identified seafloor cables and decided to eliminate two alternate sites and switch one primary site.

The process to obtain clearance for Expedition 403 started in FY23. Expedition 403 sites are in the Svalbard Archipelago, which falls in Norway's Exclusive Economic Zone. Norway raised concerns about the vertical seismic profile (VSP) work planned and strongly recommended against any seismic work taking place 1 July–31 October because of the increased presence of whales and their calves. JRSO continued discussions with Norway regarding their recommendation. The required VSP Environmental Evaluation, which was approved by NSF on 17 January, was forwarded to Norway, and the expedition obtained authorization on 11 March to conduct research. The authorization limited VSPs to June and the operations plan was revised accordingly. Two ice navigators sailed on Expedition 403 to meet the vessel's polar code requirements. They worked closely with the Captain and Co-Chief Scientists to map ice conditions and ensure that drilling operations were conducted safely.

Postexpedition activities

JRSO hosted the following postexpedition meetings in College Station, Texas:

- Expedition 399 core description party, 4–15 December
- Expedition 395 editorial meeting, 26 February–1 March
- Expedition 400 editorial meeting, 3–7 June
- Expedition 399 editorial meeting and sampling party, 22 April–3 May
- Expedition 401 editorial meeting, 13–17 May
- Expedition 402 editorial meeting, 5–9 August
- Expedition 389 editorial meeting, 26–30 August

From left: Examining foraminifera through a stereoscope. Collecting a gas sample through the core liner on the catwalk.

Postexpedition sampling parties were held at the Bremen Core Repository (BCR) at the University of Bremen (Germany) for Expeditions 395 (15–21 January), 400 (18–24 March), 401 (1–7 July), and 402 (16–20 September).

Education/Outreach support

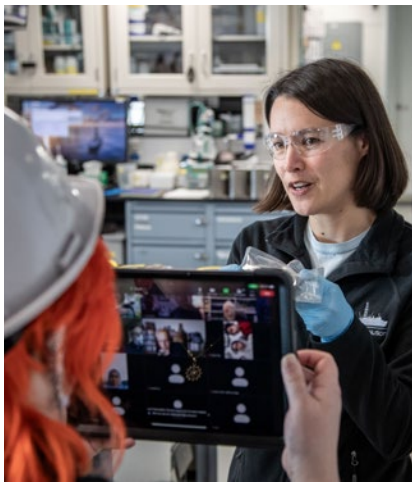
Onboard Outreach Officers sailed during Expeditions 401–403, and support was provided for social media postings, videoconferences, and other activities. One JRSO staff scientist supported a JR Academy that was held on the *JOIDES Resolution* during the Expedition 402T April transit from Napoli, Italy, to Amsterdam, Netherlands. The same staff scientist returned to the Amsterdam tie up to support the School of Rock that took place in mid-May. Port call tours took place at the Naples February and April port calls at the request of IODP-Italy. JRSO staff worked with a three-person film crew during Expedition 403 to facilitate outreach activities. The GLacial Sedimentation School (GLASS) was held 14–19 July at the Gulf Coast Repository (GCR) with the support of JRSO staff. Greek and German documentaries were released about Hellenic Arc Volcanic Field Expedition 398.

6. Technical and analytical services

The TAS department facilitates core flow and oversees laboratories. TAS stocks the shipboard laboratories; operates scientific measurement equipment and provides support to shipboard scientists; provides a supervisory and reporting structure for seagoing JRSO personnel; educates customers regarding laboratory and general shipboard safety; maintains, repairs, and develops scientific equipment at sea; provides support for downhole tools and measurements; works to ensure quality assurance/quality control of measurements made in the shipboard laboratories; and supports shore-based laboratories.

Analytical systems

The 3.5 kHz echo sounder had been nonfunctional since 2021, requiring that we rely solely on the 12 kHz system. Multiple attempts to repair and replace accessible components of the 3.5 kHz system failed to resolve the issue. During the dry dock in November, the sonar dome was removed from the ship and inspected. The 3.5 kHz electronics compartment was found to be flooded, and signs of arcing


From left: Working on the Whole-Round Multisensor Logger (WRMSL). Scientist describing analyses in the shipboard chemistry laboratory to an outreach audience. A view of the *JOIDES Resolution* docked in the port of Amsterdam, Netherlands.

were evident. TAS staff replaced the electronics and the seals and returned the 3.5 kHz echo sounder to functionality.

Work continued on the HyperScan logger. The developers and project team made significant progress in programming and testing new software components and integrating them into the IMS system, including major improvements to camera control and calibration, lighting, and motion control for the hyperspectral track. Modules to enhance the images, extract RGB data from the data cube, and write the large datasets to disk remain under development.

Data archiving

During FY24, data from several IODP Expeditions were published in Zenodo, which is a general-purpose FAIR, open-access repository operated by the European Organization for Nuclear Research (CERN). Archiving these data is part of an effort to create a long-term repository of referenceable information for all IODP expeditions, including information beyond that which is currently available online in the IODP Laboratory Information Management System (LIMS) database. The data are uploaded within the IODP community on Zenodo (**https://zenodo.org/communities/iodp**), which can also be used by the general science community to archive data collected postexpedition. Each dataset uploaded is assigned a unique digital object identifier (DOI), allowing the data source to be tracked and cited accurately. Links to the uploaded data are provided within the associated IODP *Proceedings* volume. For example, links to published data from Expedition 350 are at **http://publications.iodp.org/proceedings/350/datasets.html**. Additional links to all expeditions that have been uploaded into Zenodo are provided from a summary index page at **https://iodp.tamu.edu/database/zenodo.html**.

Laboratory working groups

The Geochemistry and Microbiology, Geology, Geophysics, and Curation and Core Handling laboratory working groups (LWGs) include technical and science JRSO staff members and external participants who review cruise evaluations, expedition technical reports, and issues management communications to develop advice on corrective actions and potential developments on *JOIDES Resolution* and on shore. The LWGs provided advice on equipment acquisition and upgrades, improvements to methodologies and

Colorful core section halves on the description table.

measurements, improvements to laboratories, additional procedural documentation, and ongoing quality assurance work during FY24.

Shipboard laboratory support

More than 8,000 core sections were processed through the shipboard laboratories during the FY24 expeditions, and more than 30,000 samples (on the ship and at sample parties) were taken. Shipboard technical staff and expedition scientists made well over 3 million shipboard measurements on FY24 samples and placed more than 11,000 images (sections, close-ups, and microimages) and more than 8,000 X-Ray images in the database archive.

Shipboard Laboratory Demobilization

The successful demobilization of the laboratories on the *JOIDES Resolution* in Amsterdam, Netherlands, involved detailed documentation, disassembly, and careful packing of all scientific equipment along with the furniture, cabinetry, and supplies that will be of use in the shore-based laboratories. These items were loaded into ten 40-foot shipping containers and shipped to the GCR, where they will be installed in newly renovated laboratories.

7. TAMU technology services

TAMU Technology Services oversees JRSO data collection/storage, management, and archiving; maintains IT infrastructure on ship and shore; develops and maintains instrument-specific software for data acquisition; and manages the Program's extensive databases.

Expedition data services and program-wide data query services

During expeditions, laboratory work aboard *JOIDES Resolution* produces a vast amount of data that are stored in LIMS. LIMS data collected during JRSO Expeditions 401–403 were successfully transferred to shore, merged with the cumulative LIMS database, and made available online to participating scientists. More than 156,000 downloads were made from the LIMS database during FY24, and more than 67,900 downloads were made from the Janus database.

From left: The chemistry laboratory on the *JOIDES Resolution* after demobilization. Packing *JOIDES Resolution* ship laboratory instruments into custom-built crates during demobilization.

Network systems operation, maintenance, and security

JRSO conducted routine system maintenance in accordance with the TAMU IT security policy and completed its annual TAMU IT risk assessment.

8. Core curation

Core Curation provides services in support of IODP core sampling and curation of the core collection archived at the GCR and also supports the XRF core scanning facility at the GCR to provide scanning as Program measurements.

Sampling at the Gulf Core Repository

In FY24, GCR staff collected a total of 15,665 samples from legacy cores. Completion of core curation and dry imaging of Expedition 399 (Building Blocks of Life, Atlantis Massif) cores took place in October–November, followed by a core description party on 4–15 December 2023 in College Station, Texas, to complete these activities with a safe asbestos-handling protocol approved by TAMU Environmental Health & Safety. The JRSO rented a doublewide trailer and outfitted it to create a laboratory capable of safely mitigating concerns related to asbestiform minerals present in Expedition 399 cores. For the first time, air monitoring of various core handling activities and sample cutting of scientific ocean drilling cores containing asbestiform minerals were conducted by a third party to inform future handling of Expedition 399 cores and the procedures used to handle potential for recovery of serpentinized peridotites during Expedition 402. The results of air monitoring were shared with the BCR and Kochi Core Center (KCC), and will be presented at the 2024 American Geophysical Union meeting.

Use of core collection and education and outreach activities

The GCR core collection was used for Program outreach through materials provided for display at meetings and museums, tours of the repository, and educational programs. JRSO staff gave tours of the GCR to 220 visitors, including the TAMU President, several TAMU classes, visiting scientists, and Mexican undergraduate students taking part in TAMU's Yucatan Initiative.

From left: Portable building at the Gulf Coast Repository customized for safe handling of Expedition 399 serpentinite cores. JRSO staff shrink wrapping cores. Safety measures applied while cutting Expedition 399 serpentinite cores at the GCR.

JRSO lent a model K/Pg boundary core to a JRSO staff member who presented on scientific ocean drilling to over 100 elementary school children. The GCR hosted the Glacial Sedimentation Summer School (GLASS) workshop held 14–19 July. More than 30 students from the US and international locations gained hands-on experience working with glacial cores from Deep Sea Drilling Project (DSDP), Ocean Drilling Program (ODP), Integrated Ocean Drilling Program, and IODP expeditions and Antarctic Drilling Project (ANDRILL) cores.

Onshore XRF scanning

More than 4,500 core sections were X-ray fluorescence (XRF) scanned this year at the GCR.

9. Publication services

The IODP Pubs department provides publications support services for JRSO expeditions and editing, production, and graphics services for all required reports and scientific publications as defined in the JRSO cooperative agreement with NSF.

Scientific publications

IODP publications for FY24 included JRSO quarterly and annual reports, one IODP Technical Note, one *Scientific Prospectus* Addendum for a MarE3 expedition, five *Preliminary Reports* for JRSO and ECORD Science Operator (ESO) expeditions, and five *Proceedings of the International Ocean Discovery Program* volumes for Expeditions 386, 391 (including 397T), 390/393 (including 390C and 395E), 397, and 398. IODP Pubs also coordinated postexpedition publications and published Expedition Research Results content for 3 JRSO expeditions, including 12 data reports.

Shipboard publications support and postexpedition editorial meetings

Publications Specialists sailed during JRSO expeditions to coordinate shipboard reports. During postexpedition editorial meetings, Publications staff coordinate science reviews of all expedition reports content and assist meeting participants with editing prior to publication. In FY24, JRSO staff in College Station, Texas, hosted postexpedition editorial meetings for five JRSO expeditions and one ESO expedition.

From left: Close up of a rotary core drill bit. Shrink wrapping a rock sample in preparation for splitting it.

Web services

IODP Pubs hosts web services for expeditions, publications, and legacy programs. In addition to internal JRSO web page updates and additions, new content is regularly added to IODP expedition web pages at **http://iodp.tamu.edu/scienceops/expeditions.html**. All DSDP, ODP, Integrated Ocean Drilling Program, and IODP Program scientific publications are accessible online at the IODP Publications and legacy websites. Volumes are available as disk images or zip files so users can download the expedition reports portion of any IODP *Proceedings* volume. There were 241,051 visits to the IODP Publications website during FY24.

Discovery and accessibility

Metadata for IODP publications are deposited with CrossRef, an official DOI registration agency for scholarly and professional publications. Program publications accessed through CrossRef numbered 436,297 DOI resolutions for Integrated Ocean Drilling Program and IODP publications and 193,859 DOI resolutions for DSDP and ODP publications.

IODP Pubs also participates in CrossRef's cited-by linking; open reference initiative; text and data mining; ORCID, license, and funding registration; and CrossMark metadata validation services. IODP Pubs deposited 51 chapters from Integrated Ocean Drilling Program and IODP *Proceedings* volumes into ScienceOpen, a professional networking research platform for scholars and publishers. The IODP collection can be viewed at **https://www.scienceopen.com/collection/IODP_Publications**. In addition, IODP Pubs deposited more than 500 records from expedition-related research published in outside literature into the Scientific Ocean Drilling Expedition Research Results collection, which can be viewed at **https://www.scienceopen.com/** collection/8b0582f6-47bf-4988-b90a-8533135e6fcc.

IODP Pubs contributed publications metadata for the same Integrated Ocean Drilling Program and IODP *Proceedings* chapters to TAMU's Symplectic Elements database, which feeds data to **Altmetric.com**, a platform that enables monitoring of online activity surrounding academic research.

IODP Program publications are also indexed on Google Scholar, and IODP Pubs is a member of the Committee on Publications Ethics (COPE).

From left: Taking a closer look at a rock sample. Smear slides neatly arranged in slide trays. Closing voids caused by gas expansion.

Citation management

AGI database

The Scientific Ocean Drilling Bibliographic Database is a subset of the American Geosciences Institute's (AGI) GeoRef database and includes more than 42,900 entries related to IODP and the preceding scientific ocean drilling programs, representing more than 50 years of scientific ocean drilling research. In FY24, more than 6,600 queries were run on the Scientific Ocean Drilling Bibliographic Database, and additional records for more than 2,600 citations were viewed. IODP Pubs works closely with AGI to curate the bibliographic database by identifying and submitting expedition-related research publication citations.

ManTrack database

IODP Pubs tracks expedition-related peer-reviewed publications from journals, serial monographs, books, and theses/dissertations in an in-house database (ManTrack). ManTrack contains more than 5,600 records relating to IODP Expeditions 301–399. This database is used to generate current impact statistics for inclusion in the annual Scientific Ocean Drilling Bibliographic Database and Publications Impact Report.

IODP bibliography

Pubs maintains an EndNote library comprising more than 25,200 records including all DSDP, ODP, Integrated Ocean Drilling Program, and IODP publication citations; citations from all IODP publication reference lists; and expedition-related journal articles, theses, book chapters, and conference abstracts. The complete IODP Bibliographic EndNote library is available for download in Research Information Systems (RIS)–format on the IODP publications website, and customized excerpt RIS lists are available upon request.

Legacy and archiving activities

The main IODP publications website (**http://publications.iodp.org/index.html**), which includes the full content from all Integrated Ocean Drilling Program and IODP volumes, and other publications pages are

From left: Draining water from the core section half after cleaning its surface. A fogbow on the starboard side of the ship.

archived at the Internet Archive, a long-term archive specializing in full website backups. Currently, our collection houses 2 TB of data and more than 8.5 million files.

In FY24, IODP Publications deposited complete Integrated Ocean Drilling Program *Proceedings* volume archives in zip format for Expeditions 301–348 to the IODP Community at the Zenodo data archive.

Progress reporting

The IODP JRSO FY23 Annual Report was submitted to NSF on 20 December, and JRSO operations and management reports were submitted to NSF for the following quarters:

- Fourth quarter of FY23 (July–September 2023) on 27 October
- First quarter of FY24 (October–December 2023) on 30 January
- Second quarter of FY24 (January–March 2024) on 22 April
- Third quarter of FY24 (April–June 2024) on 29 July

All reports are available at **http://iodp.tamu.edu/publications/reports.html**.

The *JOIDES Resolution* helideck during sunset.

URL list

IODP JRSO website: **http://iodp.tamu.edu**

IODP Program Member Offices: **http://www.iodp.org/about-iodp/program-member-offices**

JOIDES Resolution Facility Board and Panels: **http://www.iodp.org/facility-boards**

IODP Science Support Office: **http://www.iodp.org/program-organization/science-support-office**

IODP JRSO FY24 Annual Program Plan: **http://iodp.tamu.edu/publications/PP/IODP_JRSO_FY24_APP.pdf**

IODP JRSO FY24 Quarterly Reports: **http://iodp.tamu.edu/publications/reports.html**

COVID Mitigation Protocols Established for Safe JR Operations (COPE): **https://iodp.tamu.edu/scienceops/JR_COVID-Mitigation-Protocols.pdf**

Illuminating Earth's Past, Present and Future: The Science Plan for the International Ocean Discovery Program 2013–2023: **http://iodp.org/about-iodp/iodp-science-plan-2013-2023**

IODP expedition schedule: **http://iodp.tamu.edu/scienceops/index.html**

IODP expedition information: **http://iodp.tamu.edu/scienceops/expeditions.html**

IODP expedition data: **https://zenodo.org/communities/iodp**

Gulf Coast Repository: **http://iodp.tamu.edu/curation/gcr/index.html**

LIMS data science applications: **https://web.iodp.tamu.edu/apps/**

Sample requests: **http://iodp.tamu.edu/curation/samples.html**

IODP scientific publications and expedition-related citation lists: **http://publications.iodp.org**

Scientific Ocean Drilling Bibliographic Database: **http://iodp.americangeosciences.org/vufind**

2024 Scientific Ocean Drilling Bibliographic Database and Publication Impact Report: **http://iodp.tamu.edu/publications/AGI_studies/2024_Pub_Impact.pdf**

IODP Publications ScienceOpen page: **https://www.scienceopen.com/collection/IODP_Publications**

IODP expedition-related outside literature ScienceOpen page: **https://www.scienceopen.com/collection/8b0582f6-47bf-4988-b90a-8533135e6fcc**

IODP Publications Internet Archive collection: **https://archive-it.org/collections/9148**

HathiTrust DSDP digital collection: **https://babel.hathitrust.org/cgi/mb?a=listis&c=1930557976**

HathiTrust ODP digital collection: **https://babel.hathitrust.org/cgi/mb?a=listis&c=1868324439**

DSDP volumes: **http://www.deepseadrilling.org/**

ODP volumes: **http://www-odp.tamu.edu/publications/**

ODP Legacy site: **http://odplegacy.org**