International Ocean Discovery Program Expedition 395 Scientific Prospectus Addendum

Reykjanes Mantle Convection and Climate: Mantle Dynamics, Paleoceanography and Climate Evolution in the North Atlantic Ocean

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Abstract

The intersection between the Mid-Atlantic Ridge and Iceland hotspot provides a natural laboratory where the composition and dynamics of Earth's upper mantle can be observed. Plume-ridge interaction drives variations in the melting regime, which result in a range of crustal types, including a series of V-shaped ridges and V-shaped troughs south of Iceland. Expedition 395 has three objectives: (1) to test contrasting hypotheses for the formation of V-shaped ridges, (2) to understand temporal changes in ocean circulation and explore connections with plume activity, and (3) to reconstruct the evolving chemistry of hydrothermal fluids with increasing crustal age and varying sediment thickness and crustal architecture. After being postponed from summer 2020 due to the COVID-19 pandemic, the drilling objectives of Expedition 395 were partially completed without a science party on board during Expedition 395C in summer 2021, when basalt cores were collected at four sites (U1554, U1555, U1562, and U1563). Sediment cores were collected from these sites, as well as from Site U1564, and casing was installed to 602 meters below seafloor at Site U1554. Expedition 395 is scheduled with sufficient time to complete the planned operations remaining at Sites U1564 and U1554, leaving approximately 22 operating days available for other sites, including a new proposed site, REYK-14B, which is located west of Reykjanes Ridge on the Eirik drift. This addendum provides the operations plan for rescheduled Expedition 395, including details of the additional site.

Plain language summary

In the North Atlantic Ocean, hot rocks are thought to rise up beneath Iceland from deep within Earth's interior, called the mantle, forming a giant mantle plume. This plume likely plays a key role in shaping the ocean crust around Iceland, including a pattern of distinctive crustal V-shaped ridges (highs) and V-shaped troughs (lows) that stretch over hundreds of kilometers on the seabed south of Iceland. Some think that these V-shaped ridges are generated by increases and decreases in plume activity, but their precise origin is hotly debated. Plume activity variations may also have contributed to changes in the height of oceanic gateways—passages that link Greenland, Iceland, and Scotland, thus controlling the amount of cold, deep water that has been flowing from the Norwegian Sea to the Atlantic Ocean over the past few million years. Expedition 395 will use the age, composition, and history of sediments and basaltic rocks south of Iceland to test several scientific ideas. First scheduled for summer 2020, the objectives of Expedition 395 were partially completed in summer 2021 during Expedition 395C without a science party on board. The remaining objectives are to be completed in summer 2023 during the rescheduled Expedition 395. This addendum details the updated operations plan for Expedition 395, which includes an additional site, REYK-14B, that targets sediments on the eastern margin of Greenland.

1. Schedule for Expedition 395

International Ocean Discovery Program (IODP) Expedition 395 is based on IODP drilling Proposal 892-Full2 and Addendum 892-Add (available at **https://iodp.tamu.edu/scienceops/expeditions/reykjanes_mantle_convection_and_climate.html**). Following evaluation by the IODP Scientific Advisory Structure, the expedition was scheduled for the research vessel (R/V) *JOIDES Resolution*, operating under contract with the *JOIDES Resolution* Science Operator (JRSO). At the time of publication of this *Scientific Prospectus* addendum, the expedition is scheduled to start in Ponta Delgada, Portugal, on 12 June 2023 and to end in Reykjavik, Iceland, on 12 August. A total of 56 days will be available for the transit, drilling, coring, and downhole measurements described in this report (for the current detailed schedule, see **https://iodp.tamu.edu/scienceops**). Further details about the facilities aboard *JOIDES Resolution* can be found at **https://iodp.tamu.edu/labs/index.html**.

2. Introduction

The objectives of Expedition 395 are to (1) investigate temporal variations in ocean crust generation at the Reykjanes Ridge and test hypotheses for the influence of Iceland mantle plume fluctuations on these processes; (2) analyze sedimentation rates at the Björn, Gardar, and Eirik contourite drifts as proxies for Cenozoic variations of North Atlantic deepwater circulation and for uplift and subsidence of the Greenland-Scotland Ridge gateway related to plume activity; and (3) analyze the alteration of oceanic crust and its interaction with seawater and sediments (Parnell-Turner et al., 2020). Expedition 395 consists of three phases of drilling, necessitated by the COVID-19 pandemic. The first phase of drilling occurred during Expedition 384 in 2020, followed by coring and logging operations during Expedition 395C in 2021. The final phase of operations will take place during Expedition 395 in June–August 2023. As a result of the operations that took place during Expeditions 384 and 395C, a majority of the original Expedition 395 operations plan has been completed. The revised operations plan for Expedition 395 will include finishing operations at two of the initial primary sites, U1554 and U1564, both located on sediment drifts. To fill the remaining time and further advance the expedition's scientific objectives, a new site, REYK-14B, has been added to the primary operations plan. Site REYK-14B is located on the western side of Reykjanes Ridge off the coast of Greenland on the Eirik drift (Figure **F1**). The sedimentary record obtained at Site REYK-14B will provide additional information on the evolution of North Atlantic deepwater currents, their relation to plume activity, and the onset of deposition of contourite drift packages on the opposite side of the Mid-Atlantic Ridge.

2.1. Expedition 384: Engineering Testing

Expedition 395 was first postponed in May 2020 due to the COVID-19 pandemic. The *JOIDES Resolution* Facility Board (JRFB) scheduled Expedition 384: Engineering Testing for 20 July through 24 August 2020 in its place. The primary objective of Expedition 384 was to carry out engineering tests with the goal of improving the chances of success in deep (>1 km) drilling and coring in igneous ocean crust. The operations plan included drilling in basalt to test three different types of drill bits. A secondary objective was later added to evaluate the magnetic orientation tools, which had been providing incorrect measurements.

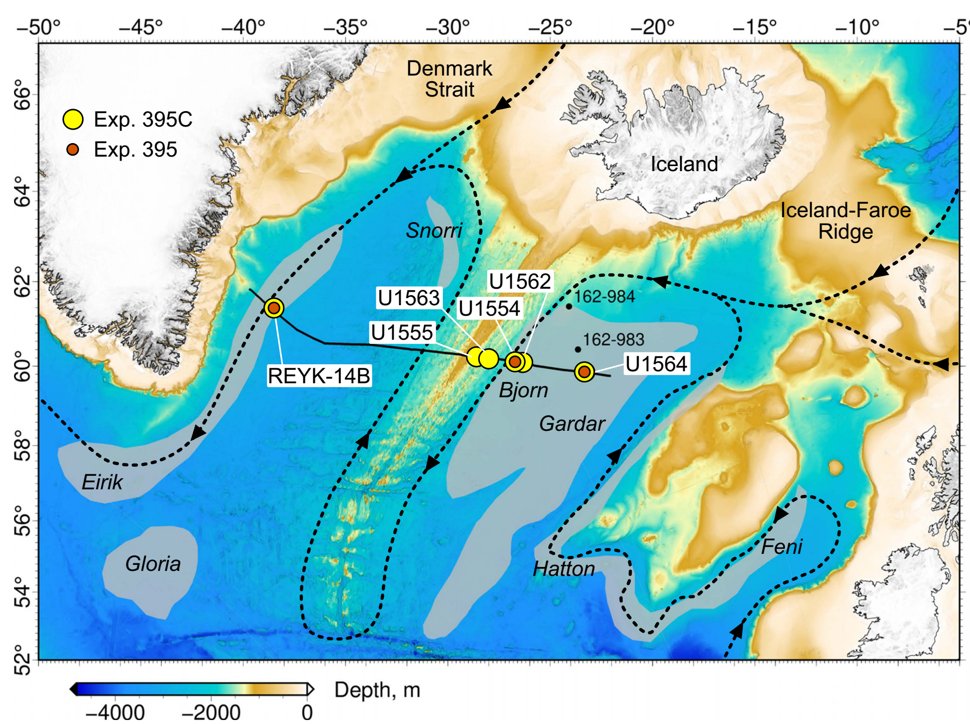

Figure F1. Bathymetry, deepwater currents (dashed lines), contourite drifts (gray shading), Seismic Profile JC50-1 (solid line), and Expedition 395 and 395C sites.

Expedition 384 operated at Expedition 395 primary localities that are located in international waters. During the expedition, the crew cored 130 m into the basement at Site U1555 and cored three holes to ~75 meters below seafloor (mbsf) at Site U1554 and produced a splice (Blum et al., 2020) (Figure **F2**). All cored materials from Expedition 384 are associated with Expedition 395.

2.2. Expedition 395C: Reykjanes Mantle Convection and Climate: Crustal Objectives

Expedition 395 was postponed for a second time in March 2021 due to pandemic safety concerns. Expedition 395C was scheduled by the JRFB in its place with the goal of advancing the basement, or crustal, objectives of Expedition 395 with only JRSO staff aboard the ship. The JRSO staff members were responsible for processing all of the core and running laboratory equipment. Expedition 395C took place 6 June through 6 August 2021 and the five primary sites proposed for Expedition 395 were drilled, cored, and logged (Parnell-Turner et al., 2022). The operations plan, shipboard measurements, and core sampling were adjusted to account for the absence of a sailing science party.

During Expedition 395C, basalt cores were collected at four sites (U1554, U1555, U1562, and U1563). Sediment cores were collected from these sites, as well as from Site U1564, and casing was installed to 602 mbsf at Site U1554 (Figure **F2**). The recovered cores, their preliminary descriptions, and the analyses of shipboard samples show that the results of Expedition 395C will fulfill a significant part of the Expedition 395 objectives. In total, 2444 m of sediment and basalt were recovered. Basalts were collected from two V-shaped ridge (Sites U1554 and U1555) and V-shaped trough (Sites U1562 and U1563) pairs, which will allow investigation of the variability in mantle source and temperature causing this ridge/trough pattern. Basalt cores span an expected age range of 2.8–13.9 Ma, which will allow us to investigate the hydrothermal weathering processes. Sediments from the Björn drift (Site U1554) were cored to the basement, along with the upper 600 m of sediments from the Gardar drift (Site U1564). The data provided by Expedition 395C are a major advancement in achieving the work of Expedition 395. For a more detailed account of the operations, please refer to Parnell-Turner et al. (2022).

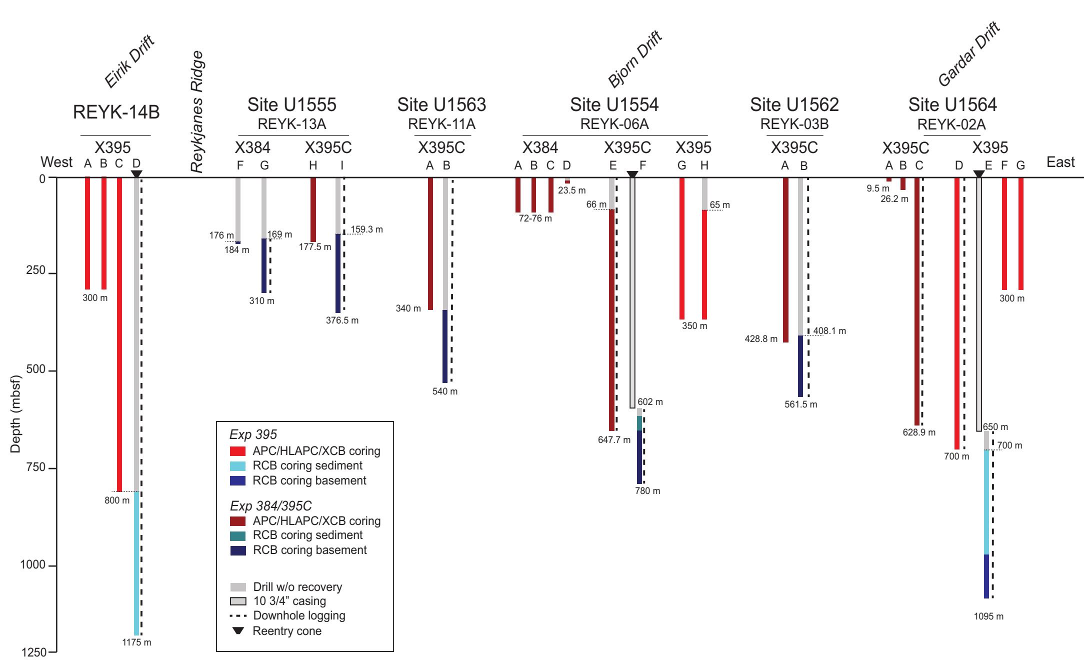

Figure F2. Summary of completed (Expeditions 384 and 395C) and planned (Expedition 395) operations for the Expedition 395 science plan.

3. Revised Expedition 395 operations plan

The Expedition 395 drilling and coring strategy is designed to complete the planned operations outlined in the Expedition 395 *Scientific Prospectus* (Parnell-Turner et al., 2020) and to maximize recovery of core material at three primary locations to meet the scientific objectives outlined above. With most of the basement operations complete, the focus will be on the paleoceanographic objectives. Operations will occur along an east–west oriented plate-spreading flowline on the eastern flank of Reykjanes Ridge, centered at ~60°N (Figure **F1**). Additionally, a new site, REYK-14B, was added on the western side of Reykjanes Ridge, coincident with the Eirik drift. Sediments at Sites U1554, U1564, and REYK-14B will be cored using a combination of the advanced piston corer (APC), extended core barrel (XCB), and rotary core barrel (RCB) systems to achieve our paleoceanographic objectives and are expected to be similar in composition to those recovered at Ocean Drilling Program (ODP) Sites 983 and 984. Dominant lithologies encountered at these sites were silty clay, clay, clayey nannofossil mixed sediment, and nannofossil ooze (Jansen and Raymo, 1996). Basalt will be cored at Site U1564 to 120 m into the basement, which will provide the final set of cores for addressing the basement objectives. Based upon results from Expeditions 395C and 384, oceanic basement is expected to consist of vesicular olivine basalt with flow units that are ~4 m thick on average. All holes are expected to be abandoned after Expedition 395 and will not be used for future basement experiments.

3.1. Primary drill sites

Expedition 395 consists of three primary sites and seven alternates (Tables **T1**, **T2**). Alternate sites were chosen to provide a range of options dependent on the desired scientific outcomes and/or

Table T1. Operations and time estimates for primary sites, Expedition 395.

Site	Location (Latitude Longitude)	Seafloor Depth (mbsl)	Operations	Transit (days)	Drilling and Coring (days)	Wireline Logging (days)
Ponta Delgada			Begin Expedition 5.0	port call days		
			Transit ~1350 nmi to Site U1564 (REYK-2A) @ 10.5 kt	5.4		
U1564 (REYK-2A)	59° 51.0360' N	2206	Hole U1564D - APC/HLAPC coring to 300 mbsf	0.0	2.0	0.0
EPSP approved	23° 15.9840' W		Hole U1564E - APC/HLAPC coring to 300 mbsf	0.0	1.5	0.0
to 1170 mbsf			Hole U1564F - APC/HLAPC/XCB to coring 700 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, and VSI	0.0	4.4	1.5
			Hole U1564G - Drill in 650 m of 10 3/4 inch casing	0.0	3.1	0.0
			Hole U1564G - Reenter Hole U1564G and drill without recovery to 675 mbsf; RCB coring to 1095 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	0.0	6.1	1.8
			Sub-Total Days On-Site: 20.5			
			Transit ~104 nmi to Site U1554 (REYK-6A) @ 10.5 kt	0.4		
U1554 (REYK-6A)	60° 7.5060' N	1871	Hole U1554G - APC/HLAPC coring to 350 mbsf	0.0	2.0	0.0
EPSP approved	26° 42.0960' W		Hole U1554H - APC/HLAPC coring to 350 mbsf	0.0	1.9	0.0
to 905 mbsf						
			Sub-Total Days On-Site: 3.9			
			Transit ~343 nmi to REYK-14B @ 10.5 kt	1.4		
REYK-14B	61° 11.7138' N	2829	Hole A - APC/HLAPC coring to 300 mbsf	0.0	2.2	0.0
EPSP approved	38° 10.8186' W		Hole B - APC/HLAPC coring to 300 mbsf	0.0	1.8	0.0
to 1376 mbsf			Hole C - APC/HLAPC/XCB coring to 800 mbsf	0.0	6.0	0.0
			Hole D - Drill without recovery to 800 mbsf; RCB coring to 1175 mbsf; deploy a freefall funnel for a bit change; downhole wireline logging with Triple Combo, FMS-Sonic, and VSI	0.0	8.5	2.2
			Sub-Total Days On-Site: 20.7			
			Transit ~482 nmi to Reykjavik @ 10.5 kt	1.9		
Reykjavik			End Expedition	9.0	39.6	5.5

Port Call Days:	5.0	Total Operating Days:	54.1
Days On-Site:	45.1	Total Expedition:	59.1

operational requirements that necessitate operations at an alternate site. Estimates of total sediment thickness at each site are based upon a combination of sonic velocities measured at Sites 983 and 984 and from seismic stacking velocities. Sites U1554 (proposed Site REYK-6A) and U1564 (proposed Site REYK-2B) are fully described in the Expedition 395 *Scientific Prospectus* (Parnell-Turner et al., 2020).

Table T2. Time estimates for alternate sites, Expedition 395.

Site	Location (Latitude Longitude)	Seafloor Depth (mbsl)	Operations	Drilling and Coring (days)	Wireline Logging (days)
REYK-1A	59° 50.9760' N	2209	Hole A - APC/HLAPC coring to 300 mbsf	2.0	0.0
EPSP approved	23° 14.8380' W		Hole B - APC/HLAPC coring to 300 mbsf	1.5	0.0
to 1155 mbsf			Hole C - APC/HLAPC/XCB coring to 955 mbsf; downhole wireline logging with the Triple Combo, FMS Sonic, and VSI	5.7	1.9
			Hole D - Drill in 650 m of 10 3/4 inch casing	3.1	0.0
			Hole D - Reenter Hole D and drill without recovery to 935 mbsf; RCB coring to 1085 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	5.3	1.4
			Sub-Total Days On-Site: 20.9		
REYK-4B	60° 6.0564' N	2109	Hole A - RCB coring to 545 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	5.4	1.4
EPSP approved	26° 27.6666' W				
to 615 mbsf			Sub-Total Days On-Site: 6.8		
REYK-5A	60° 7.5840' N	1894	Hole A - APC/HLAPC coring to 300 mbsf	1.9	0.0
EPSP approved	26° 45.0960' W		Hole B - APC/HLAPC coring to 300 mbsf	1.5	0.0
to 875 mbsf			Hole C - APC/HLAPC/XCB coring to 675 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, and VSI	3.7	1.5
			Hole D - Drill in 650 m of 10 3/4 inch casing	3.1	0.0
			Hole D - Reenter Hole D; RCB coring to 805 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	3.3	1.1
			Sub-Total Days On-Site: 16.1		
REYK-7A	60° 9.0420' N	1735	Hole A - RCB coring to 460 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	4.6	1.3
EPSP approved	27° 10.1880' W				
to 530 mbsf			Sub-Total Days On-Site: 5.9		
REYK-8A	60° 8.9460' N	1695	Hole A - RCB coring to 450 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	4.4	1.3
EPSP approved	27° 8.2200' W				
to 520 mbsf			Sub-Total Days On-Site: 5.7		
REYK-9A	60° 10.2120' N	1701	Hole A - RCB coring to 440 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, and UBI	4.4	1.3
EPSP approved	27° 31.7964' W				
to 510 mbsf			Sub-Total Days On-Site: 5.7		
REYK-10A	60° 10.0020' N	1689	Hole A - RCB coring to 285 mbsf; downhole wireline logging with the Triple Combo, FMS-Sonic, VSI, UBI	3.6	1.1
EPSP approved	27° 28.3560' W				
to 355 mbsf			Sub-Total Days On-Site: 4.7		

3.1.1. Site REYK-14B

Proposed Site REYK-14B is located west of Reykjanes Ridge, where a 1400 m thick section of the Eirik drift lies upon a 49 My old V-shaped ridge (Figure **F1**; Table **T3**). The sedimentary section at REYK-14B can be correlated to ODP Site 646 and Integrated Ocean Drilling Program Expedition 303 sites near Cape Farewell (Parnell-Turner et al., 2015), giving reasonable confidence in predictions of the age and thickness of the sedimentary section up to the regional R3/R4 reflection (7.4 Ma), which is thought to represent the onset of Eirik drift sedimentation (e.g., Mueller-Michaelis et al., 2013). This site will complement the two contourite drift sites from Expedition 395C (U1554 and U1564), allowing the history of drift sedimentation to be traced on both sides of Reykjanes Ridge.

The site has been chosen to obtain the most pristine, undisturbed sedimentary sequence and to avoid erosional features, faults, and seismic amplitude anomalies. Time constraints for Expedition 395 mean that we are most likely to be able to core to ~1175 mbsf, coincident with the interval below Reflection R5 and rocks of late Miocene age (~11 Ma; Tortonian). This site will directly address the Expedition 395 objectives, as follows:

1. The history of sedimentation of the Eirik drift from the proposed site will allow us to test ideas about the relationships between dynamic support from the Iceland plume, the opening and closing of oceanic gateways such as the Denmark Strait, and deepwater circulation (e.g., Mueller-Michaelis et al., 2013; Parnell-Turner et al., 2015; Wright and Miller, 1996). This record of sedimentation will be compared to sites on the Björn and Gardar drifts (U1554 and U1564, respectively) drilled during Expeditions 395/395C/384 and will allow a broad view of changes in ocean circulation on both sides of Reykjanes Ridge and indicate how this may relate to mantle-driven surface (gateway) uplift and subsidence.
2. Because Site REYK-14B is on relatively old ocean crust, drilling will allow us to penetrate to at least the upper Miocene (~7.4 Ma) and possibly into older sediments, depending on operational constraints (Table **T1**). Coring this section will allow us to better understand changes in the North Atlantic deepwater circulation in relation to plume activity on both sides of Reykjanes Ridge during warm climate conditions, a highly desirable outcome for Objective 2 of Proposal 892 that was not possible to achieve in the time frame of a single expedition.
3. The rapidly accumulated sedimentary section at the Eirik drift preserves detailed records of the evolution of the Greenland Ice Sheet, surrounding surface ocean conditions, and the Western Boundary Undercurrent, which is a major component of the Atlantic Meridional Overturning Circulation. This site has the potential to provide millennial-scale insight into ocean conditions, faunal responses and evolution, geomagnetic change, and potentially the evolution of nearby ice caps on Greenland and Iceland.
4. Drilling the Gardar, Björn, and Eirik contourite drifts will allow us to generate the first comprehensive record of southward- and northward-moving deepwater circulation in the North Atlantic Ocean. Drift sediments at these sites record far-field changes in deepwater supply

Table T3. Seismic reflections, ages, interval velocities (Vint), and predicted depths, proposed Site REYK-14B. See Figure AF1 for corresponding seismic image. Velocities and predicted depths obtained using parameters from Mueller-Michaelis et al. (2013) and Parnell-Turner et al. (2015). TWT = two-way traveltime.

Reflection	Age (Ma)	TWT (ms)	Vint (m/s)	Depth (mbsf)
Seabed	0	3651	1540	0
A1	0.8	3756	1540	81
A2	1.4	3830	1600	140
R1	2.5	3986	1650	269
EU	4.5	4100	1700	366
R2	5.6	4281	1800	529
R3	7.5	4488	2000	736
R4	8.1	4495	2000	743
R5	11	4737	2300	1021
A3	18	4918	2400	1238
Basement	49.8	5033	2400	1376

from the Norwegian Sea and will therefore provide insight into changes in the key oceanic gateways either side of Iceland (i.e., the Denmark Strait and the Iceland-Faroe Ridge).

3.2. Sediment coring strategy

All three primary sites (U1564, U1554, and REYK-14B) have primary paleoceanographic objectives that target the sedimentary sequences of the Gardar, Björn, and Eirik drifts, respectively. Additionally, Expedition 395 will complete the crustal objectives at Site U1564.

Site U1554 will be cored using the APC and half-length APC (HLAPC) systems at two holes until refusal (~350 mbsf). Presently, Site U1554 has a stratigraphic splice constructed from Expedition 384 Holes U1554A–U1554C to ~75 mbsf. The two Site U1554 holes cored during Expedition 395 will be used in addition to Expedition 395C Hole U1554E to extend the stratigraphic splice as far as possible into the Björn drift.

Cores were collected from one hole of Site U1564 on the Gardar drift during Expedition 395C. Hole U1564C was extended to 629 mbsf. Expedition 395 will core two additional holes using the APC/HLAPC system to ~300 mbsf or refusal. This will be followed by a third hole using the APC/HLAPC and XCB systems to 700 mbsf. A stratigraphic splice will be created using these four holes. To reach the lower sediments of the Gardar drift and core the basement basalts, a casing string to 650 mbsf and a reentry system will be deployed, followed by the RCB system. The sediment/basement interface is projected at 975 mbsf.

The cored sediments of the Eirik drift Site REYK-14B will be used to form a stratigraphic splice as deep as possible. The first two holes (A and B) will be APC/HLAPC cored to refusal (~300 mbsf), and the third hole (C) will be cored to ~800 mbsf using the APC/HLAPC/XCB systems. To obtain cores from as deep as possible within the Eirik drift, the final hole (D) will be drilled without recovery using the RCB system to the total depth of Hole C, followed by RCB coring until expedition time runs out.

APC, HLAPC, and RCB cores will be collected in nonmagnetic core barrels. XCB core barrels are composed of steel.

For more information on the coring tools, see **https://iodp.tamu.edu/tools**.

3.3. Basement coring strategy

Our basement objectives require recovery of samples from ~15 lava flow units to obtain a space- and time-averaged geochemical record of basalt composition. Our operations plan includes 120 m of basement penetration at Site U1564. This basement target depth is based on results from Expedition 395C, where basaltic flow units were typically 4 m thick, and hence 120 m would be sufficient to meet our objective of ~15 flow units with contingency. In addition, at Site U1555, where basement coring was extended to 200 m, no significant depth dependency in geochemical composition was detected, and 120 m is likely to be sufficient to capture any compositional variability in melt content.

We will deploy a single RCB bit, but a bit change may be required depending on the penetration rate. Based on the coring rates observed during Expeditions 384 and 395C, the operations plan estimate uses an expected penetration rate of 2 m/h. Because the holes will not be required for future use, the RCB drill bit will be dropped in the hole prior to wireline logging operations.

3.4. Logging/downhole measurements strategy

Wireline logging is planned for Sites U1564 and REYK-14B, and our operations are designed to log the entire length of the cored section. Downhole log data provide the only in situ formation characterization and are the only data in sections of the holes where core recovery is incomplete, allowing interpretations even in core gaps. The drill pipe will be set 80–100 m into the hole to prevent it from collapsing, precluding logging of the uppermost sediments. Four different tool strings will be deployed: the triple combination (triple combo), Formation MicroScanner (FMS)-sonic, Ultrasonic Borehole Imager (UBI), and Versatile Seismic Imager (VSI). The triple combo tool string will consist of tools that log formation resistivity, density, porosity, natural (spectral) gamma radiation, magnetic susceptibility, and borehole diameter. The FMS-sonic tool string will provide an oriented 360° resistivity image of the borehole wall and logs of formation acoustic velocity, natural gamma radiation, and borehole diameter. The UBI provides high-resolution images with 100% borehole wall coverage, allowing detection of small-scale fractures and complex formation contacts. The General Purpose Inclinometry Tool (GPIT) will be deployed with the UBI to allow orientation of the images. The UBI will be deployed in the basement section at Site U1564. A check shot survey with the VSI tool string is also planned for all site locations to allow depth-to-traveltime conversion. A combination of sonic velocity and density data will be used to generate a synthetic seismic profile at each site, thus enabling lithostratigraphy to be tied to seismic stratigraphy, which will extend the knowledge gained from the cores over a much broader area. The VSI can only be run during daylight hours to enable the observation of marine mammals.

The downhole logging strategy differs for each site. At Site U1564, Hole U1564F will be logged to the total penetration depth (~700 m) using the triple combo tool string with the Magnetic Susceptibility Sonde (MSS), FMS-sonic, and VSI (Table **T1**). After completing coring operations in Hole U1564G, logging will take place from the base of the casing string (~650 m) to the total penetration depth of 1095 mbsf. All four tool strings will be deployed, including the UBI. The final hole at Site REYK-14B will be logged with the triple combo, FMS-sonic, and VSI tool strings to the total depth. For more information on the downhole logging tools, see **https://iodp.tamu.edu/tools/logging**.

Temperature formation measurements will be conducted using the third-generation advanced piston corer temperature (APCT-3) tool. This tool is housed in an APC cutting shoe and is deployed with the APC core barrel. The APCT-3 tool is only used in soft sediments.

Core orientation will be measured on all APC cores using the Icefield MI-5 core orientation tool. The Icefield MI-5 collects azimuth, inclination, toolface gravity, toolface magnetism, total magnetic field strength, magnetic dip angle, and probe temperature.

4. Risks and contingencies

Our priority is to recover basalt samples from ~15 flow units in the basement at Site U1564, sample the sediment/basement interface at Site U1564, core sediments from all three drift sites to form a complete stratigraphic splice, and sample sediments from deep within the Eirik drift. These objectives will require flexibility in our operational plans to counter any unexpected eventualities.

Sea-surface conditions, even in the boreal summer, can be unsettled in the North Atlantic Ocean. Therefore, the greatest risk to the expedition is loss of time due to adverse weather conditions. Other risks to the completion of the program include operational problems like difficulties installing casing or stuck pipe; lower than predicted penetration rates, as was observed during Expedition 395C; or unstable borehole conditions. Hiatuses in the recovered sediments, which would result in incomplete recovery of paleoceanographic records, are considered a low risk because these were not encountered during Leg 162; however, there appear to be hiatus intervals at the base of the Björn drift at Site U1554.

Operational decisions for time allocation will be based on an assessment of the recovered sedimentary and basaltic samples and wireline data along with the ability to meet the primary science objectives. Options to reduce operations time include reducing downhole logging activities, reducing basement penetration at Site U1564, and reducing the depth of penetration in the final hole of Site REYK-14B.

5. Description of Expedition 384 and 395C cores

The cores retrieved from Expedition 395 sites during Expeditions 384 and 395C were described at the Gulf Coast Repository in May 2022. A 3 week long core description party was attended by most shipboard science party members and several students. During this time, they described all of the sedimentary and igneous cores, a total of over 2700 m of cored material. Additionally, samples were collected shipboard for shore-based biostratigraphy, which is ongoing.

Igneous samples for personal postcruise research were collected from Sites U1554, U1555, U1562, and U1563 in May 2022. Sedimentary samples from all five cored sites were sampled for postcruise research in December 2022 to January 2023. Additional personal samples will be collected at a shore-based sample party following Expedition 395 at the Bremen Core Repository in 2024.

All collected data and cores from Expeditions 384 and 395C fall under the Expedition 395 moratorium period.

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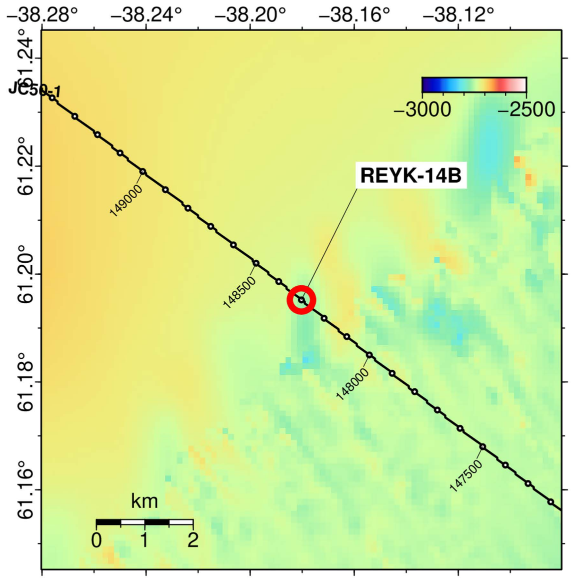
Site summary

Site REYK-14B

Figure AF1. Site summary figure, proposed Site REYK-14B. CMP = common midpoint.



Priority:	Primary
Position:	38°10.8186′W, 61°11.7138′N
Water depth (m):	2829
Target drilling depth (mbsf):	1175
Approved maximum penetration (mbsf):	1376
Survey coverage (track map; seismic profile):	CMP 148300 on JC50-1 (Figure AF1)
Objective(s):	Science Objectives: Oceanic Circulation, Gateways and Sedimentation This site will target the Eirik drift. Coring will extend past Reflector R5 (1021 m), ~11 Ma.
Coring program:	Holes A/B: APC/HLAPC coring to 300 mbsf or refusal; Hole C: APC/HLAPC/XCB to 800 mbsf; Hole D: drill without recovery to 800 mbsf, RCB coring to 1175 mbsf.
Downhole measurements program:	Downhole wireline logging using the triple combo, FMS-Sonic, and VSI in Hole D. APCT-3 temperature measurements in Hole A. Core orientation as needed.
Nature of rock anticipated:	Recent to late Miocene clay or ooze.