**IODP Expedition 395: Reykjanes Mantle Convection and Climate**

**Site U1564 Summary**

## Background and objectives

IODP Site U1564 (proposed Site REYK-2A) is located in the North Atlantic Ocean on the eastern flank of the Reykjanes Ridge, south of Iceland. Expedition 384, 395C, and 395 sites comprise a crustal flow line transect across the eastern flank of Reykjanes Ridge. Four sites, U1554, U1555, U1562, and U1563, sampled two pairs of the V-shaped ridges (VSR) and V-shaped troughs (VST) that straddle the flanks of the Reykjanes Ridge. Site U1564 is located on the same flow line, on crust with a segmented pattern that does not show evidence for VSR/VST. The estimated basement age at Site U1564 is 32.4 Ma based on magnetic anomalies and plate reconstructions. Basalt samples from this site will provide a record with which to compare samples from VST/VSR pairs, which will provide constraints on the formation of these crustal structures and on hydrothermal alteration of the crust with time.

Site U1564 is also located on Gardar drift, one of the major contourite drifts in the North Atlantic, which has the potential to provide high-resolution, millennial-scale records for paleoceanographic research. The sedimentation rate of this drift can serve as a proxy for deep water current strength, providing information on oceanic gateways and their potential ties to mantle plume pulses. ODP Site 983 was cored on Gardar drift, obtaining a sedimentary sequence back to 1.7 Ma (early Pleistocene). Cores at Site U1564 will extend this record back to the Oligocene epoch.

One main target for Site U1564 was to obtain basalt core from crust not showing traces of VST/VSR structures. Another main target was to obtain a continuous sedimentary record of the Gardar drift. Cores and data from this site will address all three of the primary science objectives: (1) crustal accretion and mantle behavior; (2) ocean circulation, gateways, and sedimentation; and (3) time-dependent hydrothermal alteration of oceanic crust. The operational objectives for this site were to core the sedimentary section using the advanced piston corer (APC), extended core barrel (XCB), and rotary core barrel (RCB) coring systems, install a reentry system with casing to 600 m drilling depth below seafloor (DSF), use the RCB to core ~130 m into the basement, and use downhole wireline tools to log the borehole.

## Operations

Site U1564 (proposed Site REYK-2A, 59°51.0366′N, 23°15.9858′W) consists of six holes drilled during Expeditions 395C and 395. These holes range in depth from 8.8 to 1169.7 m DSF. A total of 255 cores were recorded for Site U1564. These cores collected 1881.5 m of sediment and 114.2 m of basalt over a 2155.1 m cored interval (93% recovery).

The APC system was used to collect 65 cores over a 609.0 m interval with 636.1 m of core recovered (104% core recovery). The half-length APC (HLAPC) was deployed for 24 cores and recovered 117.76 m of sediment from a 112.8 m interval (104%). The XCB system was deployed over an 861.6 m long interval. The 51 XCB cores recovered 807.67 m of sediment (94%). The RCB system was deployed for 75 cores and recovered 434.15 m of sediment and basalt across a 571.7 m interval (76%). Downhole wireline logging operations using the triple combo, Formation MicroScanner (FMS)-sonic, and Ultrasonic Borehole Imager (UBI) logging tools took place at Holes U1564C and U1564F.

The total time spent at Site U1564 was 21.69 d across Expeditions 395C and 395.

## Expedition 395C

### *Hole U1564A*

The vessel arrived at Site U1564 at 1748 h on 30 July 2021. The thrusters were lowered, the ship entered dynamic positioning (DP) mode, and the drill string was made up with an APC/XCB bottom-hole assembly (BHA). The drill string was run to a depth of 2220.0 m below sea level (mbsl) to spud Hole U1564A (59°51.0377′N, 23°16.0071′W), ~20 m west of the site coordinates. The exact site coordinates were to be reserved for future reentry system and casing installation during Expedition 395. Hole U1564A was initiated at 0245 h on 31 July and Core U1564A-1H recovered a full core (9.89 m), prohibiting the establishment of the seafloor depth.

### *Hole U1564B*

The ship was offset 20 m to the east—unintentionally locating the ship directly over the site coordinates—and Hole U1564B (59°51.0372′N, 23°15.9868′W) was spudded at 0342 h on 31 July. Core U1564B-1H recovered 7.22 m of sediment, placing the seafloor at 2207.9 mbsl. Coring continued through Core 3H when the error in the ship's offset was noted and operations at Hole U1564B were terminated. The bit cleared the seafloor at 0630 h, ending Hole U1564B. A total of 26.81 m of core was collected over a 26.2 m cored interval (102% recovery).

### *Hole U1564C*

The ship was offset 20 m west, over the Hole U1564A coordinates, and Hole U1564C (59°51.0374′N, 23°16.0087′W) was spudded at 0707 h on 31 July. The seafloor depth was calculated at 2208.1 mbsl, based on the recovery of Core U1564C-1H (7.02 m). Coring continued with the APC system recovering Cores 2H to 17H (7.0–159.0 m DSF). APC refusal was reached and HLAPC Cores 18F to 35F advanced from 159.0 to 243.6 m DSF. XCB cores 36X to 75X were collected to a depth of 628.9 m DSF. Following Core 75X, the crew began pulling up the drill string in preparation for downhole logging operations using the triple combo tool.

The drill pipe was raised until the bit was at 80.6 m DSF. The triple combo logging tool string was made up, and at 0250 h on 4 August, the tool string was deployed. The triple combo made two passes of the borehole, was recovered at 0930 h, and broken down. The FMS-sonic tool string was made up, deployed to the base of the hole, and made a single pass imaging the borehole wall. The downhole logging equipment was put away and the logging tools were moved to the helideck. The rig floor crew began pulling up the pipe, with the bit clearing the seafloor at 1845 h. At 0106 h on 5 August 2021, the ship switched from DP to cruise mode, ending Site U1564. The ship began the 293 nmi transit to Reykjavík, Iceland. In all, 618.71 m of core was recovered from Hole U1564C (98.4%).

**Expedition 395**

*Hole U1564D*

Following a 1349.5 nmi voyage from Ponta Delgada, Portugal, at an average speed of 11.2 kt, the vessel arrived onsite at 1424 h on 21 June 2023. The thrusters were lowered and secured at 1456 h on 21 June and the ship was fully in DP mode at 1502 h. Hole U1564D (59°51.0483′N, 23°16.0080′W; 2208.2 mbsl) was spudded at 0500 h on 22 June with the first core on deck at 0530 h.

APC coring advanced from Core U1564D-1H through 22H (0–209.0 m DSF), with 218.87 m of core recovered (105%). APC refusal was reached at Core 22H, which was drilled over with the drill bit to recover the core barrel. The HLAPC system was deployed for Cores 23F to 29F (209.0–239.2 m DSF). The stratigraphic correlators requested a 2 m drilled interval (26-1), from 223.2 to 225.2 m DSF, to offset coring gaps. The XCB system using a polycrystalline diamond compact (PDC) bit and cutting shoe was deployed. XCB coring advanced from Core 30X to 74X (239.2–657.3 m DSF). The rate of penetration (ROP) slowed and recovery in the final three cores (72X–74X) was lower than the rest of the hole (33%) due to the water jets in the cutting shoe getting clogged with sediment. The hole was terminated at a final depth of 657.3 m DSF. A total of 73 cores were collected in Hole U1564D over a 655.3 m interval, recovering 632.42 m of core (97%).

The drill pipe was pulled out of the hole, with the bit clearing the seafloor at 2015 h on 25 June, ending Hole U1564D. In all, 632.42 m of core was recovered (97%).

*Hole U1564E*

The vessel was offset 20 m east and Hole U1564E (59°51.0485′N, 23°15.9876′W) was spudded at 2306 h on 25 June. Core U1564E-1H recovered a 5.8 m mudline core, establishing a seafloor depth of 2207.3 mbsl. Coring continued from 5.8 to 205.3 m DSF with Cores U1564E-1H to 22H. Cores 23X to 28X extended the hole to 263.5 m DSF. Following Core 28X, the decision

was made to end the hole. A total of 273.7 m of sediment was recovered from the 263.5 m cored interval at Hole U1564E (104%).

At 0030 h on 27 June, the drill bit cleared the seafloor, and at 0545 h, the bit cleared the rig floor. At 0640 h, the ship was secured for transit. The thrusters were raised and the transit to Site U1554 began at 0700 h, ending Hole U1564E. In all, 273.7 m of core was recovered from Hole U1564E (104%).

*Hole U1564F*

The vessel completed the 448 nmi transit from Site U1602 to Site U1564 at 2030 h on 25 July. The thrusters were lowered and the ship was put into DP mode at 2106 h, resuming operations at Site U1564.

The rig crew made up the hydraulic release tool (HRT) casing running stand. The weather was forecasted to deteriorate throughout the day with ~5 m heave, preventing the assembly of the casing and reentry system. The vessel began waiting on weather (WOW) at 0200 h on 26 July.

At 1500 h on 26 July, the Icelandic Coast Guard offshore patrol vessel *Þór* (*Thor*) arrived to deliver Schlumberger severing charges, other supplies, and fresh produce. After waiting nearly 2 h, the transfer was postponed due to weather. *Thor* returned the next day at 0823 h. *Thor* pulled alongside the vessel and the portside aft crane was used to transfer six pallets onto the helideck starting at 0902 h. By 0919 h, the transfer was complete, and *Thor* departed at 0925 h.

The rig crew began preparing for the casing installation operations on 27 July, immediately following the departure of *Thor*. The casing and reentry system was assembled. At 1200 h on 28 July, the moonpool doors were opened and the reentry system was lowered below the ship. The rig crew began making up the drill string to a depth of 2180 mbsl. The subsea camera system, along with Niskin water samplers and the Conductivity-Temperature-Depth (CTD) tool, was deployed at 1730 h. The top drive was picked up and the bit spaced out to initiate Hole U1564F at 2125 h on 28 July. The casing string was drilled to 550 m DSF and the bit advanced to 553.5 m DSF. The go-devil was pumped down the pipe to release the casing stinger from the reentry system. The vibration isolated television (VIT) camera system was retrieved, and the drill string was pulled to surface. The bit cleared the seafloor at 1440 h on 29 July and the rig floor at 2230 h.

After breaking down the reentry equipment, the RCB BHA was made up with a C-4 drill bit. The drill pipe was run to a depth of 1598.7 mbsl. The VIT camera system with the CTD recorder and two attached Niskin bottles were deployed through the moonpool at 0845 h on 30 July. The drill string continued to be lowered to several meters above the seafloor. The reentry cone for Hole U1564F was found and the bit reentered the hole at 1052 h on 30 July. The subsea camera was recovered while the drill string was lowered to the base of the hole and the top drive picked up. The center bit was deployed, and the hole was conditioned with 20 barrels of high viscosity mud.

The hole was advanced without recovery from 553.4 to 598.0 m DSF. The center bit was retrieved and an RCB core barrel deployed.

Cores U1564F-2R to 43R (598.0–995.8 m DSF) were recovered and Core 4R had no recovery.

The basaltic basement was reached at ~997.2 m DSF within Core 44R. This core recovered 7.03 m of material (74%), including 1.43 m of sediment and the remainder basalt. Coring continued with Cores 45R to 49R (1005.3–1039.2 m DSF). Beginning with Core 46R, all cores were half advances (4.7 or 5.0 m), except for Core 48R.

Following Core U1564F-49R, the drill bit had reached 59.7 rotating h and the drill string was pulled out of the hole to change the bit. At 1640 h on 4 August, the bit cleared the seafloor, and the vessel was offset 20 m east of Hole U1564F. At 2030 h the bit cleared the rig floor. The drill pipe and BHA with a new RCB bit were run from the ship to near the seafloor for reentry into Hole U1564F. At 0315 h on 5 August, the VIT camera was deployed to guide the hole reentry. The bit was spaced out, and after nearly 2 h of searching for the reentry cone, the bit entered Hole U1564F at 0725 h. The drill pipe was run in the hole and the subsea camera retrieved. Coring resumed at 1115 h.

Cores U1564F-50R to 76R (1039.2–1169.7 m DSF) were retrieved. Hole U1564F was terminated at a final depth of 1169.7 m DSF. A total of 434.15 m of core was recovered from a 571.7 m interval (76%). The recovery within the basement section was high (66%), with 114.2 m of core recovered over 172.4 m. Two drilled intervals totaling 598.0 m were recorded.

Following the completion of coring operations, the hole was cleaned with a mud sweep. The drill pipe was pulled out of the hole. At 0215 h on 9 August, the subsea camera was deployed and descended to near the seafloor. The bit cleared the seafloor at 0325 h, and the vessel was offset 20 m from Hole U1564F. In preparation for logging, the mechanical bit release sleeve was activated, and the drill bit fell to the seafloor. The end of the drill pipe reentered Hole U1564F at 0625 h. The end of the pipe was positioned at 59.3 m DSF within the casing string for logging operations.

The triple combo tool string was rigged up and deployed to the base of the hole (1169.7 m DSF). On the upward pass, the Accelerator Porosity Sonde (APS) malfunctioned and porosity measurements were not collected. Following a complete pass of the hole, the triple combo was pulled to the rig floor and broken down. The FMS-sonic was made up and deployed in the hole. On the downward pass, the Dipole Sonic Imager (DSI) tool malfunctioned and was not used. Two passes of the borehole were successfully made with the FMS-sonic tool string. The UBI was run to a depth of 1164.7 m wireline depth below seafloor (WSF), 5 m above the base of the hole. The basement section was first logged at high resolution to test the image quality and because there was enough time in the expedition. The UBI was then lowered back to 1164.7 m WSF and the entire hole was logged at a lower resolution. The rig crew pulled the drill pipe out of the hole, with the bit clearing the seafloor at 1525 h on 10 August. The BHA was broken down and the end of the pipe reached the rig floor at 2130 h. The vessel was secured for transit,

and at 2206 h, the vessel was switched from DP to cruise mode, ending Site U1564. The thrusters were raised and the vessel began the 293 nmi transit to Reykjavík at 2230 h on 10 August.

*Transit and End of Expedition*

Following a 293 nmi transit, the vessel reached the pilot station and the pilot boarded at 0705 h on 12 August. The *JOIDES Resolution* came into Skarfabakki Harbour in Reykjavík, Iceland. The first line ashore at Vatnagardsbakki Berth was at 0812 h, marking the end of Expedition 395.

## Principal Results

*Sedimentology*

The Holocene to early Oligocene sediments cored at Site U1564 are primarily composed of silty clay, silty clay/claystone with nannofossils, nannofossil silty clay/claystone, and nannofossil chalk with silty clay. Based primarily on lithological observations and sediment composition, alongside natural gamma radiation (NGR) and calcium carbonate ($CaCO_3$) measurements, Site U1564 is divided into two major lithostratigraphic, Units I and II. Each unit is further subdivided into three subunits.

Within Unit I, Subunit IA is dominated by gray silty clay, with a variable but generally minor biogenic component. The biogenic component is dominated by nannofossils, while foraminifers and siliceous microfossils are also observed. $CaCO_3$ wt% is variable in this subunit. Several prominent glass layers are present, dark green banding is observed throughout, and some sharp contacts are observed intermittently. Subunit IB is similarly dominated by gray silty clay and silty clay with biogenics. In addition to thin glass layers and intermittent sharp contacts, pyritization of burrows and halos around burrows are observed. Subunit IC is dominated by dark gray silty clay; this subunit contains the least biogenic carbonate of all units in Site U1564 (supported by smear slide analysis and $CaCO_3$ wt%).

Unit II is marked by an increase in carbonate content and a transition to nannofossil chalk with silty clay. Within this unit, glass layers, sharp contacts, and dark banding continue to be present. Fractures with slickensides and/or calcite veins, and soft sediment deformation features are also observed. Subunit IIA is dominated by dark gray silty clay with nannofossils interbedded with nannofossil chalk. There is a significant increase in the variability of both biogenic carbonate and $CaCO_3$ wt%, coinciding with cyclical color grading of sediment beds. Subunit IIB is dominated by greenish gray nannofossil chalk and dark gray silty nannofossil chalk. Subunit IIC is dominated by gray nannofossil chalk with silty clay, with some intervals of silty nannofossil chalk. Near the base of the sedimentary sequence, red and pink nannofossil chalks become interbedded. Evidence for hydrothermal mineralization is observed.

*Igneous Petrology*

Site U1564 is the oldest oceanic crust drilled during this expedition (~32.3 Ma) with a water depth of 2206 m. It is located in faulted abyssal hill topography that formed when the ridge axis was segmented by a series of transform offsets. The sediment/basement interface was encountered at a depth of 997 m below seafloor (mbsf). Basement was drilled to a depth of 1170 m core depth below seafloor, Method A (CSF-A) at Hole U1564F, penetrating 172.4 m of basalt, of which 114.2 m of core was recovered, resulting in a recovery rate of 66%. The bulk of this core consists of continuous sheet flows that are moderately to highly altered, with sparsely plagioclase phyric basalt and occasional clinopyroxene microphenocrysts. The fine- to medium-grained groundmass consists of plagioclase, clinopyroxene, and opaque minerals. A 4 m thick dusky red sediment layer was encountered at ~1050 m CSF-A. Within the bottom ~40 m of the cored section, pillow lavas become more abundant, with chilled margins and occasional glassy rinds. Throughout the hole, sediment-filled fractures and complex anastomosing calcite-filled veins are common. Alteration minerals mostly consist of celadonite, calcite, iron oxides, and assorted clay minerals.

*Alteration Petrology*

The majority of basalt core recovered from Site U1564 is completely or highly altered. Alteration is dominantly pervasive though localized alteration, mainly in the form of fracture halos, and occurs throughout the basalts. Alteration intensity is observed to be slightly higher in sheet flows than in pillow lavas. The basalt alteration assemblage is Fe-oxide/oxyhydroxides + celadonite + clay with minor, localized chlorite. Vesicles are dominantly filled with celadonite, calcite, Fe-oxide/oxyhydroxides, some saponite, and minor zeolite. Vesicle fills are commonly mineralogically zoned with multiple minerals in each. Fracture density in Hole U1564F is ~23 fractures per m and increases gradually with depth. Fractures are dominantly <1 mm wide and occur mostly within complex cross-cutting networks. Fractures up to 3.4 cm wide are more common in the upper intervals of basalt. Fracture mineral fills are dominantly carbonate ± Fe-oxide/oxyhydroxide ± celadonite with minor clay. Chlorite fracture fill occurs in specific intervals, and quartz is sporadically observed as a late fill in some mineralogically layered fractures. Fracture alteration halos can be >15 cm wide, and are red, brown, green-gray, to green-brown in color.

*Micropaleontology*

At Site U1564, a 997.23 m long interval of lower Oligocene to upper Pleistocene sediments was recovered across multiple holes. Planktonic foraminifers are common to dominant in most samples examined, except where quartz grains and rock fragments predominate, and their preservation is very good to excellent down to ~530 m CSF-A. Below that level the sediment becomes progressively more lithified, and the foraminifers are mostly infilled by calcite, although they continue having moderate to good preservation up to ~800 m CSF-A. Seven early Pliocene to Pleistocene biohorizons, three Miocene biohorizons, and two Oligocene biohorizons were recorded. The last sample of the regular succession above basement has an assemblage that

indicates a lower Oligocene age (32.2–27.29 Ma), while the assemblage within the sedimentary layer recovered between the basement succession points to an age between 33.8 and 32.2 Ma.

Similar to the planktonic foraminifers, calcareous nannofossils are present in almost all samples examined, ranging from few to dominant in abundance and with very good to poor preservation. Preservation worsens with depth in the succession. Ten Pleistocene biohorizons, only one Pliocene biohorizon, and 11 Miocene biohorizons were identified spanning the interval between 5.53 and 17.65 Ma. Oligocene assemblages are present below ~920 m CSF-A, characterized by the presence of *Cyclicargolithus abisectus*, with the lower Oligocene biohorizon Top *Reticulofenestra umbilicus* at ~987 m CSF-A, constraining the base of the sedimentary succession to be older than 32.02 Ma.

*Physical Properties*

Physical properties measurements for Site U1564 consist of whole-round and half-round measurements on cores from Holes U1564B through U1564F. Physical properties measurements were also made on discrete samples from Holes U1564D, U1564E, and U1564F. Whole-round density measurements show an increase with depth, with marked increases at ~550, ~700, and ~1000 m CSF-A (the sediment/basement interface). Density measured on discrete samples is consistently higher than values obtained from whole-round sections, below ~700 m CSF-A. Whole-round and point magnetic susceptibility (MSP) measurements covary, showing meter- to decameter-scale fluctuations throughout the sedimentary section. Below 700 m CSF-A, magnetic susceptibility (MS) drops dramatically to values below 10 IU. *P*-wave velocities from whole-round measurements increase between 450 and 650 m CSF-A, below which the measurements were constrained to discrete caliper measurements because RCB cores do not fill the core liner, making whole-round measurements unreliable. Below 650 m CSF-A in the sediment interval, velocities increase from 2200 to 3000 m/s. Caliper-derived velocities in the basalts were measured on the orthogonal direction using the paleomagnetic cubes; these velocities vary between 3600 and 6000 m/s. Natural gamma radiation (NGR) measurements show an increase between 600 and 700 m CSF-A and then fluctuate between 700 to ~1000 m CSF-A. NGR is generally lower in the basaltic intervals. RGB, L*, and a* show meter- to decameter-scale variations with depth between 0 and 450 m CSF-A, below which the data display higher amplitude variability. RGB measurements have lower values in the basaltic intervals, averaging around ~50. L* shows lower values in the basalts, averaging round 40, while L* and b* display a similar range of values to the sediment intervals.

*Stratigraphic Correlation*

The stratigraphic splice for Site U1564 contains two long uninterrupted intervals that are complete, with a ~200 m long interval in between that has several gaps. A continuous splice was constructed using only Holes 395-U1564D and 395-U1564E to a depth of 239 m composite core depth below seafloor, method A (CCSF-A). The lowermost, continuous part of the Site U1564 shipboard splice was constructed using material from Holes 395C-U1564C and 395-U1564D

down to 674.71 m CCSF-A. Between these intervals, several gaps are unavoidable and cores from Holes 395C-U1564C, 395-U1564D, and 395-U1564E were positioned to our best judgement, with additional guidance from the downhole wireline MS logging profile from Hole 395C-U1564C.

*Paleomagnetism*

Natural remanent magnetization (NRM) was measured for sedimentary cores recovered from Holes U1564A, U1564B, U1564C, U1564D, U1564E, and U1564F. The cores from Holes U1564B, U1564C, and U1564E were then demagnetized with a stepwise alternating field (AF) cleaning protocol with a measurement resolution of 5 cm, and Holes U1564A, U1564D, and U1564F with a resolution of 2.5 cm. A set of about 150 discrete samples were collected to confirm the semicontinuous measurements. The inclinations measured at the demagnetization step of 20 mT from Holes U1564D and U1564F were used to interpret a downhole sequence of normal and reverse polarities. Cores U1564F-10R to 30R of the section half measurements and for all the discrete samples were used in the principal component analysis for interpreting the paleomagnetic signal. The change in lithology below about 750 m CSF-A corresponds to a decrease of the NRM intensity and the MS, together with the deterioration quality of the paleomagnetic signal. Below 997 m CSF-A, the sediment/basement interface in Hole U1564F, between Sections U1564F-44R-1A and 44R-2A, marks a three-fold increase in the intensity of the NRM and MS, but the alteration of the basement rocks causes a deterioration of the paleomagnetic signal. Hence, between about 760 m CSF-A and the bottom of the hole, the paleomagnetic inclinations were not suitable for a univocal magnetostratigraphic interpretation. Magnetic polarities from Holes U1564D and U1564F were correlated with the geomagnetic polarity timescale (GPTS) chrons to establish an age-depth trend for Site U1564.

*Geochemistry*

Cores collected from Site U1564 were analyzed for headspace gas, interstitial water (IW) chemistry, and bulk sediment geochemistry. Headspace gas analyses were conducted at Holes U1564A, U1564B, U1564C, U1564D, and U1564F; methane concentrations are variable and range from 0 to ~1,260 ppmv. Ethane, at concentrations lower than 94.6 ppmv, was present in Holes U1564C, U1564D, and U1564F below a depth of 510.31 m CSF-A.

Material from Holes U1564D, U1564E, and U1564F was analyzed for IW chemistry and bulk sediment geochemistry. Calcium ion ($Ca^{2+}$) concentrations generally increase, while magnesium ion ($Mg^{2+}$) concentrations decrease with depth. Sulfate ion ($SO_4^{2-}$) concentrations decrease from seawater-like values at the top of the sediment column <1 mM at 173.87 m CSF-A, with a small increase in concentration below 607.12 m CSF-A. Calcium carbonate ($CaCO_3$) wt% generally increases downhole, trending from an average of 13.3% ± 9.6% through Sample U1564D-52X-2, 141–151 cm (442.31 m CSF-A) to an average of 35.4% ± 20.6% for the remaining sediment samples to the sediment/basement interface. Bulk sediment generally has low total organic carbon (TOC), total nitrogen (TN), and total sulfur (TS) content.

*Downhole Logging*

After coring operations concluded at Holes U1564C and U1564F, the holes were cleaned with a mud sweep and the drilling mud was displaced with seawater before logging operations started. During Expedition 395C, Hole U1564C was logged with the triple combo and the FMS-sonic tool strings from the seafloor to ~630 m WSF. During Expedition 395, Hole U1564F was logged from ~550 to 1160 m WSF to allow for some data overlap with Hole U1564C. For Site U1564, six logging units have been identified from first order variations in the wireline measurements, predominantly using observable changes in the NGR log, and in places using other logs such as resistivity, MS, and density. Logging Subunit 1a encompasses data collected through the drill pipe while Logging Subunit 1b records the open hole logging responses of Logging Unit 1. Logging Unit 1 is defined by NGR measurement of 19 ± 3 gAPI and densities ranging between 1.2 and 1.6 g/cm$^3$. Logging Unit 2 (L2, 108–318 m WSF) is defined by an increase in NGR to an average value around 21 ± 3 gAPI, a spectral gamma log that shows several large district peaks in thorium counts, and an increase in MS (average of 117 ± 45 SI), the latter of which increasingly fluctuates with depth. Logging Unit 3 is marked by a decrease in gamma radiation, and gradually increasing $V_P$ and $V_S$. This unit is subdivided into two subunits based on changes in the frequency of fluctuations observed in the MS. A large distinct peak in NGR uranium content at ~529 m WSF is observed within Logging Subunit 3b. Logging Unit 4 (L4, 560–957 m WSF) is marked by an increase in gamma radiation, resistivity, MS, and density. This logging unit contains three subunits defined by variations in gamma radiation. Logging Unit 5 is marked by a large spike in NGR as well as an increase in resistivity and density. Logging Unit 6 marks the transition from sediment to basaltic basement with a decrease in NGR and thorium counts in the spectral gamma log, and large increases in resistivity and density. Hole U1564C FMS images are of good quality, and alternating conductive and resistive bedding features can be observed. FMS and UBI images in the sediment and basement lithologies of Hole U1564F are also of good quality and show multiple sedimentary and structural geology features.

*Age Model*

The age model is based mainly on a combination of paleomagnetic and biostratigraphic age determinations from Holes U1564D and U1564F, with additional biostratigraphic constraints from Hole U1564C. Fourteen tie points were selected that divide the stratigraphy into a series of intervals characterized by significantly different sedimentation rates, ranging from ~1.4 cm/ky to ~16.5 cm/ky. The age of the sediment in the lowermost part of the regular succession above igneous basement is lower Oligocene (between 32.02 Ma and 32.20 Ma). This finding is in good agreement with the age of basement anticipated from regional magnetic surveys at 32.4 Ma.