

IODP Expedition 398: Hellenic Arc Volcanic Field

Week 5 Report (8–14 January 2023)

During the fifth week of the International Ocean Discovery Program (IODP) Expedition 398, we drilled Hole U1591C in the Christiana Basin, Hole U1590B at the Kolumbo Volcano, and spudded Hole U1592A in the Anafi Basin.

Operations

Week 5 of the expedition began on 8 January 2023 with rotary core barrel (RCB) coring in Hole U1591C from Core U1591C-42R at 611.9 meters below seafloor (mbsf). Coring continued into 10 January to Core 71R at 902.9 mbsf, the final depth for Hole U1591C, when the decision was made to terminate coring in favor of other objectives.

At 1115 h on 10 January, the drill string was pulled up with the top drive from 892.5 mbsf to 834.7 mbsf, with the bit clearing the seafloor at 1400 h and the rotary table at 1550 h. All thrusters were up and secured at 1648 h, and the sea passage to Site U1590 (proposed Site CSK-03A) began, ending Site U1591.

At 1852 h, the vessel came onto location at Site U1590. The transit of 20.3 nmi was completed in 2.4 h, at an average speed of 8.5 kt. All thrusters were down and secured at 1912 h. The ship was switched to dynamic positioning (DP) control at 1924 h, marking the return to Site U1590. The vessel was offset 50 m northwest of Hole U1590A. An RCB bottom-hole assembly (BHA) was assembled and lowered to 373.9 meters below rig floor (mbrf). Hole U1590B was spudded at 0030 h on 11 January. The hole was drilled down without recovery to 93.0 mbsf. High torque was observed at 26.4 mbsf and 83.8 mbsf. At 0700 h, RCB coring started with Core U1590B-2R from 93.0 mbsf. As expected, the recovery was extremely low in the upper sections, but the decision to use RCB was made to reach the target depth. However, due to the low recovery and as a precaution, a bit deplugger (tool to clean any debris from the bit's opening) was run before dropping the barrel for Core 12R, with no noticeable effect on recovery. Coring continued through 12 January, with recovery being mostly very poor.

On 13 January, RCB coring at Hole U1590B was completed with Core 57R to 634.7 mbsf, the final depth for the hole. Coring was terminated in favor of other objectives at the remaining sites. The drill string was tripped up with the top drive from 634.7 mbsf to 546.5 mbsf. The bit cleared the rotary table at 0155 h on 14 January and the drill floor was secured at 0215 h. The vessel was out of DP mode and under bridge control at 0224 h. All thrusters were brought up and secured. The sea passage started at 0230 h, ending Site U1590. The ship arrived on location at 0356 h following a 15.5 nmi transit. All thrusters were down and secured at 0412 h, and the vessel switched to DP control at 0418 h.

The rig crew proceeded to assemble the advanced piston corer/extended core barrel (APC/XCB) BHA. Hole U1592A was spudded at 0830 h from 700 mbrf. The recovered core was 5.1 m, giving a calculated seafloor depth of 704.4 mbrf (693.1 mbsl). APC coring continued to Core U1592A-16H from 135.3 mbsf, but the last three cores had partial strokes. Coring was switched to the half-length advanced piston corer (HLAPC) with Core 17F.

The week ended at midnight on 14 January with the bit advanced to 179.8 mbsf following Core 25F.

Science Operations

All Expedition 398 laboratory groups worked on their Site U1591 reports and revised the Site U1590 reports.

Lithostratigraphy

The Sedimentology group described Cores U1591C-36R to 71R, U1590B-2R to 57R, and U1592A-1H to 26F.

Site U1591 was subdivided into three major lithofacies. All of Unit I (Cores U1591A-1H to 11H, and U1591B-1H to 18F) was described last week. Description of sediments from Unit II (Cores U1591B-21X to 43X, and U1591C-2R to 58R) began last week and continued into this week. Unit II is marked by lower amounts of volcanoclastic sediments, consisting mainly of nannofossil ooze, organic-rich ooze, with interspersed tuffaceous ooze, ash and lapilli-ash. Micrite, anhydrite, dolomite, and sandstone with rare lapilli mark Unit III (Cores U1591C-59R to 71R).

Hole U1590B suffered from relatively poor recovery without any significant recovery between Cores U1590B-2R and 17R. Core U1590B-18R marks the first recovered interval of Unit II. This unit extends from Core U1590B-18R to 57R and consists of nannofossil ooze, tuffaceous ooze, and mud with or without scoria.

The cores recovered this week in Hole U1592A consist mainly of mud, nannofossil ooze, organic-rich ooze, tuffaceous ooze, ash, and lapilli-ash.

Average core recovery was 58% in Hole U1591C, 14% in Hole U1590B, 43% in Hole U1591B, and 28% in Hole U1592A.

The main structures observed at Holes U1591C and U1590B are horizontal and subhorizontal bedding. In addition, several sediment slump deposits and faults were observed.

Biostratigraphy

The Biostratigraphy group analyzed 70 core catchers and multiple discrete (toothpick) samples from Holes U1591C, U1590B, and U1592A for planktic and benthic foraminifers, as well as

calcareous nanofossils. Biostratigraphic markers identify crucial individual ages that enable a precise age-depth correlation throughout the holes. Several shells of benthic and planktic foraminifers were imaged with the shipboard scanning electron microscope (SEM). A few selected specimens were also analyzed via the SEM's energy dispersive spectrometry (EDS) function. SEM pictures and EDS analyses revealed an infilling of pyrite (FeS_2) but also greigite (Fe_3O_4), the latter being the culprit behind the “ghost reversals” described in last week's paleomagnetism paragraph.

Paleomagnetism

The Paleomagnetism group continued to measure natural remanent magnetization (NRM) on archive half core sections from Holes U1591C and U1590B. In Hole U1591C the section measurements were accompanied by 119 discrete analyses and confirmed several Pliocene and Pleistocene magnetic reversals. The very low recovery of Hole U1590B made paleomagnetism measurements very difficult. Nevertheless, with the aid of ages provided by the Biostratigraphy group, the Paleomagnetism group could identify the major reversal from normal Brunhes polarization to the reversed Matuyama period.

Geochemistry

This week the Geochemistry group conducted 27 inductively coupled plasma–atomic emission spectroscopy (ICP-AES) measurements on Site U1591. In the same way as reported last week, the ratios of different trace elements such as Ba/Rb vs. Ba/Zr, Ba/Y vs. Zr/Rb, but also SiO_2 vs. $\text{Na}_2\text{O} + \text{K}_2\text{O}$ are used to link discrete volcanoclastic layers to eruptions and volcanic centers. Headspace samples indicated very low methane levels of less than 900 ppmv in Hole U1591C and none in Hole U1590B. Shipboard interstitial water (IW) and headspace sampling continues at all sites. IW samples show an increase in salinity of up to 80 PSU (twice that of local ambient seawater) that matches maxima in Cl, Na, K, Ca, Mg, and SO_4 . Measurements of total organic carbon (TOC) and carbonate (both wt%) helped to identify 17 units of sapropels and 20 sapropelitic units in Hole U1591.

Physical Properties

On all core sections from Hole U1591C and a few sections from Hole U1590B, the Physical Properties group measured gamma ray attenuation (GRA) bulk density and magnetic susceptibility (MS). *P*-wave velocity was not measured on whole rounds, as the RCB core sections did not fully fill the core liners, rendering *P*-wave measurements useless. Noticeably, bulk density, grain density, thermal conductivity, and discrete *P*-wave velocities—with 1,534 discrete measurements—increased significantly, while porosity decreased in intervals containing evaporites. Peaks in MS highlighted changes in the lithology to breccias, sandstones, and mudstones.

The intermittent recovery of sediments in Hole U1590B made the interpretation of any trends useless.

Stratigraphic Correlation

The Stratigraphic Correlation group focused on updating the seismic velocity models with shipboard *P*-wave velocity data. Thus far, most seismic models have placed the most important stratigraphic layers deeper than they were encountered during drilling. Thus, to generate a better understanding of seismic velocities and a more basin wide understanding, the group focused on a better correlation of drilled cores and seismic units.

Education and Outreach

This week we had four media interviews. Two were in Bellingham, Washington (KGMI Radio, audience 20,018) and the Bellingham Herald (audience 12,275) and should publish in the next few days. The other two were with Greek outlets: ERT TV, the national station in Greece, available in this region, and with Kathimerini, available all over Greece, with an audience of about 95,000. We also had nine live ship-to-shore tours, reaching about 650 students.

Across all our social media platforms we had 31,228 impressions, and an average engagement rate of 6.93%.

Technical Support and HSE Activities

Laboratory Activities

- Staff processed cores and samples from Holes U1591C, U1590B, and U1592A.
- Analyzed remaining radioactive tracer from Expedition 390 for decayed activity, and preparing it for shipment to Texas A&M University's environment and health services.
- Finished making 100 slide mounts for micropaleontology.
- Continued working on special purchases for Expedition 399.
- Reorganizing D-tubes.

IT Support Activities

- Set up a temporary serial server for the Echo Sounder system. We assisted technicians with troubleshooting communication issues between laptop and serial server.
- Devised, implemented, and currently testing an IT Problem Reporting system for end users.
- Working with shore personnel to address future challenges with upcoming Adobe Creative Cloud licensing changes.
- Applied monthly updates to all Windows computers where available.
- Discussing needs for a new Telemedicine system with Siem Offshore personnel.

Application Support Activities

- GEODESC: Moved forward on updates to the ship testing environment.
- OVERVIEW app was restored to full function in shipboard environment.

Health, Safety, and Environment

- Emergency shower and eye wash stations were tested.