

Weekly Report POS 510 (19.03.17-26.03.17)

The week of 19.03.17-26.03.17 was devoted to completion of the regional surveys of the Anydros-Anafi-Amorgos basins. Greatly improved weather meant that all objectives were met in less than the anticipated time. Highlights were i) completion of the multibeam AUV survey of the Kolumbo volcano, the Kolumbo-Santorini Line, and the more distant surroundings of Kolumbo; ii) a gravity coring and heat flow survey of the Anafi and Amorgos basins and adjacent to the large Santorini-Amorgos Fault; iii) location of positive heat flow anomalies at two stations along the northern cones of the Kolumbo Line and recovery of sulfidic mud in cores from one of the cones; iv) completion of the gravity coring and heat flow survey of the entire area of the Kolumbo crater floor; v) expanded high-resolution multibeam map of the north basin of the Santorini caldera; vi) first sampling of Fe-oxide sediment in the western part of the Santorini caldera along the extension of the Kolumbo Line and on the Kameni Line separating the north and south basins. The following is the final weekly report of POS 510. More than 100 stations were completed in the last 17 working days, including one of the most aggressive mapping missions on record for the AUV Abyss, logging more than 165 hours of bottom time and covering nearly 100 km² of high-resolution multibeam and sidescan. This was only possible because of the hard work and commitment of the AUV Team and ship's crew. With 3 more working days remaining, we expect to surpass 120 stations and 180 hours of AUV bottom time.

Sunday, March 19: After recovering the AUV from its 8th dive and a 16 nm transit, operations started in the Amorgos Basin, which is older (wider) and deeper than the Anydros Basin. Two gravity cores were attempted adjacent to the Santorini-Amorgos Fault at 700 m depth and one adjacent to the Anydros Fault at 300-400 m depth. There was no recovery in the deep cores (only brown and grey mud in the core catcher). Adjacent to the Amorgos Fault, several meters of grey mud were recovered, bottoming in a 5 cm ash layer with notable fluid escape structures in fractures in the overlying mud. These are most likely related to seismic activity of the Amorgos Fault. Sediments in the Amorgos Basin were somewhat colder because of the greater depth, but heat flow measurements in both basins returned mainly negative values owing to the warmth of the bottom water.

Monday, March 20: Operations on the Kolumbo-Santorini Line resumed with gravity coring between Kolumbo and Santorini, targeting depressions above and below the fault. Grey, very fine-grained mud and clay with white pumice clasts was recovered in all of the cores. This very uniform grey mud is most likely ash that rained out of the water column following the latest eruptions of Kolumbo. Large, white pumice clasts, most likely from the 1650 eruption, were found embedded in the grey mud in several cores. A final two cores in Kolumbo near the Champagne vent field recovered 1 m of black sulfidic mud with pumice fragments at the top of the core that were coated with yellow sulfur. In the evening, the AUV was launched to continue the map of Kolumbo.

Tuesday, March 21: After recovering the AUV in the morning, regional heat flow and gravity coring resumed in the Anafi Basin. Sediments in this basin are mainly oxidized brown clay and bioturbated mud, more typical of what would be expected from erosion of the Alpine basement rocks on Anafi and Anydros, with relatively little volcanoclastic component. Only a few ash and pumice layers were recovered in the cores. In the evening, the AUV was launched near Anydros Island to map a portion of the Anydros Fault.

Wednesday, March 22: Following recovery of the AUV, a recording error was found, and the fully navigated map of the Anydros Fault Zone was lost. With only 4 dive days remaining, we chose not to repeat the dive. During the daytime the final heat flow and gravity coring stations were occupied along the line of small cones north of Kolumbo. Gravity cores targeting the northernmost cones recovered only brown clay and light grey mud in the core catcher (typical of the Anydros Basin). One gravity core on volcano 17 recovered 50 cm of dark grey sulfidic mud, similar to that in the Kolumbo crater. Two heat flow stations in this area, which penetrated up to several meters of sediment, recorded positive

heat flow of 60 mW/m² (well above background values). This was the only positive heat flow in the Anydros Basin outside the Kolumbo crater. In the evening the AUV was launched to map the final northern portion of the volcano and crater rim.

Thursday, March 23: After recovery of the AUV, the heat flow survey inside Kolumbo was expanded to include the entire crater floor. A maximum of 332 mW/m² was measured, confirming earlier measurements closer to the vent field (1600 mW/m² with a maximum bottom temperature of 20°C). Heat flow elsewhere in the crater, up to 400 m from the vents, was 34-58 mW/m², still significantly higher than background values outside the volcano. Two heat flow stations adjacent to the Kolumbo Line recorded only background values. In the evening the AUV was launched for the first dive to map the inside of the Kolumbo crater. Unfortunately the 400kHz data were not recorded.

Friday, March 24: After recovery of the AUV, the gravity coring inside Kolumbo was extended beyond the area of known venting. Cores up to 2 m long recovered very fine black sand and mud consisting of fine ash with traces of amorphous Fe-sulfide. This sediment was cored up to 300 m from the known vents, suggesting that the entire caldera is floored by reduced, sulfidic mud, well beyond the known vents. In the evening, the AUV was launched to repeat the last dive in the Kolumbo crater. The 200 kHz data were successfully recorded and the entire 7-dive map of the Kolumbo complex was finished, completing operations in the Anydros Basin.

Saturday, March 25: In the morning, we re-entered Santorini to map the remainder of the north basin and extension of the Santorini-Kolumbo Line inside the caldera. Gravity coring stations opposite a prominent mafic dike on the southernmost peninsula of Thirassia recovered Fe-oxide-rich sediment, and a temperatures of 20 °C was recorded in reduced sediments in the core catcher. Similar reduced sediments were recovered along the offshore extension of the “Kameni Line”, between the north and south basin. Charcoal fragments were found in several of the cores, and a temperature of 25 °C was measured in the core catcher from one of the station, confirming that both structures are hydrothermally active along their entire lengths. In the evening the AUV was launched to extend the map of the north basin.

Sunday, March 26: Following recovery of the AUV, heat flow measurements were performed at the locations of the gravity coring in the western part of the north basin.

Progress to date (ending 26.03.17): 90 km² of AUV mapping in 12 dives, including 7 at Kolumbo, 2 in Santorini, and 3 sidescan surveys in the Anydros Basin; 17 heat probe stations with 46 attempted penetrations; 74 gravity core stations (67 with recovery) with 275 sediment samples and 183 pore fluid samples.

On behalf of the Research Team
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Photo: AUV Abyss preparing for a dive in the caldera of Santorini Volcano.