

4. Weekly Report MSM132 MMC-1

23.12.-29.12.2024

The highlights of the fourth week of MSM132 were the completion of the 3D seismic cube and further dives with MOMO in Kolumbo crater and in the Santorini caldera. The 3D seismic cube was broadly received as an excellent Christmas present as it takes a lot of constraints on the remaining work and allows the demobilization and packing of a significant part of the equipment.

On December 22 we continued with the 3D seismic cube across the Amorgos fault. 3D seismic acquisition was ongoing without interruptions until noon on December 23 when the cube was finished. The 3D seismic data were then processed and available by evening. The data show a complex fault system around the main Amorgos fault which will be evaluated to understand how far the deformation from the deep 1956 Amorgos Earthquake reached to the surface and how it varies along the strike of the fault. Even on first sight it is clear that there are numerous faults in addition to the main Amorgos fault and that the style of faulting varies significantly along strike. Some parts of the fault showing sharp focusing and others diffuse deformation. This is highly relevant for understanding how the 1956 tsunami was generated and it is likely that many of the paradoxical observations of tsunami run-up height variation are linked to the behaviour of the fault.

The afternoon of the December 23 was used to deploy six Mola landers around Kolumbo volcano and into its crater. Throughout the night we collected multibeam and Parasound data on the northern limb of the Anhydros Graben as weather conditions were not conducive to other work.

On Christmas morning we undertook second MOMO dive into Kolumbo crater. This time we surveyed the southern part of the crater. No active hydrothermal activity was observed on the crater floor, but we discovered one inactive vent on the crater wall. The floor of the crater was littered with massive blocks that had apparently been deposited by a rockfall from one of the dikes in the crater wall.

From noon of December 24 onwards, we carried out another Multibeam and Parasound survey in the northeastern part of the study area to investigate the continuation of the Amorgos fault to the NE which lasted until 10 am on December 25. In the morning of the 25th we conducted a XBT cast to obtain a new sound velocity profile. We then passed very close to Amorgos where it was possible to inspect the onshore geology from up close. The cliff face on the north-eastern most coast of Amorgos shows spectacular folds and thrust faults indicating that the basement underwent significant compression before the present rift episode. This is likely the record of the mid-Miocene location of the Hellenic Arc subduction zone which has since rolled back to its present-day location south of Crete.

In the afternoon we collected the Mola landers that were deployed on Kolumbo on the 24th. Four of the instruments could be retrieved and their seismometer data nicely show the earthquakes that occurred in the region between the 23rd and the 25th. Unfortunately, two Mola landers did not surface. Both of them had been deployed in the crater of Kolumbo.



P-Cable 3D seismic operations on the back deck of R/V Maria S. Merian during cruise MSM132 (Photo: Andrea Geipel).

During the night from December 25 to the 26 we ran a twelve-hour long MOMO dive that investigated the crater rim of Kolumbo and finished with the inspection of one of the Mola landers that had not surfaced. It turned out that the instrument had sunken about 15 cm into soft sediments that cover the crater floor. This prevented the release mechanism to operate. Future deployments in the crater are therefore only possible after the instruments have been modified – an important lesson for the future installation of the early warning system.

At 10 am on the 26th we redeployed the 2D seismic system starting with lines around Kolumbo volcano where we discovered a previously unknown volcanic cone and then progressed towards the deep parts of the Amorgos Basin that has not been surveyed before.

2D seismic acquisition continued until Saturday 28 without interruptions, but in less-than-ideal weather conditions with winds as strong as force 9. At 8 am on December 28 the streamer was recovered and we proceeded to Santorini caldera to investigate the hydrothermal system in the northern part of the caldera using MOMO. Interesting footage showed the rapid changes of this hydrothermal system since it had been last surveyed.

The night from December 28 to 29 was used to fill gaps in the multi-beam map south of Kolumbo and MOMO was redeployed in the morning of December 29 for a third dive into Kolumbo volcano.

All are well and the team is looking forward to the final days of the voyage which we expect to complete with the port call in Heraklion on January 2.

Christian Berndt, Chief Scientist