



Research Vessel SONNE Cruise SO312

1st Weekly Report (04. - 11.05.2025)

Caldera collapse is an important geological process that shapes many of Earth's volcanoes. The structures that accommodate the collapse play a primary role in hydrothermal fluid circulation and focus, and related mineralization. In addition, the collapse process and the associated volcanism can pose a significant hazard to society. To understand caldera collapse and related hydrothermal processes, three-dimensional (3D) investigation of the structural architecture and hydrothermal fluid circulation are required. However, no 3D seismic data currently exist for any caldera in the world. During SO312 we will image Brothers volcano—one of the best-studied examples of a submarine caldera volcano in the world—to address three fundamental hypotheses: (1) that the caldera formation was caused by a sudden collapse after an explosive eruption, rather than by incremental subsidence associated with effusive eruptions; (2) that pre-existing zones of 'volcanic weakness' played a major role in the collapse; and (3) that large-scale, seawater-dominated hydrothermal activity at Brothers is intrinsically linked to caldera collapse structures. We will conduct a major, high-resolution 3D seismic experiment that images the entire volcanic edifice of Brothers volcano at a 3 x 3 x 6 m resolution. In addition, we will collect an ocean bottom seismometer dataset that will deliver a tomographic model of the upper 5 km beneath the volcano at 100-200 m resolution. We will augment these seismic data with the simultaneous acquisition of gravity and magnetic data. Ground-truthing will be achieved through the integration of geological results from IODP expedition 376 and earlier ROV and AUV surveys. The study will provide unprecedented insight into the geological processes involved in submarine caldera collapse and will aid hazard assessment as well as mineral resource assessment of similar volcanoes.

After being cleared by customs and immigration, we left Auckland on the 4th of May at 1000 sailing north towards the study area. The science crew was busy preparing the streamers and ocean bottom seismometers (OBS) and setting up the computer systems.

On the 5th of May we arrived in the study area and began with testing the OBS releasers which took from 10 am to 2pm afterwards a CTD cast was conducted to obtain a sound velocity profile for the calibration of the hydroacoustic systems. We proceeded to the first OBS deployment position in the north of Brothers Volcano which we reached at 8 pm. Deployment started immediately and commenced during the night.

All 24 OBS were deployed until 0830 on the 6th. Then we proceeded in fair weather to the deployment position of the 2D seismic acquisition south of Healy Volcano. After watching for marine mammals for one hour, we began with the soft start of the GI gun and slowed ramped up the shooting interval. By 1400 we were on the first seismic line.

The seismic survey continued largely without interruptions until Saturday 10.5. at 09:00. We then recovered both the seismic system and the magnetometer. The following 2 hours were used by the ship to inspect a damage on the fiber-optical cable that was caused during the previous voyage. By 1230 we were steaming southward to Rumble III Volcano which was the target for the next two days while preparations for the 3D seismic survey took place.

We arrived in the Rumble III study area by 1700 and started to deploy the 2D seismic gear. Acquisition of seismic and multibeam data was underway by 1800. Within 25 hours we completed the survey and by Sunday night at 1900 we retrieved the system and started to steam northward to collect multibeam data to the east of Brothers Volcano.

All on board are well and look forward to the next week of the expedition.

On behalf of all cruise participants,

Christian Berndt
(Chief Scientist)

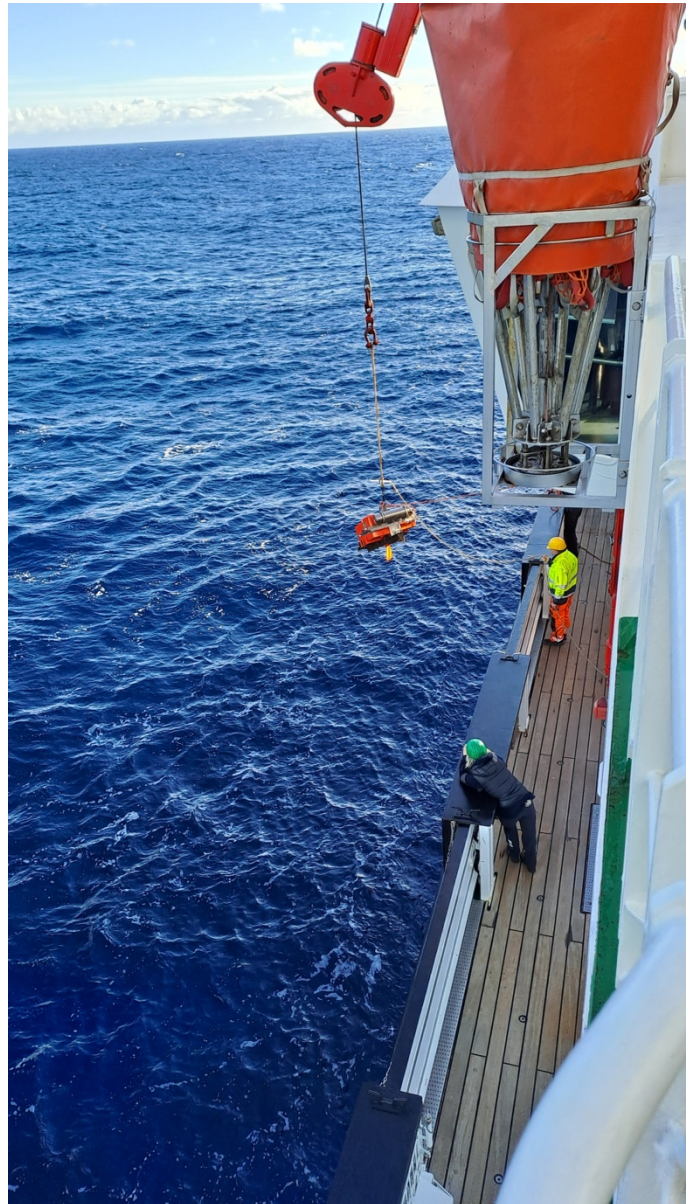


Figure 1 Ocean bottom seismometer deployment. Photograph by Ines Staben.