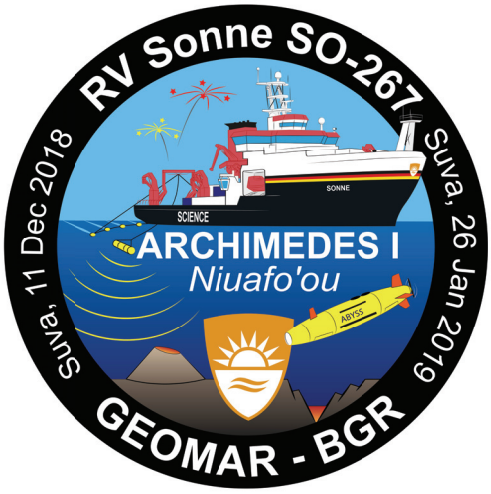
SO-267: ARCHIMEDES I Expedition with RV SONNE

Weekly Report No. 7 (21 to 26 January, 2019)



On Monday 21 January, we continued to recover our OBSs and OBMTs on line P3 (BGR18-203). Our last AUV Dive (315) was launched during the recovery program to complete the mapping of hydrothermal plumes in the southern Fonualei Rift (S-FRSC). The AUV plume survey identified a new hydrothermal vent site on the northernmost of the axial volcanic cones in the S-FRSC rift valley, filling an important gap in the known occurrence of vents. The spacing of the vents, now clearly about 20-30 km, is much higher than expected for such an early-stage rift and compared and mid-ocean ridges with a comparable spreading rate. In the night, the last of the OBMTs was recovered and the opportunity was taken to attempt two more heat flow stations on the eastern flank and in the deepest part of the rift.

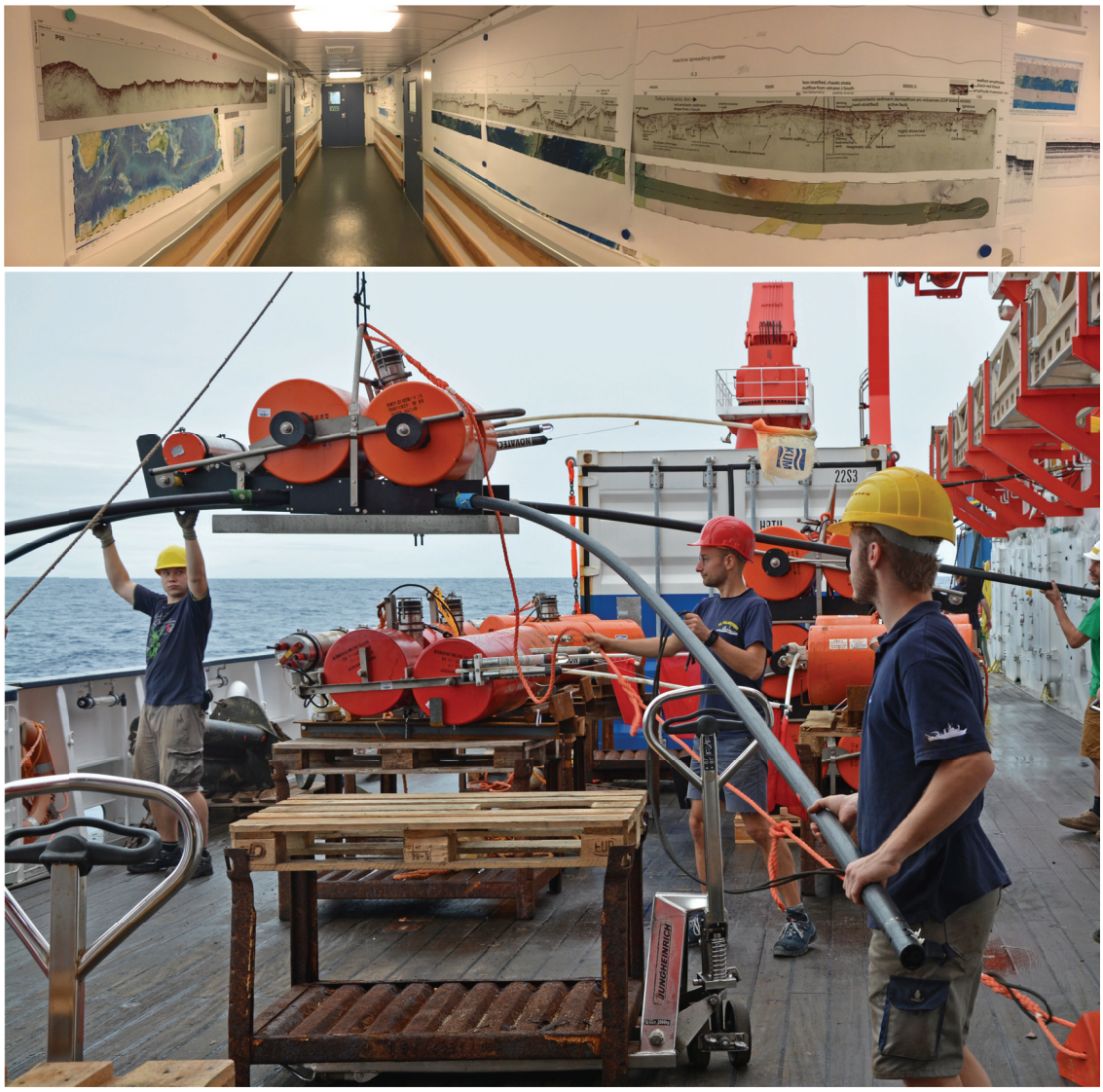
After recovery of the AUV on Tuesday morning, 22 January, we began a final program of dredging and multibeam mapping in northwest of the FRSC. The first dredge was along a series of N-trending ridges on the west flank of the FRSC that are thought to be manifestations of basement structures cutting across the FRSC in the south. Large blocks of lithified mudstone were recovered, together with fresh-looking scoriaceous basalt, indicating that these may be reactivated structures. In the evening, the magnetometer was deployed for a multibeam survey of the west flank of the FRSC in the complex horst-and-graben terrain of the Central Volcanic Field (CVF). Three more dredges were completed in the CVF during Wednesday and Thursday, 23-24 January, targeting a number of isolated volcanic highs and blocks of abandoned arc crust. This part of the CVF has never been mapped, and the new multibeam, backscatter, and magnetic data seem to confirm that it is dominated by large blocks of abandoned arc and back-arc crust overprinted by much younger intraplate volcanoes. All indications are that the Niuafo'ou microplate was not formed by a continuous process of seafloor spreading and back-arc accretion, but originated episodically from a combination of arc rifting, rift volcanism, the transfer of relict arc material into the back-arc, and widespread intrusion into the crust. The entire study area is strongly influenced by plate rotation, which could explain the greater intensity of magmatic and hydrothermal activity in NE Lau compared to other back-arc basins. This complexity may also be characteristic of the formation of juvenile continental crust.

The final week of the cruise completed an intensive 43-day program of multichannel reflection seismics, refraction profiling with OBS, and nearly continuous towed magnetometer and gravimeter recordings throughout the NE Lau Basin, complemented by dredging, heat flow measurements, and high-resolution sidescan imaging and plume detection with the AUV ABYSS. We conducted 6 transects across the plate boundary in an area covering nearly 300 km x 300 km. The entire scientific crew of 39 participated around-the-clock in the seismic experiments, including mobilization and de-mobilization of the OBSs and OBMTs, deployment of the instruments, data acquisition and analysis, monitoring and maintenance of the equipment, and mammal watches. 110 stations were finally completed, including 9 seismic profiles (1,065 km of MCS and 673 km of refraction seismics) with more than 25,000 shot points. Our work included 146 OBS and OBMT deployments, 8 AUV dives with a total distance of 910 km travelled, 41 dredges, and 21 heat flow and 6 gravity corer stations,

plus nearly 46,600 km^2 of high-resolution multibeam, backscatter, and sub-bottom profiling, and more than 4200 km of towed magnetics. This ambitious program was made possible by a close collaboration between GEOMAR and BGR scientists, bringing together diverse expertise and state-of-the-art technologies. The combined data represent one of the most comprehensive surveys of microplate formation in a subduction setting and a unique record of crustal growth in complex arc-backarc systems.

The last dredging station was in the early afternoon of Thursday, 24 January. When completed the magnetometer was redeployed for the transit out of the working area. The magnetometer was recovered before entering the Fiji EEZ, and the vessel continued to the pilot station in Suva on Saturday, 26 January.

With best regards on the last day of a great cruise with RV SONNE,
Mark Hannington and Heidrun Kopp



Upper: Some of the 2D seismic reflection profiles produced during SO-267, lining the science corridor of RV SONNE. The 6 profiles (and some of the preliminary interpretations) shown here were collected during more than 1,000 km of profiling. (Photo by N. Augustin) ***Lower***: One of the 18 OBMTs deployed at the beginning of the cruise to record passive electromagnetic signals in the crust along profile P3. (Photo by P. Brandl)