Cruise SO 313 with RV SONNE

Louisville Ridge

At See 27° 42'S, 174° 21'W

4. Weekly Report (23.06. – 29.06.2025)

The 4th week of cruise SO313 was characterised by the exploration of Seamount 420 in the northern working area. On Monday, 23 June, four TV grab stations were successfully carried out to sample ferromanganese crusts in the summit area of the seamount. Further successful TV grab deployments were completed on 24 June and 29 June, including the recovery of the sample shown in Figure 1. In most cases, the TVG stations were planned on the basis of previously conducted video stations, so that targeted sampling was possible (see Figure 2). Similar to the Burton Seamount, the substrate of the crusts consists of conglomerates or breccias with volcanoclastic components or altered basalts. In the summit area of the seamount, indurated sediment occurs, which is mainly composed of volcanic ash or other volcanic rocks (see Figure 1). The ferromanganese crusts are thickest in the area of the summit plateau between 1400 and 1070 m at over 5 cm, their layer thickness decreases significantly on the slopes below 1800 m. The crusts on both Burton Seamount and Seamount 420 appear to be slightly phosphatised or not phosphatised at all. Initial geochemical analyses with a mobile XRF indicate that the crusts at Seamount 420 contain significantly more cobalt than at Burton Seamount. However, detailed analyses will be carried out in the home laboratories.

The biology sampling programme continued on Tuesday 24 June and the morning of 25 June. Four multicorer stations, one epibenthos and one seamount sled station as well as one multinet and one miniplankton net station were planned in each of four areas of the approx. 550 km² summit plateau. In the two days, the programme for the southern area was completed. From the afternoon of 25 June, the weather deteriorated. An area of high pressure slowly passed us to the south. On its northern flank, strong easterly winds led to the build-up of a swell, which increased to a maximum wave height of 6 metres with wind forces of up to Bft. 8 by Friday morning (27 June). Under these conditions, the sampling programme had to be interrupted. It was now only possible to deploy the deep-towed bathymetry sled HOMESIDE, the video sled STROMER and the CTD. HOMESIDE was used for high-resolution mapping of the north-western slope of the seamount and the central structures in the summit area (26 and 27 June). Video mapping was carried out along the same transects. This work confirms the correlation of the EM122 backscatter data with the occurrence of ferromanganese crusts, so that the summit plateau of Seamount 420 can now be assessed as a whole for the presence of ferromanganese crusts.

On the night of 26 June (Thursday) to 27 June (Friday), an L-ADCP/CTD programme was carried out over various areas of the seamount, which was concluded with a trace metal CTD. The water masses around the seamounts of the Louisville Ridge can be clearly distinguished by their temperature and salinity characteristics (see Figure 3). At and near the surface is subtropical water (STW) with temperatures of up to 20° C and high salinities of more than 35.5 psu. Below this, our observations show a layer of Antarctic Intermediate Water (AAIW), which is characterised by a relative salinity minimum and an oxygen maximum. The local deep water mass, the so-called Circumpolar Deep Water (CDW), also originates from the Southern Ocean

and is a mixture of several deep water masses that circulate around Antarctica with the Antarctic Circumpolar Current (ACC). It is characterised by temperatures between 1 - 2° C and a local maximum salinity. The densest and coldest water mass in this area is the Antarctic Bottom Water (AABW), which forms south of the ACC under very cold conditions and has a maximum of oxygen. The vertical distribution of these water masses leads to environmental conditions at the seamounts that vary greatly with depth. The tops of the seamounts in water depths between 1000 and 1500 m are influenced by fresh and oxygen-rich AAIW (oxygen content up to 220 µmol/kg), while the flanks are mainly under the influence of a mixture of AAIW and CDW, whereby the salinity increases continuously with depth (from 34.4 psu to 34.7 psu) and the oxygen concentration is reduced to around 140 µmol/kg.

The biological sampling programme was resumed on Saturday morning (28.06.) with further deployments of the above-mentioned tools over the western area and on the lower north-western slope of the seamount, so that all relevant areas of Seamount 420 could now be sampled. In contrast to the Burton Seamount, the density of sessile animals is significantly higher on Seamount 420 (see Figure 4). There are higher abundances of holothurians (sea cucumbers) at greater depths on the slope of the seamount (> 3000 m), of sponges at the transition from the slope to the summit plateau (at approx. 1600 - 1800 m) and of corals in the summit area (at approx. 1100 m).

All participants of SO313 are well.

Best regards,

Thomas Kuhn (Chief scientist)

Figure 1: Ferromanganese crust on 'volcanic sandstone' from Seamount 420. The layered volcanic sandstone probably consists of volcanic ash layers that may have been redeposited under submarine conditions. The sample measures 110 x 80 x 25 cm and weighs approx. 120 kg. Photo: S. Sturm.

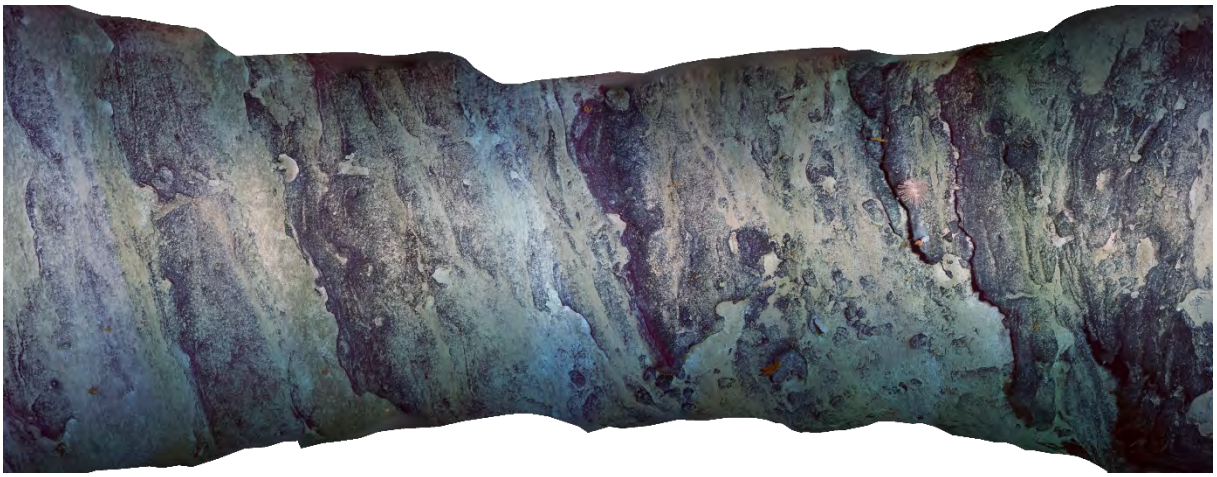

Figure 2: Photogrammetric image of the seabed at Seamount 420 (at a water depth of approx. 1200 m) with layers of ferromanganese crusts, pelagic sediment and sessile animals (corals and sponges). The image section is 22 x 8.5 m, created from underwater photos taken by the ROTV STROMER. The sample in Figure 1 was obtained from a similar position. Image: H. Wedemeyer.

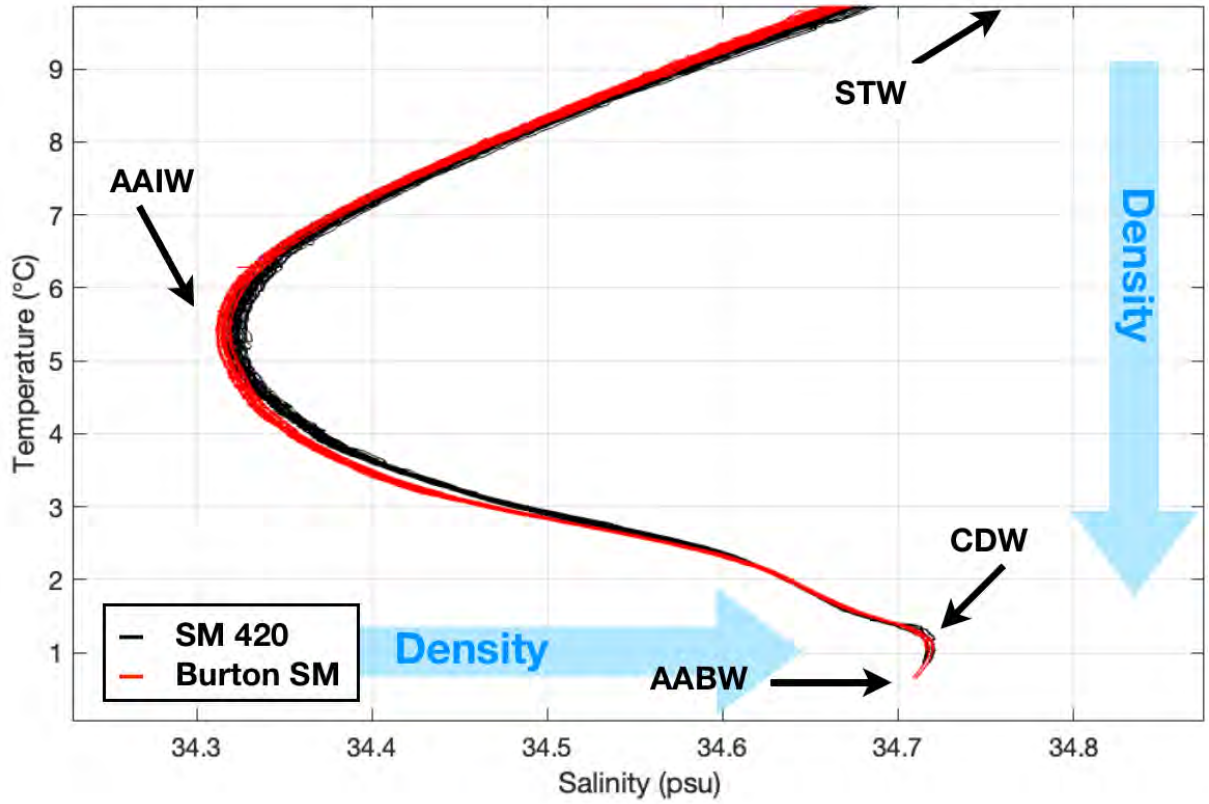

Figure 3: Temperature-salinity diagram for the water masses around Seamount 420 (black) and Burton Seamount (red). STW: Subtropical Water; AAIW: Antarctic Intermediate Water; CDW: Circumpolar Deep Water; AABW: Antarctic Bottom Water. The density increases with increasing salinity and decreasing temperature.

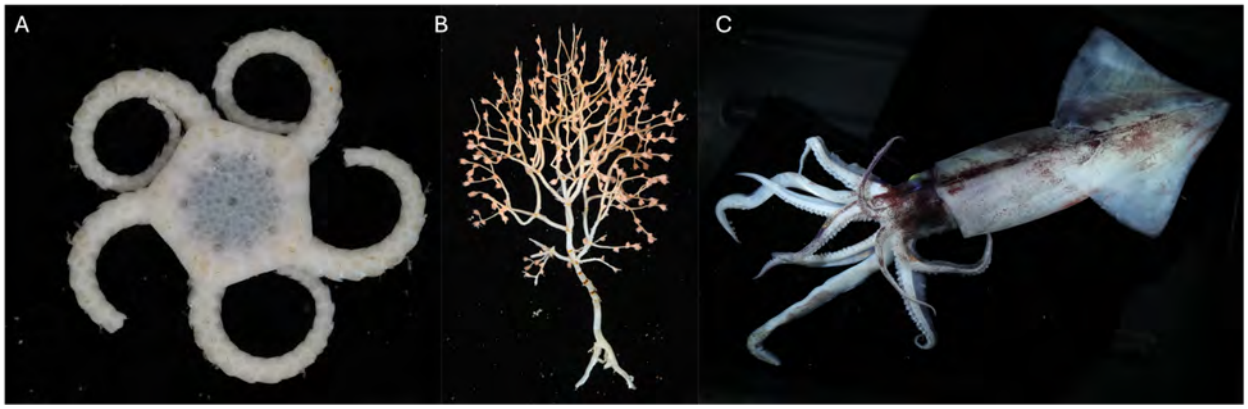

Figure 4: A: Ophiuroidea from the seamount sled, B: Coral from the multicorer, C: Squid from the deck. Photos: N. Gatzemeier.