

## Research vessel POLARSTERN

PS119: 13.04. – 31.05.2019

Punta Arenas - Port Stanley

Sixth weekly report: 13. – 19. May, 2019

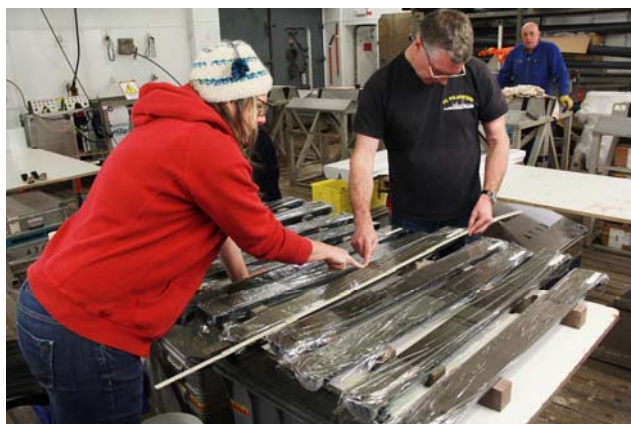


### To the smoking volcano of Saunders Island

Like last week, we spent the sixth week in the southernmost area of the South Sandwich Plate, from the back-arc spreading ridge of the segments 8 and 9 in the west to the Kemp Caldera. The volcano of Kemp Caldera is part of the collision zone with the South American plate to the East. A look to our expedition logo shows symbolically the spreading ridge on the left and flowing to the right the volcanoes, fore-arc area and subduction zone. The weather conditions, which denied from Sunday to Tuesday morning further dives, permitted not until Tuesday to dive down with ROV QUEST to the seafloor. We used the dive-free time for the deployment of other sampling gear. On Sunday, 12<sup>th</sup> of May, we sampled the deepest area of the Kemp caldera with a 3 m long gravity corer and the multi-corer. The until then surveyed Parasound profiles over the caldera showed in the deepest area narrow sediment layers, whose mineral and chemical composition in references to hydrothermal deposits are of huge interest. With our corers we were able to sample sediment layers of 230 cm depth, which surprised us by their colouring and diverse sediment compositions.



**Figure 1:** Penguins being washed up by a wave's high to an iceberg following by a steep climb (© Carsten Zillgen).



**Figure 2:** Analyses of sediment cores in the laboratory of Polarstern. The cores close to spreading center show strong colour changes unusual for pelagic sediments (© Yiting Tseng).

Pure biogenic opal ooze came to show, which are composed of diatom skeletons. These diatoms are growing in huge numbers in the surface waters of the Southern Ocean, south of the Polar Front, and after death, their skeletons are deposited on the sea floor along the so-called Opal Belt. Especially obvious in our core are the mats of the diatom genus *Thalassiotrix*, which are built from needle-like cell covers of biogenic opal and if appearing with a single species in the sediment core, look like wet paper tissues. The pure opal ooze is strongly coloured in some layers by metal sulphides, documenting the hydrothermal activity in the caldera over time. On Monday, 13<sup>th</sup> of May, we sampled sediments by piston corer about 60 km to the west of the Kemp caldera on the eastern flank of the ridge segment E8 (Fig. 2). The sediments of the 8.70 m long core had high contents of volcanic components and our geochemists are interested in investigating the influence of the hydrothermal activity and especially that of the iron geochemistry. Based on these interested, pore water samples were taken every 10 cm along the length of the core to measure alkalinity and iron concentrations already on board. Further nutrients and specific dissolved components will be analysed after the expeditions in the labs of the home institutes.

On Tuesday, 14<sup>th</sup> of May, the Kemp Caldera was back in the centre of our research. Several CTD and water rosette stations were taken near the hydrothermal area, in the caldera centre and on the rim area. Based on anomalies of turbidity, redox potential, temperature and methane content we wanted to analyse the influence of the active hydrothermal area on the seawater chemistry. A ROV dive followed located at the northern, inner rim of the Kemp Caldera in 1100 m depth, over an area where we had detected gas bubble streams several times in the water column. Diving with ROV Quest, we were unable to find the original exit of the gas bubbles on the seafloor, and therefore we concentrated our efforts on sampling the hydrothermal fluids of new discovered smokers. A black smoker, which fluid temperatures were measured as 230° C (Fig. 3), had a high iron concentration and the lowest pH values of 2.3, while a second chimney which we sampled had a temperature of 200° C contained almost no iron and had a pH of 5.5. We have to wait until after the detailed fluid analyses at home to find out if the fluid chemistry is in line with the precipitate content.



**Figure 3:** Shimmering vent fluids, which gush with a temperature of 230° C from a chimney in the Kemp Caldera and are being collected by fluid sampler. These fluids are Fe-rich and with a pH of 2.3 quite acidic (© MARUM).



**Figure 4:** Polarstern is steaming out of Saunders Island's Cordelia Bay in full sunshine. In the background on the right hand side the 991 m high summit of Mount Michael is seen, which is smoking clouds (© Volker Ratmeyer).

Despite the new detected dive target wishes, which emerged during our 3 dives in the Kemp Caldera, we had to leave the Kemp Caldera on the 15<sup>th</sup> of May in view of our further expedition objectives. Our route lead us along the northwestern part of the South Sandwich Plate to the fore-arc, passing the islands of Leskov, Visokoi and Zavadovski. We run an OFOBS profile over a fore-arc high, in the hope to find indicators for cold seepage. There, British scientists had dredged up serpentinite crustal rocks a few years ago, which are associated with active seafloor fluid exits in other oceans. During the night, we progressed southwards, reaching the volcanic Saunders Island in the morning of the 17<sup>th</sup> of May. Our volcanologists had planned a visit with sampling and a photogrammetrically survey via drone flights. In light of the weather, which improved as the day went by, drone flights starting from Polarstern were possible, especially after Polarstern made her way through Cordelia Bay and stopped very close to the island (Fig. 4).

A further successful ROV dive took place in the hydrothermal area E2-South on Saturday, 18<sup>th</sup> of May, before the weather got bad during the night. As a strong storm of up to hurricane level was forecasted for the second part of the night and the following morning, we steamed with Polarstern westwards and found shelter behind the volcanic island Zavodovski. With a wind strength of 10 to 11 Beaufort with occasional gusts of 12, we had waves of 3-4 m height in the shelter of the island while further out waves of more than 8 m height were forecasted. Despite the fact that the vessel is more rocking and rolling today, we feel and well looked after on Polarstern. However, not all scientists were seen for breakfast and lunch. Best wishes in the name of all participants,

Gerhard Bohrmann

RV POLARSTERN Sunday, 19<sup>th</sup> of May 2019