Research Vessel METEOR

M134:
Port Stanley – Punta Arenas
Second weekly report: 22 – 29 January 2017

Last weekend our two dives with ROV SQUID in 230 m depth of the King Haakon Trough (Fig. 1) turned out to be more difficult than expected due to easily disturbed surface sediments. The causes were less the movements of the diving robotic vehicle then the fast movements of local fish that made the waters murky and the diver operation challenging. A group of about 40 marbled rock cod swam in front of the camera-eyes of the ROV and stirred the sediments up. We had selected the diving locations based on the positions of gas flares that the vessels' hydroaccustic systems had detected. Unfortunately we were unable to find the emission sites of the gas bubbles by ROV because of the poor visibility. The forward looking sonar system of the ROV, which generally helps with the detection of flare origins on the seafloor, was unable to find the right target because of the signal overload in the water column. But chemical measurements throughout the watercolumn had shown clear signals of methane input from the sediments. To do this, the CTD with its 24 water samplers is placed into the water column on an almost daily basis and the collected water samples from 24 different depth are used for the anaylsis of different chemical parameters – including those to measure methane. The resulting methane concentration profiles are extended to the seafloor by the deployment of a bottom water sampler, and samples by multi- and gravity corer lengthening the methane profile into the seafloor. In general the background concentrations of methane in the ocean are about 1-2 nanomol/l, while in the area of gas emissions, concentrations of 20-50 nanomol/l are measureable. On the seafloor of King Haakon Trough concentrations of 300-400 nanomol/l were present.

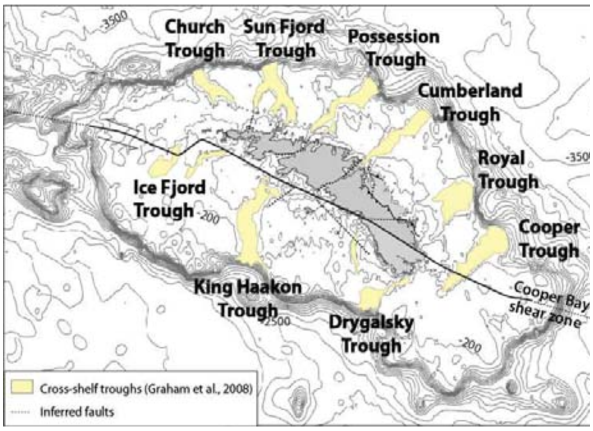

Fig. 1: South Georgia (grey) and its shelf troughs in yellow. Based on their methane emission flares, our research targets are the long shelf troughs which were formed by radial flowing ice streams.

Fig 2: ROV-pilots and scientists in the rough wet lab of RV METEOR, which was transformed into the ROV control room for this expedition (© vdL).

On Monday, 23. January, we looked in detail into the gas emmisions in the Ice Fjord Trough (Fig. 1) that we had detected the night before. After CTD, bottom water sampler and gravity core the third dive of this expedition was done in the Ice Fjord Trough. The ROV-team and scientists took over the rough wet lab of the vessel (Fig. 2) that is used as control centre during dives. Further scientists are in constant contact and support on the dives from the conference room through live video streaming and online voice communication with the scientists in the ROV control centre. The visibility on the seafloor in 250 m deopth of the Ice Fjord Trough was also heavily compromised but at least emitted gas bubble were seen at this location. Next to this a rich variety of benthic organisms were observed, like notothenoid fish (white blooded fish), filter feeding sea anemones, sun- and brittle stars as well as glass sponges, which are typical for the Southern Ocean, and now an then an octupus, just to name a few.

Based on forcasted worsening weather conditions we moved on Monday night eastwards on the southern side of the island and continued our mapping survey on RV METEOR. On Tuesday we carried out station work in the Drygalski Fjord at the south-eastern tip of South Georgia (Fig. 3). While the weather outside the fjord was challening with high winds and 4-5 m high waves, it was much calmer in the narrow fjord and all station work was possible. At time, strong katabatic winds coming down the over 2000 m high mountains and the Risting Glacier caused winds speeds of 8-10 Beaufort but large wave movements stayed away.

Fig. 3: Multicorer sampling in Drygalski-Fjord, named after Erich von Drygalski, the expedition leader of the 1st German Antarctic expedition with RV GAUSS (© Christian Rohleder).

Fig. 4: Part of a recently opened gravity core with white methane hydrates, which transform to water and methane on board. Syringe samples are taken from the sediments are taken to study the pore waters (© vdL).

The Drygalski Fjord is not only of interest because of its historical connection to the 1st German Antarctic expedition (1901-1903) but also because of its geological structure as a shearing zone as these shearing zones are often used as emmission lanes for deep-based fluids. The methane emissions of these fjords could be caused by thermogenic methane, which either rise from depth along the deep disturbance lane or at one of the numerous parallel disturbance, and then emerges from the seafloor. Only when we're back on land can isotope analyses of the methane's carbon and oxygen can tell us if the source is biogenic or thermogenic methane that we sampled in Drygalski Fjord.

Following a promising good weather forecast by the on board DWD (German weather service) on Thursday 26. January, we moved to Cumberland Bay East and ran a CTD profile from the inner fjord next to Nordenskjöld glacier to the outer end of the bay. Crossing the Grytviken Flare we noticed that this gas emission site is still active. This gas emission site had been detected in 2013 by RV Polarstern and was named after the neighbouring, 1904 Norwegian founded whaling station Grytviken. The extremely pleasant weather and the fantastic scencery of high mount fantastic scenery with glaciers and calving icebergs called most of us on board of METEOR again and again out on deck during all breaks, just to enjoy the view.

On Friday, 27. January, we started our survey and station work in the Church Trough area, where we had detected gas emissions in 380 m water depth. At this depth level and with sea temperatures of less than 2°C the methane hydrate stability zone is reached and methane should form in contact with water the solid structure methane hydrate. A gravity core which we took today on Sunday confirmed very convincingly the presence of methane hydrates (Fig. 4). With this gravity core it was possible for the first time to confirm undoubtly the existence of methane hydrates south of the Polar Front. We are very pleased about this and our other sucesses during this expedition. All on board are very well and excited.

Best wishes on behalf of everyone on board,

Gerhard Bohrmann

FS METEOR Sunday, 29. January 2017