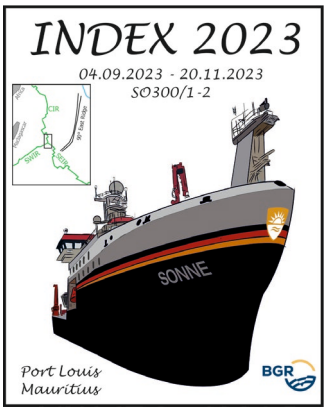
RV SONNE cruise SO300/2

INDEX 2023

23 - 29 October 2023

At sea 26°28‘S, 71°41’E



Weekly report No. 4 (23/10 – 29/10)

In the 4th week of the expedition we worked exclusively in the JIM hydrothermal field and its surroundings in cluster #09. Six ROPOS stations and seven HOMESIDE stations were run, the gravity corer was deployed five times, the baited fish camera was deployed twice over 24 hours each, the BGR video sled STROMER was used for the first time on this cruise, and at the end of the week a mooring was deployed with two sediment traps, two current meters, and 2 plates with a total of 18 passive samplers. This is the first mooring in Cluster #09, it was placed in close proximity to an inactive hydrothermal mound. Its near-bottom sediment trap (30 m above ground) and the flow meters and passive samplers mounted immediately below and above it will be used to initiate a near-bottom monitoring program that will collect environmental baseline data in a potential mining component test area.

The JIM hydrothermal field was discovered on the INDEX2022 campaign and described with 10 hydrothermal sites. During this cruise we could extend the field with one high temperature vent site and three additional inactive sites. The majority of the hydrothermal sites consists of well-defined mounds that are 100 - 150 m base diameter and 20 - 50 m high. In all cases they are covered with iron and manganese oxide crusts, at some of these mounds sulfides could be detected under the crusts. A characteristic mound structure was photogrammetrically recorded with a total of 5224 photos and a preliminary three-dimensional model was created (see Fig. 1). This allows detailed analysis of parameters such as steepness and surface texture. Most of the mounds occur like a string of pearls over a distance of 3.3 km in a N-S direction. Additional hydrothermal sites are tied to a 2.7 km long NW-SE to E-W striking ridge, at the NW end of which is the active high temperature vent site. This ridge divides the JIM field into an active northern and inactive southern part. The high-temperature vent site was discovered by video cameras on the first leg of the INDEX2023 expedition (SO300/1) and sampled and studied in detail biologically, geologically and fluid-chemically during this leg. It is composed of only one active black smoker complex and numerous inactive sulfide chimneys (see Fig. 2). The emanating fluids were sampled at 296°C using the KIPS fluid sampling system. They were characterized by strong degassing on deck and had an elevated salinity of 44 psu and a pH of 4.9.

The newly discovered active Jim site was biologically mapped and sampled for all major vent-endemic organisms present. These included the vent field shrimps, *Rimicaris kairei*, anemones of the genus *Maractis*, vent field mussels and numerous species of polychaete and gastropod species amongst many others. An exceptional finding within this active site was the discovery

of capitellid worms in the deeper layers of an aggregation of shrimp carcasses, the exuvia or shells that the vent field shrimps discard when molting in order to grow. During sampling for scavengers in this small-scale area within the active site, that is usually inhabited by numerous snails and worms scavenging the surface of this deposits, we discovered numerous extraordinary large polychaetes. Specific sampling for these worms showed that they form a structural stockwork underneath the carcass pile and occur in incredibly dense aggregations. Initial identification on board confirmed the family Capitellidae and length measurements revealed individual sizes of about 20 cm, which is almost double the size of any known and described capitellid of this family worldwide. This finding revealed a hidden food source and a high amount of biomass within this active vent site that could be discovered for the first time and will be further investigated in our home laboratories and *in situ* at further hydrothermal vent fields during the upcoming weeks.

During ROV deployments, the individual sites of the JIM hydrothermal field were intensively sampled for geological investigations as well. Unlike most massive sulfide deposits along mid-ocean ridges, the JIM field is associated with plutonic, mafic to ultramafic host rocks. Initial on-board studies using scanning electron microscopy, X-ray diffraction and fluorescence spectrometry indicate that the rocks are gabbronorites as well as peridotites (e.g., harzburgite). The suite of sampled massive sulfides comprises of isolated inactive black smokers and fragments of sulfide talus, and consist of fine-grained Fe(pyrite)-rich material. In the southern part of the JIM field, the sulfides show much stronger indication of oxidative weathering by seawater. Thus, the southern (inactive) occurrences seem to be much older than those in the north, where active hydrothermal venting is still ongoing.

In addition to the work directly in the JIM field, the wider area was surveyed with seven HOMESIDE tracks covering about 85 square kilometers. Numerous redox and turbidity anomalies were discovered in the water column south of a steep, east-west trending ridge. The location of the anomalies - about 4.3 km from known hydrothermal fluid discharge sites - suggests that the source of these anomalies is an unknown active site. Unfortunately, this source could not yet be located on the seafloor in the past days, so that further investigations are necessary here in the coming years.

After finishing the station work in Cluster #09 RV SONNE is now on her way to Clusters #11 and #12 where we will work in the coming week.

All participants of cruise SO300/2 are well.

Best regards on behalf of the entire crew,

Thomas Kuhn, Federal Institute for Geosciences and Natural Resources (BGR)

Chief Scientist

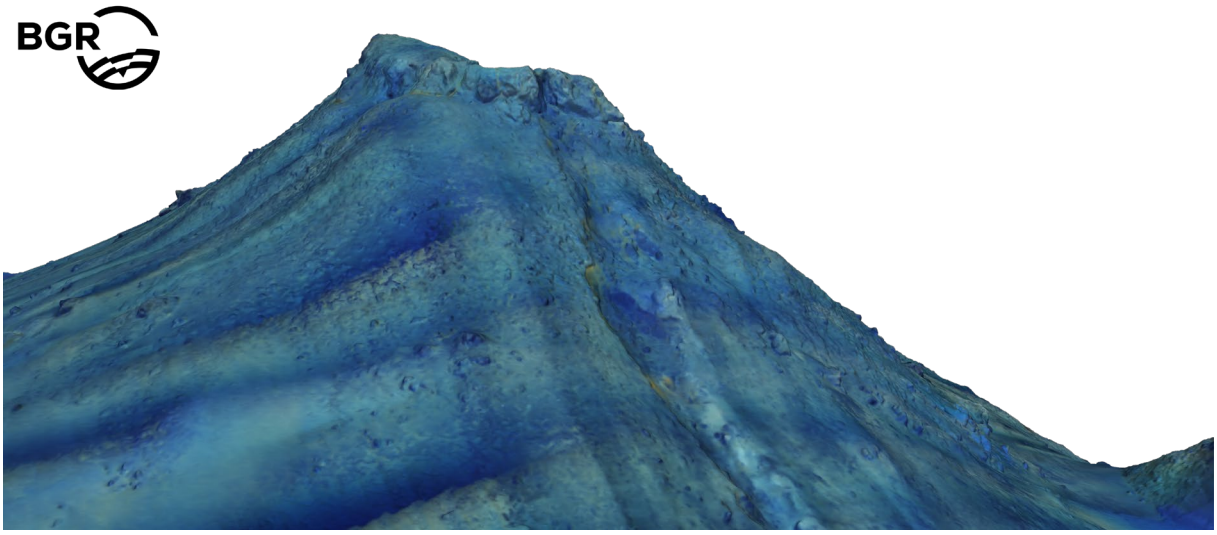


Figure 1: Preliminary photogrammetric model of a hydrothermal mound from JIM based on 5224 photographs. Length of mound about 100 m, height about 40 m.

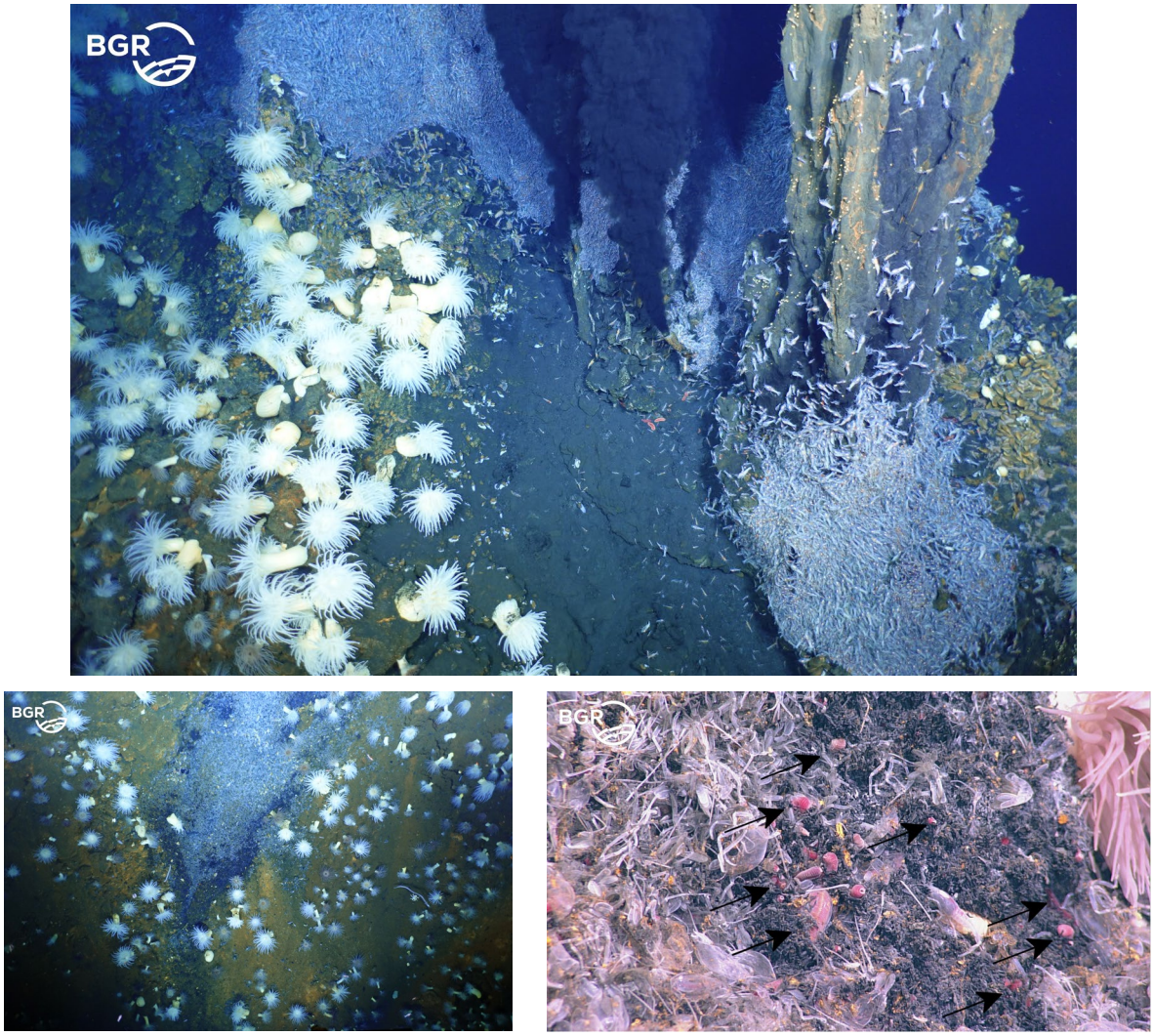


Figure 2: The active Jim Mound with hydrothermal shrimps, anemones and black smokers. Lower left: Deposits of shrimp exuvia discarded during molting at the base of an active chimney. Lower right: Detail of the shrimp exuvia in differing states of decomposition and the giant polychaetes of the family Capitellidae (black arrows) in the deeper layers of this deposit.