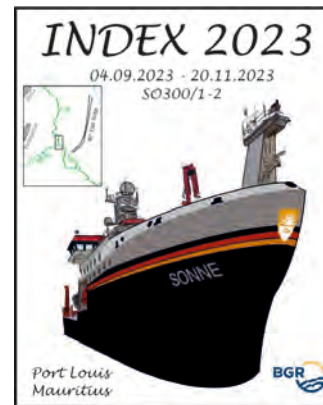


RV SONNE cruise SO300/2

INDEX 2023

16 - 22 October 2023

At sea 26°27'S, 71°41'E



Weekly report No. 3 (16/10 – 22/10)

The focus of our work in the third week of the expedition SO300/2 was on Cluster #05 and #07 with the hydrothermal fields KAIMANA and SOORAJ. The following stations were realized in these areas: four ROPOS dives, two gravity cores, two baited fish camera moorings each for 24 hours, five CTD stations, one mooring recovered, and four HOMESIDE tracks. During the night from 21 October (Saturday) to 22 October (Sunday) RV SONNE moved to Cluster #10 to recover another mooring and then went to Cluster #09. The moorings with sediment traps, current meters and passive samplers recovered in Clusters #07 and #10 will be combined and re-deployed in Cluster #09.

The KAIMANA field is located in a tectonic massif about 15 km to the northwest of the Rodriguez Triple Junction in 2650 m to 3000 m water depth. The ROPOS dives aimed at mapping the areal extension of massive sulfide outcrops as well as taking geological and biological samples. One outstanding result of this exploration was the detection of native copper in several push cores from the base of a hydrothermal mound. Native copper occurs in dendritic form (up to 2 cm in size, see Fig. 1) or as gravel-sized grains together with Cu sulfides, atacamite ($\text{Cu}_2\text{Cl}(\text{OH})_3$) and mussel shells in a coarse-grained sediment layer at 10 – 30 cm below seafloor. This layer could be a slumping from upper parts of the nearby hydrothermal mound, but the formation of native copper probably was *in situ*. Oxygen content in pore water of the coarse-grained layer was low with ca. 10 $\mu\text{mol/l}$, whereas the near-bottom seawater contained 118 $\mu\text{mol/l}$. While the formation conditions and process of native copper will be subject to future studies, this finding clearly indicates the high Cu potential of the KAIMANA hydrothermal field.

Apart from geological investigations we recorded a large number of photo and video data as well as biological samples from KAIMANA and SOORAJ fields in order to complete the samples, data and photo coverage of these sites. In the SOORAJ field reconolization experiments were recovered which were deployed one year ago. Every now and then we either observe and even sample species which were not fully scientifically described or their behavior is not fully understood. Some examples are squids and octopods as the observed squid *Magnapinna* (Fig. 2). The specimen photographed during one ROPOS dive probably is a juvenile animal, i.e. a not fully grown young animal, the length of its tentacles already reaches some meters in length. Another example is a specimen of the deep sea squid *Cirroteuthis* (Fig. 2), the occurrence of which in the Indian Ocean could now be documented. The recorded video

will provide information about the behavior of these animals close to the seafloor and thus about their biology.

Apart from geological and biological sampling with ROV ROPOS we also sampled high-temperature hydrothermal fluids from KAIMANA vents and, for the first time, from the SOORAJ field. Black smoker fluids in the KAIMANA field, Site #5 and Site #1, have been sampled at *in situ* temperatures of 307°C and 280°C, with pH₂₅ of 3.1 and 3.2 and salinities of 43 and 41 psu, respectively. These preliminary measurements confirm our results from 2015, 2018, and 2019 and allow first conclusions on the temporal stability of the system. Two black smokers were sampled for the first time in the SOORAJ field, newly discovered in 2019, which is located in mafic-ultramafic rocks like KAIMANA. First measurements showed pH₂₅ of 4.2 and 5.0, respectively, and a salinity of 50 psu. Thus, all hydrothermal systems visited so far in the INDEX license area during this cruise are characterized by strongly elevated salinities. This can be attributed to boiling of the fluids at depth with subsequent phase separation.

Extensive CTD data (oceanographic data) have been recorded and water samples collected for biogeochemical analyses in five clusters so far during the cruise. First evaluations of the CTD profiles from the northern clusters (#01 and #04), along the Central Indian Ridge, provide comparable data with records from previous years, whereas in the more southern clusters (#05, #07 and #09), at the triple junction and along the Southeast Indian Ridge, slight deviations in the water mass distribution can be observed. These findings must now be investigated in more detail.

On Sunday afternoon RV SONNE has reached Cluster #09 which contains the JIM hydrothermal field discovered in 2022. In this field, which is mainly inactive as known so far, we will work during the upcoming week. Our investigations will also include a site with possible high-temperature vents which was detected during the previous cruise SO 300/1.

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: Dendrites of native copper (scale: 2 cm, left). Occurrence of native copper in the push core sediments (right). Photos: C. Wöhrl (left), S. Sturm (right).

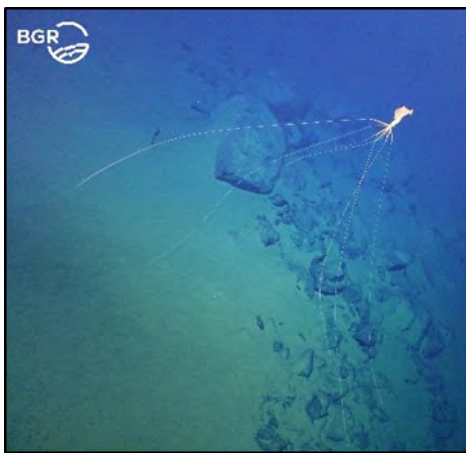


Figure 2: A probably undescribed specimen of a deep-sea squid of the genus *Magnapinna* (left) and an octopus of the genus *Cirroteuthis* (right) in the Indian Ocean.