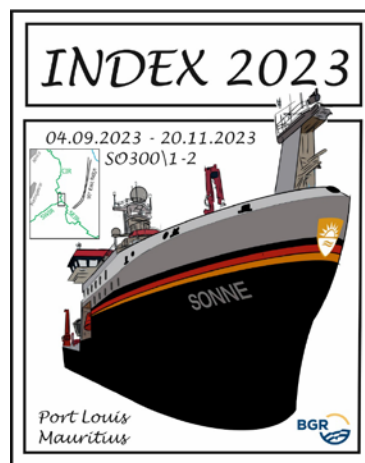


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Short Cruise Report RV SONNE cruise SO300/1

Port Louis – Port Louis (Mauritius)

04.09.2023 – 28.09.2023

Chief Scientist: Udo Barckhausen

Captain: Oliver Meyer

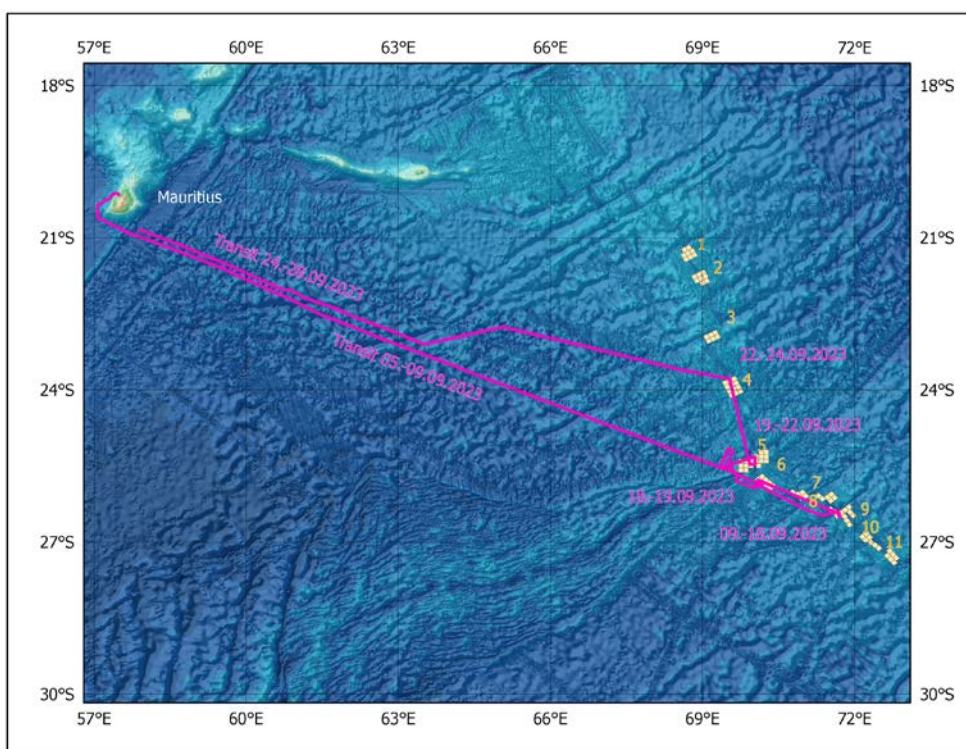


Fig. 1: Cruise track of RV SONNE cruise SO300/1

Objectives

In 2015, BGR signed an exploration contract with the International Seabed Authority (ISA) in Kingston, Jamaica, for polymetallic sulphides (so-called Seafloor Massive Sulphides, SMS) in the central Indian Ocean near the Rodrigues Triple Junction. This exploration contract authorizes and commits Germany, represented by BGR, to a 15-years exploration programme in this license area. The license area is divided into a total of 100, 10 km x 10 km blocks organized in 12 clusters along the southern Central Indian Ridge and the northern South East Indian Ridge. In addition to the specific assessment of the mineral resource potential of the SMS deposits, extensive studies are also being carried out to protect and conserve the marine environment.

The objective of cruise SO300/1 was to carry out electromagnetic surveys of the known JIM, SURYA, KAIMANA, and ALPHA sulphide deposits. This was done with detailed measurements with BGR's GOLDEN EYE (electromagnetic profiler) and HOMESIDE/VULCAN (deep towed bathymetric sled with tri-axial self-potential receivers) measurement systems. The goal was to map the electric and magnetic properties of the sub-seafloor at the SMS deposits and their surroundings down to a depth of a few tens of meters. In addition, the measurements provide ultra high resolution bathymetry data of the areas surveyed and many hours of video observations from the seafloor along the tracklines of the GOLDEN EYE surveys. Another task was the deployment of five Ocean Bottom Seismometers at the KAIREI sulphide mound in order to record the microseismicity for a period of three months.

Narrative

RV Sonne sailed from Port Louis on 5 September on a 1700 km long transit to the first working area in the northern part of the Southeast Indian Ridge. After leaving the 12 nautical mile zone, the recording of underway bathymetry started in the EEZ of Mauritius, which has been mapped very little so far. During the transit a technical problem occurred with the ship's propulsion system, which resulted in a delayed arrival in cluster #9 at the JIM sulphide deposit in the morning of 10 September.

This large field of massive sulphides from a no longer active hydrothermal system was surveyed with the HOMESIDE deep towed bathymetry system in combination with a magnetometer and an attached VULCAN receiver for self-potential measurements, which was towed about 50 m above the seafloor on 11 survey lines each 6.7 km long. In total, an area of 18.6 km² was mapped in 51 hours. This was followed by a survey with GOLDEN EYE using the coil system and magnetometer. The deployment lasted for 111.5 hours until 18 Sept.; however, this survey had to be interrupted repeatedly due to high winds and swell which made the precise navigation of the ship along the survey lines impossible.

After a 190 km transit to the northwest to the SURYA field in cluster #6 was reached. This presumably only small active hydrothermal field was surveyed in a 21-hour deployment with HOMESIDE and a VULCAN receiver until the evening of 19 Sept, covering an area of 12.7 km². During the hoisting of HOMESIDE towards the water surface, probably due to a movement of the ship in the swell, a malfunction occurred at 1650 m cable length when the cable jumped off a guide pulley in the winch room.

The work to fix the immediate problem took several hours and as it was clear that a repair with a new termination of the fibre optic cable would be required afterwards, a bathymetry mapping was carried out at short notice in the area west of the license area and directly north of the Rodrigues Triple Junction.

On the evening of 20.09. all repairs were completed and work continued with deploying a total of five ocean bottom seismometers (OBS) 65 km north of the last station at the KAIREI field in cluster #5. Since in this case it was important to place the OBS very precisely on the hill of an inactive hydrothermal field, a video-guided placement device was used for the first time at BGR. This enabled a total of four OBS to be placed on the seabed during the night of 20 September, with full control of the position and nature of the placement point. A fifth OBS was placed classically in free fall mode. The instruments will record local seismicity until the end of December and will be recovered during cruise SO301.

After a short transit, the GOLDEN EYE was deployed again on the morning of 21.09. to map out in detail a self potential anomaly with high conductivities in the seabed found last year at the KAIMANA field in cluster #5. During this 24-hour deployment, a previously unknown inactive area of the extensive KAIMANA massive sulphide field was confirmed by the morning of 22 September.

After a further transit of almost 200 km to the north, the last working area of the cruise was reached at the ALPHA field in cluster #4. An extension of the hydrothermal field found in recent years with predominantly inactive massive sulphide areas was surveyed in detail with electromagnetic methods using the GOLDEN EYE from the evening of 22 September. The coil system and the dipole-dipole system of the GOLDEN EYE were used

successively. In the last section of the survey, the device was also briefly set down a total of 37 times in order to achieve the best possible coupling of the measurements to the seabed.

On the afternoon of Sunday, 24.09. the time for the scientific programme of this cruise had expired and the GOLDEN EYE was taken on board for the last time in the early evening after 46 hours. On the return transit to Port Louis, underway bathymetry mapping was continued until reaching the 12 nautical mile zone of the island of Mauritius in the early morning hours of 28 Sept. RV SONNE berthed in Port Louis on 28 Sept., 09:30.

Acknowledgements

We are grateful to the Government of the Republic of Mauritius for granting permission to work in Mauritius' Exclusive Economic Zone. The cruise was carried out based on an agreement between the Federal Ministry for Science and Education and the Ministry for Economic Affairs and Energy. We thank the German Research Fleet Coordination Centre, Institute for Geology, Hamburg University, and BRIESE research for their comprehensive support in logistic preparation of the cruise. On behalf of the scientific crew, I would like to thank captain Oliver Meyer and the ship's crew for their outstanding assistance and support during all survey operations.

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BGR	BGR Federal Institute for Geosciences and Natural Resources, Hannover, Germany
INES	Integrated Environmental Solutions UG, Wilhelmshaven, Germany
HCU	Hafen City University Hamburg, Germany
SIO	Scripps Institution of Oceanography, UCSD, San Diego, USA
ISA	International Seabed Authority
Mauritius	Government of Mauritius

Stationsliste

Station No.	Date and Time [UTC]	Device	Latitude	Longitude	Depth [m]
SO300/1_2-1	07.09.2023 04:09	CTD	23° 30,153' S	064° 02,732' E	3779.6
SO300/1_2-1	07.09.2023 05:40	CTD	23° 30,150' S	064° 02,735' E	3785.9
SO300/1_3-1	07.09.2023 05:41	OBEM	23° 30,150' S	064° 02,735' E	3780.2
SO300/1_3-1	07.09.2023 06:49	OBEM	23° 30,154' S	064° 02,740' E	3800.2
SO300/1_4-1	07.09.2023 06:56	MB	23° 30,115' S	064° 02,922' E	3763.4
SO300/1_4-1	09.09.2023 08:52	MB	25° 52,131' S	064° 02,740' E	3039.4
SO300/1_0 Underway-4	08.09.2023 04:40	UWS	24° 35,227' S	066° 51,602' E	3813.9
SO300/1_0 Underway-4	25.09.2023 15:50	UWS	22° 46,706' S	065° 08,448' E	4399.5
SO300/1_5-1	09.09.2023 08:59	OBEM	25° 52,314' S	070° 05,164' E	2985.7
SO300/1_5-1	09.09.2023 13:12	OBEM	25° 52,312' S	070° 05,157' E	2986.3
SO300/1_7-1	10.09.2023 02:17	CTD	26° 23,530' S	071° 40,933' E	3814.2
SO300/1_7-1	10.09.2023 04:22	CTD	26° 23,531' S	071° 40,931' E	
SO300/1_8-1	10.09.2023 04:24	MB	26° 23,531' S	071° 40,931' E	
SO300/1_8-1	12.09.2023 10:05	MB	26° 25,562' S	071° 40,178' E	2771.9
SO300/1_9-1	12.09.2023 12:00	OBEM	26° 28,563' S	071° 41,545' E	2846.3
SO300/1_9-1	12.09.2023 17:21	OBEM	26° 28,575' S	071° 41,530' E	2847.3
SO300/1_10-1	13.09.2023 02:30	MB	26° 30,723' S	071° 41,813' E	3049.4
SO300/1_10-1	13.09.2023 09:30	MB	26° 24,080' S	071° 39,967' E	3514.8
SO300/1_11-1	13.09.2023 10:44	OBEM	26° 28,549' S	071° 41,595' E	2836.6
SO300/1_11-1	18.09.2023 02:45	OBEM	26° 26,432' S	071° 40,909' E	2673.1
SO300/1_12-1	18.09.2023 14:34	MB	25° 46,579' S	070° 05,238' E	3319.2
SO300/1_12-1	19.09.2023 18:57	MB	25° 52,426' S	070° 10,605' E	3095.9
SO300/1_13-1	19.09.2023 20:26	MB	25° 55,796' S	069° 59,827' E	3137.7
SO300/1_13-1	20.09.2023 07:23	MB	25° 25,002' S	069° 20,956' E	2838.1
SO300/1_14-1	20.09.2023 15:00	SEISOBR	25° 31,416' S	070° 02,528' E	2434.6
SO300/1_14-1	20.09.2023 19:06	SEISOBR	25° 19,317' S	070° 02,470' E	2439.1

SO300/1_15-1	20.09.2023 19:23	SEISOBR	25° 19,313' S	070° 02,471' E	2437.0
SO300/1_15-1	20.09.2023 22:30	SEISOBR	25° 19,375' S	070° 02,234' E	2606.4
SO300/1_16-1	20.09.2023 22:32	SEISOBR	25° 19,375' S	070° 02,235' E	2607.5
SO300/1_16-1	20.09.2023 22:34	SEISOBR	25° 19,375' S	070° 02,235' E	2612.3
SO300/1_17-1	21.09.2023 02:05	OBEM	25° 28,103' S	069° 55,710' E	2717.6
SO300/1_17-1	22.09.2023 02:50	OBEM	25° 27,906' S	069° 56,111' E	2922.9
SO300/1_18-1	22.09.2023 13:54	OBEM	23° 46,825' S	069° 32,055' E	3073.2
SO300/1_18-1	24.09.2023 12:07	OBEM	23° 46,998' S	069° 32,422' E	3042.5
SO300/1_20-1	25.09.2023 04:00	CTD	23° 11,536' S	066° 54,103' E	3467.7
SO300/1_20-1	25.09.2023 05:40	CTD	23° 11,537' S	066° 54,103' E	3483.0
SO300/1_21-1	25.09.2023 05:47	MB	23° 11,408' S	066° 53,836' E	3507.2
SO300/1_21-1	27.09.2023 22:57	MB	20° 14,181' S	056° 51,001' E	4346.2