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Short Cruise Report
SONNE cruise SO259
Colombo (Sri Lanka) – Cape Town (South Africa)
24.08.2017 – 13.10.2017
Chief Scientist: Dr. Ulrich Schwarz-Schampera
Captain: Lutz Mallon

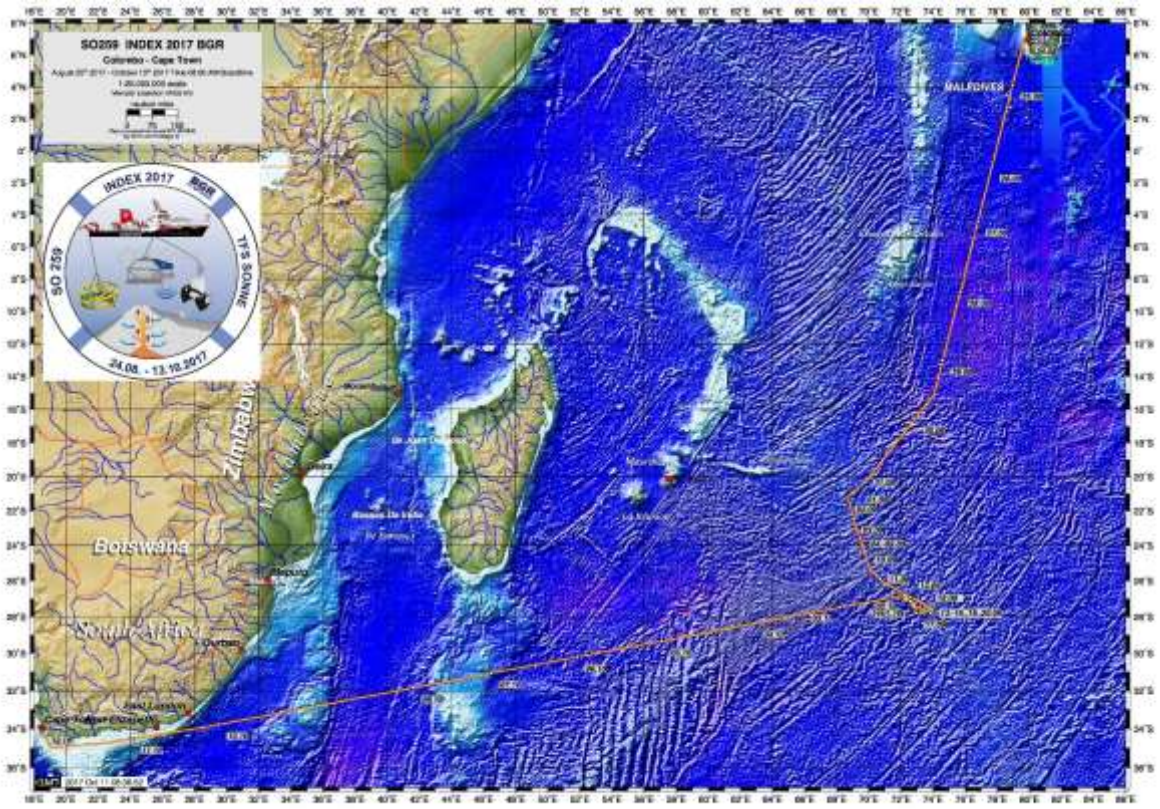

Fig. 1. Overview of the SO259 (INDEX 2017) working area, the cruise plot and courses along the southern Central and the northern Southeast Indian Ridge, Central Indian Ocean. The cruise started in Colombo, Sri Lanka and ended in Cape Town, South Africa.

ABSTRACT

The SO259 expedition (INDEX 2017) of BGR with TFS SONNE targeted the German license area for polymetallic sulfides in the Indian Ocean. Cruise participants included the Universities at Bremen, Hamburg, HCU Hamburg, Erlangen, the DZMB Senckenberg Am Meer Wilhelmshaven and GEOMAR in Kiel. Trainees from Egypt, Thailand, Cook Islands, Ghana and Nigeria represented the International Seabed Authority. The cruise focused on the detailed bathymetric, geophysical and geological exploration for active vents and inactive sulfide fields in the clusters #10, #11 and #12. The wider license area, the clusters #1, #3#, #4, #5 and #7 and the clusters of interest were also sampled for environmental, i.e., (paleo) oceanographic, sedimentary and faunal base line studies by gravity coring and multicoring, water sampling, and sediment trap moorings. Very few environmental and geological studies exist in this part of the Indian Ocean so far. Our work contributes to the understanding of regional oceanographic and sedimentation processes and to the faunal census.

Cruise SO259 (INDEX 2017) was very successful. Sea conditions were generally good with only one day of limited operational capability. Ship operation was unproblematic. A total of 109 stations with survey, observation and sampling operations were completed and 14 different operational tools were used for diverse and extensive exploration and environmental studies in transit and within the license area, including

- 17 vertical CTD rosette casts for environmental, water masses and sedimentary studies,
- 7 multicorer and five gravity corer stations for paleooceanographic and biogeochemical studies,
- 4 heat flow probe measurements for crustal temperature regime estimations,
- 27 wax corer and 13 dredge stations for petrological reconnaissance and spreading ridge evolution studies,
- 8 sediment trap and one ADCP mooring operations for biogeochemistry, particle flux and ocean current measurements,
- 6 deep-towed HOMESIDE surveys for high-resolution bathymetric mapping, magnetics and water anomaly surveys (total of 329 km in 147 hours),
- 8 tow-yo stations with the SOPHI sensor sled for plume hunting (125 km, 119 hours),
- 4 STROMER video sled ocean floor observations,
- 3 Golden Eye operations for electromagnetic measurements (4 km, 22 hours),
- 2 TV-guided grab survey and sampling operations,
- 4 bathymetric, magnetic and gravity surveys (total of 783 km and 60 hours for 14 profiles).

Additionally, two transit profiles in the license area (450km, 24 hours) for bathymetry and magnetics, a total of 9,430 km of swath bathymetric mapping (776 hours) and 9,955km (1,005 hours) of scientific echosounder measurements for water column imaging were carried out. The biodiversity was studied and sampled at 51 stations with 630 samples and 3,232 individuals, and 5:29 hours of video material and 4522 photos were collected. Molecular work produced a number of 422 cell extractions and 305 PCR DNA products from different species.

Four plumes were detected during eight tows with the plume sled SOPHI (125 km) and a new site of hydrothermal venting was localized by HOMESIDE and STROMER surveys on the eastern graben flank of cluster #11, and named “New SONNE” field. The site is located at the eroding upper slope of a 300m wide fault bound plateau. It shows diffuse discharge at small mounds, with well-developed characteristic vent fauna and the venting of clear, probably phase-separated hydrothermal fluids. Secondary copper mineral phases in an area of eroded stockwork mineralization indicate high fluid temperatures in the subsurface. Features prospective for active and inactive sulfide sites were identified in all three clusters, both on the eastern and western graben valleys. Our findings attest to the high potential for sulfide mineralization in all three clusters.

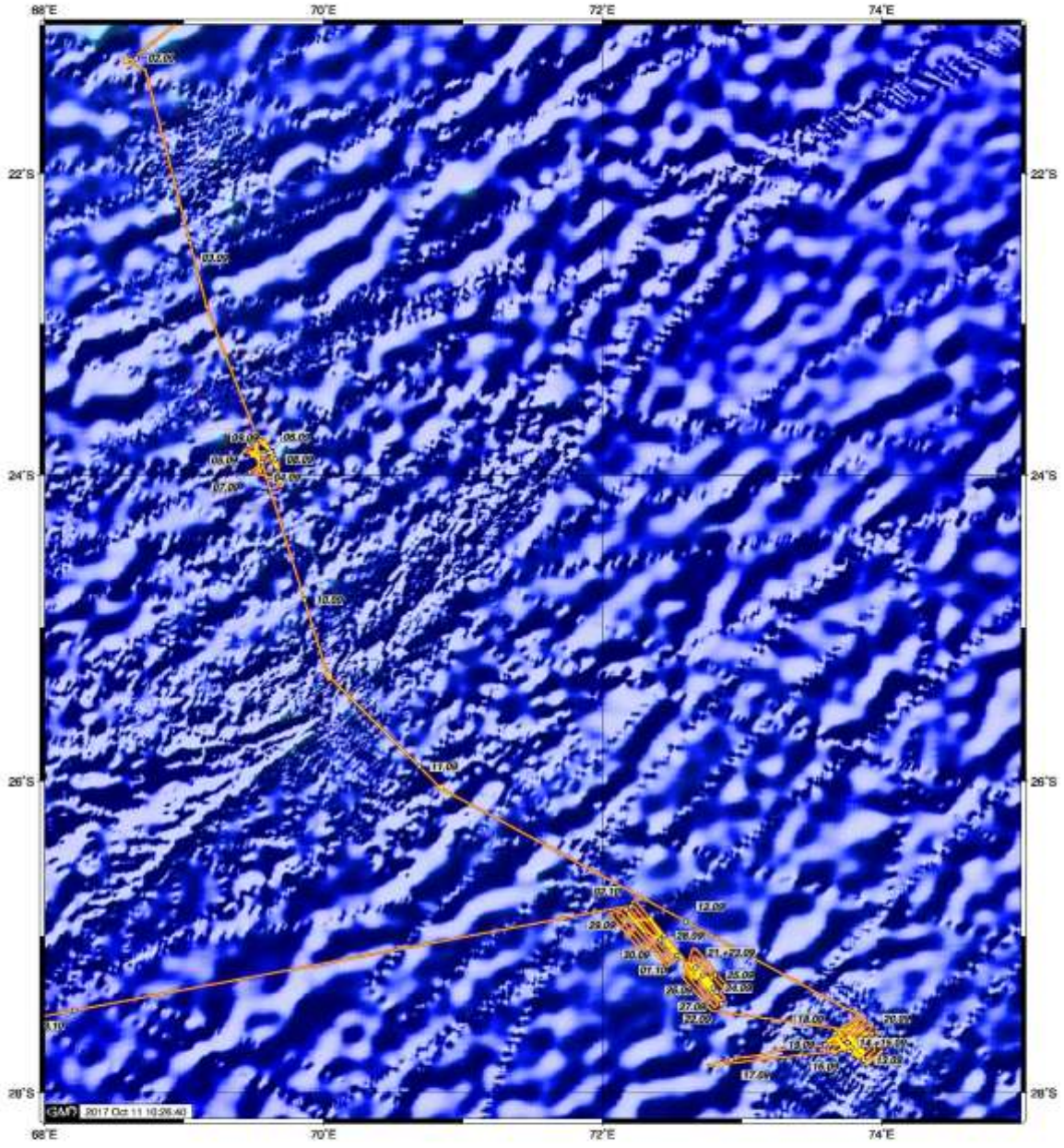

Fig. 2. Overview of the SO259 (INDEX 2017) working areas (from North to South cluster #1, cluster #2, cluster #3, cluster #4, cluster #5, cluster #7, cluster #10, cluster #11 and cluster #12) and courses along the southern Central and the northern Southeast Indian Ridge, Central Indian Ocean (refer to Fig. 3 for cluster distribution in the German license area).

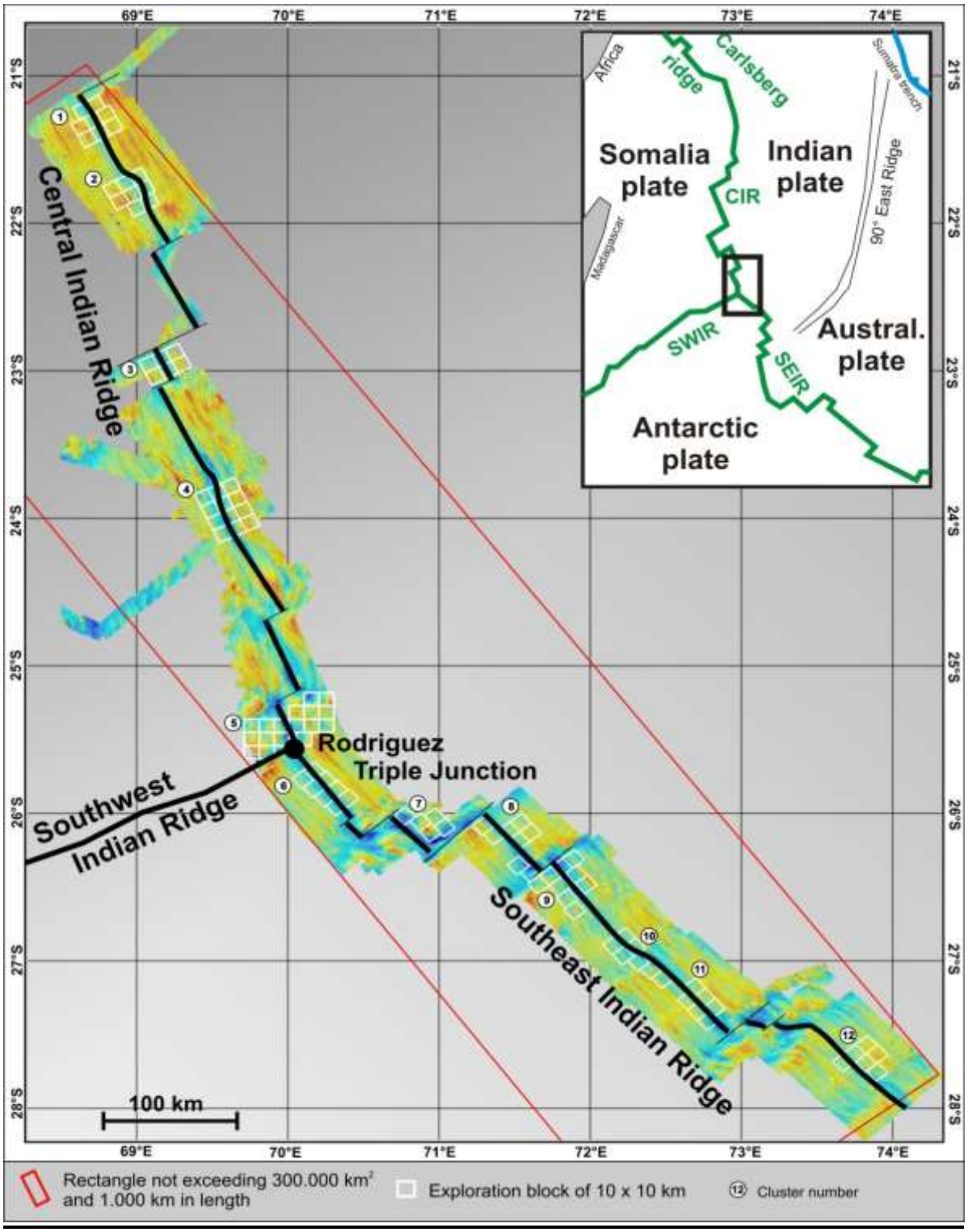

Fig. 3. The German exploration license area along the southernmost Central Indian Ridge and the northernmost Southeast Indian Ridge. Cruise SO259 (INDEX 2017) with FS SONNE addressed the clusters #1, #3#, #4, #5, #7, #10, #11 and #12 along the southern Central and the northern Southeast Indian Ridges.

1. CRUISE NARRATIVE

The Shipboard Scientific Party for cruise SO259 (INDEX2017) boarded TFS SONNE in Colombo, Sri Lanka in the morning of August 23rd (Fig. 1). The containers and the lab equipment were delivered in the morning hours and were taken aboard. Heavy weight equipment including the plume sled SOPHI (PS), gravity corer (GC) and multicorer (MUC) and their weights, HOMESIDE (HMS), the video sled STROMER (STR), the TV-guided grab (TVG), Golden Eye (GE), sediment trap (ST) and ADCP equipment and anchors, the heat flow probe (HF), magnetometers (Bathy), the wax corer (WC) and the dredges (DR) as well as various laboratory equipment were installed and unpacked during the afternoon.

We arrived at the first CTD station (*INDEX2017-01CTD*) for the identification of south-flowing water masses on Saturday August 26th at 14:00 (figs. 1, 2). At a total water depth of 5,007m, the oxygen minimum zone from the Arabian Sea flowing south occurs at 700m depth. A shallow CTD (*INDEX2017-02CTD*) at same position sampled the trophic zone down to 300 m water depth. The next set of CTD stations (*INDEX2017-03CTD*, *-04CTD*) on August 28th targeted the water masses east of the Mascarene plateau down to 5,000 m and 300m, respectively. The oxygen-depleted zone developed irregularly and already starts at 80 m water depth, seems to undulate and occurs down to a depth of about 1,500 m. The third open ocean CTD station on Tuesday August 29th covered the entire water depth of 5,183m (*INDEX2017-05CTD*) and subsequently to 300 m water depth (*INDEX2017-06CTD*). Arrival at the first sediment station in the morning of August 31st, at 150km east of the CIR graben axis. Start of station *INDEX2017-07CTD* at a water depth of 3,271m.

A mixed layer water mass was observed at 165m. A multicorer station was deployed at same location (*INDEX2017-08MUC*) with successful sampling of 12 cores with up to 15 cm core length. The subsequent gravity core station *INDEX2017-09GC* recovered 480 cm of foraminiferal ooze. Work at this location ended with successful heat flow measurements (*INDEX2017-10HF*). The same set of stations were repeated 100km and 50km east of the CIR axial graben at 3,238m and 3,272m water depths (*INDEX2017-11CTD, -12MUC, -13GC* (8,94 m recovery), *-14HF* and *INDEX2017-15CTD, -16CTD, -17MUC, -18GC* (recovery of 2,87m) and *-19HF*.

On Saturday September 2nd we reached our license area (cluster #1; Fig. 3) in the CIR graben axis. Station *INDEX2017-20WC* addressed the sampling of a young axial volcanic edifice in the northern part of the cluster. After a short transit we recovered the sediment trap mooring cluster 01-01 (station *INDEX2017-21ST*) which was installed during cruise INDEX2016_2. The recovery was followed by station *INDEX2017-22MUC* at the same location of the sediment trap mooring. The multicorer recovered 12/12 cores with 30cm on average. Subsequently we redeployed a sediment trap mooring at the same position (cluster01-02; station *INDEX2017-23ST*) for interannual variation studies. Two more volcanic edifices were sampled successfully with stations *INDEX2017-24WC* and *-25WC*. Afterwards, a 10hours transit brought us to the site of sediment trap mooring 03-01 (cruise INDEX2016_2) in cluster #3. We started the acoustic release of the mooring (station *INDEX2017-026ST*) at 06:25 on Sunday, September 3rd. A weak buoyancy from 3,700m water depth was related to imploded float modules but the mooring was recovered safely. Station *INDEX2017-27MUC* at the same location was not successful. After a short transit to cluster #4 (~5 hrs) the preparation of the first Golden Eye operation started for electromagnetic measurements at the known ALPHA field. The station failed because of problems with the electrical conductivity and identification of cable leakage. A series of wax corer stations (*INDEX2017-28WC, -29WC, -30WC*) addressed volcanic edifices along the graben axis in the northern part of cluster #4. The sediment trap mooring (trap cluster 04-02, *INDEX2017-31ST*) was recovered. Again, four Benthos 17'' float modules imploded. We resumed station *INDEX2017-32GE* for measurements at the ALPHA field. Sea conditions and the lightweight of Golden Eye ended

up in vast movements on the cable, with the termination getting tangled with ropes and subsequent rupture of an attached line to the cable. Technical failures made recovery necessary. Damages of the cable led to alternative wax corer stations (*INDEX2017-33WC, -34WC, -35WC, -36WC*) targeting volcanic edifices. Station *INDEX2017-37HMS* aimed at the high-resolution mapping of the wider ALPHA area and continued to Wednesday noon, September 6th. Three active fields were reidentified over the ALPHA field (α1-α3) by bathymetry and their plumes by the WCI function. A deployment of station *INDEX2017-38GE* on the same profile as station -32GE failed again in a water depth of 800m due to weather conditions, lightweight and the instability of the Golden Eye installation despite SONNE's wave compensation technology. A series of successful dredge stations addressed the graben flanks in cluster 4 (*INDEX2017-39DR, -40DR, -41DR, -42DR*). At 20:54 start of station *INDEX2017-43HMS* at the upper ridge segment of the eastern graben wall checking for sulfide occurrences at elevations higher than the known ALPHA and EGS fields. The station finished after 31:23 hours and 70.4 km of high-resolution bathymetry (32.38 sqkm). HOMESIDE bathymetry was followed by the deployment of particle flux sediment mooring station *INDEX2017-44ST* (cluster 04-03) at 06:20. The mooring is ~2,837m long and contains three sediment traps. Station *INDEX2017-45CTD* was deployed at the deepest graben axis in cluster #4 (4,218m water depth) in the northern half of the cluster, some 3-4 nm apart from the sediment mooring site of -44ST.

On Sunday, September 10th, arrival in cluster #5 for station INDEX2017-46PS for SOPHI sensor and mapr testing and plume reidentification at the known KAIREI field. The following station *INDEX2017-47TVG* was aborted due to malfunction during closing at 50m water depth. Deployed of *INDEX2017-48ADCP* mooring about 200m SE of the inactive mound of the KAIREI vent field. The sea conditions prevented the planned Golden Eye station at the KAIREI field in order to avoid additional damages to the fibre optic cable and the Golden Eye system. Afterwards we left cluster #5 for an installation of a sediment trap mooring in cluster #7 (transit 60nm, 7:00 hrs). We arrived in cluster #7 on Monday 11th and started station *INDEX2017-49CTD* for a water masses survey at 06:00, followed by shallow cast and water sampling down to 500m water depth at the same position (*INDEX2017-50CTD*). Afterwards, we continued with the deployment of the sediment trap mooring cluster 07-01 (station *INDEX2017-51ST*). Start of bathymetric, magnetic and gravity measurements of station *INDEX2017-52Bathy* on transit to cluster 12. Deployment of the magnetometer gradiometer at 17:00 and start of the track at 19:00. The length of the transit is 315 km.

We arrived at cluster #12 on Tuesday, September 12th, 11:30 and immediately started the bathymetric, magnetic and gravity measurements of station *INDEX2017-53Bathy* at 11:38. The survey included 10 profiles in SW-NE direction with 3.3 km profile spacing, with a total of 240km (130nm) of magnetic and bathymetry measurements. After completion, we started station *INDEX2017-54PS* with a 17nm long SOPHI tow-yo survey along the graben axis to check the water column for particle and redox plumes. During the night to September 14th we continued with three wax corer stations (*INDEX2017-55WC, -56WC, -57WC*. In the morning, we started station *INDEX2017-58HMS* on the upper eastern slope in the southern-central part of the cluster. The high resolution mapping finished on Friday 15th, after 59.2 km of profiling on four parallel lines and 24 hours of bottom time. It identified vast sheet flow terraces between prominent fault offsets. Pillow domes are distributed in between the faults but also on fault scarps. We continued with the deployment of the sediment trap mooring (cluster 12-01) in the southernmost and deepest part of cluster 12 (station *INDEX2017-59ST*). At 2 nm distance, we deployed station *INDEX2017-60CTD* for a full depth range CTD cast and station *INDEX2017-61CTD* for sampling of the upper 600m of the water column. During the night and until noon on Saturday, September 16th we deployed a series of wax corer station at young volcanic edifices in the southern ridge axis (*INDEX2017-62WC, -63WC, -64WC, -65WC, -66WC, -*

67WC, - 68WC). The following station *INDEX2017-69HMS* targeted the lower western graben slope of the SEIR. Station -69HMS covered a total of 45km in four profiles approximately 10 km long. End of the HMS station on Monday 18th at 20:58. Several dredge stations to sample the younger western and eastern graben flanks followed during the night (*INDEX2017-70DR, -71DR, -72DR*). We continued with station *INDEX2017-73PS* for the identification of the plume recorded during -69HMS. No plumes were detected in the water column above the edifice (3,402m). Station *INDEX2017-74STR* identified a lobate to pillow lava edifice, intensely structured by steep graben faults. We continued the program with the transit to sediment sampling and associated heat flow measurements at the easternmost border of cluster #12 in a small sedimentary basin in between ancient volcanic graben ridges (*INDEX2017-75GC*, 337cm length). Station *INDEX2017-76MUC* at the same location recovered 11-15cm of surface sample material. Station *INDEX2017-77HF* had two successful penetrations. The measurements resulted in a very high heat flow with a calculated temperature increase of 3°C within the upper 10m of sediment. After the recovery, we started our transit to cluster #11 at 08:30 and deployed the magnetometers for station *INDEX2017-78Bathy* for bathymetry, magnetic and gravity measurements in transit (~50nm) and in cluster 11 (in total ~23 hours, ~190km, 3.3km line spacing in cluster #11).

On Thursday, September 21st, we finished the mapping survey in cluster #11. Station *INDEX2017-79PS* along the graben axis detected a small particle and dORP anomaly with a peak at ~2,950m. Stations *INDEX2017-80WC* and *-81WC* sampled young axial volcanic edifices. In the morning, we deployed station *INDEX2017-82HMS* for a reconnaissance dive on the source of the dORP plume identified earlier, close to the northern end of cluster #11. The station performed high resolution mapping along the eastern graben flank. There was evidence of two plumes in the water column. Redox and pH anomalies are present, which can be addressed to the edge of a fault-bound terrace. The program continued with the deployment of station *INDEX2017-83STR* for vent field verification. However, no evidence for hydrothermal activity was observed. We resumed our petrological sampling program with stations *INDEX2017-84DR* and *-85DR*. Another STROMER station (*INDEX2017-86STR*) at the edge of the eastern graben wall to identify the “vent 1” site did not identify any indications for hydrothermal activity. Given the calm sea conditions, we continued with another attempt to deploy Golden Eye for electromagnetic measurements along the eastern upper graben flank (*INDEX2017-87GE*). Successful measurements were carried out in a planned quadrangle above a basaltic plateau. While crossing the area of the anomaly “vent2”, the camera identified a rather distal hydrothermal vent fauna including crabs and anemones on pillow basalt outcrops. No vent indications were recorded at site “vent1”, confirming the results of station -86STR. We deployed *INDEX2017-88PS* on the redox anomaly (plume maximum at 2,952m) in the central graben identified during station –79PS. The 7 km-long tow across the graben axis identified a maximum plume thickness of 194x160m. A series of petrological stations followed to study the geochemical variation in cluster #11 and identify potential host rocks for hydrothermal sites (*INDEX2017-89WC, -90WC, -91WC, -92DR, -93DR*). The following station *INDEX2017-94STR* intended to localize the new vent field at the eastern flank of cluster #11. The STROMER track started at the base of a steep slope (70°) above a prominent normal fault scarp. While moving up the slope obvious oxidized sulfide debris and intensely altered basaltic fragments occurred in the talus apron. Single inactive upright mounds and chimneys were identified as intensely oxidized former sulfide edifices. The active field is characterized by diffuse discharge. The venting of clear to very faint grey fluids suggest phase-separation processes at depth. There are virtually no particles or smoke visible. Following the tradition, we named the location of the venting “New SONNE field”. We avoided damages to the site and the vent fauna by using our TV-guided grab and decided to postpone the sampling to a cruise with ROV opportunity. The TV-guided grab, however, was deployed (*INDEX2017-95TVG*) to sample the volcanic plateau on the eastern slope of cluster #11, which was

surveyed in detail during station -87GE. A 5 km-long plume sled tow (*INDEX2017-96PS*) at the northwestern upper flank of the graben aimed at the survey of a significant and rather regional magnetic low. The tow relocated the plume identified in station -88PS with same intensities. We finished our workings in cluster #11 and started the transit and bathymetric, magnetic and gravity survey in cluster #10 on Thursday morning, September 28th.

Start of station *INDEX2017-97Bathy* within cluster #10 at 02:19, with a total length of 181nm (98km; 3.3 km profile spacing). Continuing with station *INDEX2017-98PS* to survey the blocks of cluster #10 for plumes and hydrothermal activity along the axial and western graben flank by a 30km (16nm) long survey from N to S of the cluster. No plumes were detected during the tow. The following casts *INDEX2017-99CTD* and *-100CTD* aimed at the full identification of the water masses in cluster #10 down to a water depth of 4,240m. We continued the SOPHI survey of station -98PS with *INDEX2017-101PS* to tow the remaining 20 km (11nm) of axial and western graben area of the southern part of cluster #10. We continued with the transit to the site of scheduled sediment trap deployment (-105ST) and started station *INDEX2017-102GC* at a small sedimentary basin at the easternmost edge of cluster #10. The station recovered a disturbed core of 100cm length. Station *INDEX2017-103MUC* addressed the same position for surface sediment sampling. It recovered 12/12 cores filled with 15-17 cm of sediment. The following station *INDEX2017-104HMS* aimed at the survey of an interesting fault bound volcanic ridge on the western flank at the southern end of cluster #10. This volcanic and structural feature shows a pronounced positive magnetic anomaly and may suggest an OCC-type origin. Sediment trap 10-01 was deployed at station *INDEX2017-105ST*. Our workings during SO259 (INDEX2017) ended with a set of rock sampling stations for petrological purposes (*INDEX2017-106WC, -107WC, -108DR, -109DR*). After the last dredge station, we departed for the transit to Cape Town, South Africa (2,868nm, 5,311km) at 08:15. Magnetometer gradiometer was deployed for the transit onto the EEZ of South Africa. However, after 1,334km (60,5 hours) two magnetometers were lost due to shark bite(s) in the cable at ~20:30 on Wednesday, October 4th. Subsequent recovery of the remaining magnetometer. Continuing swath bathymetric mapping and EK60 scientific echosounding until we reached the EEZ of South Africa at noon, October 9th. We arrived in Cape Town, South Africa on October 13th 2017. On pilot station at 05:00. Arrival on the pier (“D”) at 06:00. Demobilization and leaving of the scientific crew for the airport.

Table 1. Timing and station plan during cruise SO259 (INDEX 2017).

Date	**Activities**	**Position**	**Working days/at sea**
Sun 20.08.2017	Departure		1
Mon 21.08.2017	Arrival Colombo, Sri Lanka		2
Tue 22.08.2017	Colombo, Sri Lanka. Ship, agent, immigration management		3
Wed 23.08.2017	Colombo, Mobilization on TFS SONNE		4
Thu 24.08.2017	Departure Colombo, Mobilization **Transit**		5 / 1
Fri 25.08.2017	**Transit**, Mobilization		6 / 2
Sat 26.08.2017	**Transit** INDEX2017-01CTD INDEX2017-02CTD	 02°45’S 77°10’E 02°45’S 77°10’E	7 / 3

Table 1. (continued) Timing and station plan during cruise SO259 (INDEX 2017).

Sun 27.08.2017	**Transit**			8 / 4
Mon 28.08.2017	**Transit**			9 / 5
	INDEX2017-03CTD	08°49'S	74°26'E	
	INDEX2017-04CTD	08°49'S	74°26'E	
Tue 29.08.2017	**Transit**			10/6
	INDEX2017-05CTD	15°05'S	71°36'E	
	INDEX2017-06CTD	15°05'S	71°36'E	
Wed 30.08.2017	**Transit**			11/7
Thu 31.08.2017	**Transit**			12/8
	INDEX2017-07CTD	20°21.438'S	69°45.064'E	
	INDEX2017-08MUC	20°21.438'S	69°45.064'E	
	INDEX2017-09GC	20°21.438'S	69°45.064'E	
	INDEX2017-10HF	20°21.438'S	69°45.064'E	
	INDEX2017-11CTD	20°40.015'S	69°19.522'E	
	INDEX2017-12MUC	20°40.015'S	69°19.522'E	
Fri 01.09.2017	**Transit**			13/9
	INDEX2017-13GC	20°40.015'S	69°19.522'E	
	INDEX2017-14HF	20°40.015'S	69°19.522'E	
	INDEX2017-15CTD	20°57.582'S	68°54.988'E	
	INDEX2017-16CTD	20°57.582'S	68°54.988'E	
	INDEX2017-17MUC	20°57.582'S	68°54.988'E	
	INDEX2017-18GC	20°57.582'S	68°54.988'E	
	INDEX2017-19HF	20°57.582'S	68°54.988'E	
Sat 02.09.2017	**Cluster #1/1**			14/10
	INDEX2017-20WC	21°13.648'S	68°39.430'E	
	INDEX2017-ST21	21°14.80'S	68°35.47'E	
	INDEX2017-22MUC	21°14.80'S	68°35.47'E	
	INDEX2017-23ST	21°14.80'S	68°35.47'E	
	INDEX2017-24WC	21°18.316'S	68°43.386'E	
	INDEX2017-25WC	21°20.333'S	68°43.974'E	
Sun 03.09.2017	**Cluster #3/1**			15/11
	INDEX2017-026ST	22°53.11'S	69°09.70'E	
	INDEX2017-27MUC	22°53.11'S	69°09.70'E	
	Cluster #4/1			
	INDEX2017-28WC	23°48.715'S	69°31.469'E	
Mon 04.09.2017	**Cluster #4/2**			16/12
	INDEX2017-29WC	23°52.171'S	69°31.400'E	
	INDEX2017-30WC	23°54.996'S	69°33.506'E	
	INDEX2017-31ST	23°51.89'S	69°29.78'E	
	INDEX2017-32GE	23°46.838'S	69°32.118'E	
Tue 05.09.2017	**Cluster #4/3**			17/13
	INDEX2017-33WC	23°48.205'S	69°27.651'E	
	INDEX2017-34WC	23°50.532'S	69°25.475'E	
	INDEX2017-35WC	23°54.004'S	69°36.573'E	
	INDEX2017-36WC	23°58.799'S	69°32.667'E	
	INDEX2017-37HMS	23°47.180'S	69°30.357'E	
Wed 06.09.2017	**Cluster #4/4**			18/14
	INDEX2017-38GE	23°45.99'S	69°32.85'E	
	INDEX2017-39DR	23°56.172'S	69°32.497'E	

Table 1. (continued) Timing and station plan during cruise SO259 (INDEX 2017).

Thu 07.09.2017	**Cluster #4/5**			19/15
	INDEX2017-40DR	23°58.558’S	69°28.994’E	
	INDEX2017-41DR	24°01.653’S	69°40.423’E	
	INDEX2017-42DR	24°04.696’S	69°40.261’E	
	INDEX2017-43HMS	23°56.568’S	69°40.492’E	
Fri 08.09.2017	**Cluster #4/6**			20/16
	INDEX2017-43HMS	23°56.568’S	69°40.492’E	
Sat 09.09.2017	**Cluster #4/7**			21/17
	INDEX2017-43HMS	23°56.568’S	69°40.492’E	
	INDEX2017-44ST	23°51.89’S,	69°29.78’E	
	INDEX2017-45CTD	23°54.759’S	69°33.357’E	
Sun 10.09.2017	**Cluster #5/1**			22/18
	INDEX2017-46PS	25°19.497’S	70°02.071’E	
	INDEX2017-47TVG	25°19.229’S	70°02.429’E	
	INDEX2017-48ADCP	25°19.229’S	70°02.429’E	
Mon 11.09.2017	**Cluster #7/1**			23/19
	INDEX2017-49CTD	26°02.776’S	70°50.391’E	
	INDEX2017-50CTD	26°02.776’S	70°50.391’E	
	INDEX2017-51ST	26°02.776’S	70°50.391’E	
	INDEX2017-52Bathy	26°03.237’S	70°51.249’E	
Tue 12.09.2017	**Cluster #12/1**			24/20
	INDEX2017-53Bathy	27°30.322’S	73°50.049’E	
Wed 13.09.2017	**Cluster #12/2**			25/21
	INDEX2017-54PS	27°49.081’S	73°53.607’E	
Thu 14.09.2017	**Cluster #12/3**			26/22
	INDEX2017-55WC	27°36.261’S	73°40.550’E	
	INDEX2017-56WC	27°41.730’S	73°45.618’E	
	INDEX2017-57WC	27°42.721’S	73°45.922’E	
	INDEX2017-58HMS	27°38.290’S	73°46.460’E	
Fri 15.09.2017	**Cluster #12/4**			27/23
	INDEX2017-59ST	27°48.169’S	73°53.345’E	
	INDEX2017-60CTD	27°48.169’S	73°53.345’E	
	INDEX2017-61CTD	27°48.169’S	73°53.345’E	
Sat 16.09.2017	**Cluster #12/5**			28/24
	INDEX2017-62WC	27°46.080’S	73°49.391’E	
	INDEX2017-63WC	27°44.256’S	73°46.149’E	
	INDEX2017-64WC	27°43.453’S	73°45.081’E	
	INDEX2017-65WC	27°42.732’S	73°44.587’E	
Sun 17.09.2017	**Cluster #12/6**	27°43.892’S	73°43.730’E	29/25
	INDEX2017-66WC	27°44.442’S	73°44.904’E	
	INDEX2017-67WC	27°47.787’S	73°52.753’E	
	INDEX2017-68WC	27°42.607’S	73°44.178’E	
	INDEX2017-69HMS			
Mon 18.09.2017	**Cluster #12/7**			30/26
	INDEX2017-70DR	27°38.78’S	73°39.88’E	

Table 1. (continued) Timing and station plan during cruise SO259 (INDEX 2017).

Tue 19.09.2017	**Cluster #12/8**			31/27
	INDEX2017-71DR	27°41.57’S	73°36.03’E	
	INDEX2017-72DR	27°33.69’S	73°49.72’E	
	INDEX2017-73PS	27°42.368’S	73°44.065’E	
	INDEX2017-74STR	27°42.323’S	73°44.141’E	
	INDEX2017-75GC	27°37.409’S	73°55.943’E	
Wed 20.09.2017	**Cluster #12/9**			32/28
	INDEX2017-76MUC	27°37.409’S	73°55.943’E	
	INDEX2017-77HF	27°37.409’S	73°55.943’E	
	Cluster #11/1			
	INDEX2017-78Bathy	27°36.75’S	73°50.59’E	
Thu 21.09.2017	**Cluster #11/2**			33/29
	INDEX2017-79PS	27°10.619’S	72°36.789’E	
Fri 22.09.2017	**Cluster #11/3**			34/30
	INDEX2017-80WC	27°14.610’S	72°40.773’E	
	INDEX2017-81WC	27°15.658’S	72°40.538’E	
	INDEX2017-82HMS	27°16.689’S	72°43.699’E	
Sat 23.09.2017	**Cluster #11/4**			35/31
	INDEX2017-82HMS	27°16.689’S	72°43.699’E	
Sun 24.09.2017	**Cluster #11/5**			36/32
	INDEX2017-82HMS	27°16.689’S	72°43.699’E	
	INDEX2017-83STR	27°14.722’S	72°42.871’E	
	INDEX2017-84DR	27°18.162’S	72°45.036’E	
Mon 25.09.2017	**Cluster #11/6**			37/33
	INDEX2017-85DR	27°15.381’S	72°48.089’E	
	INDEX2017-86STR	27°15.389’S	72°43.278’E	
	INDEX2017-87GE	27°14.64’S	72°42.635’E	
Tue 26.09.2017	**Cluster #11/7**			38/34
	INDEX2017-88PS	27°14.417’S	72°37.682’E	
	INDEX2017-89WC	27°19.804’S	72°45.405’E	
	INDEX2017-90WC	27°21.310’S	72°46.966’E	
	INDEX2017-91WC	27°23.263’S	72°48.731’E	
Wed 27.09.2017	**Cluster #11/8**			39/35
	INDEX2017-92DR	27°21.612’S	72°48.609’E	
	INDEX2017-93DR	27°21.459’S	72°49.405’E	
	INDEX2017-94STR	27°15.042’S	72°42.904’E	
	INDEX2017-95TVG	27°14.714’S	72°42.708’E	
	INDEX2017-96PS	27°15.85’S	72°38.65’E	
Thu 28.09.2017	**Cluster #10/1**			40/36
	INDEX2017-97Bathy	27°10.190’S	72°35.487’E	
Fri 29.09.2017	**Cluster #10/2**			41/37
	INDEX2017-98PS	26°49.783’S	72°09.793’E	
	INDEX2017-99CTD	27°00.384’S	72°24.211’E	
Sat 30.09.2017	**Cluster #10/3**			42/38
	INDEX2017-100CTD	27°00.384’S	72°24.211’E	
	INDEX2017-101PS	27°00.725’S	72°23.412’E	
	INDEX2017-102GC	26°53.684’S	72°20.374’E	
	INDEX2017-103MUC	26°53.684’S	72°20.374’E	
	INDEX2017-104HMS	27°05.818’S	72°29.871’E	

Table 1. (continued) Timing and station plan during cruise SO259 (INDEX 2017).

Sun 01.10.2017	**Cluster #10/4** INDEX2017-105ST INDEX2017-106WC INDEX2017-107WC	 26°53.684'S 26°53.823'S 26°54.574'S	 72°20.374'E 72°13.803'E 72°15.225'E	43/39
Mon 02.10.2017	**Cluster #10/5** INDEX2017-108DR INDEX2017-109DR , Transit	 26°49.211'S 26°48.545'S	 72°10.658'E 72°12.126'E	44/40
Tue 03.10.2017	**Transit** to Cape Town, S. Africa			45/41
Wed 04.10.2017	**Transit** to Cape Town, S. Africa			46/42
Thu 05.10.2017	**Transit** to Cape Town, S. Africa			47/43
Fri 06.10.2017	**Transit** to Cape Town, S. Africa			48/44
Sat 07.10.2017	**Transit** to Cape Town, S. Africa			49/45
Sun 08.10.2017	**Transit** to Cape Town, S. Africa			50/46
Mon 09.10.2017	**Transit** to Cape Town, S. Africa			51/47
Tue 10.10.2017	**Transit** to Cape Town, S. Africa			52/48
Wed 11.10.2017	**Transit** to Cape Town, S. Africa			53/49
Thu 12.10.2017	**Transit** to Cape Town, S. Africa			54/50
Fri 13.10.2017	Arrival in Cape Town, S. Africa			55/51
Sat 14.10.2017	Cape Town, S. Africa			56

Acknowledgements
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Participants

Participant	Discipline	Institution
1. Dr. Ulrich Schwarz-Schampera	Economic Geology/ Chief Scientist	BGR
2. Dr. Ralf Freitag	Geology/Bathymetry	BGR
3. Dr. Andreas Lückge	Geology/Paleooceanography	BGR
4. Dr. Ingo Heyde	Geophysics/Magnetics, Heat Flow	BGR
5. Conny Kriete	Chemistry/Sensor sled	BGR
6. Dr. Antje Wittenberg	Mineralogy/Petrology	BGR
7. Henning Wedemeier	Technician/Elektronics	BGR
8. Dennis Hagedorn	Technician/Elektronics	BGR
9. Dr. Jeannette Meima	Geochemistry/ Sensor sled	BGR
10. Christian Wöhrl	Technician/Analytics	BGR
11. Dr. Katrin Schwalenberg	Geophysics/CSEM Golden Eye	BGR
12. Dr. Bettina Landsmann	Geology/ISA-Training, Public Outreach	BGR
13. Oliver Kefel	Technician/Mechanics	BGR
14. Simone Sturm	Technician/Logistics, Sampling	BGR
15. Andreas Heiner	Technician/Sample Preparation	BGR
16. Gary Massoth	Geochemistry/ Sensor sled	Mass-Ex³
17. Dr. Terue Kihara	Biology/Biodiversity	DZMB
18. Klaas Gerdes	Biology/Biodiversity	DZMB
19. Katharina Kniesz	Biology/Biodiversity	DZMB
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21. Natalie Harms	Biogeochemistry/Sediment traps	Uni Hamburg
22. Dr. Willi Weinrebe	Geophysics/Bathymetrie, WCI	Wein_Kiel
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28. Melanie Steffen	Geodetics/Hydrography	HCU Hamburg
29. Sara Vulpius	Geology/Petrology	Uni Erlangen
30. Patrick Hoyer	Geology/Petrology	Uni Erlangen
31. Meike Klischies	Geology/Modelling	GEOMAR
32. Sebastian Graber	Geology/Modelling	GEOMAR
33. Unyime Udodu Umoh	Geology/Biogeochemistry	ISA, U. Shanghai
34. Eric Arthur-Mensah	Engineer/Training	ISA
35. Sumram Praphat	Geology/Training	ISA
36. Alyaa A.M. Zidan	Geochemistry/Training	ISA
37. Thomas Whiddon	Geology/Training	ISA

Fig. 4. The participants of cruise SO259 (INDEX2017) (upper row, from left to right): Unyime Umoh (ISA, Tongji U.), Ralf Freitag (BGR), Christian Hilgenfeld (U. Bremen), Henning Wedemeyer (BGR), Andreas Lückge (BGR), Simone Sturm (BGR), Niko Lahajnar (U. Hamburg), Klaas Gerdes (DZMB), Katrin Schwalenberg (BGR), Andreas Heiner (BGR), Conny Kriete (BGR), Hendrik Müller (U. Bremen), Dennis Hagedorn (BGR), Ingo Heyde (BGR), Ulrich Schwarz-Schampera (BGR), Konstantin Reek (U. Bremen), Gary Massoth (USA). (middle row, from left to right) Sumran Praphat (ISA), Patrick Hoyer (U. Erlangen), Willi Weinrebe (Kiel), Antje Wittenberg (BGR), Thomas Whiddon (ISA), Natalie Harms (U. Hamburg), Tanja Dufek (HCU Hamburg), Jeannette Meima (BGR), Meike Klischies (GEOMAR), Melanie Steffen (HCU Hamburg). (lower row) Oliver Kefel (BGR), Sarah Vulpius (U. Erlangen), Christian Wöhrl (BGR), Dilip Adhaikari (HCU Hamburg), Katharina Kniesz (DZMB), Sebastian Graber (GEOMAR), Eric Arthur-Mensah (ISA), Terue Kihara (DZMB), Bettina Landsmann (BGR).