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16.12.2019

We finished our work in the license cluster #12 around the HUNA and PENUMBRA areas last week. An area of high heat flow, identified during cruise SO258 (INDEX2017) and at about 16km distance from the actual spreading axis, was revisited with gravity corer and heat flow stations. While the sediment core sampling did not reach greater depths than in 2017 (<3m), the series of heat flow measurements identified and better defined areas of elevated heat flow up to 232mW/m². Again, hydrothermal sediment or alteration could not be identified in the sediment cores but thin layers of fresh volcanic glass in the core catcher suggest younger volcanic processes at depth. It remains unclear if those anomalies are associated with hydrothermal processes. The PENUMBRA area, however, occurs at about 2 km distance and the potential for enhanced hydrothermal activity underneath the sediment is present. The future use of seafloor drills like BGS's Rockdrill will provide evidence for prevailing heat sources at depth. Gravity corer and heat flow probe were also deployed on a prominent hydrothermal mound in the HUNA area. The mound vents clear fluids at temperatures above 200°C. We were able to recover about 150cm of very siliceous precipitates, partly associated with fine-grained pyrite mineralization and distinct H_2S smell. The features resemble shallow submarine vents in island arc systems and parameters of formation will be studied back in the home labs. We finished our work in the cluster with a number of petrological dredge sites, and high-resolution bathymetry and sensor sled surveys along the western rim of the cluster. ROPOS surveyed the mineralized areas as well as a very young volcanic edifice and its surroundings on the western flank of the SEIR where we identified native gold particles in 2017. Evidences for hydrothermal activity could not be found but the transportation of particulate gold strongly suggests venting of phase-separated fluids within a few kilometers distance.

After the last plume sled station, we started our 1100nm transit for the return to Port Louis, Mauritius, Friday 13th noon. During transit onto the EEZ of Mauritius, we continued with bathymetric and gravity measurements.

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Cruise SO271/1 (INDEX 2019) was very successful. Sea conditions were generally good with only a half day of limited operational capability. There were no problems with the ship operation despite the high number of tools we deployed during the cruise and the limited remaining space on SONNE's working deck. A total of 131 stations with survey, observation and sampling operations were completed in the license clusters #01, #04, #05, #06, #07, #10, and #12. A total of 12 different operational tools were used for diverse and extensive exploration and environmental studies during this cruise within the license area, including

- 6 vertical CTD rosette casts for environmental, water masses and sedimentary studies,
- 7 gravity corer and 3 multicorer stations for paleooceanographic and biogeochemical studies,
- 8 heat flow probe measurements for crustal temperature regime estimations,
- 24 wax corer and 15 dredge stations for petrological reconnaissance and spreading ridge and triple junction evolution studies,
- 10 sediment trap and two ADCP mooring operations for biogeochemistry, particle flux and ocean current measurements,
- 20 deep-towed HOMESIDE surveys for high-resolution bathymetric mapping, magnetics and water anomaly surveys (total of 330 km, 202km² in 153 hours),
- 11 tow-yo stations with the SOPHI sensor sled for plume hunting (183 km, 116 hours),
- 18 ROPOS operations for detailed site surveys and sampling,
- bathymetric surveys with 938 hours of survey time (total of 4541 km) with EM122 and 994 hours (4828km) of survey with the echo-sounder EK60 for water column imaging and analyses.

The biodiversity was studied and sampled with 4125 samples and 5,477 individuals. 89 samples were collected for microbiological analyses.

Two new sites (SURYA, SOORAJ; both Sanskrit/Hindi for SONNE') were identified in the license clusters #06 and #07, respectively. SURYA is the very first identified vent

site on the western flank of the entire SEIR. The new findings again attest to the high potential for sulfide mineralization in all clusters of the German license area.

The cruise participants are busy with the reporting of the work during our cruise but also with the demobilization of all scientific tools and laboratory equipment. The arrival in Port Louis is scheduled for tomorrow, Tuesday, December 17th. At the end of the cruise I would like to heartily thank all participants for their high motivation and professional performance. This is especially true for the participating scientists from the Universities Hamburg, HCU Hamburg, Erlangen, the GEOMAR, the DZMB Senckenberg am Meer - INES, the contracted scientists Dr. Willi Weinrebe, Gary Massoth, Harold Gibson and Marina Schofield and particularly the ROPOS team for their first dive campaigns on the new SONNE. A special thank is due to captain Lutz Mallon and the entire SONNE crew. The cooperation and the communication on board was very efficient, professional, very friendly and exceptional at all times. The variety and the broad technical range of the deployed scientific tools were unproblematic at all times. The deployment and recovery were managed routinely and safely, even at difficult weather conditions. BGR is looking forward to use SONNE for the next exploration cruise INDEX2020 (SO278) next year.

Very best regards from R/V SONNE,

Dr. Ulrich Schwarz-Schampera, Chief Scientist

Bundesanstalt für Geowissenschaften und Rohstoffe/
Federal Institute for Geosciences and Natural Resources

More information about SO271 (INDEX2019) at
https://www.bgr.bund.de/DE/Themen/MarineRohstoffforschung/Meeresforschung/INDEX2019-Logbuch/aktuelles_node.html

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https://www.planeterde.de/logbuecher/fs-sonne-port-louis/metallsulfid-und-schwarze-raucher

https://www.youtube.com/watch?v=JFVe-1NqOMI&feature=youtu.be

Fig. 1. The participants of cruise SO271/1 (INDEX2019) (upper row, from left to right): Ulrich Schwarz-Schampera (BGR), Willi Weinrebe (Kiel), Niko Lahajnar (U. Hamburg), Simone Sturm (BGR), René Romer (U. Erlangen), Sebastian Graber (GEOMAR), Terue Kihara (DZMB-INES), Tanja Dufek (HCU Hamburg), Ragnar Fröhlich (BGR), Stephan Deike (BGR), Dieter Garbe-Schönberg (CAU Kiel), Andreas Lückge, Ralf Freitag, Sebastian Fuchs, Henning Wedemeyer (all BGR), Harold L. Gibson (Laurentian U. Canada), Jonathan Lee, Keith Tamburri, Peter Lockhart (all ROPOS). (middle row, from left to right) Christian Wöhrl (BGR), Ingo Heyde (BGR), Klaas Gerdes (DZMB-INES), Natalie Harms (U. Hamburg), Katja Laufer (GEOMAR), Joachim Deppe (BGR), Luke Girard (ROPOS), Barry Brake ROPOS). (lower row, from left to right) Bastienne Schoening (DZMB), Bettina Landsmann (BGR), Marine Schofield (Laurentian U. Canada), Katharina Kniesz (DZMB), Gary Massoth (USA), Christine Meyzen (U. Padua Italy), Conny Kriete (BGR), Andreas Heiner (BGR), Dilip Adhikari (HCU Hamburg), Oliver Kefel (BGR), Anke Spethmann (U. Hamburg), Paul Macoun (ROPOS).