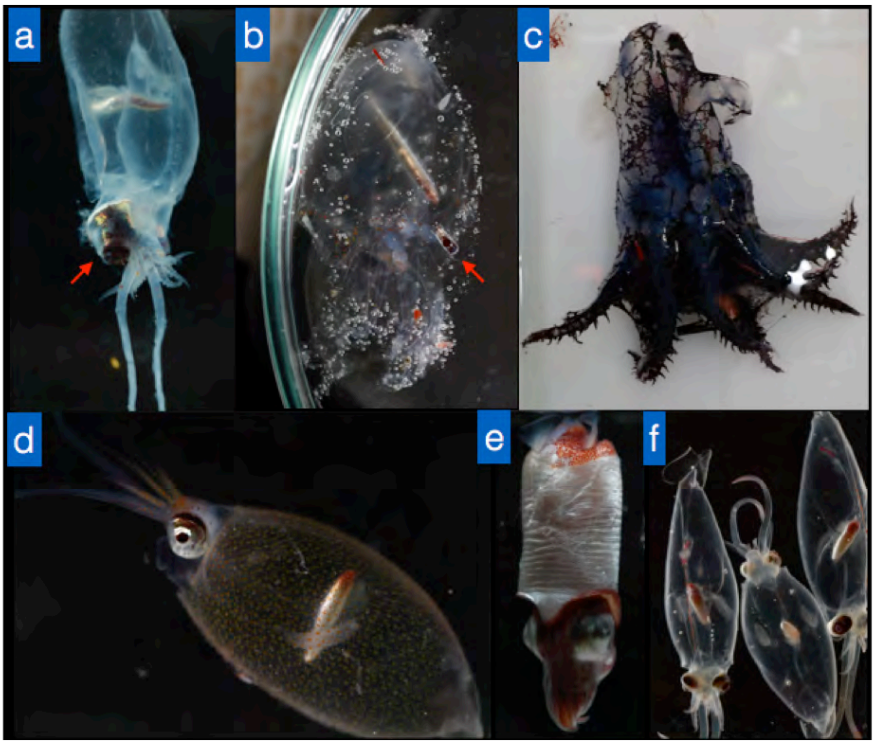
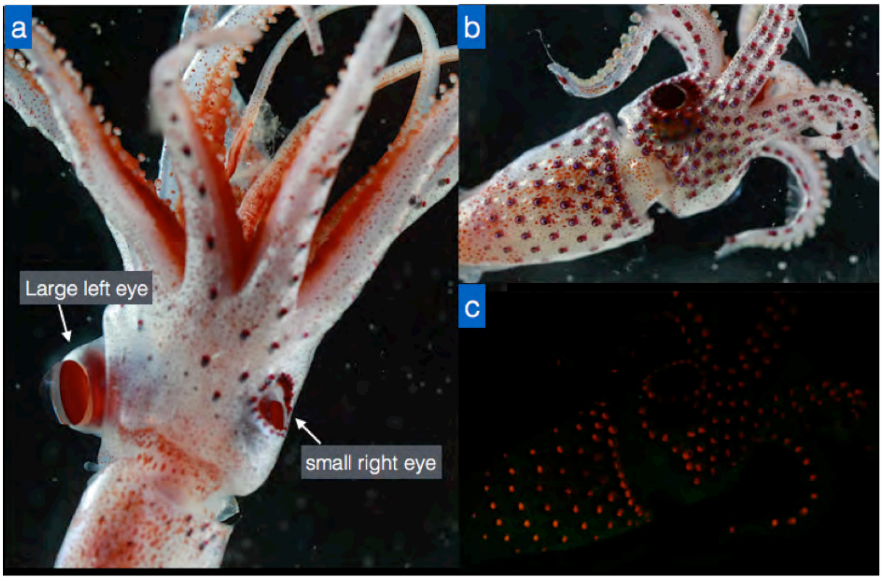
SO258 Leg 1
INGON
Weekly Report No. 3
(19.06. – 25.06.2017)

R/V SONNE
5°26´S / 82°27´E

At the beginning of the third week, R/V SONNE cruise SO258 leg 1 conducted further trawls before the series of Tucker-Trawl deployments was discontinued until reaching the Afanasi Nikitin Seamounts area. The last trawls were short (4h) and shallow (200 m, at night) and brought a big squid (*Octopoteuthis sicula*), many smaller live squids, and apart from the usual complement of hatchetfish, and viperfish, two rare and interesting fish: a juvenile *Dolichpteryx* and a larval *Opisthoproctus*. Both are of special interest for the barreleye project. Plankton net deployments during dredge stations caught flying fish which served as controls (surface dwelling) for the auditory experiments on deep-sea species.



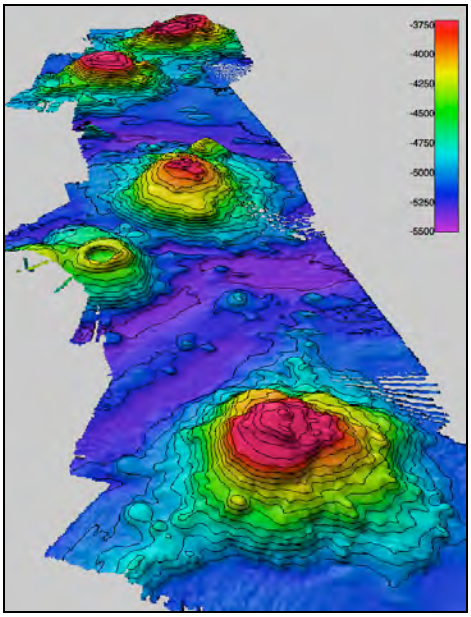
Diversity of cephalopods in the south Indian Ocean.
(a) Melancholicus cranch squid (*Sandalops melancholicus*). Red arrow indicates the tubular eye. (b) Glass octopus (*Vitreledonella richardi*). Red arrow indicates the elongated eye. (c) Vampire squid (*Vampyroteuthis infernalis*). (d) Eight arm squid (*Octopoteuthis sicula*). (e) Rough cranch squid (*Cranchia scabra*). (f) Ram's horn squid (*Spiruala spirula*). (g) *Liocranchia sp.* (photo: Wensung Chung)



Jewel squid (*Histioteuthis hoylei*) (a) Asymmetric eyes. The size of the left eye is approximately 2-3 fold larger than its right eye. (b-c) Photophores. (photo: Wensung Chung)

For the present weekly report, we take a closer look at the squids of the deep-sea. In the past trawls we caught 23 cephalopod species from depths between 200 and 1,200 m. The visual system of cephalopods is a textbook example of convergent evolution as their camera-type eyes share optical, anatomical and functional characteristics with fish, but are made up of different cells and tissues. What Wensung Chung from Queensland University, Brisbane demonstrates in the pictures shown on page one of this report, is that this applies not only to the general principles of ocular design like the camera eye, but includes other adaptive specialisations such as tubular eyes which are also found in many mesopelagic fish (upper figure). In the jewel squid there is a different, and unique feature of the visual system: his left, probably upward-facing eye is much larger than the right, probably downward-facing eye. It also presents many red photophores (lower figure). Along with the discovery of these special cephalopod eye designs, histology, magnetic resonance imagery (MRI), diffusion tensor imaging (DTI) and depth distributions are used to understand how the squid visual systems and the versatility of their neural architecture reflect the diverse and specific lifestyles of each species.

This week our investigations focused on bathymetric mapping and hard rock sampling. The first two dredge hauls of this journey have been conducted at the southern flank of Osborn Seamount. This circular (Ø 250 km!), approximately 2,500 m high seamount is located at ~15°S directly west of the Ninetyeast Ridge, a prominent ridge structure which stretches across the entire Indian Ocean in N-S direction. The seamount has been named after the cable ship SHERARD OSBORN, which discovered and delineated it in June, 1900. Our dredges indeed returned the first rocks ever sampled from this feature but unfortunately they comprised only altered volcaniclastic rocks. We hope, however, that we can extract material suitable for geochemical analyses and possible radiometric age dating. En route to our first major dredge area, we stopped at the "85° Fracture Zone" which shows a prominent morphology with a steep eastern slope between 7°S and 15°S. In this section it is possible to sample directly the ocean crust. Despite difficult weather conditions, we were able to recover lava fragments and intrusive rocks (gabbro).



The southern part of the "Southern Seamounts", which have been mapped for the first time on this journey. The flat tops and circular depressions (up to 2.5 km in diameter) are typical features of this seamount province.

A chain bag dredge returns on board R/V SONNE with rocks from the ocean floor at 4.600 m water depth. (photo: Luise Wagner)

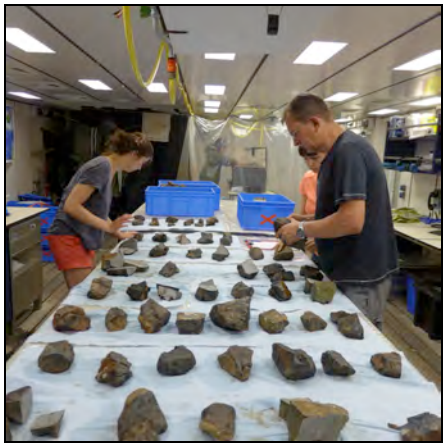
A dirty business: All rock samples are cut on board in order to allow better classification and to prepare them for the analyses in the home labs. (Foto: Nina Furchheim)

In the evening of June 21, R/V SONNE reached a completely unexplored area. Here the predicted bathymetry shows some seamounts and ridge structures scattered between 8°30´S and 11°S, which have been named "Southern Seamounts" by the cruise participants.

They represent the southern tip of a chain of geomorphological features called "85° Ridge", which extends from Sri Lanka to the south and includes the Afanasi Nikitin Complex. The "85° Ridge" is the major target of the geological studies of SO258 Leg 1. On the basis of the chemical composition and ages of its rocks, we intend to gather new information on magmatic, tectonic, and volcanic processes which may have triggered and have accompanied the break-up of Gondwana, here in particular the separation of India and Sri Lanka from Antarctica in Early Cretaceous, and the formation of the Indian Ocean. This is primarily basic research but our approach contributes to a better understanding of how our „System Earth“ works. With that we also provide basic data for applied research as, for example, for a better evaluation of volcanic and tectonic hazards or the formation of natural resources.

Our survey of the "Southern Seamounts" revealed that they comprise at least 10 circular or oval, up to 2,000 m high features, measuring up to 20 km in diameter, and numerous smaller volcanic structures. Sampling of these volcanoes proved difficult because obviously they are covered with manganese crusts and volcaniclastic material. Nevertheless we managed to obtain aphyric and feldspar-, pyroxene- and olivine-phyric lava fragments from seven of the larger seamounts. Surprisingly fresh volcanic glass persisted on some of the lava fragments. Volcanic glass forms by rapid cooling of lava for example when hot lava comes in contact with water. Such glass is of particular interest to study the original composition of melts and their pre-eruptive volatile contents. Volcanic glass, however, is not stable and alters over the course of time; initially to palagonite and finally to clay. This process is accelerated when glass is exposed to seawater. Therefore it is a great achievement that we have sampled fresh glass at several sites of the presumably ancient "Southern Seamounts".

When R/V SONNE headed towards the Afanasi Nikitin Complex, we realized astonished, that a chain of somewhat smaller, up to 1.500 m high seamounts emanates from the "Southern Seamounts" at least 150 km in northern direction. These seamounts are not displayed by the predicted bathymetry. An attempt to sample one of these newly discovered volcanoes unfortunately yielded only crusts and heavily altered lava fragments.



Scientists evaluate rock samples recovered at the southern tip of the Afanasi Nikitin Complex (photo: Nina Furchheim)

A rock sample from the "85° Fracture Zone" prepared for the geochemical analyses. (photo: GEOMAR)

On Sunday, June 25, we reached the Afanasi Nikitin Complex - our main working area. A first, very successful dredge haul yielded fresh pillow lava from its southern tip. During the upcoming week we will continue mapping and dredging as well as conducting various biological investigations at Afanasi Nikitin. The weather remained variable this week with a mixture of clouds, sun, and rain showers. In the night from Saturday to Sunday SONNE sailed to the Afanasi Nikitin complex and therefore no deployments of our devices were scheduled. That provided an excellent opportunity for the midway party, enjoyed by both crew and scientists. At midnight we raised our glasses in a toast to a cruise participants who celebrated his 50th birthday on Sunday. All participants are well and send greetings from the central Indic to everyone at home.

Reinhard Werner, Jochen Wagner, and the SO258/1 scientific party