	SO265 **SHATSKY EVOLUTION** **1. Weekly Report** **(27.08 - 02.09. 2018)**	**R.V. Sonne**

R/V SONNE cruise SO265 is the central activity of the research project "Shatsky Evolution" that is funded by the Federal Ministry of Education and Research and conducted by the GEOMAR Helmholtz Centre for Ocean Research Kiel in collaboration with international partners.

The goal of the project is the geological investigation of the Shatsky Rise, a vast, submarine volcanic mountain range in the northwest Pacific that stretches over an area as large as Germany, Austria and Switzerland combined. The highest peaks of the Shatsky Rise tower up to 3 km above the surrounding 5-6 km deep abyssal plain. Even with these enormous dimensions, Shatsky Rise doesn't rank among the very largest of these volcanic plateaus in the world's oceans.

Clearing port in Yokohama: As nice as seafaring can get!

The Pacific Ocean is not so pacifying anymore....

The cause for the origin of volcanic plateaus is still debated. According to the generally accepted theory, which is also used in geology textbooks, these large-spread volcanic provinces form above mushroom-shaped blobs of upwelling material in the Earth's mantle, so-called mantle plumes. These plumes slowly transport material from deeper (hotter) parts of the mantle up to the base of the Earth's tectonic plates where the material melts (because of decompression) and then fuels widespread volcanism on plate above. Recently, evidence is mounting that marine volcanic plateaus could also have formed at mid-ocean spreading centers, which crosses all the worlds ocean basins. At these spreading centers, the tectonic plates are constantly torn apart and new magma from the upper mantle ascends through the cracks and eventually seals them with solidifying lava thereby creating new oceanic crust. It is quite conceivable that the upper mantle below certain areas of a spreading center at certain times could have had a different chemical composition e. g. making it more easy to melt.

This would cause a greatly enhanced magma production and could lead to the formation of a thick volcanic plateau. The debate regarding the cause of oceanic plateau formation nearly divided the Earth science community into two camps, those who defend the classical model (origin by mantle plumes ascending from the deep mantle) and those who propose alternative "plate-based" concepts (e.g. shallow formation at spreading centers).

Why did we choose to investigate Shatsky Rise? Previous research revealed that this particular volcanic plateau bears characteristics of both plume and spreading center formation. Therefore, we want to test the model that Shatsky Rise was formed by interaction of a spreading center with a mantle plume that coincidentally (?) ascended directly beneath it. The results of our investigation will provide an important contribution to the question of how marine volcanic plateaus are formed in general. In addition, our research will produce basic data on the relationship of magmatic, volcanic and tectonic activities and their impact on the environment, the Earth's climate and the marine eco-system.

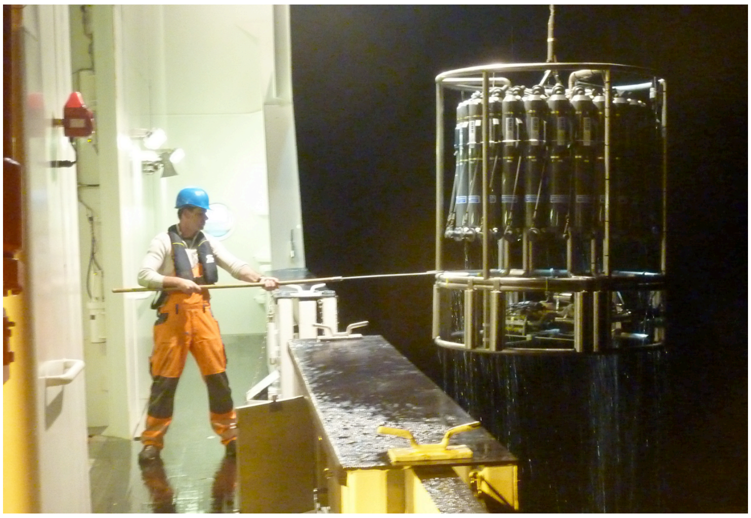
Who are "we"? Besides the ships 29 highly skilled crew, we are 21 scientific cruise participants from six different countries and eight international research institutions. After loading our two equipment containers and embarkation of all scientists, the vessel left Yokohama (Japan) in the afternoon of August 27 with fine weather and begun its 4-day transit to our first planned sampling location on the northern Shatsky Rise. During transit the weather conditions deteriorated and the forecast for our planned first working area predicted wind speeds and swell highs that would drastically limit our operational options. Therefore, we decided to switch towards a more southerly located alternative working area on the central Shatsky Rise for which the weather forecast looked more promising. After arrival, we firstly conducted a water sound profile by running the CTD-Probe (conductivity, temperature, depth) down to 2000m water depths. These data are used to calibrate the ships-own multibeam echosound system, which calculates water depths based on the travel time of reflected sound waves and produces colorful relief maps of the seafloor in "real time"(more on that in the next report). Thereafter, we successfully conducted two dredge hauls (an effective method to recover rocks from the seafloor) and then continued our transit to northern Shatsky Rise where weather conditions had improved in the meantime. By the end of the first week, we had conducted seven dredge hauls, with six of them returning the desired volcanic rock samples.

All cruise participants are doing well and send greetings to everybody at home.

Jörg Geldmacher and the scientific party of SO265

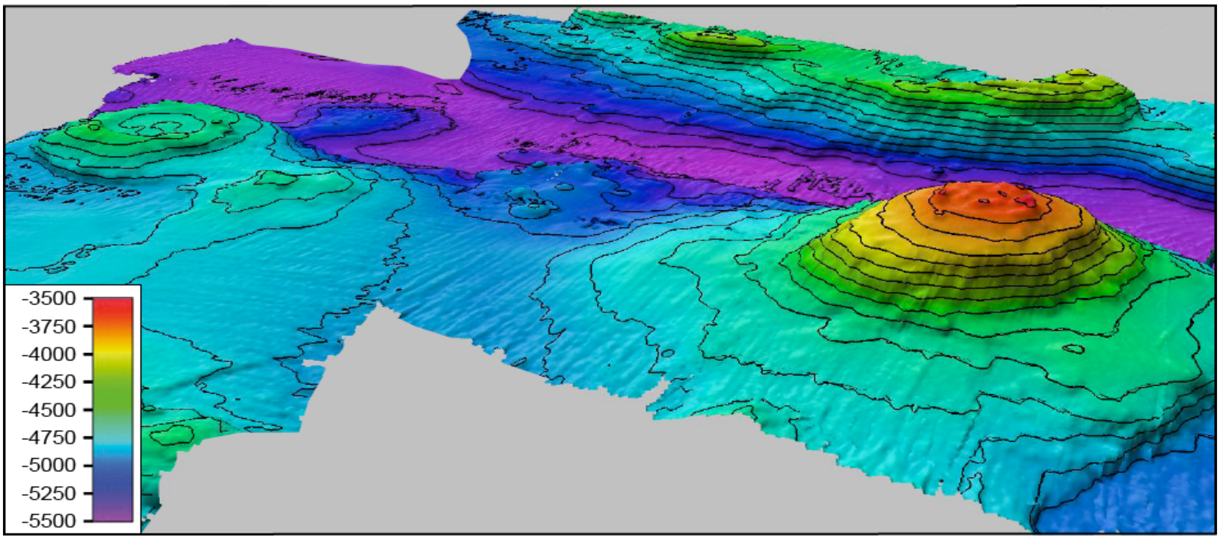
	SO265 **SHATSKY EVOLUTION** **Weekly Report No. 2** **(03.09. - 09.09. 2018)**	**F.S. Sonne**

During the second week of the R/V SONNE cruise SO265 everyone on board became accustomed to the constant alternation between searching for new sampling sites (i.e. mapping of the seafloor) and sampling (dredging). Furthermore, the sample preparation in the labs became routine.



Retrieving the CTD probe at night time.

The selection of our sampling sites is based on the best possible knowledge of the seafloor relief, the bathymetry (from the Greek "bathys" (deep) and "metron" (measure), meaning the surveying of the topographic shape). Until the beginning of the last century the water depth could only be determined by means of plumb lining. This method, however, is only viable for relatively shallow water depths (e.g. nearshore) and provides only single-point information. From time immemorial, the open ocean was therefore considered as "unfathomably deep" and its floor as monotonously flat and lifeless. With the invention of the echo-sounder by Alexander Behm (1880-1952) this view dramatically changed. This method uses the transit time of sound waves that are transmitted from a ship and reflected at the sea floor. State-of-the-art research vessels, like the SONNE, are nowadays equipped with multi-beam sonar systems, which transmit (and receive) a large number of sound waves with different frequencies in staged angles to survey a wide stripe of seafloor (at right angle to the ships heading). The width of the covered area is thereby proportional to the water depth. If the ship is moving, a computer assembles the individual stripes and produces a three-dimensional map of the seafloor's bathymetry in real time, which is immediately displayed on a screen. Since the speed of sound waves in water depends on temperature, pressure and salinity, these parameters need to be determined every time the ship arrives at a new working area (where the parameters in the water masses might differ) to calibrate the echo sounder. The required data are obtained by lowering a CTD probe ("Conductivity, Temperature, Depth") down to 2000 m water depth. During the last week, changing water conditions forced us to conduct two CTD profiles.



Multi-beam echo sounder (EM 122 system) data from "Thompson Trough", a 10 km wide canyon that separates Papanin Ridge (upper right side) from the main Shatsky plateau (in the foreground). The large cone in the right was named "Earthwatch Seamount" by a previous expedition. The three dimensional presentation was processed with "Fledermaus" software and is shown with 4-times exaggeration.

In this week our mapping and sampling efforts focused first on the transition between northern Shatsky Rise and its less pronounced northerly extension, Papanin Ridge, which could represent the beginning of a hotspot track. By the end of the week, we had sampled the Papanin Ridge up to a latitude of 42°30' N which roughly corresponds to one half of its North-South extension. We are very pleased that we have recovered at least one or two volcanic samples (that are suitable for geochemical analyses) from each major structure (often collecting much more). If only the number of dredge hauls returning the desired volcanic rocks are counted, we reach a success rate of nearly 75% so far, which is unusually high for sampling such an old volcanic province. Also, the quality of the obtained sample material has been satisfying. Despite their apparently old age, several samples contain well-preserved feldspar crystals or show only moderate groundmass alteration making them suitable for a range of geochemical analyses, including radiometric age determination. In addition, we often recovered large numbers of manganese nodules as a "by-catch". Although sampling manganese nodules was not in the objectives of this expedition, we cut all larger nodules open because they often include volcanic rocks in their cores. More on this topic in the next report.

Fortunately, the influence of the little high-pressure zone, that accompanied us since we arrived on Papanin Ridge, lasted until the end of this week, allowing smooth operations with little swell and moderate winds. By the end of our second week at sea (after 9 working days in total) we have conducted 31 dredge hauls and 3 CTD stations.

All cruise participants are doing well and send greetings to everybody at home.

Jörg Geldmacher and the scientific party of SO265

SO265
SHATSKY EVOLUTION
Weekly report No. 3
(10.09. - 16.09. 2018)

R.V. Sonne

At the beginning of the third week the operations on the northern edge of Papanin Ridge initially continued as planned. Sampling this upper area is of great importance to us because the ridge is proposed to have no longer formed at a spreading axis, but originated by true intraplate volcanism (i.e. volcanism away from plate boundaries). Accordingly, we expect that the lavas obtained from this area possess a different geochemical composition (compared to the southern part of Papanin Ridge).

Upper left: The dredge is hauled on board (Photo: J. Geldmacher). Lower left: Always much excitement! (Photo: F. Hampel) Upper right: Cutting rocks is a messy job! (Photo: J. Geldmacher). Lower right: Cleanup of protective clothing with scientist Takashi Sano inside! (Photo: M.L. Tejada).

How do we get the rock samples from water depths of often more than 5000 meters? We use heavy chain bag dredges. These are basically large metal baskets with an open bottom and a chain bag attached. The dredge is slowly dragged over the sea floor (like a trawl net) and collects/ rips off stones from the ground. Since the Shatsky Rise was formed 120 to 140 million years ago, all its flat surfaces or gently inclined slopes have progressively been covered by up to several hundred meters of pelagic sediment. Only at the steep slopes of seamounts or rampant flanks of deep sea canyons will our dredge actually have a chance to encounter a rocky outcrop. And that's where the knowledge on bathymetry comes into play (see last report)! Since most parts of our working area have never been visited (and mapped) by a research vessel before, we usually need to first pass over the potential sampling side, to check if the slopes are auspiciously steep enough for dredging.

Every time a dredge is hauled on board, at least the 5-6 scientists from the shift on duty and the expedition leadership flock to the working deck and peer over the railing, full of anticipation. It almost feels like Christmas Eve with the joyous expectation of presents. Unfortunately, a tightly filled chain bag does not always guarantee a yield of desired items (another analogy to receiving Christmas presents!) Upon closer examination, it sometimes turns out that the apparent rocks are actually manganese crusts or manganese nodules instead. These are precipitations of metal oxides (mainly iron and manganese compounds) from seawater, which contain economically valuable trace metals like cobalt, cupper or nickel and the so-called "rare earth" elements. Whereas manganese crusts precipitate extremely slowly on outcropping rock surfaces, grow the potato-sized manganese nodules (also slowly) in concentric rings around a nucleus of any solid material. Large parts of the deep ocean floor are densely covered with such nodules. Since the 1970s, the idea of mining these nodules for their metals occasionally pops up. At a very small scale we are now doing this (unintentionally) with some of our dredge hauls.

Cut manganese nodule with a nucleus made of an indurated sediment clast showing concentric growth rings. As meanwhile known, these rings grow extremely slow reaching just 2 to 10 mm in 1 million years!

Sometimes, we are at first disappointed about the seemingly exclusive haul of manganese nodules, but there is a second chance: Occasionally nodules enclose clasts of the desired volcanic rocks, which were broken off from volcanoes slopes a long time ago. Therefore, we cut all manganese nodules in half to check the nature of their nucleus. Sometimes the giving of presents is just belated...

During the middle of the week, we had to avoid an approaching storm. After the ship's command and the expedition leadership consultation with the meteorologist from the National Meteorological Service (DWD), who is joining this expedition, the decision was made to northwardly sidestep the storm and to safely return on its backside into the working area. This plan worked out well. By Saturday morning we found ourselves dredging again on the northern edge of Papanin Ridge in nice weather conditions. The little excursion to the north, furthermore, enabled us to map and sample the hitherto totally uninvestigated Hokkaido Trough, a 1000 km long canyon that likely represents an abandoned spreading ridge. The recovered rock samples will allow us to determine the age of this structure and thus to better constrain the plate tectonic history of this little investigated part of the Pacific ocean.

All cruise participants are doing well and send greetings to everybody at home.

Jörg Geldmacher and the scientific party of SO265

	SO265 **SHATSKY EVOLUTION** **Weekly Report No. 4** **(17.09. - 23.09. 2018)**	**R/V Sonne**

During this week we have successfully completed our work at the northeastern tip of Papanin Ridge. This flat ridge structure forms the northern "arm" of Shatsky Rise. Based on paleomagnetic data, this part of the ridge (east of 165°30' E) did not form at a mid-ocean spreading center (like the rest of Shatsky Rise) but was built by true intraplate volcanism. Sampling this very important area, however, turned out to be challenging. Sometimes we only collected large numbers of manganese nodules (see also last report). Moreover, after completing a 40 km long transit to an apparently large volcano (15 km in diameter) at the far edge of the working area that was predicted to exist based on satellite gravimetry data, the structure could not be found. Experiencing such bugs in the satellite data happens sometimes in unknown, uncharted areas (but luckily very seldom). Overall, however, we managed to get good material, suitable for addressing all research objectives for this area, from five spatially well-distributed locations.

Scientist Maxim Portnyagin screening manganese nodules for hidden rocks. (Revelation of the picture puzzle: It's the angular block just in the middle of the picture!)

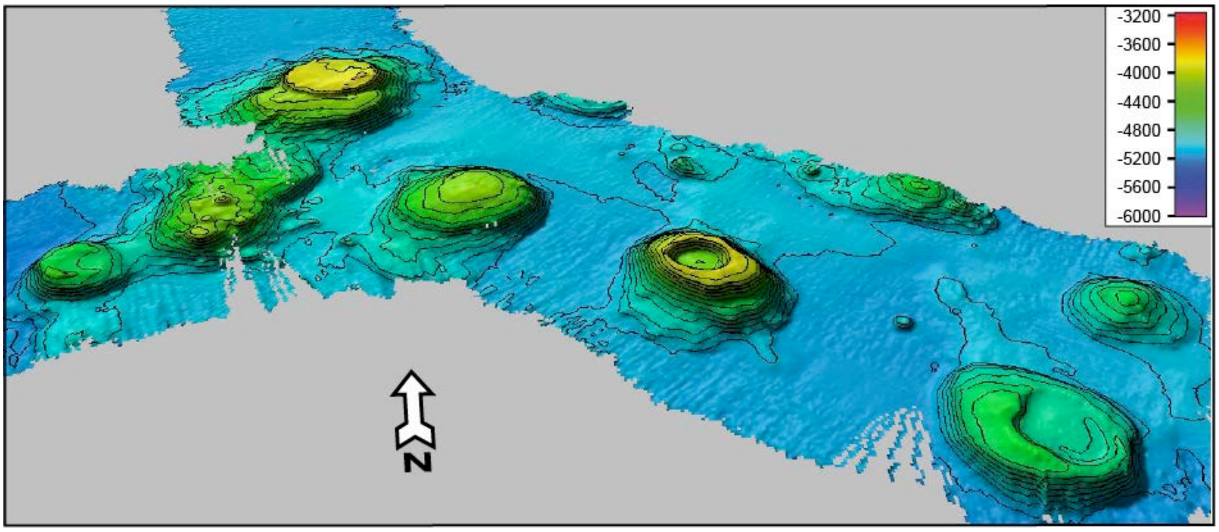
When we talk about "suitable" samples we mean reasonably "fresh" volcanic rocks that are well-preserved despite having been subjected to seawater alteration for more than 100 million years. Usually we can recognize the preservation state of a rock sample immediately after cutting it in half with our rock saw, e.g. recognizing if the original minerals of the rock have been replaced with clay minerals. The latter will alter the initial chemical composition of the rock and severely limits its use for a variety of geochemical applications. Interestingly, dredge hauls conducted to the north of 41° N frequently recovered surprisingly fresh and often rounded or subangular cobbles of (often) volcanic origin. These are so-called drop stones, which are ice-rafted debris that was transported to the oceans during the last ice age. Moving glaciers pick up debris from the ground. When reaching the coast, icebergs break of from the glaciers front and float into the open ocean. When the iceberg slowly melts, its icebound load is gradually distributed (dropped) on the ocean floor. In the higher and lower latitudes this debris can be found in large numbers on the sea floor. The drop stones that we encountered in our northern working area came most likely from the Kamchatka peninsular, which is located just 1200 km to the north and is known for its many volcanoes. Therefore, it is not astonishing that the drop stones that lie on the much older volcanic basement are also of (much younger!) volcanic origin. Luckily, these "false" volcanics can be easily recognized by their exceptionally fresh appearance (e.g, all minerals are well-preserved) and in particular by the lack of any significant manganese coating. In the rare case of doubt, volcanic rocks from the Kamchatka subduction zone volcanism will reveal their nature since their chemical composition distinctly differs from oceanic intraplate lavas (these elaborate analyses, however, will be conducted post-cruise in our labs onshore).

In the middle of the week we started our long transit to the next working area, the Ojin Rise seamount province. The transit was conducted in two legs: The first leg led us 200 nm (about 370 km) to the south to the northernmost representatives of the broad belt of Ojin seamounts. We managed to get volcanic rocks from two out of three sampled structures. One dredge haul recovered a large amount (the chain bag was half full!) of relatively well-preserved pillow lava. Their characteristic pillow-shaped form and radiating shrinkage cracks are attributed to the extrusion of lava under water, which causes rapid cooling and formation of a skin ("chilled margin"). Outgassing volatiles escape outwards from the still molten interior of the pillow, and form elongated pipe vesicles (photo). The rapid quenching of the skin leaves no time for crystal growth (upon cooling and solidifying) so that the chilled margin is originally made of volcanic glass. Getting fresh (unaltered) volcanic glass is highly desired because it allows a number of geochemical applications. However, glass does not age very well, particular after contact with seawater, and therefore we did not expect to find fresh glass in our millions of years old volcanic rock samples.

Pillow lava fragment with chilled margin (yellowish rim) and elongated pipe vesicles which were trapped when their ascent trough the still molten interior of the pillow stopped at the already solidified margin rim.

We also used the long transit for celebrating the traditional "Bergfest" (hump day party) indicating that half of the time for this expedition is over. After two weeks of around the clock shift work, everyone enjoyed this short break to gain new motivation for the remaining, almost too short, time on board.

The second leg of the transit led us another 240 km southeastwards to the eastern termination of the Ojin Seamount province. If this widespread belt of seamounts represents an age-progressive hotspot track, this must be its youngest end. Therefore, it was of great importance to us to recover well-preserved rocks suitable for radiometric age dating (by measuring the decay of naturally occurring radiogenic isotopes). The alleged end of the hotspot track turned out to consist of a cluster of medium-sized (c. 10 km Ø), pancake-shaped seamounts. We managed to get suitable lava rock material from three out of four sampled pancake volcanoes. One of the seamounts features an almost perfectly round, several hundred meters deep "crater" of more than 3 km diameter at its summit. This depression probably represents a collapse structure instead, a so-called caldera (Spanish for "cauldron"), than a classical (explosive) crater. A caldera can form after an eruption and evacuation of a shallow magma reservoir, depriving structural support of the crust above, which leads to its downward collapse into the emptied magma chamber. Interestingly, we have frequently detected such caldera structures on medium-sized (pancake-shaped) seamounts in both working areas. Because of the remarkable steepness of the inner caldera wall of this seamount, we decided to conduct a dredge haul up the caldera wall and were awarded by exceptionally fresh pillow lava fragments. The rocks contain phenocrysts (certain minerals that are larger then the minerals of the groundmass around them) of feldspar, a mineral highly suitable for age dating. In addition, we found relicts of fresh glass in the chilled margins! A totally unexpected (see above) surprise!

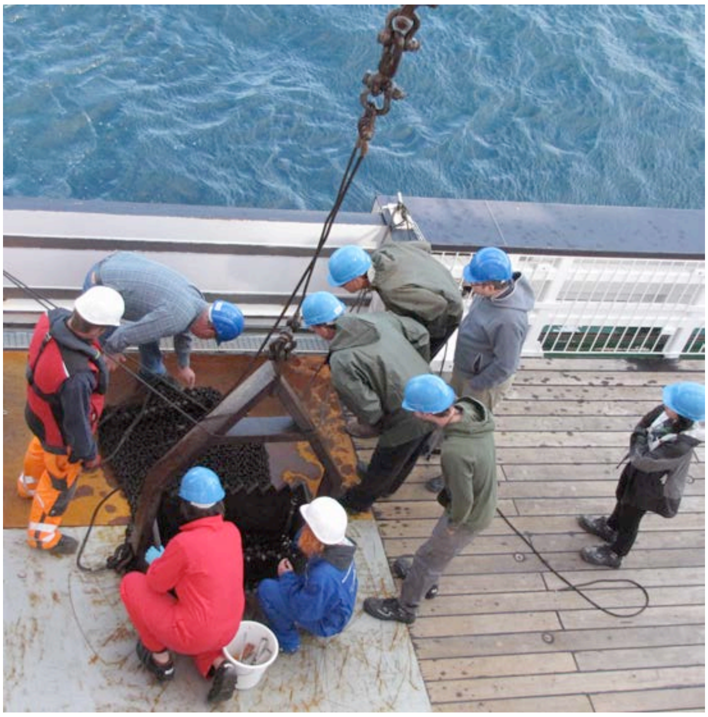


The southeastern termination of the Ojin Rise seamount province (at 36° 30' N, 170° 00' E) is composed by several medium-sized (c. 10 km Ø), pancake-shaped seamounts. A dredge haul conducted within the eye-catching caldera of the seamount in the center of the picture recovered particular well-preserved lava rocks including fresh volcanic glass. The three dimensional presentation was processed by R. Werner with "Fledermaus" software and is shown with 4-times vertical exaggeration.

With these successes and in nice weather (here in the south the water and air temperatures have reached 24° Celsius again), we conclude this week and send best regards to everybody at home!

Jörg Geldmacher and the SO265 scientific party

During this week, we have completed station work in our last working area, the Ojin Rise seamount province. We managed to get suitable samples from all parts of the 760 km long and up to 350 km wide province. Occasionally, the recovered rocks contained well-preserved, large feldspar crystals (good for age dating), and samples from three of the Ojin Seamounts even contained fresh volcanic glass. Therefore, all three research goals (Do the Ojin volcanoes get younger towards the east? Does the geochemical composition vary with time? Can we see a geographic zonation in the geochemistry?) can be addressed by the planned analyses on shore.

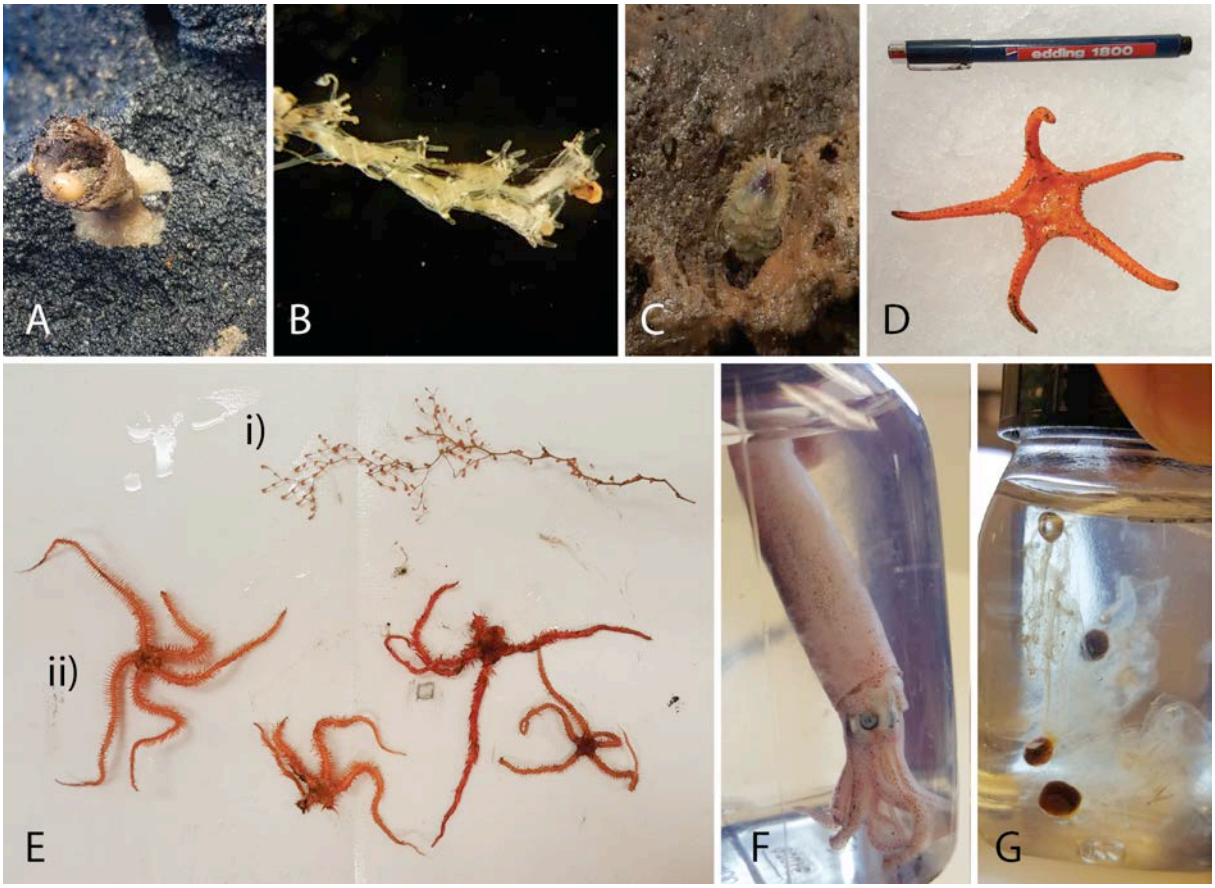


While biologist Anne Zakrzewski (with red overall) starts sampling the sediment traps of a dredge that just arrived on deck, do all geologists peek through the chain bag to check if the desired volcanic rocks were recovered. Photo: C. Heitmann-Bacza

Even after four weeks of dredging operations, the arrival of every new dredge on deck still attracts a small crowd of scientists (beyond members of the respective shift on duty) and even members of the crew. Besides the important question if suitable volcanic rocks were recovered, searching for sessile organisms on the rocks is always interesting. To take professional care of this "by-catch", we are joined by a specialized biologist from the Museum of Natural Science in Berlin, who is the first to review the catch and samples any fragile organisms. After she "clears" the rocks, the geologists can start with their destructive work.

We mainly operate our dredge hauls in the "bathypelagic zone" (between 1000 and 4000 m water depths), that comprises 75% of the entire ocean volume. The ecologic role of the organisms in this zone and their genetic and biogeochemical relationship to the zones above and below is still largely unclear. This week‘s biological samples turned out to be quite exciting. Beside the common sessile and free moving animals, we also caught free pelagic animals. Considering the deep depths of the dredge hauls, animal life forms obtained in the previous weeks had been small. The most common groups to be found were small sponges (A), tiny, fragile colonies of polyps (B) as well as annelids (worms) living without or within small tubes (C). Probably the most impressive findings were sea pens – cnidarians consisting of a colony of small polyps which give rise to the shape of a feather. This week's generally shallower dredge hauls –up to 3500 m – were sprouting different life forms. Besides the aforementioned sessile representatives such as sponges and worms we also found sea anemones and “gold corals” [E(i)]. Additionally, free moving animals like starfish

(D) and brittle stars [E(ii)] were caught in a single dredge. Brittle stars are aptly named from their fragile arms, which tend to break easily. They are quite similar to the common starfish except their arms consist of small vertebrae (like the ones in our backbone), which make them very flexible. Additionally, we were lucky to sample life forms from the open water (pelagic life). Most of the times these animals got caught in the dredge on the way up or – in a few cases – got washed up on board. These animals comprise jellyfish, squid (F), colonial sea squirts called "salps" and even a Portugese man-of-war (*Physalia physalis*). The most abundant animal was *Salpa maxima* (a salp) which was caught mainly during the night. Salps are barrel-shaped, planktonic sea squirts which aggregate in long chains to form a colony. Often up to 2 m long, such chains were visible on the water surface thanks to the bright lights of the ship's head lamps.



What else one can catch by dredging. See main text for further explanation.
Photos: A. Zakrzewski

Autumn is quickly approaching in the North Pacific, as evidenced by the increase of heavy storms at these latitudes. Luckily, weather and sea conditions (including wave height) are highly predictable nowadays. Such an approaching storm now forces us to leave our operational area one day earlier as originally planned. Therefore, the last dredge haul was conducted on Friday, September 28 and we set sail for the long transit southward to the port of destination, Kaohsiung in Taiwan.

All cruise participants are doing well and send greetings to everybody at home.

Jörg Geldmacher and the scientific party of SO265

SO265

SHATSKY EVOLUTION

Weekly Report No. 6

(01.10. - 07.10. 2018)

F.S. Sonne

Expedition SO265 is slowly coming to an end. We have begun our long transit to the port of destination Kaohsiung in Taiwan, which we plan to reach on Wednesday (Oct. 10). The typhoon "Kong-Rei" was, until recently, located between us and Taiwan thus blocking our path, finally turned north. Therefore, nothing stands in our way for a punctual arrival. This past week was spent processing the last samples, demobilizing the labs, and professional packing of our equipment. Also, efforts were ramped up to have the elaborate cruise report finalized before entering port. The time was also used for thoroughly taking inventory of all brought GEOMAR equipment including consumables. And finally, like at every ship expedition, the labs needed to be cleaned and well-swept.

In the middle of the week, a test dive of the ship's new OFOS (Ocean Floor Observation System), a video sledge that is connected to the ship by a cable, provided the welcomed opportunity to watch a live feed of pictures from the sea floor that we had only "blindly" sampled by our dredge hauls in previous weeks. The OFOS surveyed the 1340 m deep summit platform of Katayama Seamount (25°48' N, 147°50' E) while transmitting brilliant video footage of the sea floor structure to the packed conference room of the SONNE.

Manganese crusts and stalked crinoids on the summit of Katayama Seamounts at 1350 m water depth. The orange fore-runner weight in the center of the picture measures 15 cm. Photo: OFOS-team SO265.

At the end of such an expedition it is time to draw a first conclusion and to come up with a résumé of SO265. Well, when entering Kaohsiung port we will have covered a total distance of c. 7300 sm (= 13.500 km). More than 5800 eggs, 400 kg potatoes and 500 kg meat were prepared by the two excellent chefs of the SONNE and consumed by the cruise participants. And 2400 bread rolls were baked! Besides 3 CTD stations we have conducted 72 dredge hauls of which 49 (=68%) recovered *in situ* (=locally occurring) volcanic rocks. No deployed device was lost or damaged. Most important in these raw numbers is that we managed to get sample material suitable for the planned geochemical analyses from all critical areas/structures and in spatially well-distributed intervals from all working areas to address all the scientific objectives of the project.

The northeasternmost extension of Papanin Ridge (east of 165°30‘E), where the ridge was no longer formed at a spreading center but, based on paleomagnetic data, originated by pure intraplate volcanism, proved to be particularly difficult to sample. Only five of fifteen dredge hauls returned suitable volcanic rocks. Luckily, we got well-preserved and feldspar-rich lavas (suitable for age determination) from the easternmost end of the extension. If Papanin Ridge represents a classical hotspot track, the volcanism at this site should have the youngest age. Macroscopically (e.g. in terms of mineral composition), however, no principal difference could be recognized between volcanic rocks obtained from west and east of 165°30‘ E. It will be interesting to see then, if the geochemical composition of the lavas indicate any differences, i.e. a lower degree of melting compared to Papanin lavas that formed at the spreading center.

Regarding the second main working area, the Ojin seamount province, it can already be concluded, that the number and size of the individual volcanic centers decrease and the width of the province peters out towards the east: Whereas the province reaches a N-S extension of over 370 km at the edge of Shirshov Massif, the province tapers toward the east and terminates as a small cluster of medium-sized, pan cake-shaped seamounts at 170° East (see last weekly report). If the planned age dating demonstrates that the ages of the volcanoes get progressively younger towards the east, we have probably found the postulated hotspot track!

Regardless if Papanin Ridge or the Ojin seampount belt (or both?) turn out to represent a Shatsky hotspot track, this finding would mean a crucial step forward to solve the riddle of Shatsky Rise plateau formation (origin by interaction of a deep mantle plume with a spreading center or exclusive formation by an unusually productive spreading center without mantle plume involvement) (See first weekly report for more details).

Saying goodbye to Shatsky Rise.
Photo: J. Geldmacher

In conclusion, the scientific party is satisfied with what was accomplished during SO265 and always felt very comfortable on board of the SONNE. Our sincerest thanks go to Captain Mallon, his officers and the entire crew, whose help and full support we have always been able to count on.

All cruise participants are doing well and send greetings to everybody at home.

Jörg Geldmacher and the scientific party of SO265