	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!)

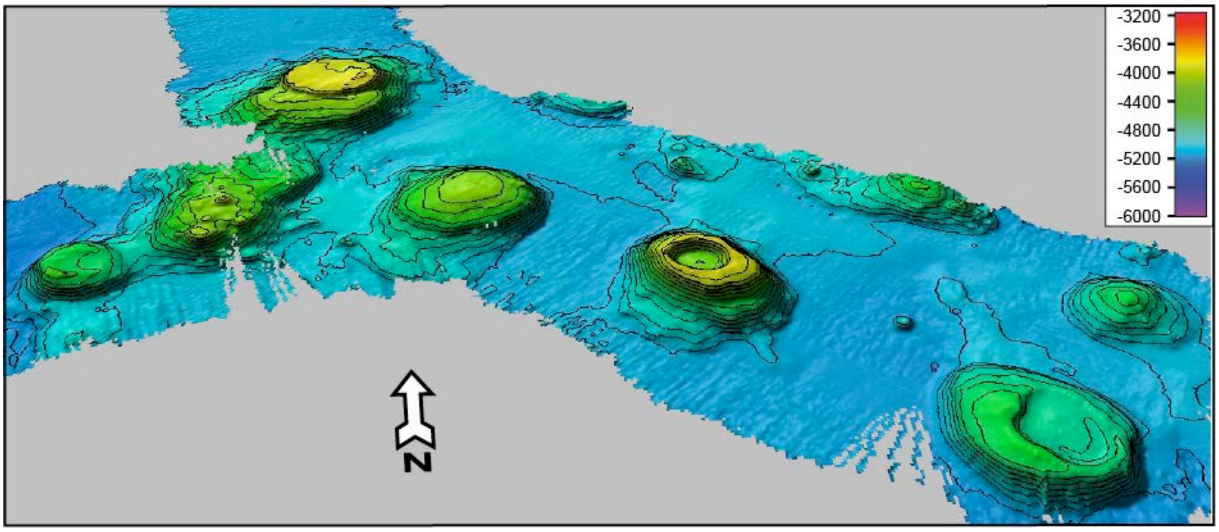
When we talk about "suitable" samples we mean reasonably "fresh" volcanic rocks that are well-preserved despite having been subjected to seawater alteration for more than 100 million years. Usually we can recognize the preservation state of a rock sample immediately after cutting it in half with our 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