1. Wochenbericht (28.04.16 – 02.05.16

SO-248 „BacGeoPac“ 01.05.2016 (Auckland, Neuseeland) – 03.06.2016 (Dutch Harbor, Alaska, USA)

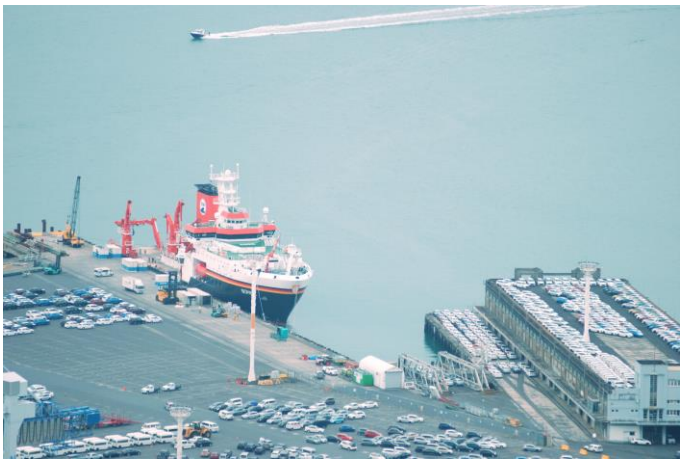
Bis zum 29. April waren alle Teilnehmerinnen und Teilnehmer der Expeditionsfahrt SO248 „BacGeoPac“ wohlbehalten und mit allem Gepäck in Auckland, Neuseeland, eingetroffen und sind am 30. April an Bord des Forschungsschiffes (FS) „Sonne“ gegangen. Alles Frachtgut, das in Containern per Schiff und per Luftfracht vorausgeschickt worden war, befand sich bereits an Bord, so dass die Fahrt pünktlich mit Auslaufen am. 1. Mai beginnen konnte. Vortrupps der Wissenschaftler waren bereits am 28. und 29. April an Bord gewesen, um Dinge mit dem Kapitän und der Mannschaft vorzubesprechen und um bereits einige Geräte aufzubauen. So konnte die 40-köpfige wissenschaftliche Besatzung aus sechs Instituten und sieben Ländern guten Mutes und mit erwartungsvoller Spannung aus dem wunderbar gelegenen Hafen von Auckland auslaufen und Kurs auf die erste Station bei 30°S nehmen, die sie am 3. Mai erreichen wird. Die Forschungsfahrt wird bis in die subarktische Beringsee auf 60°N gehen und in Dutch Harbor enden, dem größten Hafen der Alëuten auf der Insel Unalaska.

Die Wissenschaftler wollen auf dieser Expedition entlang eines Transektes um den 180° Längengrad herum neben der Hydrografie und den optischen Eigenschaften des Wassers die Zusammensetzung und Bedeutung der Bakteriengemeinschaften und ihrer gelösten organischen Nährstoffe in den verschiedenen Klimaregionen des Pazifiks, den sogenannten biogeografischen Provinzen, untersuchen. Diese Provinzen unterscheiden sich hinsichtlich der Wassertemperatur, des Salzgehaltes, der Nährstoffe und der Zusammensetzung des Phytoplanktons und Zooplanktons und nach neueren ersten Untersuchungen auch hinsichtlich der Zusammensetzung der Bakteriengemeinschaften und der gelösten organischen Substanzen, den Hauptnährstoffen der Bakterien. Genauere Untersuchungen zu den zwei letzten Aspekten gibt es aber bisher nicht. Ebenfalls kaum untersucht sind die Bakterien der Tiefsee und des Meeresbodens des Pazifiks. Daher wollen die Hydrografen, Biooptiker, Geochemiker und Mikrobiologen mit ganz unterschiedlichen Expertisen dieses Forschungsgebietes ihre Expertisen bündeln und die ersten Untersuchungen dieser Intensität im Pazifik durchführen, die größtenteils rein auf Mikroorganismen fokussiert sind.

Diese Untersuchungen erfordern die Verarbeitung großer Wassermengen an Bord. Um den Zeitbedarf der Stationen zu reduzieren, hat das Institut für Chemie und Biologie des Meeres der Universität Oldenburg (ICBM), das Heimatinstitut des FS Sonne, speziell für diese Fahrt eine großvolumige CTD-Rosette angeschafft bzw. konstruiert. Wir sind sehr froh an Bord, diese CTD zu haben, denn sonst könnten wir die geplanten Arbeiten gar nicht in der vorgesehenen Zeit durchführen.

Die Einrichtung der Labore ist inzwischen schon weit fortgeschritten und erste konkrete Planungen für die Stationsarbeiten und Absprachen mit Kapitän Lutz Mallon und seiner Mannschaft haben bereits stattgefunden. Er und alle seine Mitarbeiter sind äußerst kooperativ und hilfsbereit, so dass wir sehr zuversichtlich sind, während der Expeditionsfahrt in jeder Weise technisch und alle Angelegenheiten an Bord betreffend hervorragend unterstützt und betreut zu werden.

Meinhard Simon im Namen der Wissenschaft und Besatzung



RV Sonne seen from Sky Tower Auckland

RV Sonne in the harbour of Auckland

1st Cruise report (April 28 – May 2, 2016)
SO-248 „BacGeoPac“ 01.05.2016 (Auckland, Neuseeland) – 03.06.2016 (Dutch Harbor, Alaska, USA)

By April 29th, all scientific members of the research cruise SO248 „BacGeoPac“ had arrived safely and with all baggage in Auckland, New Zealand, and boarded Research Vessel (RV) Sonne. All equipment, shipped in containers over seas and as air fright to Auckland, was already on board, so that the voyage could start in time on May 1st. Vanguards of the scientific party had been on board already on April 28th and 29th to discuss issues with the captain and his crew and to install several instruments. So the scientific party, consisting of 40 members from six research institutes and seven countries was in a good mood and full of expectations when they left the harbour of Auckland, situated wonderfully close to the city centre, on May 1st and started steaming towards station 1 at 30°S. They expect to reach this location on May 3rd. The research cruise will go all the way to the subarctic Bering sea at 60°N and end in Dutch Harbor, the largest harbour of the Aleutian Ilands on the island Unalaska.

The scientists will investigate on this research expedition along a transect around 180° latitude, besides the hydrography and biooptics of the water, the composition and significance of the bacterial communities and the dissolved organic nutrients in the various climatic regions of the Pacific, the so-called biogeographic provinces. These provinces differ with respect to the water temperature, the salinity, nutrients and the composition of the phytoplankton and zooplankton and, according to recent preliminary research , also with respect to the composition of the bacterial communities and the dissolved organic matter, the major bacterial nutrients. Detailed investigations on the latter points, however, are still missing. Accordingly, bacteria from the deep ocean and the sea floor are still scarcely studied. Therefore, hydrographers, bioopticians, geochemists and microbiologists with greatly different expertise are joining forces and will carry out first investigations of such intensities which are mainly focused on microorganisms.

These investigations require processing of large volumes of water on board. Therefore, the Institute for Chemistry and Biology of the Marine Environment (ICBM) of the Carl von Ossietzky University of Oldenburg, the home institute of RV Sonne, acquired and constructed a large volume CTD rosette (24x20 liter Niskin-bottles). We are most happy on board to have this CTD because otherwise we could not carry out the work we had planned in the anticipated times.

The installation of the labs has proceeded quite a bit and first plannings for station work and coordination with captain Lutz Mallon and his crew took already place. He and his crew are most cooperative and helpful, such that we are most confident, to be supported excellently during the cruise in any way and regarding all affairs on board.

Meinhard Simon on behalf of the scientific party and crew on board.

2nd Cruise report (May 2 to 9, 2016)

SONNE SO248 „BacGeoPac“

01.05.2016 (Auckland, Neuseeland) – 03.06.2016 (Dutch Harbor, Alaska, USA)

After one week cruising since the departure from Auckland we arrived meanwhile at station 4 at 10° 30’ S and 176° 30’ W, far away from all continents and islands in the middle of the central Pacific. We steamed east of the Fidji Islands and thereafter in sight of the Island of Futuna, belonging to French Polynesia. This was the last view on land for the next two and a half weeks, because until we reach the Aleutian Islands the only islands in the greater vicinity of our cruise track is the Hawaiian archipelago, still around 1000 nautical miles away.

The journey so far was without any problems and we sampled four stations. One of the stations we wanted to visit, located in the exclusive economic zone of the Fidji Islands, had to be cancelled because despite an application in time we did not obtain any response from the Fidji authorities. Hence we had to cancel one of the stations at every fifth degree latitude we had planned to visit until the equator, that at 20°S. So we had roughly two and a half days steaming time and crossed a storm of Beaufort scale 8 and waves of 4-6 m height in the region of the south east trade winds. Sonne was still pretty stable in the water, thanks to the stabilizers. The water temperature increased quite a bit since station 1, from 23°C to 30°C at station 4. The air temperature is similarly high and the humidity as well. Thanks to the well air-conditioned ship it is quite comfortable on board. The water is already very clear since the first station. Our biooptics group of Daniela Voss measures at every station the transparency of the water by the so-called Secchi depth with a white disc of a diameter of 90 cm. Therefore, the disc is lowered into the water column until it cannot be seen any more. This was the case at all stations only at depths of 40 and even 50 m.

At our first station at 30°S we tested very successfully all instruments for collecting samples in the water column. We were particularly happy that the new large-volume CTD rosette worked without any problems right away. Prior to the cruise there was time only for a quick check of its functionality in the Jade Bay. It already proved its most valuable usefulness at every sampling. I would like to express my deep thanks to Thomas Badewien and his team for the thoughtful and excellent work at designing and constructing this important core instrument for oceanographic work. Due to the large amount of water of the 24 bottles of a volume of 20 liter each we obtain so much water in one “shallow” (down to 1000 m depth) and one “deep” (down to the sea floor at more than 4000 m and further on even down to 6000 m) cast that so far we can fulfill all water requests, even those of the very “thirsty” groups on board. Only now and then we need to run an extra CTD to fulfil special requests for extra large amounts of water.

Also towing a plankton net at the surface with twin nets (Bongo net) worked at the first try. Using this net one group on board wants to collect microplastic at the surface and to study its abundance and microbial colonization. However, so far the water is so clear and pristine that no single piece of plastic was trapped in the net.

At station 2 at 25°S we tested very successfully the new multicorer (MUC) to sample surface sediment. All plastic tubes were filled with brown, soft sediment. Unfortunately, one of the eight tubes including its fixation did not return on deck so that Bert Engelen and his team need to continue working with seven tubes to investigate the bacterial communities in the sediment. The first data show that in the deep sea sediments of the tropical Pacific below 4000 m much fewer bacteria strive as compared to other sea floors. Further analyses after this cruise will show which bacteria are present.

All station work is supported excellently and in a very cooperative way by captain Lutz Mallon and his crew. One or another technical problem in the laboratories and with instruments was fixed rapidly so that all our instruments and equipment and the infrastructure on board were always ready to use and hopefully will continue to be.

For preparing and planning the station work and to learn more about the various projects which are being conducted by the different groups on board meetings and short presentations take place in the evening in the very suitable conference room. These meetings may even lead to new cooperations at

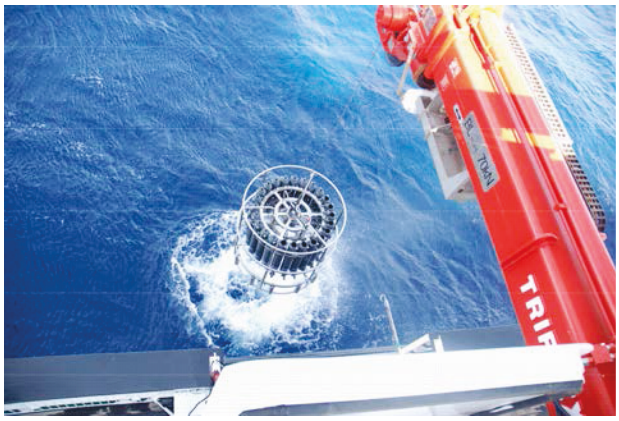
which the groups did not even think of when preparing the cruise and which may lead to interesting additions of the research program.

According to the plan we will have one more station at 5°S before we come to the equator at 0°S or N on May 12th at 180°E or W and will have a 24 hour time series station.

With best regards from the remote tropical Pacific on behalf of the scientific party and crew on board,

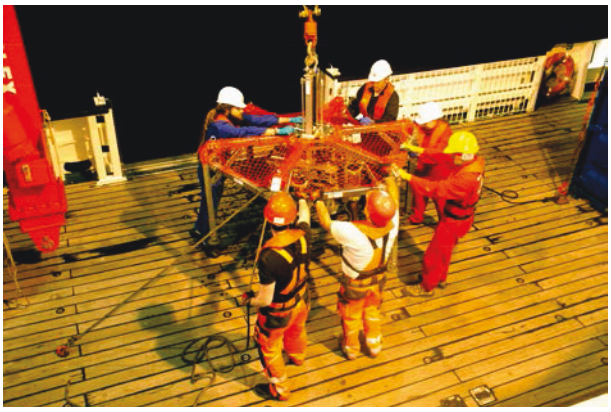
Meinhard Simon

Sonne steaming
in the central Pacific

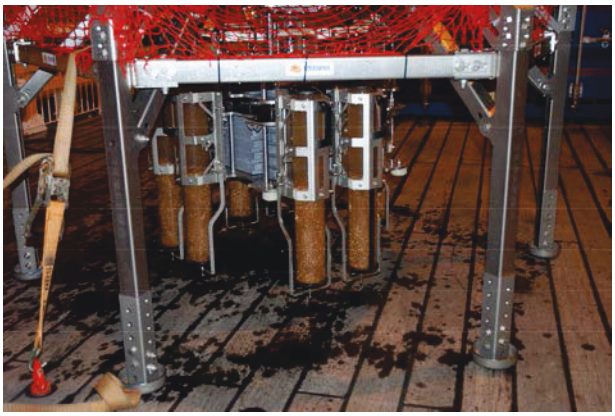


The CTD coming out of the water

The CTD being prepared for the next cast



The MUC coming out of the water



The MUC full of sediment

3rd Cruise report (May 9 to 16, 2016)

SO-248 „BacGeoPac“ 01.05.2016 (Auckland, Neuseeland) – 03.06.2016 (Dutch Harbor, Alaska, USA)

In the late evening of May 11th we arrived at the most prominent station of our long transect: the equator at the date line (0° N/S, 180° W/E), our station 6. Before we had sampled successfully station 5 at 5° S, 178° 19,0‘ W. At the equator we had a 24 hour station and two nautical miles before we had the accompanying MUC station. By several indications we noticed that we met the nutrient-rich upwelling region of the equatorial current. The current velocity from east to west was up to 2 kn and showed impressively how strongly pronounced this current is. In addition, the deep chlorophyll maximum, the depth in which the phytoplankton, in this case blue green cyanobacteria, are mainly concentrated, was at 60 m in contrast to 90-110 m further south in the tropical south Pacific. Further, in sediment samples diatom frustules could be seen under the microscope.

The work of the microbiologists in the upper 1000 m of the water column and of the geochemists is part of projects in the frame work of the Collaborative Research Center (CRC) “Ecology, Physiology and Molecular Biology of the Roseobacter group: towards a system biology understanding of a globally important group of marine bacteria” (www.roseobacter.de). The overarching goal of this CRC is to understand the evolutionary, genetic and physiological principles of this important group of marine bacteria. During this cruise this group of bacteria is in the special focus of the microbiological investigations.

The main goal of the station at the equator was to study the day-night cycle of the bacterial communities and the dissolved organic nutrients available to them. Therefore a CTD was run down to at least 300 m every three hours from 6 am on May 12th until 6 am on May 13th and several depths down to at least 100 m were sampled. The microbiologists on board filtered out of these samples bacteria and froze them at -80°C to later analyze in the home labs how the phylogenetic composition of the bacterial communities, their metabolic activities and gene expression pattern change during day and night. In addition, these samples served to assess directly on board the bacterial abundance, biomass production, growth rate and turnover rate of dissolved amino acids and glucose and the hydrolysis rate of polysaccharides. When these samples will have been analyzed in several days we will have right on board first results on the day night rhythm of the cycling of matter of the bacterial communities. These results will help to even better plan and carry out a similar 24 hour time series in the northern Pacific. The geochemists and biooptician took samples during the 24 hour time series to assess them later on with respect to the dissolved organic nutrients.

The mentioned parameters are analyzed at every station down to a depth of 300 m and at selected stations down to 1000 m. In addition samples are collected to analyze inorganic nutrients, dissolved amino acids and carbohydrates, dissolved organic matter (DOM), chlorophyll and particulate organic carbon, as biogeochemical background information. Therefore, the main activity of the microbiologists on board is to filter water which takes at least several hours after each station. One group on board needs very much water to investigate population genomics of specific subgroups of the Roseobacter group and therefore uses a so-called in situ pump. This pump is used usually at every other station and lowered to the desired depth, usually 60 m, on a wire and pumps seawater computer-controlled usually for three hours. Thereafter, the pump is brought on board again, the filters with the concentrated bacteria removed and frozen at -80°C.

To examine how the bacterial communities respond to changing nutrient conditions so-called mesocosm experiments are conducted. Therefore, 20 liter-carboys are filled with seawater. One series is supplemented with secretion products of diatoms, another with distinct polysaccharides and a third one with vitamin B12. The mesocosms are subsampled for six days, the samples processed in the same way as those of the profiles at the stations so that we later can analyze how the bacterial communities responded to these different nutrient conditions. This enables us to infer how the bacterial community composition is controlled by the different conditions and to better understand the data of our station profiles. The mesocosm experiments are conducted at three stations. The experiment at station 2 is finished, a second experimental series started yesterday at station 5 at 3° 30’ N and the third series will

be conducted at appr. 40° N where we expect to meet the phytoplankton spring bloom of the north Pacific.

At the station at the equator and during the intense work over the 24 hours we still found enough time to document our visit at this very special location appropriately by photos. On Whitsunday we steamed all day to arrive at our next station at 11° N on Monday at 2 am. Therefore we had enough time to celebrate this holiday appropriately by a barbecue in the hangar and on the working deck. The dinner was excellent. On behalf of the scientists I would like to thank the cook Andreas Spindler and his crew for this exquisite barbecue but also for the delicious daily meals.

With best regards on behalf of the scientists,

Meinhard Simon

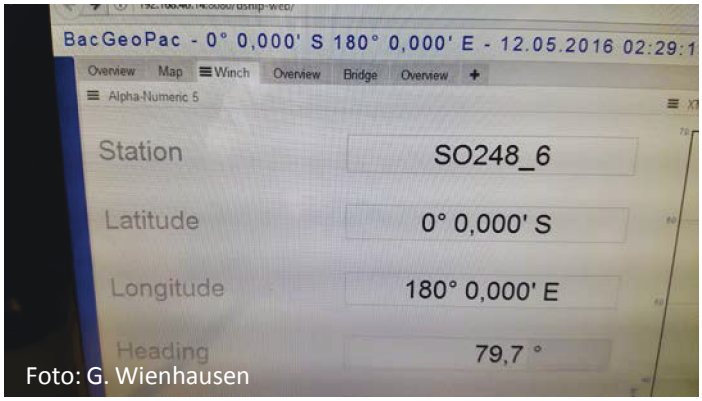


Foto: G. Wienhausen


In situ pump (Foto M. Simon)


Filtration devices (Foto: M. Simon)


Mesocosms (Foto: M. Simon)

4th Cruise report (May 16 to 23, 2016)

SO-248 „BacGeoPac“ 01.05.2016 (Auckland, Neuseeland) – 03.06.2016 (Dutch Harbor, Alaska, USA)

After cruising through the tropical and subtropical regions of the Pacific we reached the temperate zone at 37°N on May 23rd. The water temperature is only 16°C and the air temperature even only 12°C. From a European perspective one would not expect such low temperatures in these latitudes, but in the Pacific the influence of the temperate and subarctic zone without any barrier to the Arctic is effective much further south. We investigated a station at every 6th degree latitude, always alternating between a shallow one down to 1000 m and a deep one down to the bottom. On May 22nd the shallow station 12 was visited. The water color already indicated that the water is less transparent than in the tropics. The transparency measured by the Secchi disc was only 14 m and no deep chlorophyll maximum existed. The towed Bongo net contained for the first time radiolarians and many crustacean zooplankton, a clear indication of the higher productivity in these latitudes. Further, quite a few plastic particles were trapped as well, a clear sign of civilization and presumably a hint to the large amounts of plastic in the north Pacific central gyre. Indications of this much more productive area were discernable since the day before yesterday, as more pelagic birds occurred, mainly petrels and albatrosses and on May 21st also the first wales were spotted, mainly mink wales.

The occurrence of plastic particles at the surface and their colonization by animals and microorganisms is one of the topics of the group on board from the University of Vienna. Its leader, Prof. Gerhard Herndl, is not on board but well represented by his senior research associate Thomas Reinthaler, who, together with five colleagues, carries out the work on board. The main question of this group is to investigate the carbon cycle in the deep ocean and the identification of the prokaryotes involved, mainly Archaea. Because quite a few of them are able to fix CO_2, i.e. live autotrophically, they measure in water samples from below the illuminated near surface layer how much CO_2 is fixed. Further, they study how fast, or more precisely how slow the prokaryote grow in the deep ocean, how much biomass they produce and which significance these processes have for the carbon cycle in the oceans. The processes in the deep ocean are much slower than in the near surface layer due to the low temperature, the scarcity of nutrients and the fact that much fewer microorganisms dwell in these depths. However, one should not underestimate the significance of these processes simply because of the enormous range of the deep oceans. In a related project they investigate whether the Archaea can use urea to meet their carbon demand at least partially. In a pilot project dissolved proteins are isolated from the deep sea for a later identification. Therefore the proteins are concentrated from 480 liters of sea water, which takes two days. As the abundance of microorganisms in the deep ocean is lower than in the near surface ocean by at least a factor of 10, in depths below 3000 m up to a factor of 100, the Vienna group requires large amounts of water, for the mentioned analyses 1000 L and for several experiments between 240 and 480 L, equivalent to half or all bottles of one CTD cast. Thanks to the large volume bottles this demand of water is no problem and so far all water wishes were fulfilled. Below 2000 m the prokaryotes obviously are adapted to the high pressure which, however, may inhibit their growth at atmospheric pressure at the surface, causing technical problems for measurements at atmospheric pressure. Therefore, at one station the growth of the prokaryotes was measured in a special incubator in 2000 m depth by deploying it fixed at a steel wire for eight hours at this depth. The data of this experiment are still being processed.

Meanwhile every scientist is well acquainted with all rooms and spots on board. The last missing areas of the ship to become acquainted with were the facilities in the lower decks where the engine and power unit, the winch room, the drinking water processing facilities and the sewage treatment system are located. The chief engineer, Achim Schüler, gave a very interesting and competent guided tour through these catacombs of the ship which remain unnoticed when the ship is steaming and the scientists are working. It became clear to everybody that for the smooth operations and the most complex requirements of this research vessel a technical team is on duty which is very well familiar with all facilities on the lower decks. Smaller or larger technical problems, which occur again and again, are solved and fixed such that the scientific work on board is affected not at all. On behalf of the scientists I would like to thank Achim Schüler and his team very much for his unnoticed but most valuable commitment.

With best regards on behalf of the scientists,

Meinhard Simon


Foto: M. Simon


Foto: M. Simon

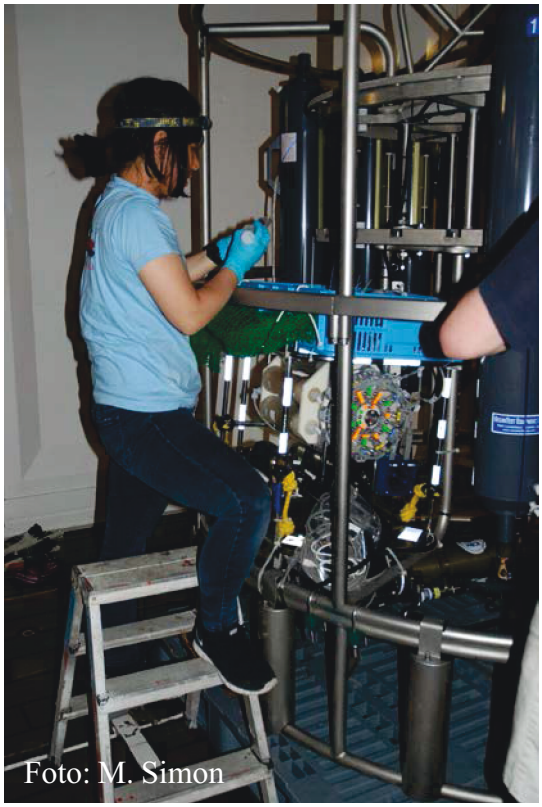


Foto: M. Simon

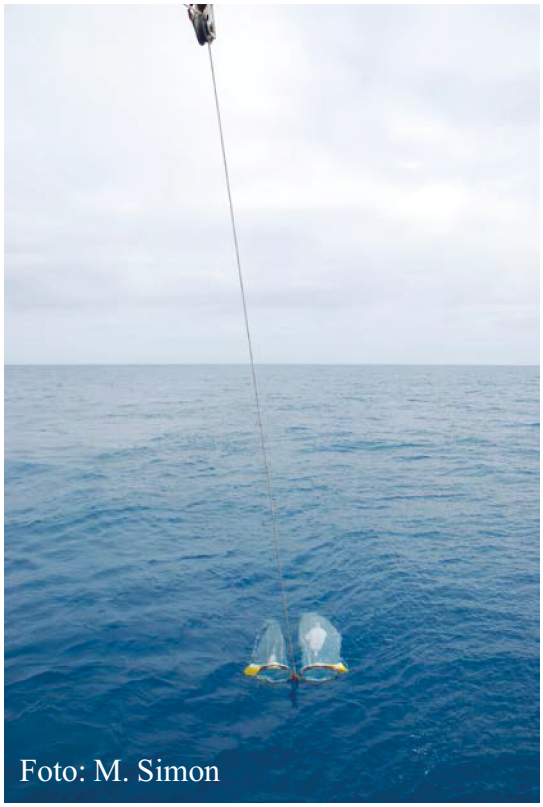


Foto: M. Simon

5th Cruise report (May 23 to 30, 2016)

SO-248 „BacGeoPac“ 01.05.2016 (Auckland, New Zealand) – 03.06.2016 (Dutch Harbor, Alaska, USA)

In the evening of May 27th we left the Pacific proper and steamed through the chain of the Aleutian Islands into the Bering Sea. We were lucky and able to see with binoculars in a distance of 40 nautical miles at a fair visibility three of the snow covered islands. Before, we had visited between May 23rd and 27th stations 13 to 16 at 40°, 45°, 47,5° and at 50°N again a 40-hour time series station, at which the in situ incubator of the Vienna group was exposed again. The sea surface temperature decreased further. At 40°N it was 10°C and at 45°N only 6°C and now in the Bering Sea it is around 4-5°C. When writing this report, we are at station 18 and 57°N, 179° 35’E. Yesterday we visited the first station in the Bering Sea, station 17, still on the Aleutian crest and therefore only 770 m depth. The sky is cloud-covered since days but it stayed dry. It is impressive to experience here locally how cold the Pacific is in the geographically temperate zone; understandably giving the name subarctic Pacific due to this feature . When the warming effect of the Gulf Stream is missing, like in Europe, the influence of the Arctic stretches, though, fairly far south.

All stations north of 34°N exhibited a relatively high productivity of the phytoplankton, measured as chloro- phyll fluorescence, as compared to the nutrient depleted stations further south. In addition, the Bongo net tows contained large amounts of zooplankton, but only few plastic particles. The biomass production of the bacteria in the upper 100 m of the water column, however, strongly decreased with decreasing temperature further north, presumably due to the low temperature as bacterial nutrients are abundant here. In contrast, bacterial numbers in the upper 100 m of the water column strongly increased, from less than half a million to more than 2 million per milliliter. Further analyses will show why the cell numbers increased that much towards colder temperatures. In the surface sediment samples collected by the MUC cell numbers increased as well, presumably also a consequence of the higher productivity of the subarctic Pacific relative to regions located further south. The color of the sediment in the north is much more brownish, pointing to a higher content of organic matter and indicating that a higher proportion of the material reaches the sea floor. The sediment in the Bering Sea at station 18 is even olive green, presumably due to large amounts of settled and little degraded phytoplankton. An unexpected finding for the entire transect from the tropics to the Subarctic is the well pronounced oxygen minimum at depths between 300 and below 1000 m, partly with minima of only 10-20% of the near-surface values. In the Bering Sea it appears to be well pronounced as well.

This will be the last weekly report of our cruise SO248, as it ends next Friday, June 3rd, in Dutch Harbor, the most important fishing harbor of the Aleutian Islands on the island Unalaska. Ahead of us is only the north- ern most station 19 at 58° 54‘ N, 179° 20‘ E tomorrow. Both deep stations in the Bering Sea are of great interest to us because the 3900 m deep basin of the Bering Sea is well separated from and exhibit only little water exchange with the Pacific. After the station tomorrow we just need to process the last samples and then will pack all material and stow it into the boxes and containers for shipping them back to Germany and Auckland. Finally all laboratories will be cleaned. A considerable part of the material will be used again on cruise SO254 from January 29th to March 1st, 2017. This cruise will start again in Auckland and ends there and has 60°S as the southernmost location. During cruise SO254 we will continue this transect to the south such that we cover in total a transect from 60°S to almost 60°N. Thus we encompass all biogeographic provinces of the Pacific from the subantarctic to the subarctic regions and will obtain a most comprehensive insight into the composition and metabolic potential of the bacterial communities in these provinces.

At all work on deck and using winches and instruments like the CTD, MUC, the in situ pump, the profiler, and the in situ incubator, Torsten Bierstetd and his team always supported us in a most helpful way and very competent. Without their help we would not have brought any instrument into the water. Therefore I would like to thank very much Torsten Bierstedt and his team for their great commitment and their support at any time during day and night.

At the end of this cruise we will have made appr. 6500 nautical miles and, regarding the distance, one of the longest cruises with RC Sonne. Even though the cruise is not yet over and we have still a few days to go I would like on behalf of all scientist to thank very much all members of the crew for their in every respect outstanding support of our work available at any time. This is true particularly for the captain, Lutz Mallon, who, with his quiet and easy-going manner, directs the vessel most competently through all stormy and otherwise difficult conditions.

With best regards and a farewell on behalf of the

scientists, Meinhard Simon.

Foto: M. Simon