

## TransBrom Sonne

### Weekly report Nr. 3 (19.10.-25.10.2009)

RV Sonne now at 19°11' S /146°50' E avast



After enjoying several sunny and calm days at the end of last week, we encountered south-east trade winds, intensified by a low pressure system near Papua New Guinea and a strong high pressure system above Australia. The oceanic currents from behind and the wind from ahead formed a rough sea, which had great impact on our physical condition and mood, despite the fact that wave heights of 3 metres don't seem to be harmful. It was like working and living in a huge swingboat, known from fairs for which we had a seasonal ticket. It is definitely a challenge to cope with this extraordinary situation, especially when the ship bends over because of interfering waves while one is about to handle a thin capillary glass column (diameter: 0.5mm) or inject a chemical solution through a mini septum using a gauzy needle. Gert Petrick, Karen Stange and Hansup Nam Kong, of the halocarbon troop, have perfected those exercises to perfection by now.



Gert Petrick at the GC/MS analyzing halogenated trace gases from sea water.

Keeping calm while positioning the highly sensitive capillary columns and keeping the legs and hips moving skilful in order to spontaneously balance with the ship's movements is a skill. After ten hours of laboratory activities, only interrupted by one or two meals, one is looking forward to the bunk, which again rather reminds oneself of an amusement park's drop tower. Hints on how to not fall out of bed during the ship's rolling motions: build a nest and try not to let go, choose a recovery position or, in desperate cases, rest in hammocks on the top deck which sometimes turns out to be quite wet due to tropical rainfalls. All measurement systems carry on providing proper data and interesting results, even though operators suffer from continuous tiredness during the last days.

Having seen only small amplitudes of bromoform for several days while being within the blue waters of the North Pacific Gyre, we suddenly have a concentration increase of one order of magnitude. Those concentrations occurred while passing atolls and small islands 20-30 miles east of us, which we realized after taking a closer look at the sea maps. Reefs and atolls to the west don't seem to have a great impact on our measured concentrations, which may be due to the water's direction of flow. Thursday last week, we arrived in the Coral Sea, where the concentration of all halogenated hydrocarbons rose slowly, but considerably. The satellite images of the PHYTOOPTICS group as well as their filtrations showed an increase in phytoplankton levels. Who are the producers after all? Local phytoplankton or corals? This

question remains unanswered and exciting. By now we became quite curious about what to expect in the Great Barrier Reef.

The air sampling group, Arne Lanatowitz, Christian Müller and Herbert Quack, are happy to see the stock of empty sampling canisters, adsorption tubes and aerosol filters decreasing. The sampling intervals of 3 to 6 hours under rough seas become difficult. Limbs become especially heavy when the ship rises again from below while one is sure to still be among the movement's weightless conditions. More than 300 air samples were collected during the last two weeks which will be, upon arrival in Townsville, sent to the respective home labs for analysis.



Cathleen Zindler taking water samples.

We need to also wait for quantitative results of Cathleen Zindler's and Franziska Wittke's on-board measurements of dimethyl sulphide concentrations. They already pointed out to have detected "interesting variations" within the water, but won't have definitive statements before finishing the quantitative evaluation in Kiel. Water samples of dimethyl sulphide (DMS), dimethylsulfoniopropionate (DMSP) as well as dimethyl sulfoxide (DMSO) were taken every three hours during the transit from the North- to the South Pacific. Using a purge and trap system, connected to a gas chromatograph and a flame photometer detector, DMS and DMSP concentration could be measured on board. DMSO-concentrations will be determined at IFM-GEOMAR subsequent to the cruise.

Sulphur compounds are of extraordinary interest in the western Pacific, since those waters have not been investigated to date concerning this issue. All three compounds, DMS, DMSP and DMSO, are central constituents of a complex production- and consumption cycle, mainly being influenced by phytoplankton and bacteria within the surface layer. Therefore and because all compounds are measured at once, the dataset collected during the TransBrom cruise is unique up to now. Simultaneously collected data concerning phytoplankton pigments and species assemblage of phytoplankton provide a basis for a comparison with the above mentioned compounds in order to get an overview of the marine plankton's influence on DMS-, DMSP- and DMSO-production.

Atmospheric DMS-concentrations, also measured during the cruise, will be used for computing possible DMS-emissions from the ocean to the atmosphere. The later quantitative analyses of all groups in their home laboratories will yield exciting and surprising results from this unique set of about 100 "stations" due to simultaneous sampling of atmospheric as well as marine groups.

To achieve the best synergy among all participating groups, we met for a daily noon seminar, giving each group the opportunity to present their work by giving one or two talks. Despite the 24h shifts, at least 75% of all scientists attended this meeting. This inspiring time of exchange helped to better understand the participating disciplines, even though some lecturers felt seasick due to rough sea conditions or all attendants slipped through the conference room simultaneously on their chairs. The enthusiastic and interdisciplinary interpretation of oceanic and atmospheric feedbacks by meteorologists, chemists, biologists and physicists during the transit was surely fostered through the interdisciplinary exchange time.



The TransBrom-Sonne Team.

The measurement equipment and scientists of Heidelberg's and Bremen's MAX DOAS group were able to work reasonably unaffected by the swell. Katja Grossmann, Institute of Environmental Physics, University of Heidelberg, as well as Enno Peters and Folkard Wittrock, Institute of Environmental Physics, University of Bremen, carried out remote sensing measurements during the last weeks by making use of the MAX-DOAS method. MAX-DOAS stands for Multi-Axis Differential Optical Absorption Spectroscopy and uses scattered sunlight as a light source to detect different trace gases in the atmosphere. For TransBrom, the focus was surely on the easy detectable bromine oxide (BrO) and iodine oxide (IO). Initial analysis actually showed a small BrO-Signal within the marine boundary layer on a few days. More exact radiation transfer arithmetic at the home labs will later lead to atmospheric profile information. Apart from halogen oxides, formaldehyde (HCHO), acetaldehyde (CH<sub>3</sub>CHO), ozone (O<sub>3</sub>), sulphur dioxide (SO<sub>2</sub>) and nitrous oxide (NO<sub>2</sub>) are also determined with the DOAS. Those datasets will mainly provide a basis for satellite instrument validations such as SCIAMACHY. Especially concerning the Pacific region, no useful datasets exist to date. Both instruments worked throughout the whole campaign without having difficulties. Both datasets were able to complement one another since the Heidelberg-

system did exclusively portside scans while Bremen's system made use of different perspectives in order to derive possible horizontal gradients in trace gas distribution.

As we entered the Palm Passage on Saturday morning at 1am, it became evident that the successful struggle concerning research permissions for all protective areas within the Great Barrier Reef Marine Park paid off. The water concentrations of various compounds rose strongly and remained at high levels until we reached Townsville.

The marine sources for the measured compounds still need to be identified. However, it was determined that the Great Barrier Reef is a source for atmospheric bromine trace gases, that might even find their way up to the stratosphere.



Approaching Townsville (Great Barrier Reef Marine Park).

The analysis of the extensive dataset from the ocean and the atmosphere collected during the TransBrom transit of the 'Sonne' through the Western Pacific will give us pleasure during the next week and months and will lead to new conclusions concerning the interaction of ocean and atmosphere. We thank the Sonne-Team once again for its excellent support!

Birgit Quack and the TransBrom Sonne-Team (25.10.2009)