POS526 1st Weekly Report

Tuesday, July 24th, 16:50 UTC, 56°01N, 004°04E

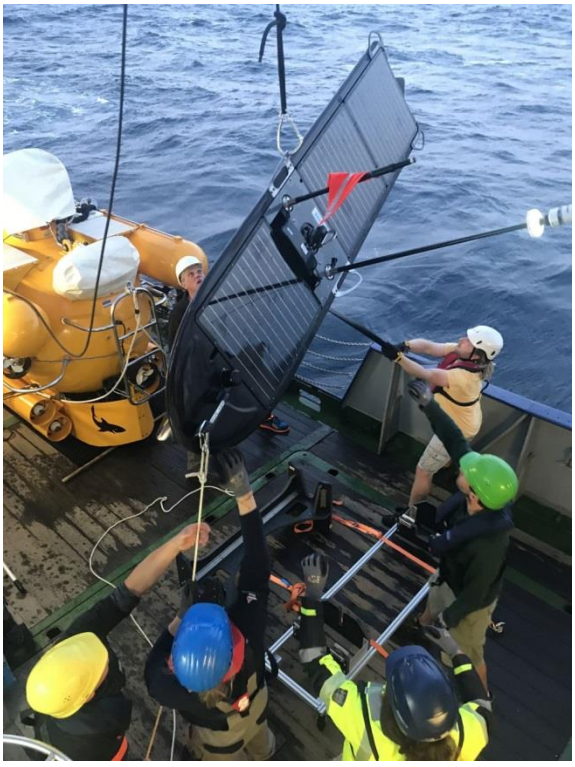
Poseidon cruise 526 "Semi-Autonomous Subsea Optical Mapping" started on July 19th with the arrival of the international colleagues from the USGS in Bergen. On the next day, the first three scientists and technicians from GEOMAR joined them for scientific debates, cruise planning and a first glimpse of Poseidon from afar. By 9am the next morning the group of five arrived at the ship for a warm welcome by the crew and the JAGO team that was already on board during POS525. Eager to get going, the waiting container was opened immediately and the full loading already emptied by 9:45 and all equipment was on its way to the various labs on the ship. In the afternoon the cruise team was completed by the arrival of the AUV technicians and further scientists from GEOMAR. Unpacking and lab setup continued through the next day and by the evening the semi-autonomous gear was readily assembled: the brand new AUV "Anton", the MOSES Wave Glider, submersible JAGO, the mobile SHiPCC computer cluster and equipment like the BubbleBox, and the GasQuant lander. Many tubes and wires were added to the vessel to pipe gas samples from the bow and the top of the mast to the wet lab, to connect further underwater navigation beacons and hydro-acoustic sensors from the moon-pool and the portside pole to the dry and chemistry lab. With the arrival of the last, delayed equipment by airfreight, the cruise personnel and technology was ready to leave port after lunch time with a slight delay of five hours to plan. The ship headed south through the fjords and soon arrived in open water to steam towards the working area. In the morning of the 24th, the vessel stopped for the first equipment test with a successful first buoyancy test of the new AUV. Afterwards the course south was resumed, the last sensors connected to the ship's and additional navigation sensors and the entire range of hydro-acoustic, optical and environmental sensors, among them three CRDS systems for continuous CH4, CO2 and isotope analyses of three air levels (GEOMAR – AIS) and the sea surface water (USGS GAS) was waiting for the ETA in the working area at 6 pm to begin the science program.

POS526 was planned as cruise serving three major task, 1) performing scientific studies around methane seep sites in the North Sea and cold water corals in Norway, 2) test and advance technology acquired within MOSES infrastructure project and 3) acquire data in a structured way to advance data science capabilities, workflows, methods and joint software development within Digital Earth.

Friday, July 27th, 16:13 UTC, 55°18N, 004°03E

Three days of extensive testing, sampling and measuring have passed. All labs are in full operation and the data archives are filling up. The primary working area is the "jumping horse" bubble seep site at 43m water depth. We inspected it by two night-long hydro-acoustic surveys using single- and multi-beam echo-sounders (EK 80 with 38kHz installed in the moon pole and the ships Seabeam 3050) as well as 300kHz ADCP installed on the port-side pole. At the same time of course the chemical analyses of the air and the surface water continued, spitting out data almost every second. During daytime, these areal measurements were extended by CTD casts (sampling the water near the seafloor and throughout the water column) and very successfully by the BubbleBox stereo camera system

mounted on JAGO. This system alone acquired more than one Terabyte of image data in the first two days in the working area. By combing all these measurements we aim for quantifying the amount of methane being released from the seafloor as gas bubbles, dissolves in the water column and finally making it to the sea surface and into the atmosphere. This easy sounding story is complicated by a strong pycnolcline in 20m water depth, tide depending changing currents, making it a challenge to be at the right spot at the right time. Luckily the pole mounted ADCP works well despite all odds that the bubbles from the propeller will disturb the acoustic signal.



A few hands more were needed when the Wave Glider was recovered during rough conditions. After recovery it was put on the same surface water supply as the USGS GAS system for a sensor comparison study with discrete water samples for verification.

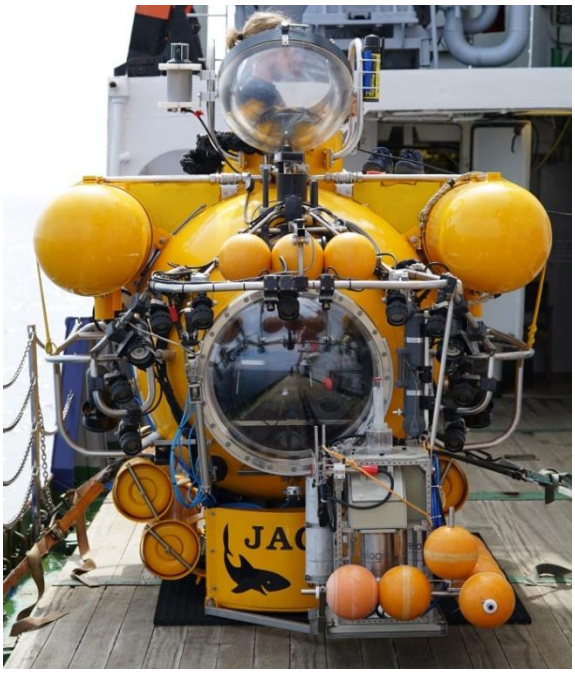
Among one of the first things when arriving at the working area was to deploy the WaveGlider. It is an autonomous surface vehicle that creates forward propulsion from wave energy and electricity from solar energy. It got equipped with a sensor packing for measuring dissolved gases in surface waters and was sniffing for elevated methane concentration near the seep sites. This gave us the opportunity to compare data from the CRDS and the WaveGlider for methodological studies but also to extend the range of analyses to places in space and time where the ship cannot be at that time. At the beginning the WaveGlider first had a hard time moving along due to the near perfectly flat sea surface but luckily was later on cruising with more than 2 kn in the much rougher weather with gusts of up to 50 knots. The Wave Glider has also shown its ability to avoid incoming ship traffic, which included RV Poseidon when we approached the Glider for its recovery after some days of continuous measurements (luckily Björn could disable the ‘avoidance’ function). In addition to the list of tasks and gear above we further aimed for a ‘one and for all’ solution for good underwater navigation using a new USBL system. The idea of this system is that it can be used with the AUVs and JAGO as well as any towed underwater device (TV-CTD, OFOS, ...) by linking to the surface transducer on the ship and/or the Wave Glider as

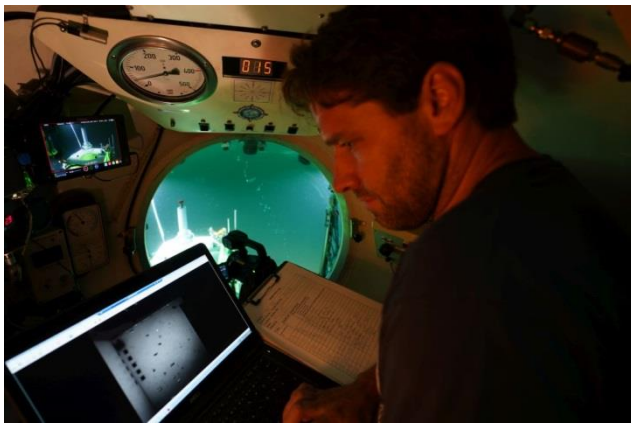
supporting surface platform. However the software, offset definitions and by most network issues made this technical playground a real challenge. Luckily the cruise was planned as technical test cruise, allowing us to spend enough time solving these problems (hopefully once and for all, the second half of the cruise will show).

AUV Anton during its very very first and later second missions. He is still stumbling along like a toddler, but we are convinced that after the cruise he will walk like a young child.

As mentioned briefly above the wind picked up on 27th after days of complete "Ententeich". This made it impossible to use the AUV or JAGO. This made us a bit worried if we can recover the GasQuant system that has be deployed before by a releaser attached to the ships CTD. GasQuant is also a hydroacoustic system analysing seep activity and intensity using a horizontally looking multibeam system.

The USGS GAS - CRDS system with Michael Casso running direct injections. Michael was the main person analysing 277 samples for CH_4, CO_2 AND its $\delta^{13}C$ ratios (not including the standards).





Top: Tim Weiß observing the 100fps BubbleBox output inside JAGO.

Left: Submersible JAGO with BubbleBox on the lower right.

The small lander was inspected and correctly oriented towards the bubbles during JAGO 2nd dive but was waiting to be recovered before we had to leave towards Denmark. The wind did not allow recovery until the 31st during the third JAGO dive of the cruise. This extended time at the seafloor caused that the batteries where completely empty, but the data storage was full with 98GB of data (to be analysed later).

Tuesday, July 31th, 20:16 UTC, 55°53.26'N 005°21.63'E

So, what to do when the weather is against you during a scientific cruise, it is 'multibeaming' or CTDs. The area just south of the Dogger Bank is flat, no, it is flat-flat, 43m deep for the next tens of miles (one reason why we picked this area for the first dives of the AUV). So CTD it was and answering the scientific question of quantifying methane fluxes and budgets needs ample of CTD casts, up- and down-stream of seep sites, vertically and laterally, below and above the pycnocline. The used Video-CTD from GEOMAR worked very well, allowing casts close to the seafloor even in bed weather (and without altimeter). A total of 44 CTDs were run, resulting in 277 analysed water samples. Results show that the increasing wind drives methane out of the water and that the depth of the pycnocline deepens causing that lower sea surface concentrations have been measured after the 'wind'.

We left the working area shortly before 3pm the 31st of July and are now making our way with 10 kn to Hirtshals in Denmark to exchange some of the scientific crew. The next stop after that will be the Tisler cold water coral reef in Norwegian waters where we will start multibeaming the reef area during the night of 2nd to 3rd August.

Everybody is well of, this is because science and technology worked out but also because of the deck and nautical crew. Their support was superb, many thanks for that!

This was the first, slightly delayed weekly report of POS526, many greetings from the North Sea, from the entire scientific and technical personal on board RV POSEIDON POS526.