SONNE 243 Weekly Report II

This week started out with a rather large challenge to overcome: we ran out of liquid nitrogen. Given that approximately 1/3 of the cruise participants depend in some way on measurements made with liquid nitrogen, plus others use liquid nitrogen to flash freeze samples, this was a serious concern. It was a hard call, but we decided to risk our schedule and go to port in Chimbote, Peru to buy 140 L of liquid nitrogen. It was a very tense time, considering that everything took much longer than planned and we only have a 17 day cruise. But, finally, on Tuesday, we obtained our goal (Figure 1)! Better late than never, as they say…Special thanks to the captain, crew, Wilson Carnhuapoma (a Peruvian scientist on board from IMARPE), and Damian Arevalo for their efforts to acquire the liquid nitrogen.

Figure 1. Left) one view of the area around Chimbote from the ship, Right) liqud nitrogen delivery (R. Link, C. Marandino)

Despite the loss of time, we have been able to recover our science plan. During this week, we performed three deliberate tracer releases (Figure 2). The Ocean Tracer Injection System (OTIS) team, led by Toste Tanhua, injected 68.5 kg of the inert tracer CF_3SF_5 into the bottom boundary layer at three sites along the Peruvian shelf. The OTIS is designed to be towed behind the ship at a set density surface. However this time we wanted a tracer release very close to the bottom, so the OTIS got “legs” and “feet” so that we could deploy the OTIS on the bottom of the ocean and release the tracer there. The reason for the close-to-bottom release is that we want to mimic release of nutrients from anoxic sediments, and qualitatively understand where ocean currents and mixing processes distribute the nutrients (i.e. the tracer) over a longer time-period. Anoxic sediments are known to release nutrients, such as phosphate and reduced iron, both of which have the potential to enhance productivity in the region – and initiate a positive feed-back loop.

The distribution of the tracer will be measured by two additional cruises over the coming 18 months; the results should inform us about the mixing pathways of nutrients from sediments in the region. This experiment is a component of the proposed third phase of the SFB754 project “Climate-Biogeochemistry Interactions in the Tropical Ocean” that has a focus in the oxygen minimum zone off Peru, and the results of the experiment are expected to provide another piece of the puzzle on how the OMZ off Peru is operating.

Another challenge during our cruise has been to search for signs of upwelling during an especially intense El Niño year. El Niño forecasts to date show an SST anomaly of approximately 5˚C (warming). This warming signifies the weakening of upwelling closer to the coast. Although the OMZ in this region is always present, its location during an El Nino event is deeper in the water column. Both of these phenomena have an impact on trace gas production and air-sea exchange. The upwelling zone

usually experiences high productivity, as enhanced levels of nutrients are brought to the surface, stimulating biological activity. For trace gases that are biogenic in origin, such as dimethylsulfide, isoprene, and bromoform, the weakening of upwelling means less production in the surface ocean and therefore potentially less air-sea exchange. Since the lack of upwelling means a deeper OMZ, trace gases

Figure 2. Left) the OTIS being lowered into the ocean, middle) Toste Tanhua and Tim Stöven working on the tracer tanks, right) Andreas Pinck and Mario Müller working on the OTIS (C. Marandino, T. Tanhua)

produced as a consequence of diminished oxygen, such as N_2O, will also be reduced at the surface. However, the signature of upwelling, as illustrated in the CO_2 and SST measured over the cruise track (Figure 3), can be seen in the most southern part of our trip. Cold CO_2 rich waters from deeper can be seen near the coast around 9˚S and extend away from the coast by 14˚S. Here we hope to find higher levels of trace substances and better track the processes that influence their cycling and air-sea exchange.

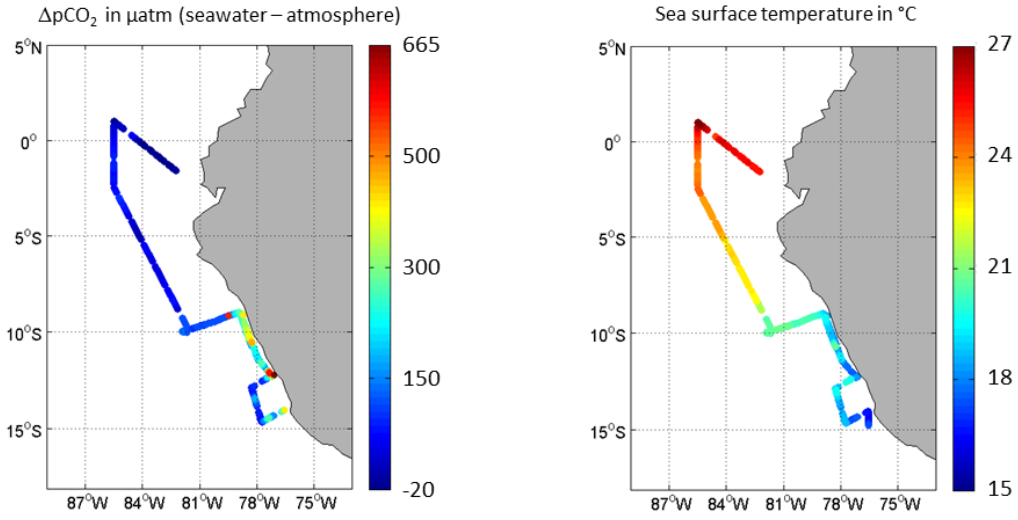

Figure 3. ASTA-OMZ cruise track to date: left) showing the difference between seawater and atmospheric levels of CO_2 (T. Steinhoff, D. Arevalo), right) showing sea surface temperature.

The upcoming final week of the cruise will occur in this more intense upwelling area. We are looking forward to our investigations there!

Greetings from the Pacific, Christa Marandino and Damian Grundle