M197

(30.12.2023 – 06.02.2024)

5th Weekly Report (22.01.2024 – 28.01.2024)

The start of this week began with our departure from the Napoli underwater mud volcano site (Figure 1 left). The crater of this unusual feature is filled with hypersaline water coming from the dissolution of salts in sediments as warm waters rise upwards to the seafloor. The high salinity of these waters causes them to be dense and therefore being retained in the crater. Using a live video stream from a video camera on the multicore sediment coring device, we could get a glimpse at this 'brine pool' ca. 2km below the surface (Figure 1 right). The live video stream is very useful, as it enables scientists to visually assess the sediments before inserting the sediment core into the seafloor; for instance, they can check for rocks that would damage the device. Once it has been confirmed that the device is above soft sediments, the multicore is lifted up a few meters before plunging downwards into the sediment and then bringing it up 2km to sea surface. The sediments at the brine pool site were a distinct grey colour with a smell of hydrogen sulphide (smells like rotten eggs), as a result of this being a low oxygen environment where sulphate is used instead of oxygen for respiration by sulphate reducing bacteria.

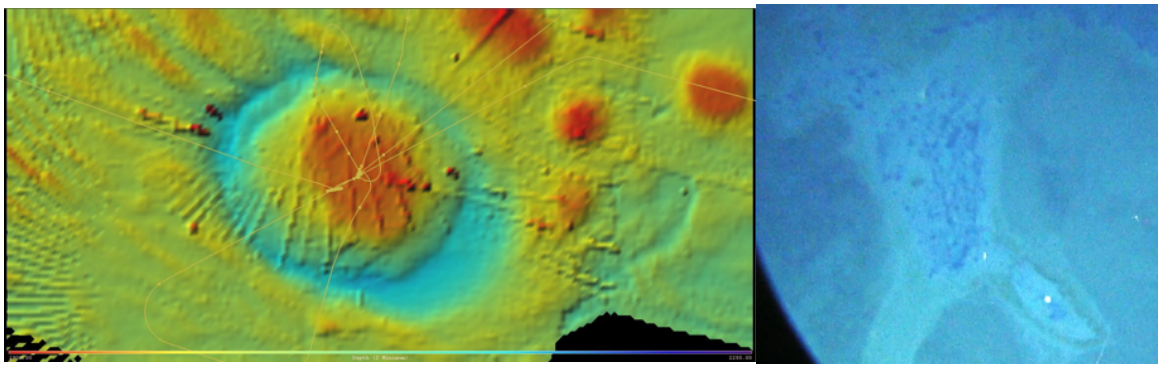

Figure 1. *Left: bathymetry around the Napoli Mud Volcano (warmer colours indicate shallower depths). Right: Video still of the brine pool in the mud volcano crater.*

At other stations we have occupied, sediment cores have generally been characterized by brown sediments with distinct dark layers (Figure 2). These dark layers are a characteristic of Mediterranean sediment cores and are referred to as 'sapropels'. The layers are rich in organic material, which gives them their dark colour. Sapropels were formed during periods in the past when primary productivity in the overlying waters was elevated, possibly due to (i) enhanced nutrient supply from stronger rainfall and more flooding of the Nile River, and (ii) more sluggish deep ocean circulation in the Mediterranean that reduced the oxygen supply to bottom waters overlying sediments. The last sapropel event was ca. 8000 years ago, so the material overlying this layer has taken around this long to accumulate. When recovered onto the ships deck, samples are taken from the sediment cores for all different sorts of analyses, ranging from chemical analysis of pore waters (including concentrations of nutrients and other elements) through to analysis of the types of microbial communities present.

Figure 2. *Example sediment core showing a distinct dark, organic rich layer at the bottom called a sapropel.*

Monday and Tuesday this week brought very strong winds and swell from the Aegean Sea to the north. With the forecasts from our onboard DWD team to hand, we sailed to the northern edge of our working area and hid behind two of Crete's large mountains, which provided excellent wind shadows (Figure 3). In these wind shadows it was calm enough conditions to carry on with our scientific programme and meant that we did not lose any station time.

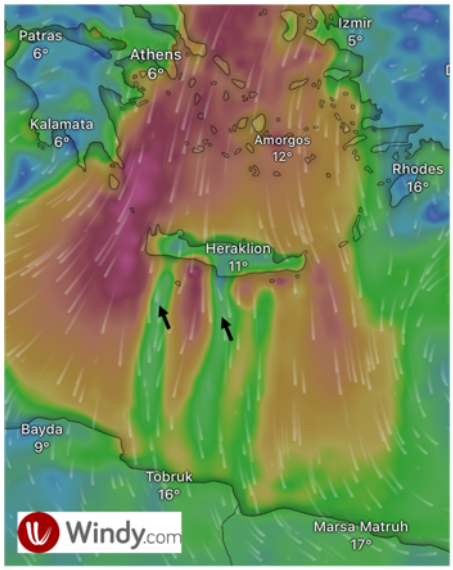

Figure 3. *Screenshot from www.windy.com showing strong winds from the north on Monday/Tuesday this week. The fingers of lower speed winds to south of Crete are a result of protection from two high mountains on the island. The arrows point to the approximate station positions of RV Meteor where, sheltered from the strong winds, we could continue with scientific deployments.*

On Tuesday morning we carried out a live video call from the ship with a group of school children, describing our scientific programme and life on board a research vessel (Figure 4). The school children were taken on a ships tour, from the bridge, the weather station, the ships gym and hospital, through to the working deck and the scientific laboratories. Apparently, the school group found it both interesting and entertaining (it is easy to forget how unusual life/work conditions on a ship are to an outsider!). We hope it also inspired an interest in the ocean.

Figure 4. *Prof. Ilana Berman-Frank and Alon Blachinsky (University of Haifa) conducting a live video call with a group of school children, explaining the science programme we are conducting and life on a research vessel.*

For the remainder of the week, we headed further west, enjoying relatively calm seas with some good weather as we sampled through a cyclonic eddy to the southwest of Crete (Figure 5). In this feature, deep waters are upwelled to the surface, bringing nutrients which should enhance the growth of phytoplankton and promote more ocean life in general. We are particularly interested to see if primary production (the rate that dissolved carbon is

transformed into organic carbon and made available to higher trophic levels) increases. One scientist on the ship has been measuring rates of primary production by spiking seawater with dissolved carbon (C) 'labelled' with isotopically heavy ^{13}C and incubating the sample for 24h (Figure 5). Almost all carbon in the environment is in the form of ^{12}C, so the incorporation of the added ^{13}C into organic matter—measured later by mass spectrometry—is proportional to rates of primary production.

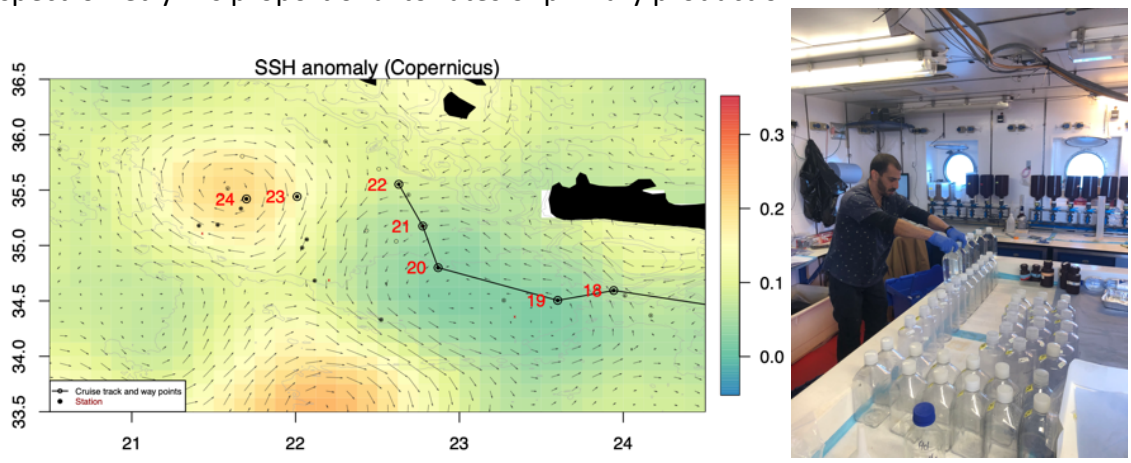

Figure 5. *Left: Sampling stations located though a cyclonic eddy (blue colours indicating lower sea surface height), where deep waters are pushed nearer to the surface bringing nutrients with them. Dots with connected show our sampling station locations. Right: Clear 1L polycarbonate bottles are filled with seawater, spiked with ^{13}C, and then incubated for 24 hours in an on-deck incubator. The incorporation of ^{13}C into phytoplankton cells is determined by collecting phytoplankton on a filter paper (using filtration rigs in the background) and then determination using a mass spectrometer in the home laboratory. Scientist: Tom Reich (University of Haifa).*

In the next week we plan to cross the so-called 'Pelops Gyre', a semi-permanent anticyclonic eddy to the south of Greece (orange colour in Figure 5), then head northwest to our final station locations east of Sicily. As always, we are being excellently taken care of by Captain Apetz and crew.

With best regards from 22.01 °E, 35.44 °N,

Tom Browning and the M197 research cruise participants

GEOMAR University of Haifa CYPRUS MARINE & MARITIME INSTITUTE Xiamen University THE UNIVERSITY OF CHICAGO MARINE BIOLOGICAL LABORATORY