M197

(30.12.2023 – 06.02.2024)

3rd Weekly Report (08.01.2024 – 14.01.2024)

We are now completing our 7th station on research cruise M197 and getting into a good rhythm with the various deployments. Our first four stations formed a transect through a large, semi-permanent eddy to the south of Cyprus called the Cyprus Gyre (Figure 1). This eddy is characterized by clockwise current motion, enhanced sea surface height, downwelling and a lower nutrient supply to the surface ocean. We expect this reduction in nutrient supply to reduce phytoplankton productivity and have an influence on the biogeochemical system as a whole. Such eddies are a major feature of the Eastern Mediterranean and we aim to sample in a number of them during the research expedition.

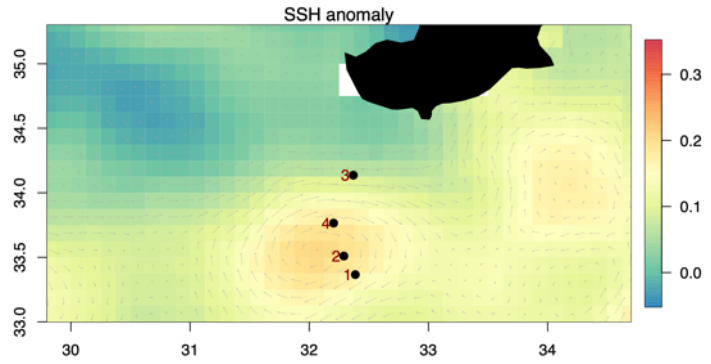

Figure 1. *The first four stations of the cruise transecting through an anticyclonic ocean eddy south of the Republic of Cyprus. Warmer colours indicate enhanced sea surface heights associated with the eddy. Grey arrows indicate surface ocean current velocities (Data product: European Seas Gridded L 4 Sea Surface Heights from the E.U. Copernicus Marine Service).*

Another characteristic of this region is that it periodically receives strong inputs of aerosol dust from surrounding land; in particular, dust from the Saharan desert. This dust can be an important supply mechanism of nutrients to surface seawaters. Last week, the prevailing winds led to elevated Saharan dust concentrations in the atmosphere. This was evident in the hazy sky and more clearly on our aerosol filters, which turned yellow/orange (Figure 2). On the cruise we have aerosol samplers running, which pump air through filter papers and trap the dust on them. When we return to home laboratories, we will do experiments to assess the nutrient and trace element concentrations in the dust, so we can quantify the flux of these dust nutrients into the surface ocean. Furthermore, we have been collecting rainwater samples that we will analyse for nutrient concentrations; rainfall is effective at 'washing out' the dust from the atmosphere and can strongly enhance nutrient inputs. In general, we expect the dust and rain to have a fertilizing effect on seawaters, via supplying nutrients that enhance phytoplankton growth. However, the fertilizing impact will be strongly regulated not only by the quantity of different nutrients supplied from the dust, but also the specific nutrient in seawater that is limiting phytoplankton growth.

Figure 2. *Left: aerosol collector (photo: Benjamin Ankri). Right: aerosol filter, approximately the size of an A4 sheet of paper (photo: Barak Herut). Air has been pumped through the filter, trapping dust particles. The yellow colour comes from Saharan dust.*

Seawaters of the Eastern Mediterranean are peculiar in that phosphate concentrations in the surface are lower than nitrate concentrations (Figure 3). This is very rarely the case in other subtropical ocean regions. It is therefore possible that phytoplankton in this region are 'co-limited' by both nitrogen and phosphorus at the same time. We are investigating this on this cruise, by conducting experiments where these nutrients are supplied alone and in combination to seawater and then phytoplankton growth is assessed over several days. There are only few experiments of this type in this region, particularly during wintertime. In finding out which nutrients are limiting to phytoplankton growth, together with measuring the nutrient supply from aerosols, we can assess the fertilization potential of dust deposition in this region.

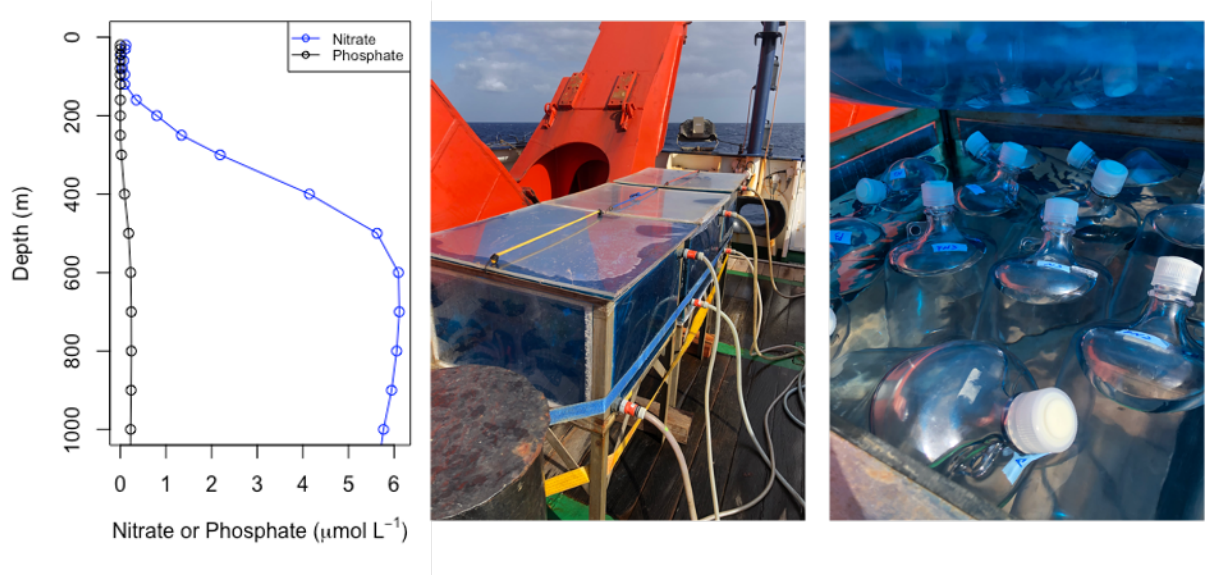

Figure 3. *Left. Seawater concentrations of nitrate and phosphate in the upper 1 km of seawater. Data courtesy of A. Mutzberg. Middle and right: experiments to assess nutrient limitation of phytoplankton in the region, where nitrogen and phosphorus are supplied to seawater and phytoplankton growth is assessed over several days.*

On 13.01.2024 we occupied Station 7 over Eratosthenes seamount, a carbonate platform around 100 km south of Cyprus that rises up to depths of 690 m (Figure 4). The alterations to water column structure, currents and seawater chemistry as a result of the seamount could influence the amounts and types of microorganisms and lager zooplankton we are studying, relative to surrounding background conditions. We expect this seamount could

drive enhanced mixing of overlying waters. This potentially could increase the supply of nutrients and trace elements to surface waters and thereby enhance productivity.

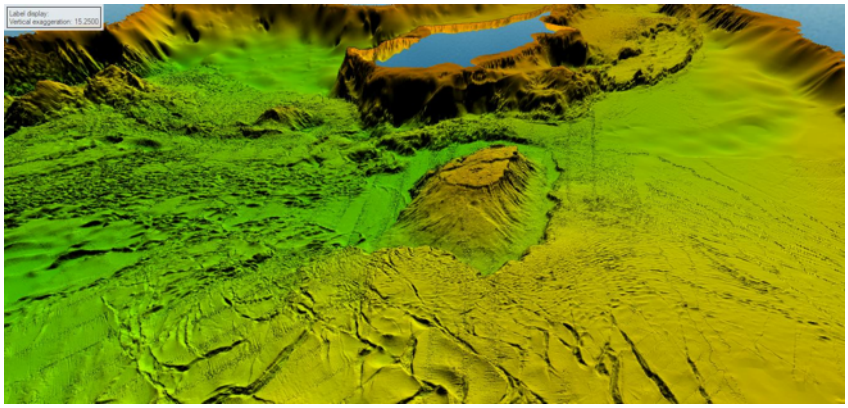

Figure. 4. *A 3D map of the bathymetry of Eratosthenes Seamount south of the Republic of Cyprus, the location of Station 7. Generated with Emodnet bathymetry visualized with Global Mapper (Henriette Wilckens).*

The weather over the last week has been mixture of some sun and clouds with occasional rain showers and some lightning. Maximum wave heights have been up to 3 m. This has mostly not been interfering with our research, apart from our sediment core device (the so-called 'multicore') where the ships motion can cause lids of the tubes containing the sediment to snap shut before even reaching the seafloor. With calmer seas forecast over the first part of next week, we are hopeful for plenty more successful sediment core retrieval. In this regard we have been benefitting from detailed, regularly updated weather reports from Patrick Suter and Martin Stelzner, the team from the DWD, which are helping us plan our work.

In the next week our plan is to head westwards towards Crete. As always, the science team have been excellently looked after by Captain Apetz and the crew.

With best regards from 32.68 °E, 34.07 °N,

Tom Browning and the M197 research cruise participants