RV SONNE

SO289 - South Pacific GEOTRACES

18th February - 8th April 2022

Valparaiso (Chile) - Noumea (New Caledonia)

6th Weekly Report

28th March – 3rd April 2022

Observations of Monowai volcano cone and mercury in the South Pacific Ocean;

Progress: We have had a successful week, following our unplanned detour to Tahiti. We commenced sampling again on March 23 and have been able to conduct daily station occupations with CTD casts and in situ pump deployments (Fig. 1). The weather has been variable with winds up to force 6-7 Beaufort, but mostly below 4 Beaufort.

Fig. 1: CTD deployments on Sonne. Photos by Lea Blum

Following our diversion to Tahiti, we decided to follow a cruise track that was more northerly (26°10S) than initially planned, in order to save steaming time on our way to New Caledonia; station spacing was 4 degrees. The chosen track allowed us to sample in the international waters between the EEZs of New Zealand and Tonga (Fig. 2). The narrow gap between these EEZs facilitated us to sample the Kermadec-Tonga Trench (station 39) and also an underwater volcanic system on the ridge (station 40). Fig. 3 shows the position of station 40 on a global map, with the multibeam data over the Monowai volcano cone, and also the vertical profile of turbidity at station 40. The underwater volcanic inputs are visible at depths between the seafloor (530 m) and ca. 300 m depth at this station. Previous cruises that worked in the vicinity of station 40, have noted seismic activities. We did not observe this, but we spotted large amounts of pumice (derived from volcanic eruptions) floating on the surface of the ocean.

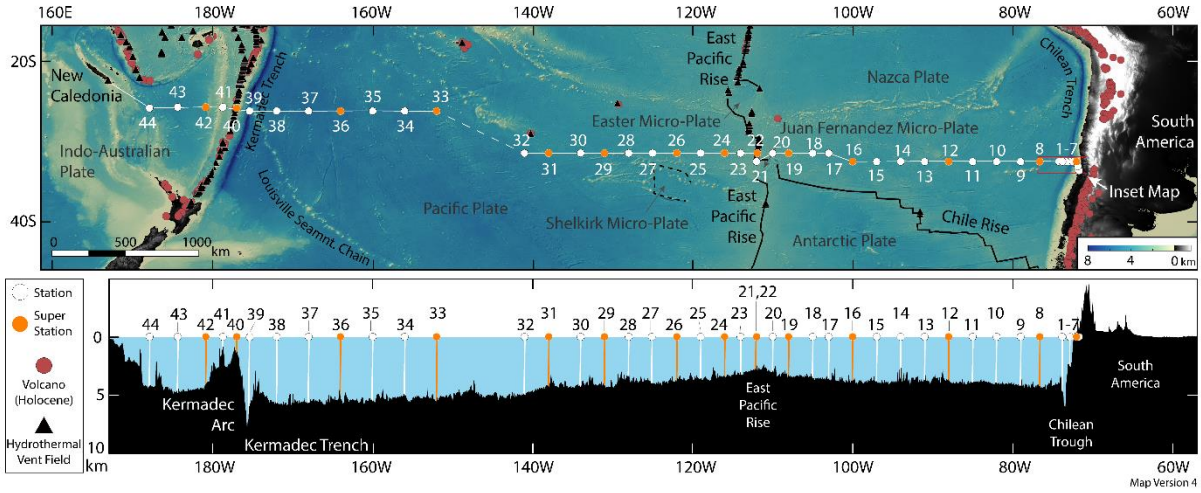

Fig. 2. Cruise track, stations and bathymetry for SO289. Graph produced by Chris Galley.

We also spotted a lot Trichodesmium which is a filamentous diazotroph (organism that fixes di-nitrogen gas from the atmosphere; like the legumes in your garden). Trichodesmium flourish in regions with low nitrate concentrations and elevated dissolved Fe concentrations as it has a high iron requirement for its enzyme system (Nitrogenase) that facilitates the nitrogen gas fixation. The region may well receive enhanced iron inputs from pumice, Australian desert dust deposition, hydrothermal inputs and run-off from islands. Our analysis of the samples after the cruise will allow us to link Trichodesmium abundance with surface water nutrient and iron concentrations.

The last 4 stations of cruise SO289 are conducted in the South Fiji Basin (Fig. 2), which is impacted by hydrothermal inputs in addition to a range of inputs from continental run-off and sediments. The last station (station 44) was occupied in the early morning of April 4.

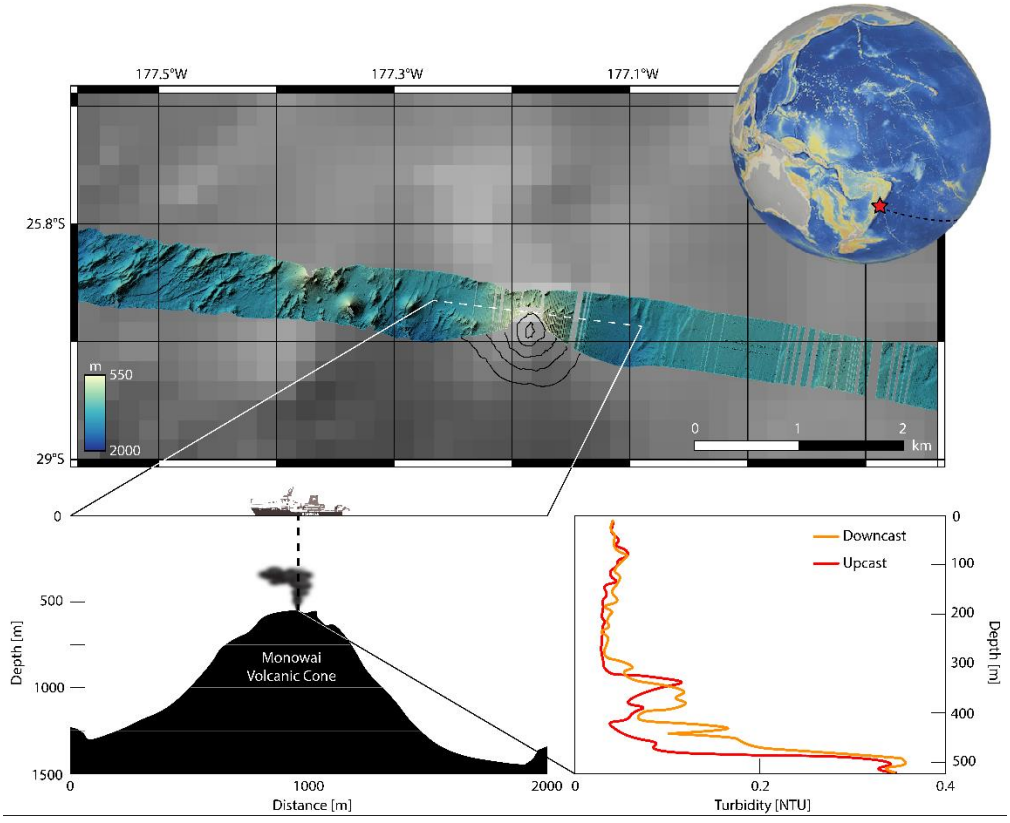

Fig. 3: Multibeam bathymetry data of cruise track over Monowai volcano cone, with vertical profile of turbidity in water column at station 40. Graph produced by Chris Galley. Global inset by N Augustine (GEOMAR), coarse bathymetry from GEBCO.

Following this station, we started packing up and loading our containers. A threat of a tropical cyclone is forcing us to pack swiftly to allow us flexibility in arriving in the port of Noumea in the coming days, before flying home on April 9. The start of our cruise was full of challenges, with a delay of nearly 5 days, and now the end of the cruise will also be impacted by the arrival of the tropical cyclone. Who said that research cruises are a jolly?!

Mercury observations: Mercury (Hg) is a natural but also a very toxic element, and the various chemical Hg species can have detrimental impacts on marine ecosystems. There is a lack of understanding of Hg sources, speciation, cycling, and distributions in marine systems. The atmospheric component dominates the global transport of Hg and has a significant influence on oceanic Hg fluxes. Natural sources of Hg include geologically active systems such as volcanoes and hydrothermal vents. Coal burning, cement manufacturing and other industrial practices form the majority of anthropogenic Hg emissions to the atmosphere and oceans, and these have persistently increased over the last 5 decades.

On cruise SO289, Kati Gosnell and Alina Kleindienst perform an ocean basin wide study in the South Pacific Ocean to assess Hg sources, speciation and cycling in one of the remotest ocean regions on our planet. The analysis for total Hg concentrations on SO289 is conducted on board by Kati and Alina. The data is immediately available and is showing the importance of various sources along the section.

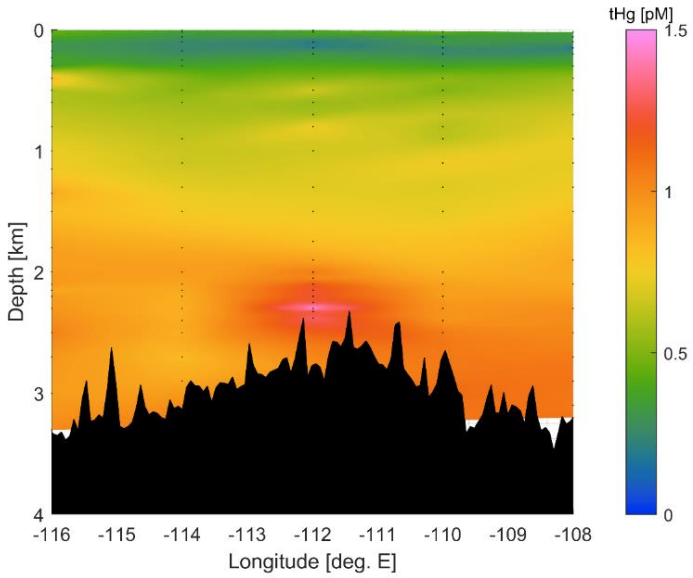

Fig. 4: Preliminary data for total Hg data measured in the vicinity of the East Pacific Rise. Data by Alina Kleindienst and Kati Gosnell. Graph produced by Chris Galley.

The Southern Pacific Ocean is host to many active seismic margins and hydrothermal vent fields and therefore subject to various natural Hg inputs. However, there is a paucity of Hg data for this region, and hence our understanding of Hg sources and behaviour is poorly constrained for this basin. Figure 4 shows enhanced total Hg concentrations at a depth of about 2500 m at station 22 in a hydrothermal plume emanating from the East Pacific Rise. The East Pacific Rise runs from the North to the South Pacific Ocean and Hg inputs to the deep ocean of its hydrothermal systems are likely to make an important contribution to deep ocean Hg concentrations.

RV SONNE at sea 25°45 S/174°2 E

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