

KOK1806 lava expedition postcruise report

By Sam with input from Mathilde, Carolina, Rhea, Sara, Oscar....

Summary: The objective of the cruise was to sample the ocean surrounding the lava entry point and then to track the satellite-derived chlorophyll plume that extended to the south (Figure 1). The expedition began at 0900 on Friday 13 July out of Hilo and we arrived at our first station at 1300 hrs. Our last station was sampled at 0900 hrs on Sunday 15 July, and we commenced our transit to Honolulu a few hours later. Overall the cruise was very successful and we accomplished all of our objectives.

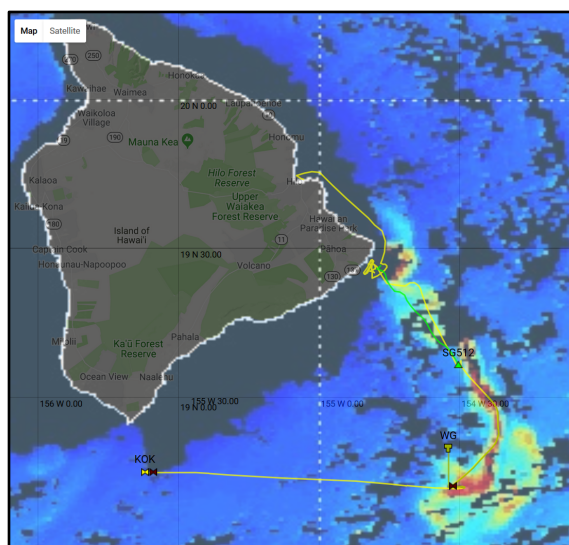


Figure 1. KOK1806 cruise track overlain with satellite observations of chlorophyll. The tracks of the SeaGlider and the Waveglider are also shown.

Friday 13 July

The science party arrived at the ship by 0800 and we left port by 0900. It was a 4 hr transit from Hilo to Cape Kumukahi and scientists were busy setting up their sampling and sample-processing equipment. Upon arrival at the first station, we deployed the SeaGlider. Since deployment, the SeaGlider has been successfully conducting profiling transects. We then commenced our CTD stations which were designed to sample 'blue water', 'green water', and 'geothermal grey water'. There were clear boundaries between the blue and green water, but it was very patchy. Furthermore, their location moved due to the coastal currents and the drifting of the ship made it difficult to sample them over a prolonged period of time. We successfully sampled the 'blue water' station and also the geothermal station. The geothermal station was located 1 mile from the lava entry point and during the first CTD cast we drifted to within 0.5 miles of the entry point. After completing these two stations, we deployed the towfish to sample trace metal clean water. The towfish was used repeatedly during the expedition and successfully pumped surface water to the trace metal van. While the trace metal scientists (Nick and Rachel) conducted their operations, the rest of the science personnel stopped for the night to catch some rest.

Overall the near-coastal stations had chlorophyll concentrations of 0.2-0.4 μg per L and the phytoplankton community were dominated by diatoms (e.g. *Skeletonema*, *Thalassiosira*) (Figure 2). Analysis of nutrient samples onboard revealed silicate concentrations of 1-36 μM and phosphate concentrations of 65-380 nM (Figure 2).

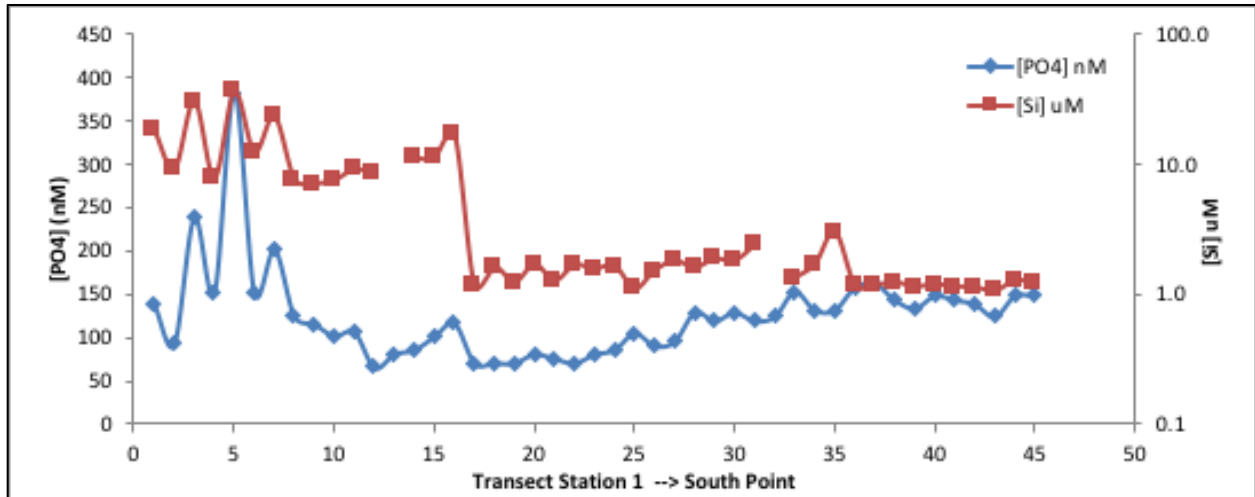


Figure 2. Silicate (μM) and phosphate (nM) concentrations measured from July 13 at Station 1 through July 15 at South Point. Samples were collected from the underway and towfish. The first seven samples were taken at stations 1-3. The decrease in silicate concentration from 16.7 to 1.2 μM is seen between stations 4 to 5.

Saturday 14 July

We began our operations at 0500 hrs with our 'green water' station. We then transited 5 miles to the east and did more towfish sampling during the transit. The towfish was deployed at the end of all CTD operations while we transited to the next station, initially at 4 knots but we later increased transit speed to 6 and then 7 knots. CTD casts were conducted at noon at the head of the chlorophyll plume and were followed by a HyperPro profile, and a hand-held net tow. A lot of material was collected during the net tow which was brown and mineral-looking. We then commenced a slow transect east-south-east. Chl concentrations began to decrease overall, but were very spikey. Between 12:30-13:30 we saw a large increase in chl (0.6 μg) which lasted approx. 1 hr and coincided with the last of the operations at the head of plume stations (Figure 3). The flow cytobot indicated that the increase in chlorophyll was diatom-diazotroph assemblages. During the expedition, there were a few observations of *Trichodesmium* in the FlowCytoBot, net tows, and general seawater filtrations but it was not prevalent or widespread. Our final CTD station was conducted at 2000 hrs as we sought to make some headway along the chlorophyll plume. During the transit and at the station, the underway fluorometer and the flow cytobot indicated increasing oligotrophic conditions, with chlorophyll concentrations of 0.1-0.15 μg per liter and some patchiness (Figure 3). During the night, the towfish sampled the near-surface seawater from 11 pm until 4am on Sunday 15 July

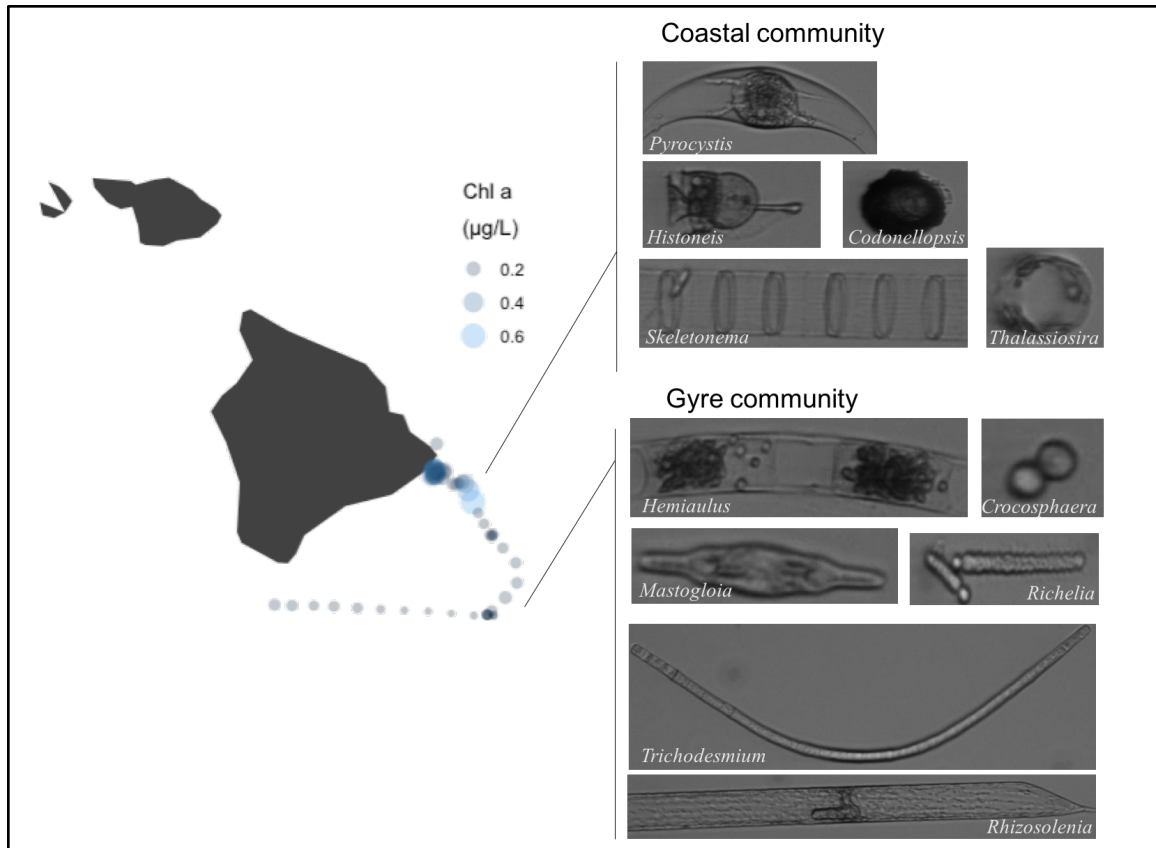


Figure 2. Flow through Chl a concentration measured by the ECO-TRIPLET along the ship track (left map). The gradient of Chl a is associated with divergent communities observed by the Imaging FlowCytoBot. The highest concentration of Chl a marks the presence of diatoms (related to Si concentration) typical of a coastal community (*Skeletonema Thalassiosira*). As we followed the Chl plume, some species were dragged along the flow but the main phytoplankton community switched to species found in oligotrophic waters. They include the Diatoms-Diazotrophs Associations species like *Hemiaulus*, *Richelia*, *Rhizosolenia* and *Trichodesmium*, *Crocosphaera*.

Sunday 15 July

Today, we had our final CTD station which was conducted at the end of the satellite-derived chlorophyll plume. It became evident that there was a mismatch between the satellite observations of chlorophyll and the shipboard underway measurements. Underway chlorophyll concentrations and community composition as revealed by the FlowCytoBot showed typical oligotrophic conditions (Figure 3). During the 10 pm to 4am transit, we should have seen an increase in chlorophyll compared to typical oligotrophic conditions, however this was not observed. The scientists onboard discussed the reasons for the differences and have informally concluded that there may have been differences between the surface seawater (as seen by the satellite) and the underway sampling (which supplied seawater for the fluorometer and FlowCytoBot). This is somewhat surprising and we had 20 knot winds with 2-3 ft of swell, and the mixed layer depth was fairly deep. However, there may have been some positively buoyant

particles from the lava entry point. Microscopic analysis of net tow material showed some 'blue-green crystals' (at a previous station), black shards, and other detrital material which is not typically present in the gyre. There was also a large presence of grazers which was surprising for a near-surface sample. With sampling time running out, we conducted some bucket sampling for a variety of measurements to try and inform us about differences between the surface and a depth of 5 m. In hindsight, we could have brought the manta trawl net and conducted tows as we were transiting. Our final operation on station was the deployment of the WaveGlider. Our recommendation for both the WG and the SG are spatial survey zig-zag transects to try and improve our understanding of the chlorophyll plume.

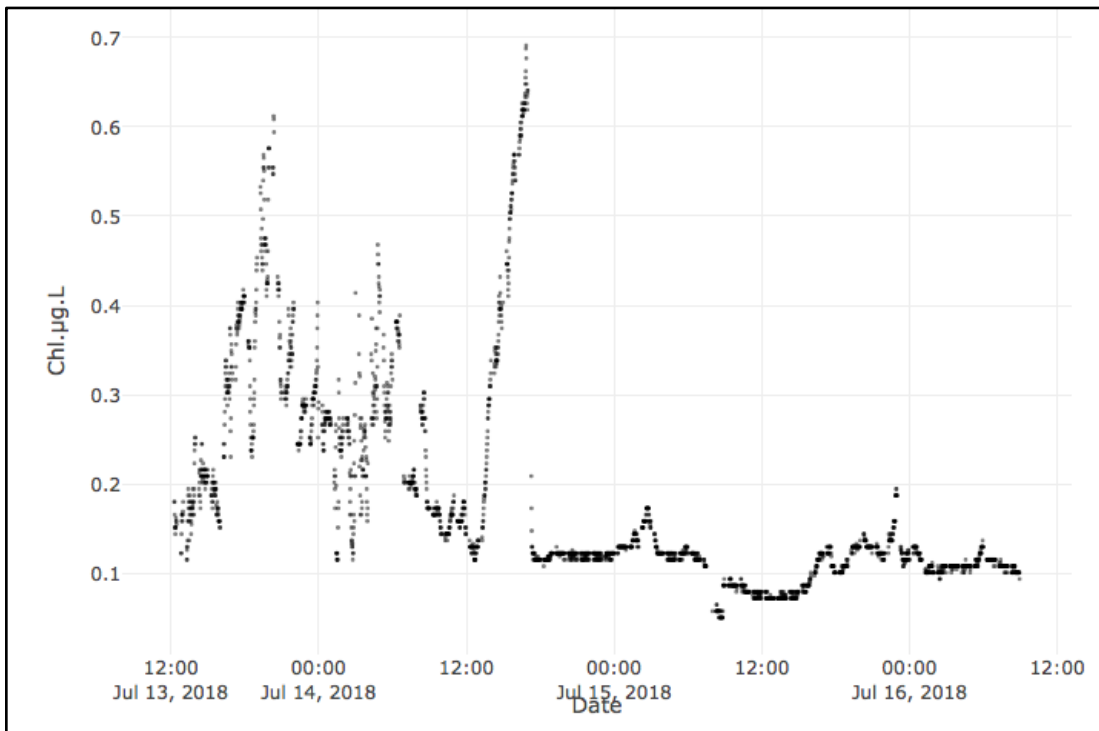


Figure 3. Time course of the flow-through Chl a concentration measured by the ECO-TRIPLET along the ship track

Monday 16 July

A transit day back to the port of Honolulu. Our ETA is 0900 hrs on Tuesday 17 July.

