March 31, 2024

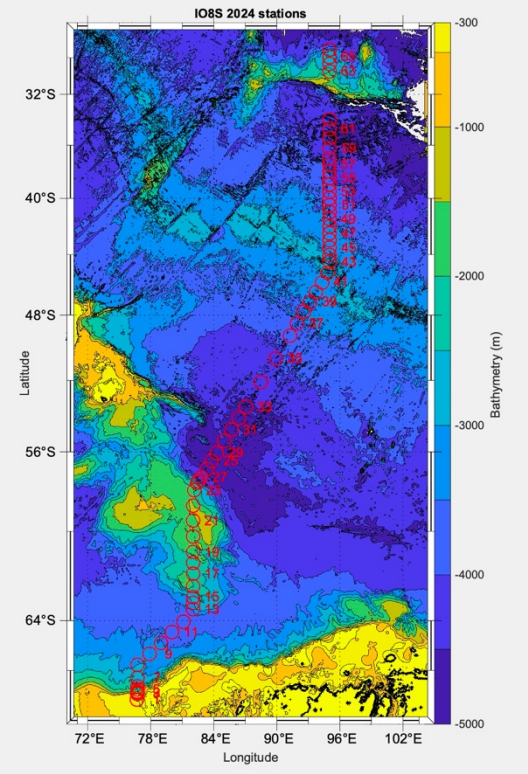
I08S 2024, weekly update #5: "Swan Song"

After entering the Forties on March 23rd, a high-pressure system sheltered us from the chaos of the Indian Ocean to the south. R/V *Thompson* cruised briskly between stations that were 30 nm apart since we had reached the final meridional stretch of the I08S line along 95°E. Sea surface temperatures quickly rose from less than 15 °C at 40°S to more than 21 °C at 34°S only three days later. With the calm weather, the sea also became quieter, the emptiness of the blue, oligotrophic waters reflecting skies now devoid of any birds. Only a stubborn southern swell kept us company, a persistent reminder of the turbulent ocean we had left behind the week prior. During CTD casts, the ship's heave created by the swell caused variations in the CTD wire tension that caused concern to the ship's crew. To mitigate these variations, the winch heave compensation was engaged in the upper 1,000 m or so during downcasts, which slowed down the wire speed. Still, everyone onboard had now settled in a remarkably well-oiled routine and the CTD operations continued in a very efficient manner as we were completing four stations per day.

Occasionally, technical hurdles punctuated the cadence of the cruise. The Seasave software froze again during station 49, as it had ten days prior at station 26. The secondary conductivity sensor developed an offset and was swapped with a spare sensor prior to station 54. Grease seeping from the CTD wire made its way to the rosette's frame when the crew handled its recovery and was now routinely cleaned up with a rag before sampling proceeded. CFC-11 levels which had been suspiciously elevated for a few casts returned to normal for unknown reasons. On March 25th, the weather was so good (10 knots wind) that we sampled the cast from station 59 (latitude 36.25°S) outside of the staging bay for the first time on the cruise. The calm weather at this station also greatly facilitated the weighing of seawater samples for Noble gases.

On March 24th, weather forecasts predicted a storm would cut our track to the north a couple of days later. We therefore spaced out station 59 and its followers to 45 nm to ensure we could at least complete the line with a station at 34°S, which was the crossover latitude with I05. We managed to complete station 62 at 34°S on March 26th, but unfortunately the storm moved east faster than the forecast had predicted and the neighboring station 63 was cancelled that same day. The size of the storm precluded any work in the area before the ship had to start transit back to Fremantle, so we steamed north along our line and away from the center of the storm, looking for lesser winds and seas. After 28 hours transiting through the storm and a couple of failed attempts to deploy the CTD, we finally reached the storm's northern edge at 30.1°S where we proceeded with a CTD cast at station 63. The sea state was still elevated and the rosette hit the ship's hull during deployment but the cast was eventually successful. We were able to complete three more stations to the north and our last CTD, at station 66 (28.3°S, 95°E), was recovered in the early afternoon of March 28th. We deployed the last Argo core float and R/V *Thompson* departed towards Fremantle.

On this occupation of the I08S line we have completed 66 stations, which include 66 core casts and 9 dedicated Bio casts. 12 casts were combined core and Bio casts whereby 3 Niskins out of the 36 available were typically reserved for Bio samples. Over the 66 core casts, the average depth was 3,213 m and the rosette travelled 424,126 m (263.6 statute miles). The southernmost station (station 1) was completed on March 4th at 67.1°S, 76.6°E in 300 m of water inside Prydz Bay on



the shelf of Antarctica. The northernmost station (station 66) was completed on March 28th at 28.3°S, 95°E. 15 Argo floats (7 BGC, 7 core, 1 deep) and 10 surface drifters were successfully deployed.

The cruise left Fremantle on February 21st and returned on April 1st. During the cruise we encountered seven storms that directly impacted our work. Two storms during the transit south on February 26th-28th delayed our arrival at the first station by one day (assuming a baseline direct transit at 10 knots). Five storms between March 8th and 27th prevented CTD work for a combined duration of 5.8 days. Average wire speed during our cruise was about 45 m/min; compared to a typical wire speed of 60 m/min in calm seas (not realistic in the Southern Ocean), an additional upper estimate for weather delay on the wire speed is 40 hours or 1.6 day. In total, weather delays were between 6.8 and 8.4 days.

Fig. 1. Bathymetry map from GEBCO 2022 in colors. Red circles denote the 66 stations completed during I08S 2024 cruise.

Weather has definitely been a defining feature of the I08S cruise but we have learned a lot. We have also accomplished many goals and managed to keep the line continuous up to the crossover with I05. We have reached and sampled the shelf of Antarctica in a region where bottom water is formed. All the labs, including Bio, have been able to sample during the whole cruise. Cruise participants have acquired sea legs, crossed the southern polar circle and witnessed the beauty of its wilderness, and are coming back home enriched with these experiences and friendships. The I08S cruise will end tomorrow, but its scientific and human legacy will endure.

All the best,

Seb and Katelyn