Expanding opportunites for science with *Sentry*, *Alvin* and WaveGlider

Highlights and tips from AT50-21 to East Pacific Rise
9° 45’N to 10° 06’N

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Jill McDermott - DeSSC Spring Meeting 2024 - May 8 2024

Expedition goals

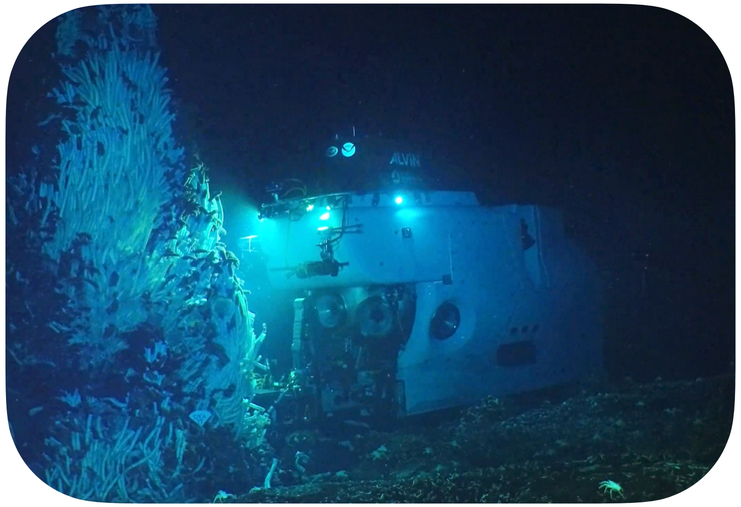
- Monitor the volcanic and hydrothermal systems at the East Pacific Rise (EPR) axis between 9° 45'N and 10° 06’N
- Primary objectives, by vehicle:

Collected vent fluids

Recovered & redeployed temperature loggers, tide gauge, current meter

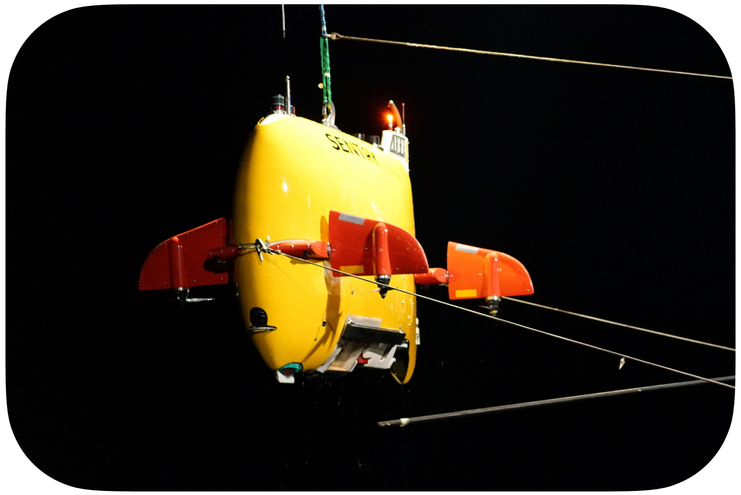
Imaging

HOV *Alvin*



Mapping: multibeam and other bathymetry products

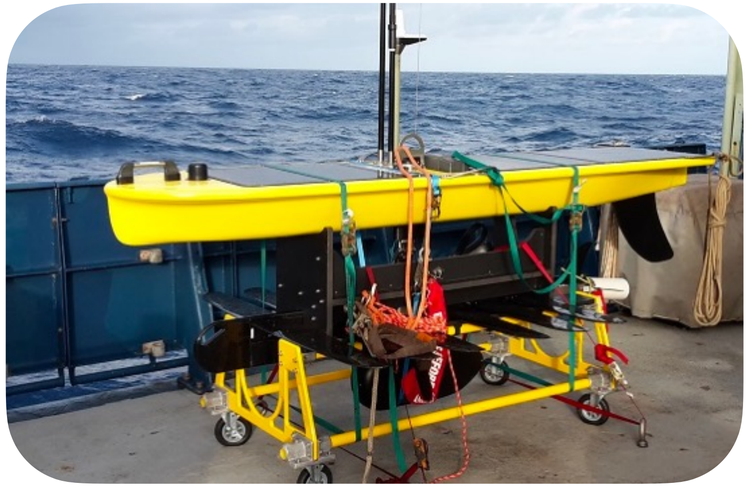
AUV *Sentry*



‘Over the horizon’ communications with *Sentry* during rock coring, CTD deployments

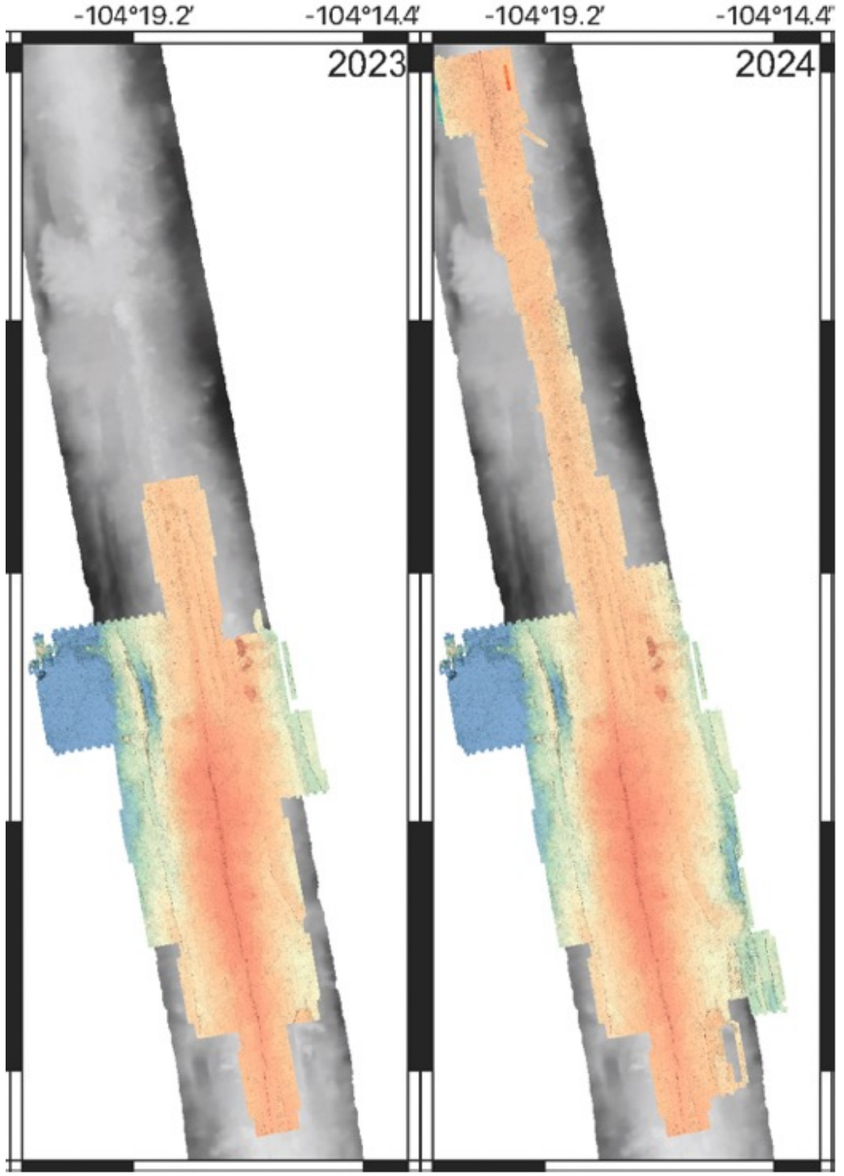
Monitor *Sentry* during full, simultaneously-operated *Alvin* dive

WaveGlider



WaveGlider for ‘Over the horizon’ communications with *Sentry* during rock coring, CTD deployments

- Many of our AUV *Sentry* dives occurred in 8-hour overnight time periods.
- Used WaveGlider to carry out ‘over the horizon’ communications to the AUV while other work was done in parallel.
- Total of 10 days/nights of simultaneous activities, which permitted the collection of 13 rock cores (out of 24 total this cruise) and 4 CTD casts (out of 11 total this cruise).
- Rock coring at the northern extent of our study area (~9° 54'N to ~10°N) aided by newly generated Sentry multibeam/bathymetry products.
- **Nearly half of all rock coring and CTD operations were conducted simultaneously with Sentry operations.**



WaveGlider for *Sentry* dive with full, simultaneously-operated *Alvin* dive

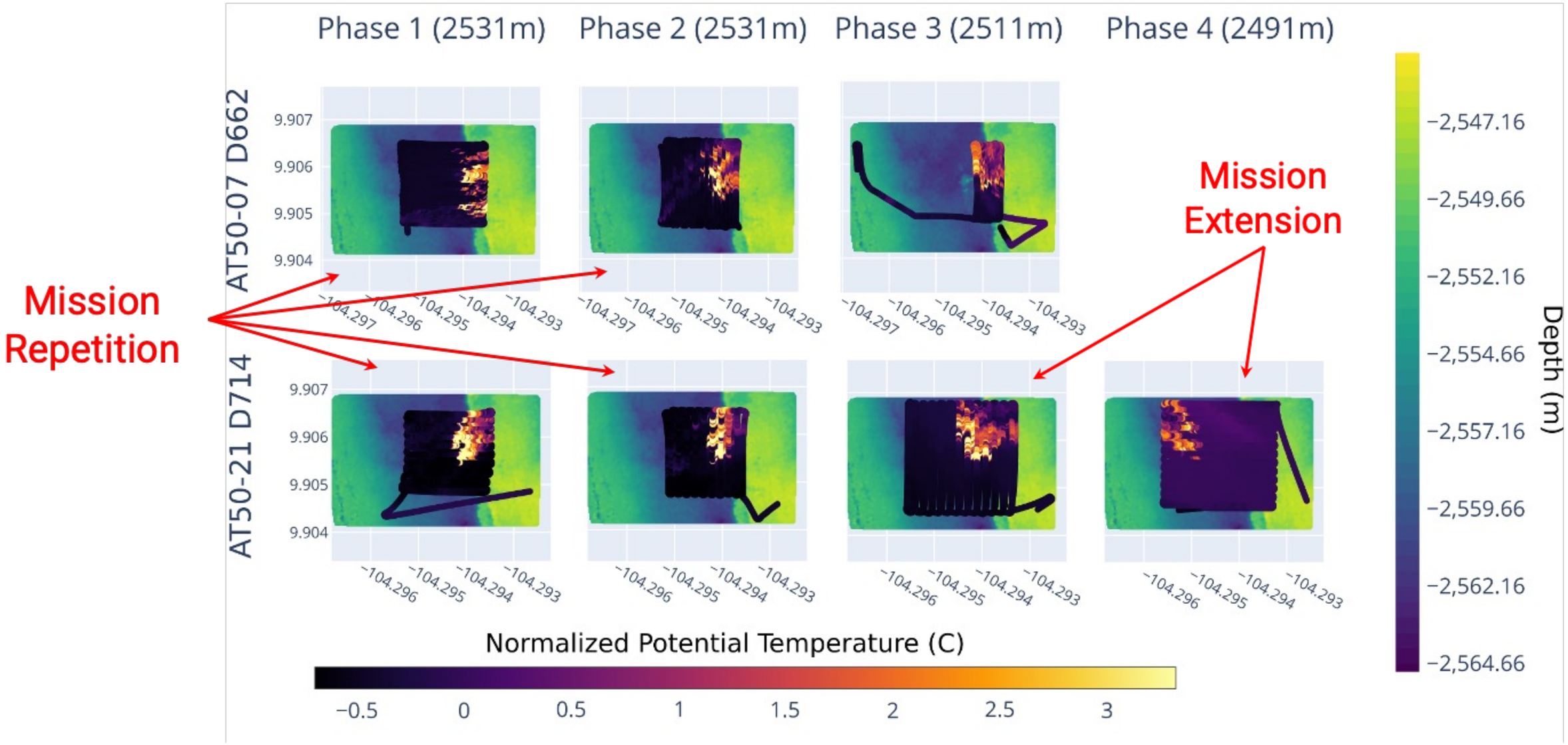
- *Sentry* 714 was launched at 2000L, with the goal to carry out a 24-hour dive, starting with plume surveys over YBW and concluding with a mapping survey. *Atlantis* remained on station with *Sentry* during the night, to provide real-time sensor data to science watch standers via Sonardyne SMS system

- At 0500L, the *Sentry* and *Alvin* ELs met to make a go/no go decision. At 0600L, the *Sentry* mission continued as planned, with monitoring from WaveGlider as *Atlantis* transited 13 km south to launch the small elevator and *Alvin*

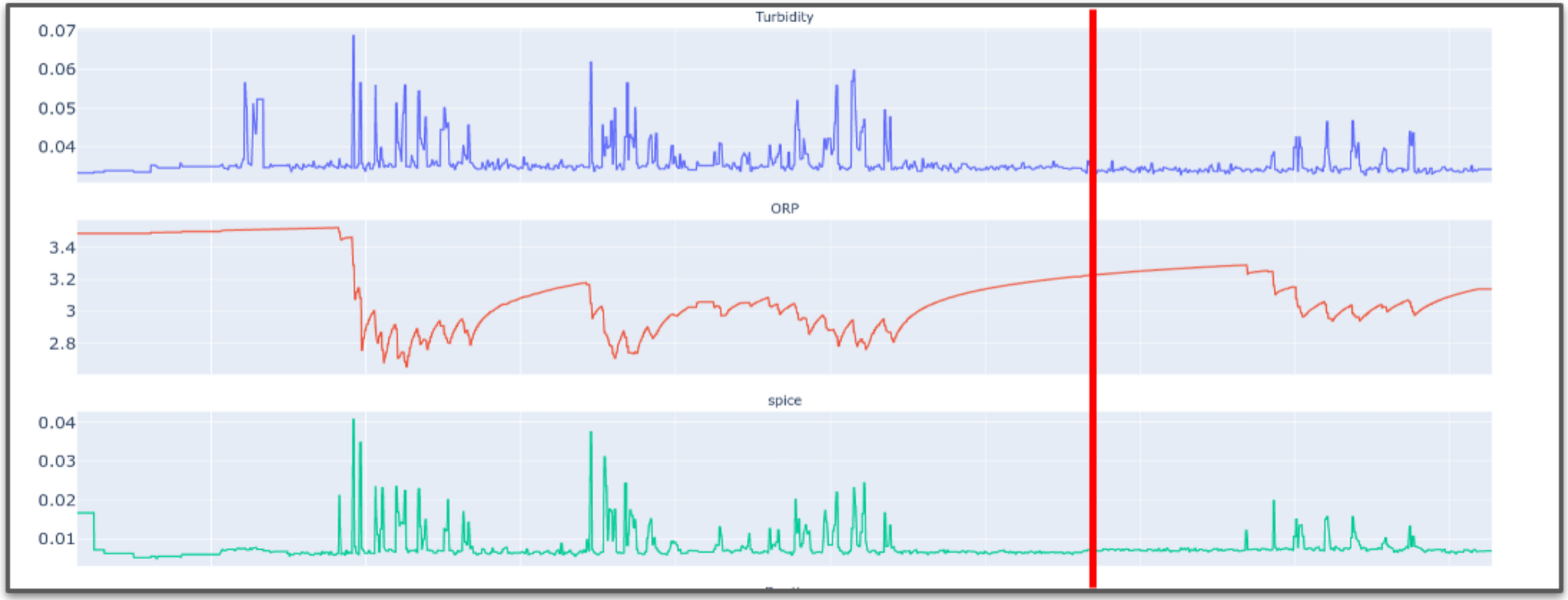
- At 0700L, deployed small elevator. At 0800L, *Alvin* 5248 proceeded at V vent: PIT dive, small elevator, 5:56 hours bottom time

- Following elevator recovery and *Alvin* recovery, we transited north to recover WaveGlider, then *Sentry*.

An extended *Sentry* mission enabled targeted characterization of a dynamic plume above a complex hydrothermal site



During “waffle” characterization, *Sentry* altitude was adapted to uncover complex plume morphology by monitoring streaming *in situ* measurements

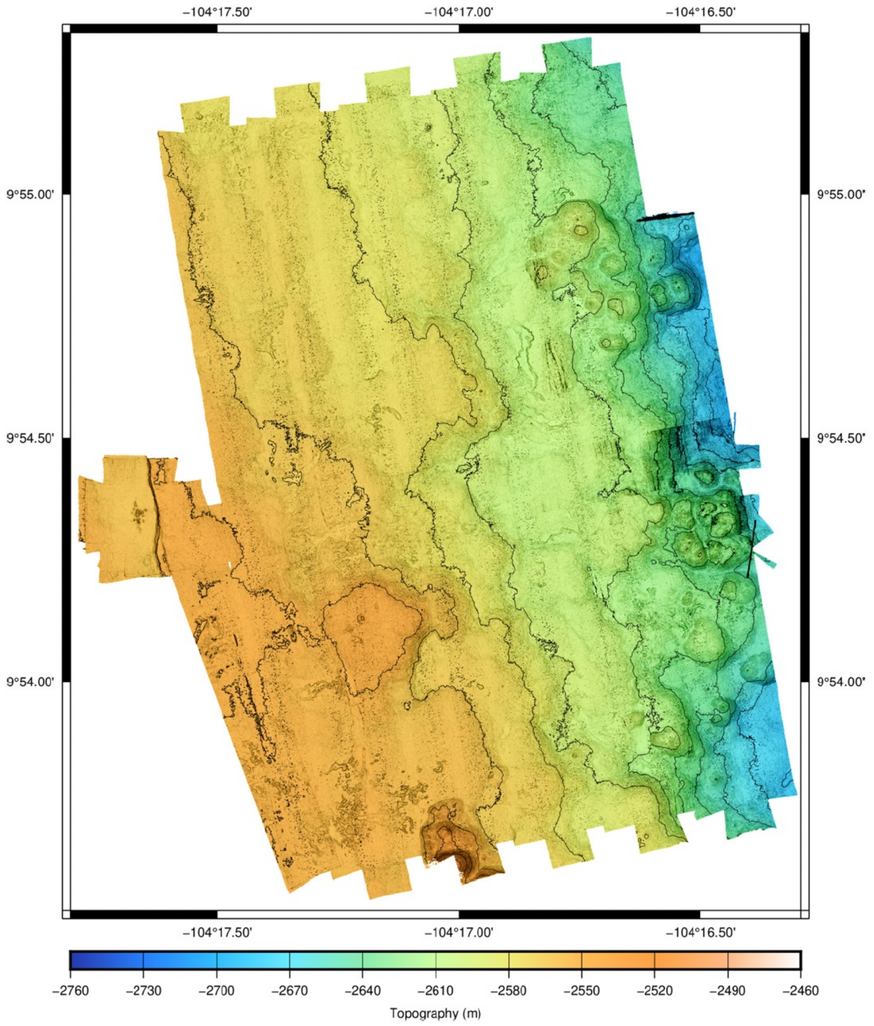


View of real-time monitor

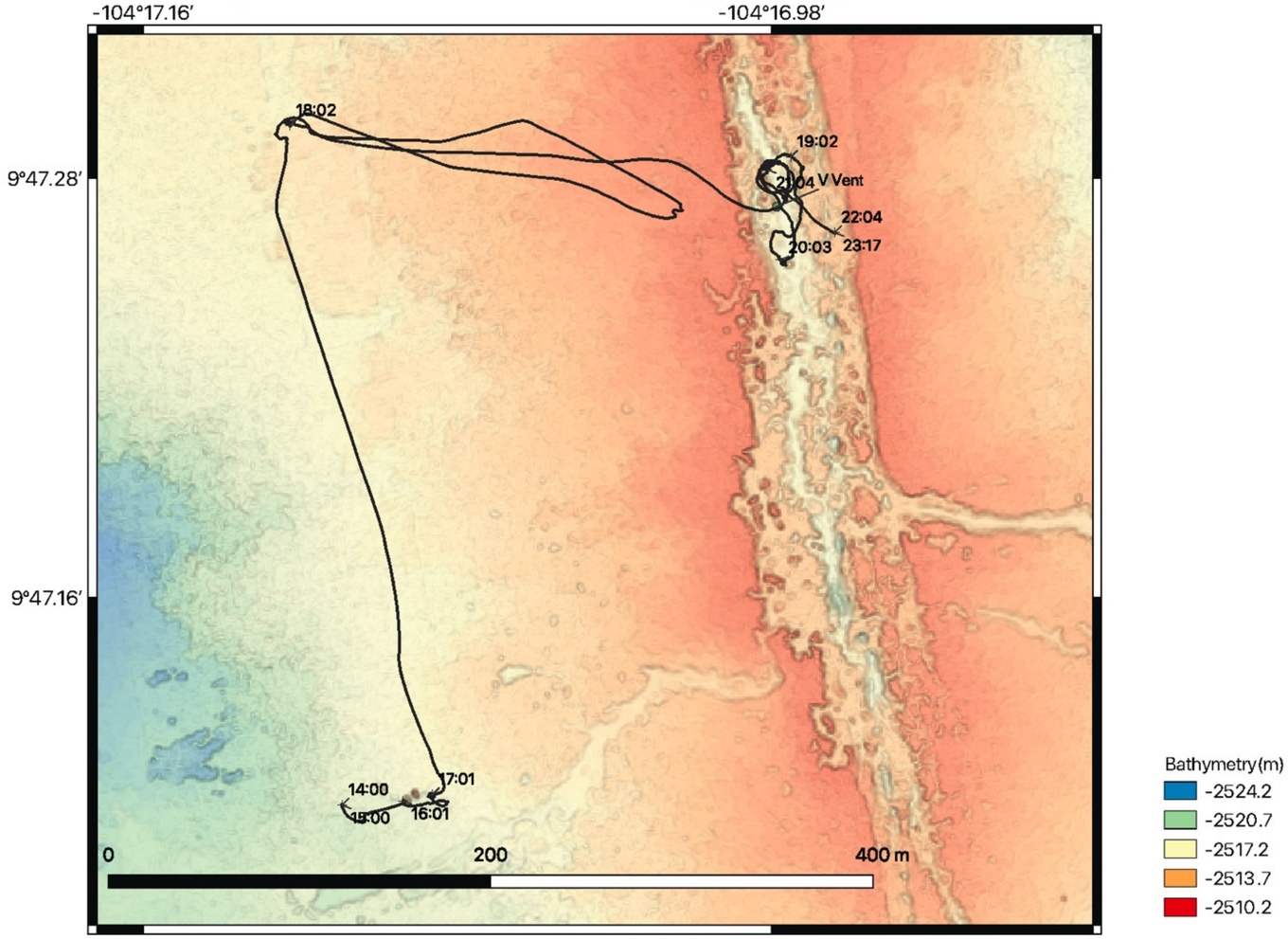
Adapted altitude selection

An extended *Sentry* mission enabled mapping a new region, following plume characterization, simultaneous with full Alvin dive

Sentry 714 preliminary multibeam coverage



AL5248 final dive track with UTC time



Using waveglider successfully begins with pre-cruise planning, consideration of science objectives for *Sentry*

- It is only possible to conduct *Sentry-Alvin* sim ops when both vehicles and WaveGlider are performing well.
- It is best to plan in blocks: blocks of back to back 8-hr overnight dives (during 12 hours in the water), or blocks of back to back 21-hour sim ops dives (during 24 hours in the water)
- If the science party has the WaveGlider, but is just interested in parallel over-the-side night ops, then communicate early with the *Sentry* group to set expectations to do 8 hour dives
- For longer cruises, it is **ok to plan to do some alternate blocks** of each dive duration: e.g., 12 hours in, 12 hours out, 12 in, 12 out, 12 in, 24 hours out, 24 hours in, 24 hours out, 24 in, 24 out, etc.
- It is **not a good plan to alternate short *Sentry* dives with long dives**; e.g., 12, 24, 12, 24, because this pattern would impose a schedule on *Sentry* that does not promote rest and the maintenance of watch schedules
- Note: it takes 12 hours minimum on deck to recharge *Sentry* prior to its next dive

Planning the sim ops day: Choosing dive objectives for *Sentry* during sim ops *Sentry-Alvin* dives

- After establishing that the three vehicles are reliably working well, the next step is to identify sufficient science objectives for *Sentry* to justify a long dive
  - In our case, we identified a time-sensitive, multi-hour science objective that would not have been possible *without* the extra *Sentry* dive time provided by sim ops.
  - Alternatively, if the primary goal for *Sentry* is multibeam mapping, long *Sentry* dives with sim ops will increase bottom coverage that will add up over time. e.g. for our 2500 m depth site:
    - Over a 48 hour interval, following 12 hours in, 12 hours out sequence: ~17 hours of bottom time/48 hrs
    - Over a 48 hour interval, following 24 hours in, 24 hours out sequence: ~21 hours of bottom time/48 hrs for ~**20% more bottom time**
    - Work with *Sentry* team during pre-cruise period to discuss optimal map shape for a ~24 hour box. A well-planned 24 hour box will minimize turns while optimizing crossing lines.

Planning the sim ops day: Selecting a good operations sequence for *Sentry-Alvin* dives

- We recommend beginning with only the AUV in the water.
  - We began the dive with *Sentry* in the water many hours before *Alvin* was scheduled to dive, so that we could establish that *Sentry* was working well before launching *Alvin*.
  - The ELs agreed on a go/no go decision time (~0500L) which gives the option to recover the AUV early without overly impacting the planned *Alvin* dive
  - Factor in contingency time to accommodate other planned recoveries in the POD (e.g., elevator, WaveGlider)

Planning the sim ops day: Organizing the pre-dive briefing

- The sim ops pre-dive briefing takes place the night before the long *Sentry* dive begins (2 nights before the *Alvin* dive). It should be scheduled so that it can be integrated into the routine *Alvin* pre-dive briefing.
  - Personnel at our sim ops pre-dive briefing included the *Alvin* and *Sentry* ELs, the Alvin pilot(s), the Chief Scientist, and 1-2 science observers. Also recommend including the Top Lab surface controller.
  - Ensures ELs, *Alvin* pilot, Top Lab, science observers are fully briefed and have thought through each possible scenario that may be somewhat unique to each dive (e.g., distance between vehicles, bathymetry considerations, weather forecast)
  - Consider how an aborted dive would be handled, for either vehicle
  - Close communication between pilot-port observer-Alvin-Top Lab-Alvin EL-Sentry EL is needed throughout the Alvin dive, especially if any delays or changes occur.
  - **Effective communication is essential to sim ops. The challenging part is not the mission programming. Rather, it is making sure that contingency plans are in place and followed.**