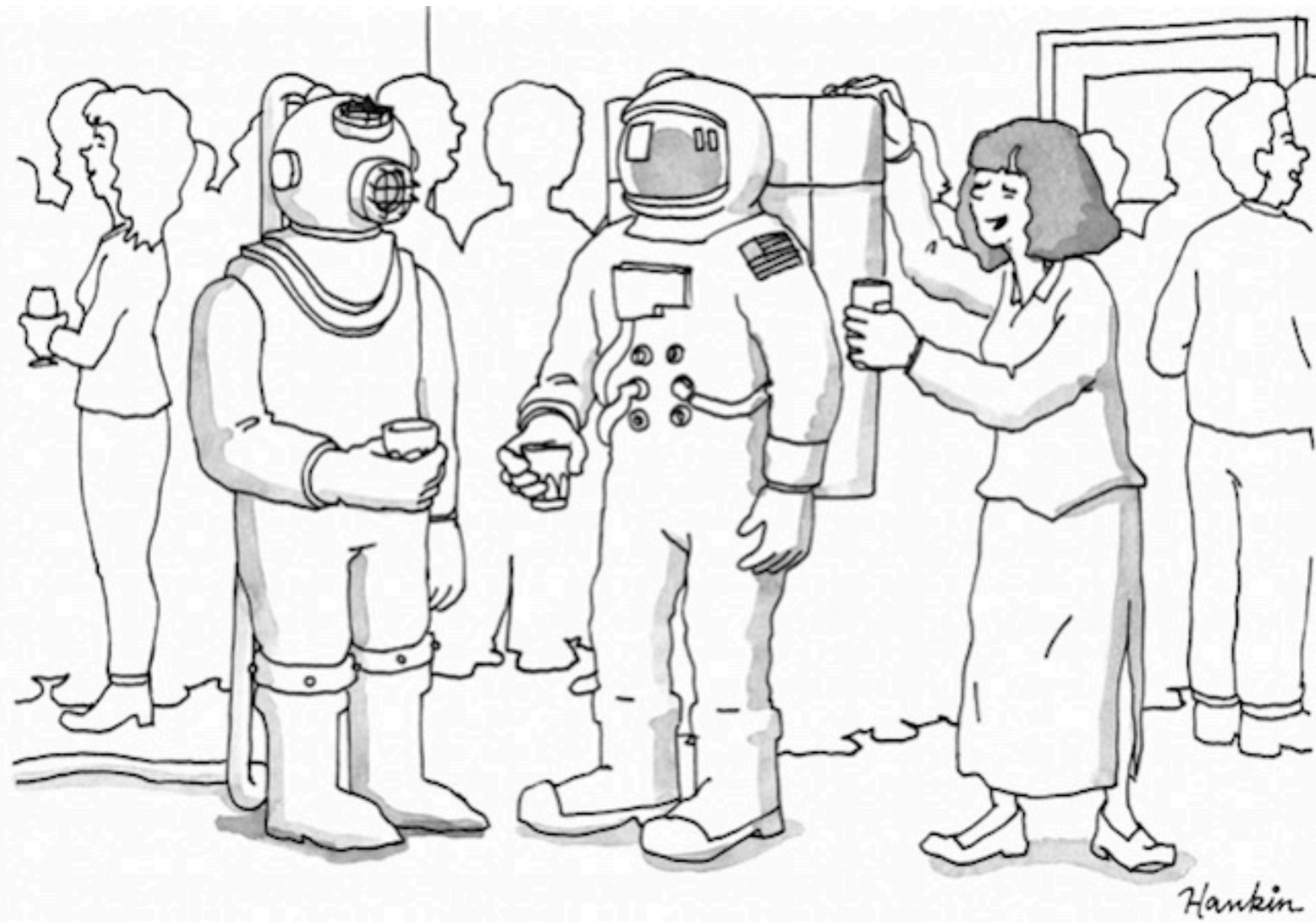


NDSF Facility Update

Facility Update

NDSF NATIONAL
DEEP SUBMERGENCE
FACILITY





"Honey, be nice... he's under a lot more pressure."

Alvin Updates: Staffing



- Anthony Tarantino sails as EL on Sylvan
- Danik and Drew promoted to Mechanical and Electrical Section Leaders
- Drew Bewley completed Pilot Certification on Dec 5 (passed final US Navy Review Panel)
- New *Alvin* Mechanical Engineer Andy Whitman joins SE&OG engineering team
- Jefferson Grau departed Ops group in December 2018
- EL Todd Litke departed Ops Group to resume DoD work in October 2019
- New *Alvin* EE position open, actively recruiting diverse candidates
- MATE Intern Kylie Pasternak on Sylvan and Drazen cruises



Courtesy Luis Lamar

Alvin Updates: Program Improvements



- Camera controller issues resolved (PCAR comments)
- Both Schilling manipulators serviced (PCAR comment)
- Replacement of outdated ICL data link underway (PCAR Comment)
- Four new sealing bio boxes delivered (PCAR comment)
- Acoustic releases for elevator available and readied for use on upcoming Sylvan cruise (PCAR comment)
- O2 sensor rating (3,000 m) was user-defined by (G. Wheat) pre-cruise. Dives to the Octopus Garden (3250 meters) exceeded this rating. Housing certification and testing is a significant part of pre-cruise planning but will be amended as needed to improve user understanding (PCAR comments)



Courtesy Luis Lamar

Alvin Updates: Program Improvements



- Group training continues to avoid future miscommunication between science party and group leads (PCAR comment)
- Short in-port periods with short transit times to station can cause training time stressors. Enabling pre-cruise training for users is planned for 2020 and beyond. (PCAR comment)
- "Sealog" event logger replacement of Framegrabber fully implemented; Frame-grabber use ends at conclusion of ops in Mar 2020 (PCAR comment)



Alvin Updates: Program Improvements



- NAVSEA approval of an *Alvin* departure from specification request was delayed due to availability of NAVSEA oversight personnel. These issues are not routine and rarely if ever impact dive time. In this case there was a reduction in total dive time on two dives by approx 1 hour. Group training on how to avoid these situations has been completed.

(PCAR comment)

- Integration of MISO GoPro cameras continues – investigating potential for 6,500 meter housings or similar imaging capabilities (HD still interval camera) (PCAR comment)

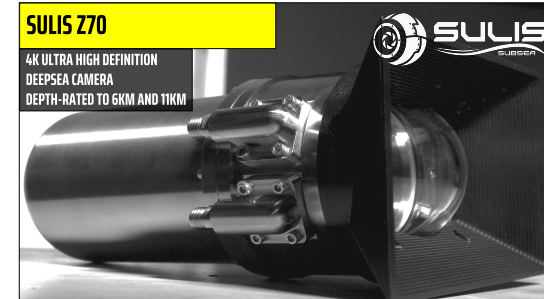


Alvin Updates: Program Improvements



4K Candidate Camera Testing

- Testing completed on October engineering series
- 6,500 meter capable housings (w/ required 1.5 X safety factor)
 - **Sulis Z70 4K UHD - could not receive an image**
 - Pros – dual 4K still/video system
 - Cons – software protocol, interface issues, connector configuration/depth rating, expensive
 - **DSPL Optim 4K camera – worked well**
 - Pros – ease of integration (using existing *Alvin* video system controls), connector configuration/rating, common software protocol, less expensive
 - Cons – 4K still image option requires additional software (non-COTS)



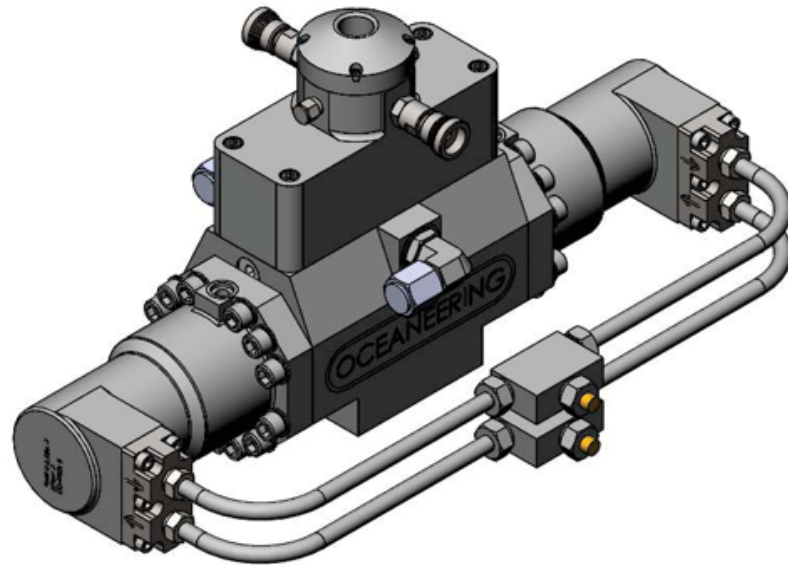
Alvin Updates: 6,500m VB System



- *Modified control system*
- *Uses primary hydraulic system*
- *6,500m rated control valves and piping*
- *System under NAVSEA review*

New 6,500m ballast spheres

- Manufacturing underway
- NAVSEA approved design
- Expected delivery late 2020



New duplex seawater pump

- Hydraulically powered seawater pump – joint WHOI/Oceaneering design
- Final design mods/testing nearing completion at WHOI

Alvin Updates: 6,500m Design Process

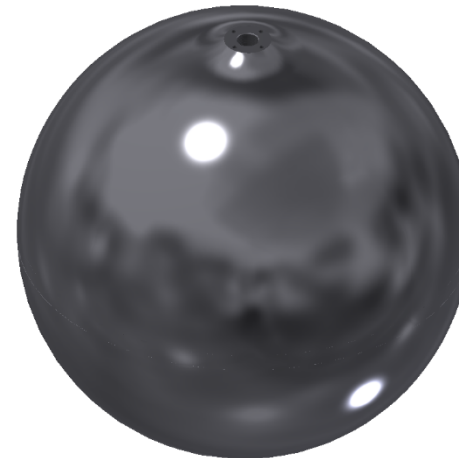
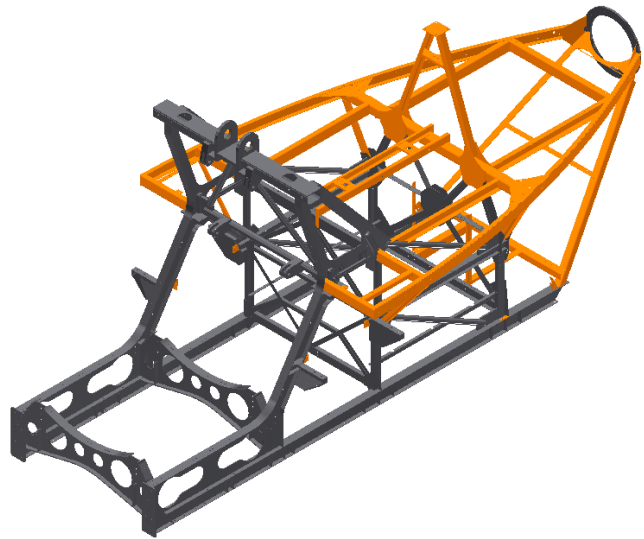


- New syntactic foam shapes fabrication underway
- New primary hydraulic system design complete
- Altered frame design to undergo NAVSEA review
- Remaining new thruster and motor controller component/housing assembly underway
- 6,500 meter component procurement underway
 - ✓ CTD (procured)
 - ✓ Scanning sonar (procured)
 - ✓ Avtrak USBL beacon (procured)
 - ✓ Cameras (procurement underway)
 - ✓ Sensors (modification of existing units underway)
 - ✓ DVL (modification of existing units underway)
- Final component configuration nearing completion

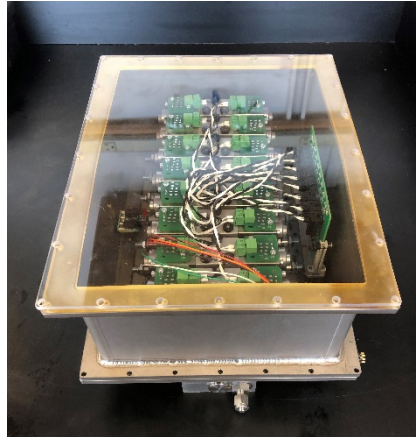


6,500m Mechanical Design Effort

- Designs are complete or nearly so
- Fabrication of major components in process
- Conducting testing on components and systems



6,500m Mechanical Systems



Aux. Hydraulic Manifold



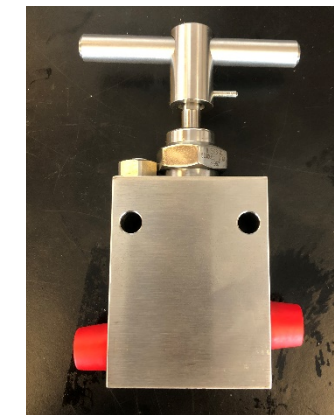
Distribution Hyd. Manifold



Seawater Pump Test Frame



Main Ballast Blow Valve



Variable Ballast Isolation Valve

Acoustic Image Transfer System Tests

- Cooperative effort between WHOI and JAMSTEC to integrate their image transfer system on *Alvin*
- Over 250 images were successfully transferred during dives 5032 and 5034
- Transfer rate is about 5 seconds/image, at VGA quality



Testing showed the value of image transfer capability to improve topside user awareness and participation

Acoustic Image Transfer System Tests

- JAMSTEC system has numerous limitations but concept is sound
- Current configuration is not the ideal system for *Alvin*
- Further evaluation and discussions continue with JAMSTEC/WHOI team
- *Alvin* program goal is to provide topside science watch station with timely metadata, sampling info, and reasonable image transfer via acoustics post-2020-2021 overhaul



Paragorgia coral image transferred via JAMSTEC acoustic system

Jason Update: Staffing



New contractors

- Summer Ferrel, experienced OET ROV operator, mechanical/Navigation
- Jim Convery, experienced oil field ROV operator, mechanical

Ben Tradd EL and RCA Project Manger

Tina Haskins Data

- Joined Jason ops from WHOI

Andy Billings Mechanical Engineer

- Moved to Jason from Sentry

Section leads assigned for each expedition ([pcar 2018](#))

Sulis Stills



Kongsberg EM2040 Multibeam (2019 Jason Tests)

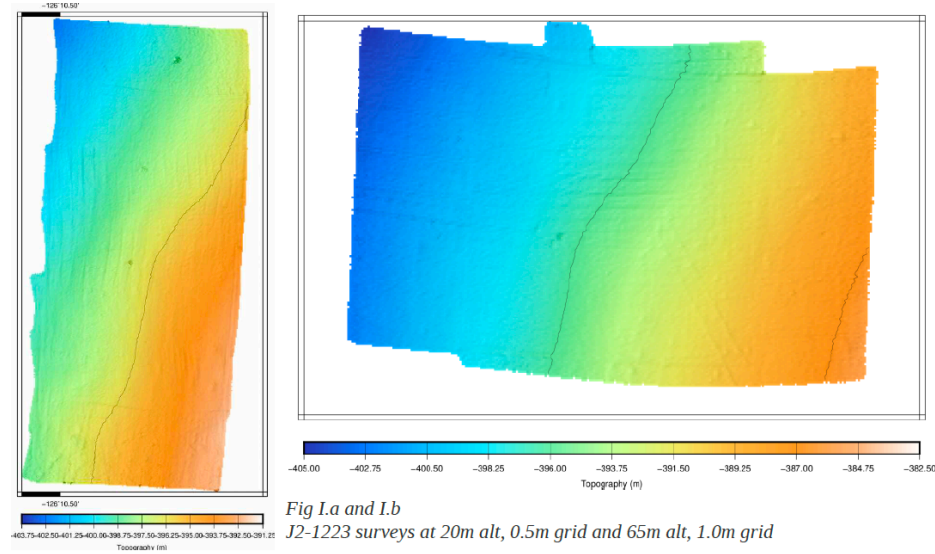
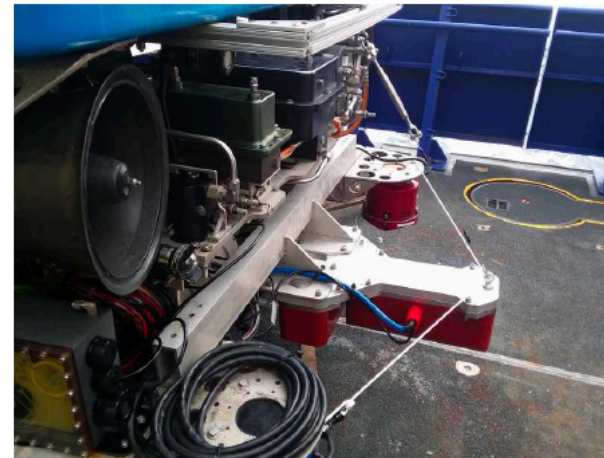
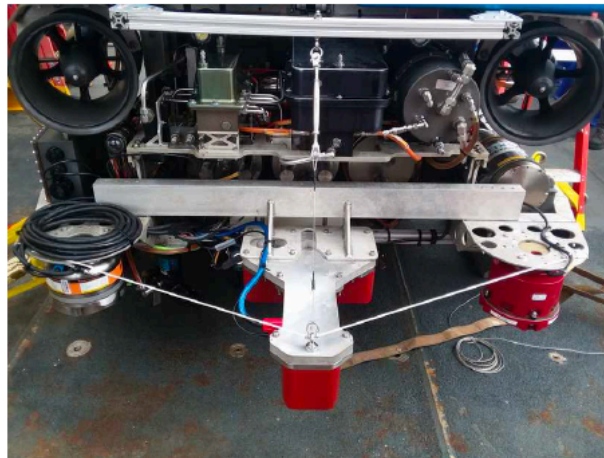


Fig 1.a and 1.b
J2-1223 surveys at 20m alt, 0.5m grid and 65m alt, 1.0m grid



Jason Highlights: NDSF Fluid Sampler



- NDSF engineers are building a fluid sampler in response to community request
- Constrain costs by using preexisting items and systems
- Manipulator operated discrete valves providing range of valving logic
- Mechanical pressure and flow gage
- Polyurathane Polyvinyl alloy tubing 100 C rated, can be replaced as Rq'd
- Off the shelf Palagic pump, pos. disp. Correlating shaft speed with flow
- Variable speed controller
- Easily connected to user supplied filters and bags
- Temp measured at inlet using existing temp probe
- Will be tested on upcoming cruises, available 2020



Jason System Upgrades



New Jason power system (AFX) continued to plague us with power outages pcar 2018/19

- Mf'r identified issue and we replaced all AFX units in 2019 with newer version, but failures continued
- One failure free cruise, followed by one failure on the next cruise (Orcutt 2019)
- Limited impact to science due to ready spares being installed, 10-45 min delay, one aborted dive with bad weather approaching
- Reviewing AFX design and considering permanent return to Jetway
- Switched to Jetway mid season
- Jetway does not fit into CV, thus installed in temporary AC'd 10' container during Pythia Oasis MOB

Permanent solution New Jetway ordered 2019

- To build waterproof deck container to avoid carrying 10' van



Jason System Upgrades – 4K Camera

- Subsea Sulis Z70 4 k (highest quality subsea cam available at time of purchase) [pcar 2019](#)
- Provides both stills and video in one camera ([pcar 2018](#))
 - Faster still storage in still mode
 - Possible to capture stills in video mode with delay
- Full res 4 k recorded in highlights and HD 24/7
- Stills in full res to separate hard drive
- Redesigned GUI with P&T control integral ([pcar 2018](#))
- Replaces Super Scorpio ([pcars 2017](#))
- Connector oil leak on demo unit replaced by Jason connector on final unit ([pcar 2018](#))

Jason System Upgrades



- Providing more manipulator training and practice with ODI connectors to assure ease of connections **pcar 2018**
 - Purchased topside controller and built HPU for at WHOI manip. training **pcar 2018**
 - ODI connector problems have been identified in other industries
 - Working with RCA personnel to assure implementation of all possible solutions (from industry) to avoid ODI issues
- Rapp winch and NPC crane at WHOI annual maintenance to address level wind and general upkeep concerns **pcar 2019**
- Implemented elevator tracking to prevent loss if weather prevents immediate recovery **pcar 2018**
- Weather limits have been reviewed with Els, must consider personnel, equip safety, PIs have strong driver to maximize dive time, Els are trained to make a safe weather call. These are at odds. **Pcar 2019**
- MRU data and Commanders weather being used to assist EL in weather call. **Pcar 2019**
- Used Vessel MRU on one cruise for Active Heave and weather
- Successful 12/12 ops on RCA cruises, pursuing 12/12 on other cruises **pcar 2019**

Jason System Upgrades



- Numerous issues contrived to cause late arrival of LARS and misc. equip. (Including CTD & 5 chamber slurp) to Nz. **Pcar 2019**
 - Heavy equipment must be trans-loaded from trucks to flat racks to go on shipping vessel
 - Nz fumigation rq'mnt
 - Holliday limited heavy gear movement
 - Changes to shipping company schedules
 - Backlog of shipments due to earlier gvm't shutdown and holiday
- NDSF and WHOI shipping office are addressing single source freight forwarder **pcar 2019**
- NDSF personnel receiving additional training ref Intrn'l shipping procedures **pcar 2019**
- NDSF and Vehicle schedulers will continue to work closely to assure contingency in the schedule

Jason System Upgrades

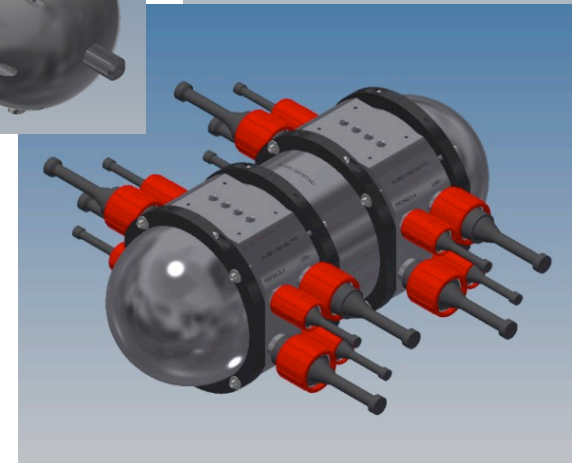
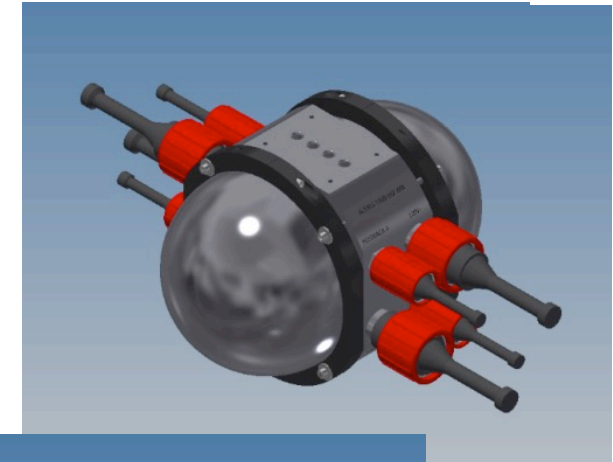
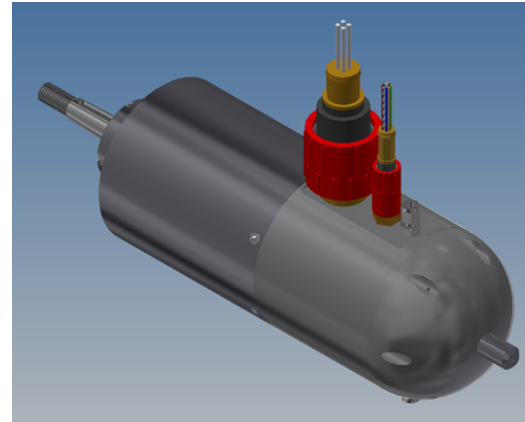


- NDSF Tested multi-beam replacement on Jason in 2019 **pcar 2018**
- NDSF is developing new heat flow probes due to increased demand, will address data quality **pcar 2018**
 - Will seek funds to complete
- SeaLog system replacing VirtualVan getting mostly praised **pcar 2019**
- Working to address concerns with Niskin trip reliability **pcar 2019**
- Tool van approaching end of life
 - Will seek funds in 2020 budget to build replacement
- Researching PRIZM telemetry system replacement
- Development of new thruster motor and controller underway

Jason Propulsion Update



- Present propulsion system is nearly 20 years old
- Improvements in motor and controller design will yield gains in efficiency
- Common design principals with Alvin and Sentry
- Sustainable COT components



Sentry Update: XR replacement (PCAR-2018)

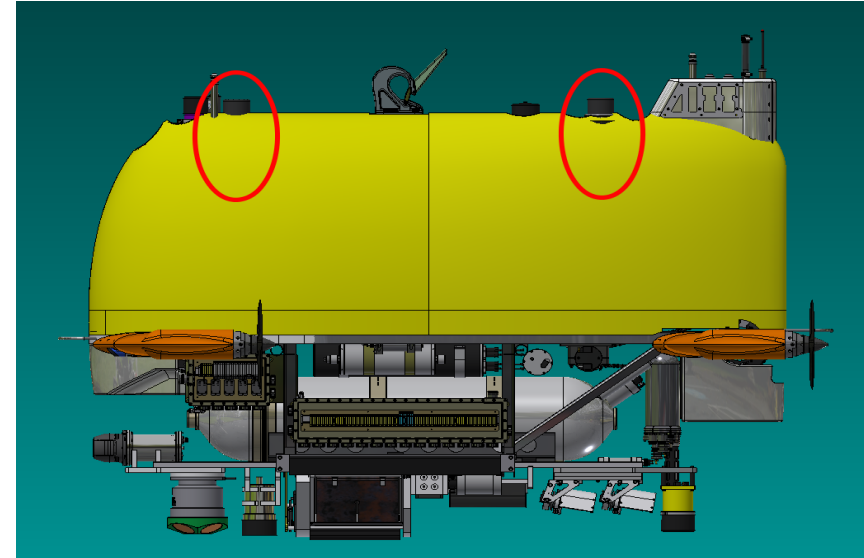
Engineering and development to replace existing XR's which are at the end of life

Summary

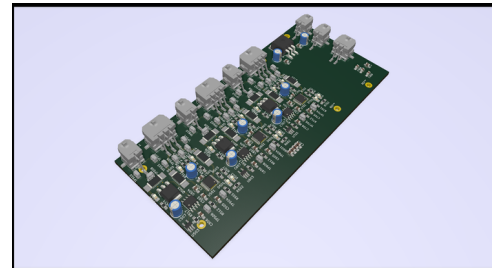
- Benthos ATM-903 Series
- Smaller Footprint, reduced water weight
- Complete solution with topside hardware
- Modem capabilities up to 15kb/s
- COTS hardware
- Leverages existing robust LBL pings/signals
- Recommended by another group at WHOI

Status

- COTS hardware purchased
- Electrical design 80% complete
- Housing design pending
- Vehicle integration pending



XR Placement on Sentry (Forward & Aft)



XR Electronics Design Progress



ATM-903 Series Hardware

Sentry EM2040 Integration (PCAR-2019/2018/2017/2016)

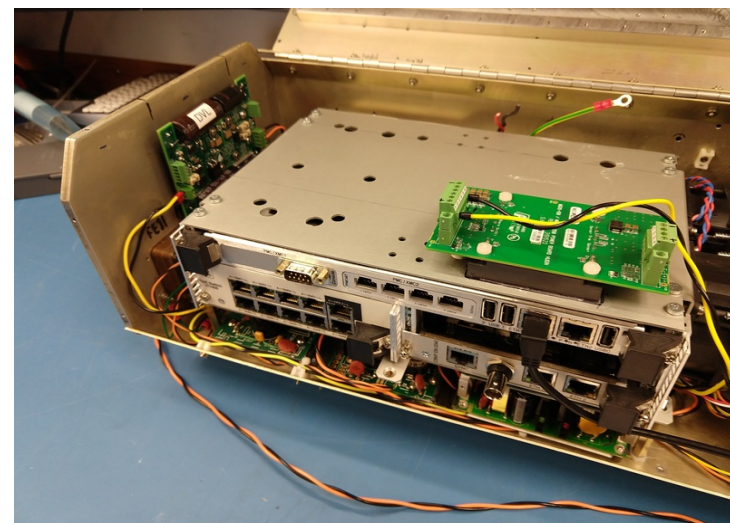
Engineering test and qualification dives conducted during the engineering 2019 cruise.

Summary

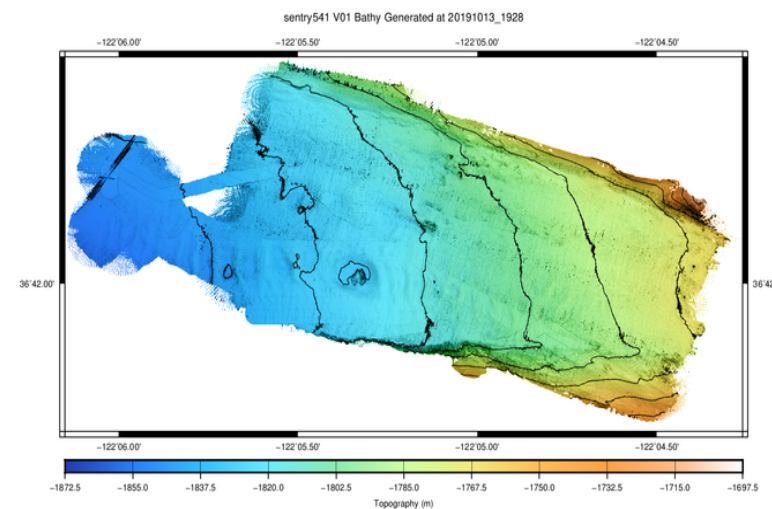
- Integration completed summer 2019
- Computer/PU to be installed into Sentry main housing, freeing up space on Sentry's starboard side
- Two units purchased, very happy with delivery times and interactions with Kongsberg
- Kongsberg providing Linux version of controller
- Kongsberg in process of upgrading software controller for all systems

Status

- Installed, has been used for 4 engineering dives, ~3 science dives to date
- Improved performance over the Reson MBES
- Will be used as full time MBES on Sentry
- Remaining work includes minor bug fixes in control and integration software
- Sentry owns TWO full system spares.



Kongsberg PU install in Sentry Chassis



MB Data from Engineering Trials

Sentry Servo Design/Integration (PCAR-2018/2017/...)

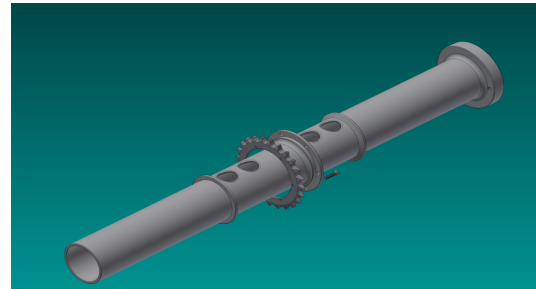
Full design and replacement of the existing servo's used to actuate Sentry's fins.

Summary

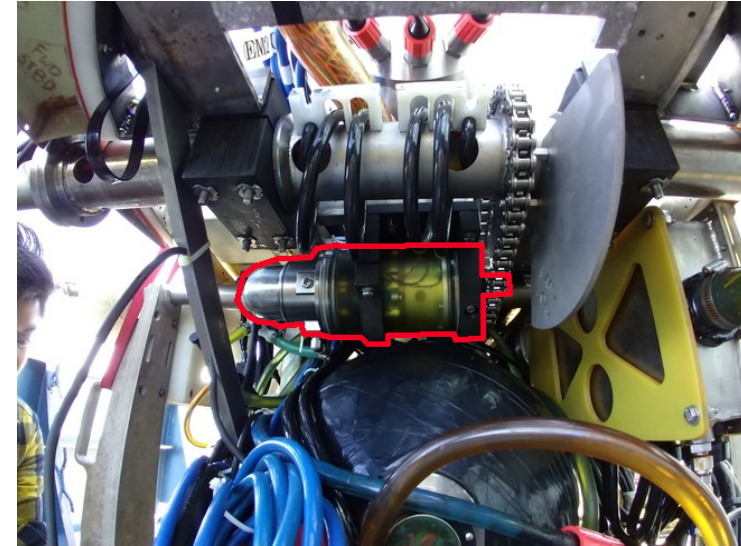
- Prototype completed summer 2019
- Integrated motor and controller housing
- COTS motor controller and motor
- Removes the need for consumable switch that is currently required to be replaced every cruise
- Speed can be increased for improved control
- Absolute positioning (current design does not have)

Status

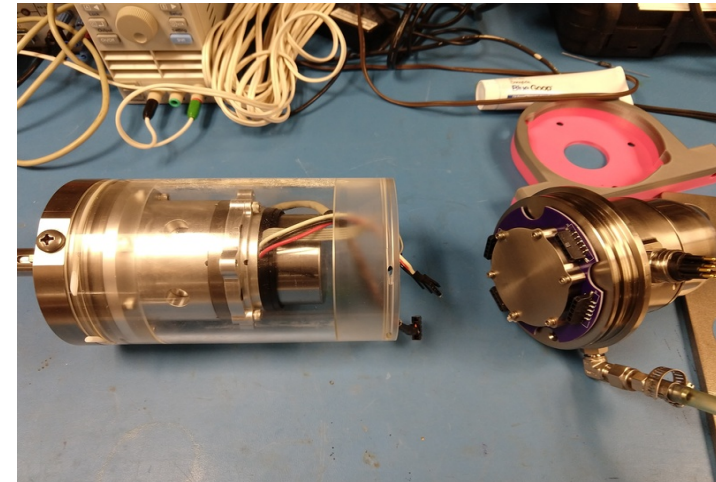
- Prototype tested during engineering trails, worked very well with no impact to dive or adjustments needed during the trails.
- Need final revision



Design includes Spar Redesign



Servo Installed during the Engineering Trials



Custom Servo Motor and controller

Sentry Operational Improvements

Data Storage RAIDS

- Replaced RAID hardware in the Sentry server van, replacing hardware that was end of life and increasing data storage to 100

Data Raid Upgrade



Coulomb Counter

- Coulomb counter will allow us to record power usage and turn this into improved mission planning.

Coulomb Counter



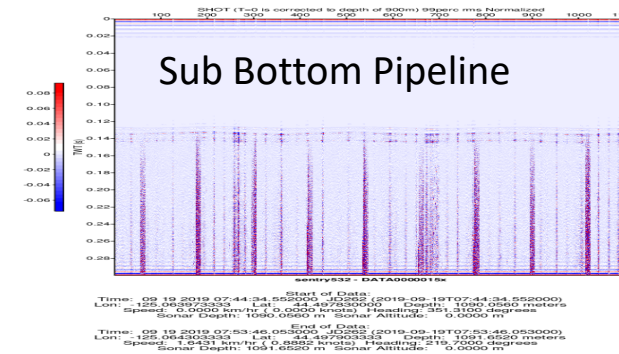
Phins IMU firmware upgrade

- This will lead to improved navigation and multibeam data.

Sub Bottom Pipeline (PCAR-2019)

- Developed sub bottom pipeline for at sea sub bottom processing, first trial during the Deb Kelley cruise, working on final bug fixes.

Sub Bottom Pipeline



Server Container AC

- Replaced all hardware and components of the AC system in the Sentry server van.

Pioneer DVL

- Developed driver and tested Pioneer DVL (replacement for workhorse) during summer maintenance period. Not currently installed

Sentry Update: Staffing

- Sean Kelley fully assuming role as program manager (3 Cruises 2019)
 - Justin Fujii – Completed first cruise as EL (3 cruises 2019)
 - Zac Berkowitz – At sea electrical support/EL (2 cruises 2019)
 - Stefano Suman – At sea software support (2 cruises)
 - Manyu Belani – trained as at sea mechanical (2 cruises)
 - Ian Vaughn – continued at sea software support (1 cruise)
 - Jennifer Vaccaro – at sea software support (2 cruises)
 - Laura Lindzay at sea software support (2 cruises)
 - Mike Skowronski – at sea EE support (2 cruises)
 - Isaac Vandor – New Software engineer (1 cruise)
 - Mike McCarthy – Fill in mechanical help (1 cruise)
-
- Alec Hewitt – Summer EE intern
 - Three High School students mentored summer 2019

Open Mechanical Engineering position

Open Software Engineering position



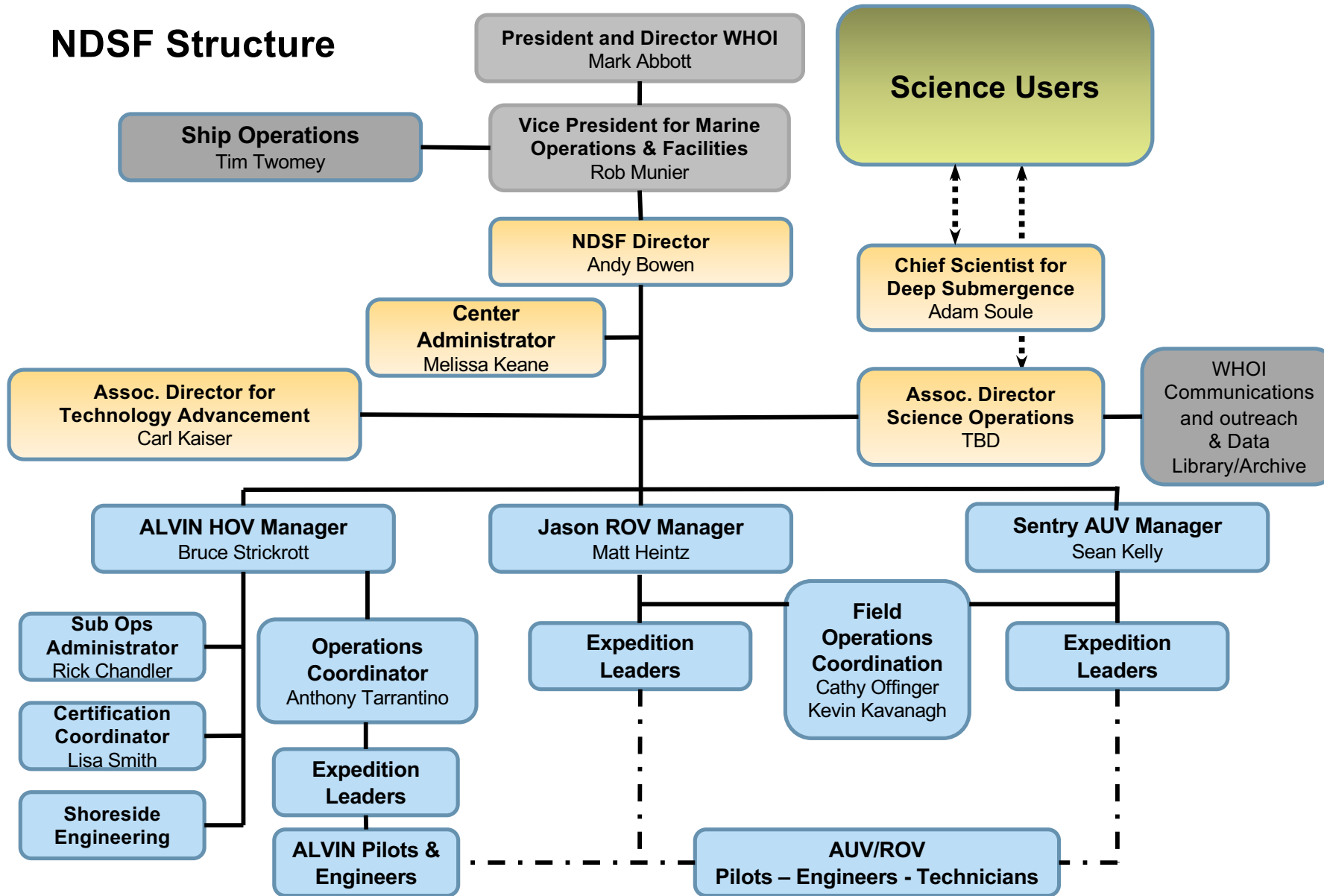
NDSF Facility Update

NDSF 2019 and onward

NDSF NATIONAL
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NDSF Structure



NDSF Technology Update: New Goals

Increase the capability, efficiency, and cross training of NDSF by:

- More aggressively pulling technology from R&D projects
- Ensuring that designs are as modular and re-useable as possible and that significant effort is put into common hardware and software on all vehicles
- Moving all vehicles to a single software platform that is also run on R&D vehicles to improve code re-use streamline maintenance and enable technology pull

NDSF Technology Update: Multibeam Project

Purchased two Kongsberg EM2040 Sonars –
Reliable and cost effective of available options

- Building a Sentry install and supporting “Fly-Away”
- Goal is Jason - August 2019, Sentry - September 2019
- “Fly-Away” is initially just different mounting, but is being designed to integrate easily onto any large vehicle with a basket with only a few connections



NDSF Technology Update: ROS/MX Upgrade

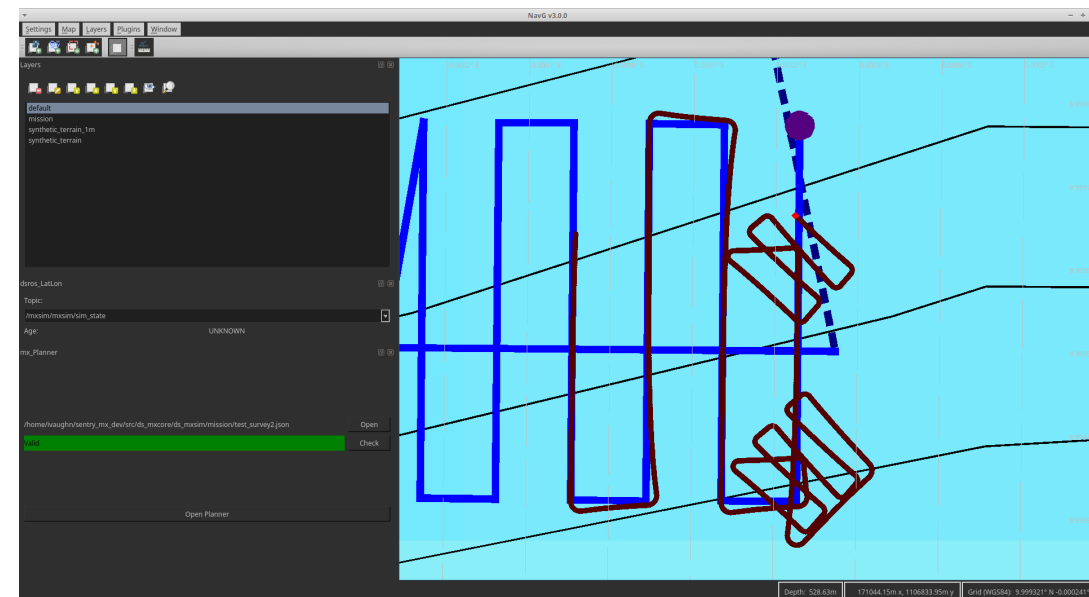
ROS now running on Sentry 60+ dives – highly reliable

Rolling out mission executive for advanced monitoring and autonomy

- Gives ability to rapidly develop new autonomy modules in a relatively low risk way
- Gives a high end monitoring and cueing system as well as configuration control that will be highly useful even on human-in/on-the-loop systems

Started planning work for moving Alvin/Jason to ROS

- Maintainable, common code base
- Interchangeable personnel
- New capabilities for both



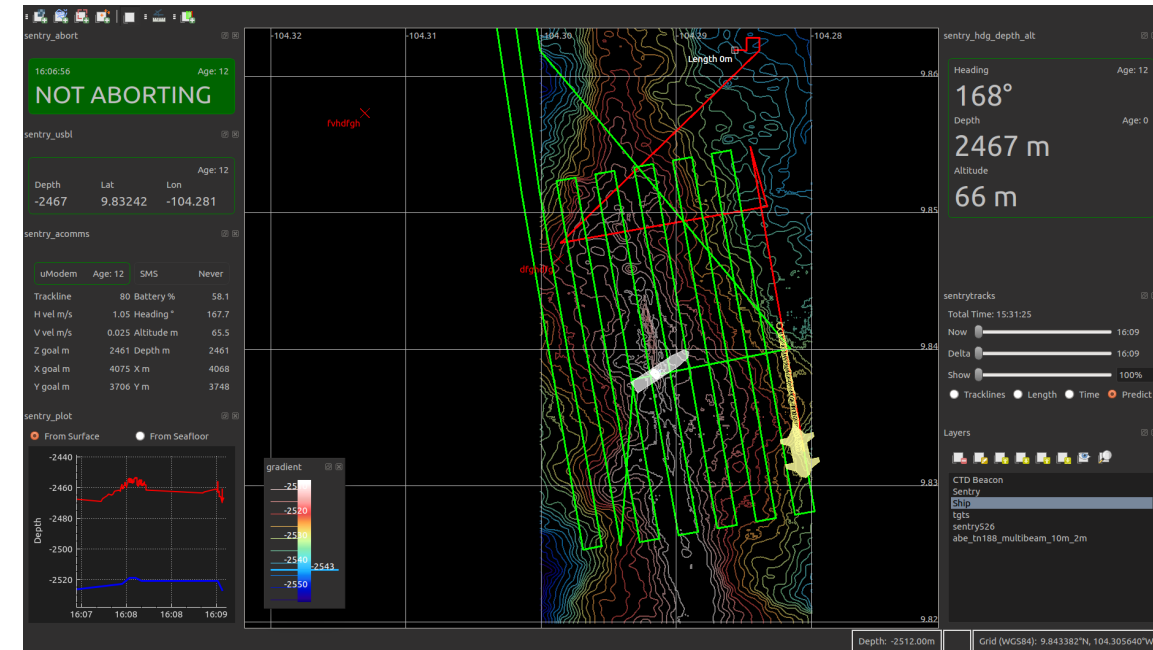
NDSF Technology Update: NavG 3

New vehicle user interface

- Looks similar, but different from the ground up
- GIS based – co-locate your data, planning, and monitoring
- Plug in based with savable configurations

Used on Sentry ops, mainstream on Sentry this fall

Adaptation planning begins for Jason this winter



NDSF Technology Update: Post Processing/Reporting

Move all three vehicles to a common post processing pipeline

- Close, but have all diverged
- Significant work done on Jason and Alvin is still the same c. 2016, but needs some additional features

Adopt Sentry cruise report format

- Requires a web front end and a database back end to make accessible to all users
- Summer student this summer to explore, engineers to finish spring 2020

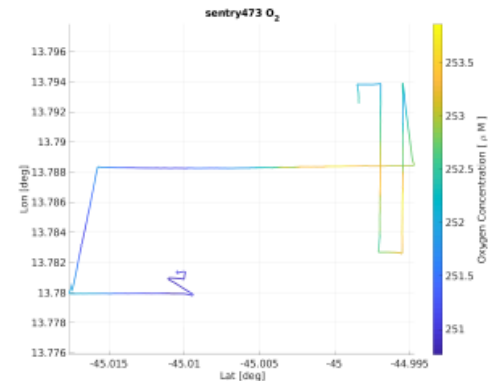
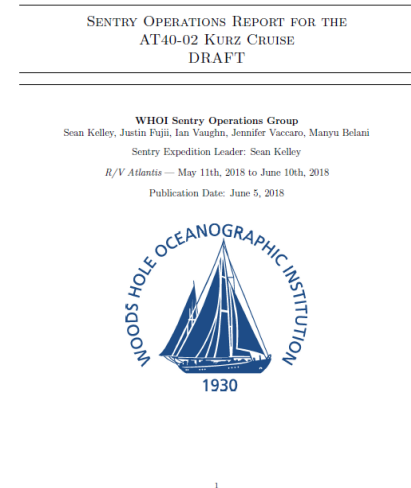


Figure 9: Navigated optode sensor data.

NDSF Technology Update: Future Road Map

DS_ROS

- Rapidly expanding to more vehicles, NDSF, NSF general, NOAA – OECl, ONR, ARPA-E, OTZ, NUWC Keyport, ???
- Two way street NDSF contributes and receives modules
- Must solve the divergence and maintenance problem

Centralize and then interconnect domain knowledge

- Nav hardware, post processing, imaging?, sonar, etc

Software and Data

- Common Code, Workflows, Hardware, and People

Auto QA/QC/Configuration Management

- Reduce errors, catch errors earlier, reduce training
- Better Error tracking, reporting, and analysis

Common Technology – Make using common tech the default not the goal

- Power supplies, hotel hardware, imaging, topside support, etc

Simulation and training – more of a far field initiative but potentially highly valuable