ROV Jason / Medea

1. Pre-Cruise Planning:

All PIs felt that pre-cruise planning went well in general with only some issues:

- **Web sites** for Atlantis and Jason cruise planning merit updating. Information is scattered among various sites that are not linked.
  - Some preliminary changes have been implemented and we are planning a more thorough update of all the NDSF web pages, to be completed before the December DeSSC meeting
- One issue that was requested but not met was the **calibration of the CTD**.
  - This was due to time limits and needing the CTD on the cruises prior to and following this cruise. The CTD was calibrated after the cruise and the data provided to the PI's to their satisfaction, as confirmed by the Ops Mgr following the relevant debrief.

3. Operations - Vehicle:

In general Jason performed very well except for some issues

- *Minor ground faults on both manipulators*. There were several dives that were impacted by faults that occurred on one and or the other manipulator or both
  - All but one manip failure was a Kraft which is reaching end of life due to operational wear and tear (almost 8,000 hrs)
  - We had the mfr. rebuild one, but they recommend replacement. This would cost $100k (slave arm only).
  - A preferred solution, technically, would be to invest in a 2nd Schilling T4 which has proven to be more robust. This would cost $275k (complete system).
- *Introduction of the new LARS* system did not go well at first attempt - Jason was bounced on the rail. Temporarily the old LARS crane was used as backup until the new LARS system was brought back into service.
  - The LARS crane is now fully functional (see Jason Upgrade report later)

4. Operations - NDSF Equipment:

Other equipment

- A bug was found in the *Event Logger software*. If the "&" character is used when typing a string of text into an Event entry, everything that follows the "&" character is deleted when the entry is completed and the operator hits "return".

  - The event logger program has been updated to trap this character.

- It was noted that an off-line version of the *Jason Virtual Van* now exists that is exported to DVD, BUT that version of the VVan is not searchable in the same way that the online version is. This greatly reduces the usefulness of the VVan log, and a search function in the off-line/DVD version of the Van should be incorporated.

  - Write-once nature of a burned DVD limits this function.
    - We recommend using the interactive server at http://4dgeo.whoi.edu/jason.
    - However, typical text-based search tools do work for the off-line version.

8. Data Hand-Over:

- For a 9-dive program that generated hundreds of DVDs which the PI considered an obsolete way of operating.
  - We agree. We are developing a system that will constantly record bottom-time video and store it as files on hard drives. A prototype is being tested on the current Jason cruise and we expect to have an operational system ready for initial testing this Fall.
- There was also confusion in terms of what the PI needed to procure in terms of Hard Drives.
  - A pre-cruise primer has been distributed to PIs that advises that video data cannot exceed 8TB (the capacity of the Jason Group hard drive for storing full HD video)
  - However, additional geophysical surveys may also acquire data in large volumes (true for all vehicles) so both PIs and NDSF need to be vigilant in anticipating this at the pre-cruise planning stage of cruises.
- On one cruise there were no HD clips recorded from one dive.
  - In consultation with the relevant PI's our working assumption is that this may have been a training failure: HD recording is performed by a Science Party watchstander. The alternate explanation is that the Jason data manager aboard ship subsequently deleted all the recorded files.
- The PI has found that 6 of 51 DVDs reviewed were in fact blank disks with no data. Another DVD had no annotation along the top of the screen as expected.
  - Assuming this was not the result of poor training/practice from the watch-standing data-loggers on this particular cruise (the losses identified were scattered through the middle and later stages of a cruise run by experienced PI's) then this speaks to the point (above) that moving away from DVDs as the primary medium for data archiving is a desirable goal.

10. User Recommendations:

- While the HDTV camera itself behaved well, it was recommended that some formal training for the science team be provided during the first few watches of any cruise.
  - This could also be a good topic for a new DESSC workshop
- The new HDTV camera still needs attention in terms of control box response times, better lighting, and the monitor in the control van assigned to display its video-feed.
  - All three systems have been upgraded in the past year but we are conscious that the control box remains challenging.
- The Brow Camera should be replaced by the Mini-Zeus.
  - This has been done with the camera now on a pan & tilt
- The PI thoroughly recommends the use of recording to hard drive from the HD camera – the quality of the materials obtained for outreach are exceptional.
  - This has been the case since 2010 but, because of the volumes that would result from continuous recording in Full HD, only (science-selected) highlights are recorded in this way up to a maximum of 8TB per cruise.
  - Constant recordings are currently captured by DVD but in the future will be captured in highly compressed form to hard drive (Fall '12).
- The practice of establishing a standard pattern of both generating a dive-plan ahead of each dive and taking the time to talk that through with the Expedition Leader is probably worth considering.
  - We are working to establish a more defined protocol for the PI to generate a dive plan in consultation with the EL.

Sentry de-brief summaries – 2011/2012

Mobilization:

- Coordinating/communication issues with ship caused significant mobilization issues on one cruise which impacted Ops Teams, and resulted in a lost day of mobilization.
- Communication started months in advance, but last minute changes from the ship operator were not communicated to the *Sentry* team.

Sentry de-brief summaries – 2011/2012

Operations – Vehicle

- During first dive of one cruise issue with vehicle not following the intended course (heading ~12°counter-clockwise)
- Issue was with delay from Phins power on to Phins fully working
- First time we had seen this. Changes to pre-dive procedures will prevent future occurrences.

Sentry de-brief summaries – 2011/2012

Operations - Vehicle:

- Apparent sources of vehicle performance issues:
  - Limitations of the USBL navigation system
  - Impact of apparent acoustic noise of ship on LBL & USBL
  - Apparent problem with the servo actuators on the dive planes, impacting *Sentry*'s ability to make progress at depth
- Issues were depth related
  - Prepared a failure analysis document – many individual causes – Feb 2012
  - All components were tested on shore pre-cruise, but often not in ways that would have revealed the failures
  - Post cruise: extensive shore side testing and repairs – now believe we have most issues resolved
  - We anticipate additional tracking improvements during current maintenance period
  - Deep water (~5,400m) testing in July – NOAA *Okeanos Explorer*

Sentry de-brief summaries – 2011/2012

Operations - Vehicle:

- Problems with mission planning software:
  - One dive aborted during the early stages of descent. Re-launched after ~3 hours of down-time, the vehicle was re-launched. Completed all but final ~2h of survey before it aborted again in the same way.
  - This was a fault in the vehicle controller. It was accidentally introduced while fixing a latent, more benign bug and is now believed fixed.
  - Failure to drop weight at 1600m for shallow test-dive, resulted in continued descent of vehicle until abort command was sent.
  - This was a programming error. No mid-water dives were planned, and they are different from near-bottom dives. The simulator was not able to catch this particular error. All qualified EL's are now trained on mid-water dives.
  - During test dive vehicle did not get to planned depth before mysteriously self-aborting the mission and coming straight back within 6 hours.
  - Investigated, but first time in 350 ABE/*Sentry* dives. We cannot replicate this failure.

Sentry de-brief summaries – 2011/2012

Operations – (Mis)communication with Ship's Crew

- Maneuvering of the ship involved a steep learning curve
- A last minute medical issue affected the makeup of the *Sentry* crew.
  Cross training continues aggressively.
- Recurrent delays due to misunderstanding of "30 minutes prior to launch" notification:
  - *Sentry* team was ready to proceed with a launch but forced to wait for key ship's personnel (e.g. the crane driver)
- We are developing a "Bridge Manual"

Sentry de-brief summaries – 2011/2012

Operations - NDSF Equipment:

- Camera system generally worked well
  - Noted that resolution (e.g. when zooming in within individual photographs for biological purposes) was not as good in comparison to what could be achieved from the TowCam 16 MB images.
- Equipping *Sentry* with better lighting and a new higher quality digital still camera would improve basic imaging capabilities
- 3D imaging capability was impressive and should be standard. Cautioned that this would require:
  - additional hardware on the vehicle
  - additional hardware required aboard ship
  - skill-set needed among the *Sentry* team to process the data in a timely fashion in the way that it was done on this cruise.
- See *Sentry* Upgrade slides

Sentry de-brief summaries – 2011/2012

Operations – NDSF & User Provided Equipment:

- Noted that [maggie] data acquired with *Sentry* were much noisier than data previously acquired with *ABE*
- Maggies were set to the maximum sample rate which turns out to be noisier than lower sample rates
  - Sensors brand new for cruise at request of PI (~100x more sensitive) – long lead time = insufficient testing
  - Sample rate discussed on cruise, but noise trade off not understood at the time
  - Some interference from DVL, unavoidable, but may be able to shield in the future
- Eh sensor
  - Signal-to-noise ratio in the Eh sensor data string was not as good (i.e. there was more electrical noise on this cruise) as when the same kind of Eh sensor used to be deployed on *ABE*
- We now believe that we may have systemic problems with electrical noise. This is also affecting other systems including the USBL. We are actively looking for causes and solutions during this overhaul and expect significant improvements over the next year.

Sentry de-brief summaries – 2011/2012

Recommendations:

•*Sentry* should be equipped with a "park" mode of operation like ABE used to have, whereby it can descend to the seafloor at the end of its programmed mission and await an acoustic command to come back to the surface.

•This has long been planned but is very difficult given *Sentry*'s streamlined shape and ban on glass spheres. We have a concept which requires testing. We had engaged a summer student fellow who was to test the concept but he chose another opportunity outside of WHOI at the last minute and it was too late to engage someone else.

Sentry de-brief summaries – 2011/2012

Recommendations:

- Due to the need to re-process various data files, issues/confusion arose due to file naming conventions. The PI suggests implementing a more systematic approach to add the same date-based notation, or a version number to **all** *Sentry* files, starting with the original.
- Noted
- Currently, vehicle tracking map and other key information including elapsed time, depth, projected time to mission end, etc. is embedded only in the *Sentry* Team watch-leader station but is difficult for Science Party to access. Developing a simple user-friendly interface that could be fed to a terminal/ screen somewhere readily accessible to Science Party would facilitate communication and science planning.
- Kaiser/Camilli have already submitted (May 1) an internal WHOI proposal which will address this along with many similar issues for other assets.

Sentry de-brief summaries – 2011/2012

Recommendations:

•In the future all NDSF vehicle upgrades should **require** a post-improvement set of engineering test-dives prior to use for funded science program. Even 1 or 2 dives would been invaluable to reveal concerns and issues that impacted the entire cruise.

•Prior to 2012 , *Sentry* had not had an NSF-funded, dedicated engineering dive since 2006. WHOI did pay for a test cruise in 2008 using internal funds, but this was only to depths of 2,000m. So far in 2012 we have four engineering days planned and we look forward to carrying out all funded testing.

•NDSF and DESSC should work together to establish a training schedule to strengthen the operational team.

•We have a training plan - see Sentry Upgrade slides

Sentry Debrief 2012

Pre-Cruise Planning

- In general went very well
  - Well-coordinated
  - *Sentry* team very communicative
- Despite extensive pre-cruise discussions for one cruise, inadequate pre-cruise testing resulted in significant problems

We always try to test to the maximum extent that funds and ship time will allow. In this case, no opportunity for full at-sea testing was available.

Mob/Demob

- Generally went well, even under difficult circumstances
- Some communications issues with ship resulted in delay in mobilization for one cruise
- Wrong crane sent for demob of one cruise caused delay

Neither issue affected science operations but better communication is always appreciated

Operations - Vehicle

- Vehicle performance was good for 2 cruises
- Multiple operational problems with *Sentry* and USBL nav on one cruise resulted in significant loss of time. *Science objectives were not met*.

Problems were depth related. We have since done 14 dives to same depth with adequate tracking and no depth related failures.

- PHINS calibration issue

New procedures in place

- Glitch in mission planning software

This was a midwater dive. No midwater dives were planned that trip.

- Telepresence worked well, thanks largely to efforts of NDSF personnel

We welcome any and all future opportunities to conduct telepresence ops

Operations – NDSF-provided equip

- USBL -- generally fine, but problems during deep water ops:
  - Apparent limitations of USBL
  - Acoustically noisy ship (?)

Has been improved to provide navigation adequate for map making. Sonardyne providing free equipment next spring that should be even better.

- Multibeam
  - Worked (extremely) well

Operations – NDSF-provided equip

- Sidescan
  - Worked well
- Sub-bottom Profiler
  - Worked well
- Magnetometers
  - Data noisier than on ABE
  - Apparent interference from DVL

We identified general electrical noise and DVL noise. General electrical noise has been dramatically reduced, DVL noise is unavoidable. Building shields for magnetometers now.

Operations – NDSF-provided equip

- Cameras
  - Overlap of adjacent photographs disappointing during some dives, but software glitch identified and fixed before end of cruise

  Brand new capability for 2x rep rate, worked on engineering dive tests but problems on longer missions. Workaround available first dive after problem identified, full fix before end of cruise.
  - For geologists & some biologists, existing camera resolution was fine for meeting science objectives, but resolution not adequate for some detailed biological investigations

  Working on 11MP camera now – see upgrade slides
  - Lighting was good

Operations – User-provided equip

- Eh sensor
  - Noisy data on one cruise (electrical noise)
  - Fine on subsequent cruise

We have systematically reduced electrical noise on *Sentry* which has benefited the Eh and all other systems

Data Handover

- Generally fine
- During 1 cruise - more data acquired than expected – almost not enough media

Would have been OK except half of normal equipment was on shore for telepresence, and we suffered a major leak in the lab. Ongoing upgrades underway to handle much higher expected volumes in the near future.

- Data consistently delivered in a timely manner
- Team was flexible accommodating needs with formats sent ashore
- Telepresence data transfer and processing workflow worked very well

Recommendations

- NDSF vehicle upgrades should include *requirement* of post-improvement set of engineering tests before the vehicle is used for a funded science program

We welcome the opportunity to test whenever possible. In this case, no funded opportunity was available.

- Implement training schedule to strengthen operational team

Underway, see upgrade slides

- User-friendly science interface accessible throughout ship for tracking mission status

Proposal declined. Will continue to look for funding – maybe 2013 NDSF budget or elsewhere.

- *Sentry* should be equipped with "park" mode (like ABE had) – anchor on seafloor and await acoustic command for recovery

Conceptual design underway - see upgrade slides

Recommendations

- A more systematic approach to file naming (including version number) for ALL *Sentry* files.

Underway

- *Sentry* can delivery the right sensors to the right part of the ocean to conduct cutting edge research, but the quality of some data (e.g. maggie/Eh/electrical noise) could be improved

Already substantial electrical improvement; working more on the maggies

ROV Jason / *Medea*

de-brief summaries – 2011/2012 - one year

1. Pre-Cruise Planning:

All PIs felt that pre-cruise planning went well in general with only one remark:

- Failure at the planning stage (Science or UNOLS operator) to obtain diplomatic clearance for the locations where moorings were located - Clearance for Bajan waters but nor for Trinidad & Tobago or Venezuela.

  Recommend UNOLS address this in ship request system.

3. Operations - Vehicle

In general Jason performed very well, except for:

- Introduction of the new LARS system was achieved over the course of the first cruise after some initial integration issues.
- The ship's winch was damaged during transfer from the R/V Thompson to the R/V Langseth, the ship came into port mid-cruise for repair, part of the science team left without accomplishing their cruise goals.

SIO portable winch was damaged during demob from TGT and tested by *Jason* manager and SIO winch pool tech and deemed in good working order. Problem only manifested itself after deep water dive.

- For one cruise the A/C in the control van was not sufficient – problems with overheating.

A/C in the control van is overworked in hot weather and especially when van occupancy is high. A remote station will help alleviate the problem; researching A/C upgrade.

4. Operations NDSF - provided equipment

Navigation (USBL and LBL) worked really well in general

- On one dive it took 6h until anyone noticed that the underlay ingested into the dive was actually from the wrong ship's multibeam (a completely different site!)

NDSF relies on the science party to provide map underlays and this is particularly important in new locations.

- On one cruise, there were increasing discrepancies between predicted locations and where the instruments were found by Jason. -> This indicated that there was an increasing problem with the accuracy of the Jason navigation.
- Will pursue this with PI, but if there was a problem with the USBL it did not reoccur on subsequent 2012 cruises.

4. Operations NDSF - provided equipment *cont.*

Lighting and Cameras worked well in general

•The HDTV science camera showed limitations in comparison to the pilot's camera: at full-zoom, the NDSF camera did not deliver as much detail, zoomed-out it it provided a wider field of view but the lighting was insufficient.
•The NDSF HDTV camera was found to be less effective than the pilots InSite Mini-Zeus for science use
The Advanced Imaging & Visualization Lab has provided a way to double the zoom of the NDSF HD camera. This will be tried on the next engineering dive.
•Mapping using the **Reson multibeam system** has been used to good effect on 4 cruises over the reported year, *except that*
•The Reson multibeam system did not work in the brine pool.
Prior experience suggested it would not map under a brine pool, and it was left on board to allow use at non-brine sites on the same dive. In response to this emerging need, we have identified tests that *may* lead to techniques capable of imaging both the surface of a brine pool and the underlying seafloor. This would be highly experimental.

8. Data hand-over:

Data hand-over went well, except for one remark:

- The PI found that 6 of 51 DVDs reviewed were in fact blank disks with no data.

For video DVDs, the protocol is for the data processor to check first recordings from each dive and then to make random checks of following recordings. Problems with procedures or equipment are corrected as they are encountered. In real time two recordings are made simultaneously, one for archives and one for science, and when found bad recordings are replaced by a copy of the simultaneous recording. This PI has asked that we only pursue this course after they have reviewed their other ~50 DVDs of interest.

We continue to use DVDs for lack of a replacement technology. DVDs are economical to record, post-process, and store. We are actively developing a system to replace DVDs; since early summer 2012 data packages have included a nascent product from a prototype system. However, the prototype requires additional features before it can be used operationally. A pending internal WHOI proposal has been submitted to develop advanced features. Other funding is being sought, including via the 2013 operating budget.

10. User Recommendations

- The practice of establishing a standard pattern of both generating a dive-plan ahead of each dive and talking that through with the Expedition Leader is probably worth considering.

NDSF agrees and a more formal process is in development.

- UNOLS should invest in a better planning tool for ship-time requests/cruise planning that ingests the planned field operational areas showing nations' EEZ boundaries to ensure diplomatic clearance.
- The ROV Jason team should work on developing a better "repeater" station, outside the control van which has both higher quality video-feed and uses more screens to project that information in the main lab.

NDSF agrees and is working to accomplish this.

- For such shallow work, the standard-configuration Jason ROV was probably 'overkill'. It might be worth considering how to develop a shallow-water option for the National Facility.

Cancellation of the Thompson cruise has led to the total loss of one year of data from one osmosis-sampler and represents a loss of $0.5 million in research-effort costs and has also impacted 2 PhD students working with the PI.