Roger Revelle Midlife Refit

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Scripps Institution of Oceanography
Overarching mandate: ONR

AGOR 23 Class Service Life Extension Program

The Global Class ships *Thompson G. Thompson* (1992), *Roger Revelle* (1996), and *Atlantis* (1997) had a 30 year design life

- ONR is focused *primarily on life extension* of the basic ship (hull, mechanical, electrical) – extending the 30 year service life to 45 years

- Ensuring reliability, maintainability and regulatory compliance are key parts of the primary goal

- Science upgrades, making ships green, and habitability improvements are *secondary goals*
Stalwart sponsorship has been key

This successful midlife refit was made possible by

**Office of Naval Research**
- Midlife Refit Contract N00014-16-C-3054
- Ship Operations Grant N00014-16-1-2745 (Cranes, IT, Networks, Labs, Habitability)
- DURIP Award N00014-17-1-2221 (HDSS)
- DURIP Award N00014-18-1-2381 (EM124)
- DURIP Award N00014-18-1-2169 (EM712)
- DURIP Award N00014-18-1-2387 (HiPAP, EK80, pCO2 & Acoustics)
- DURIP Award N00014-19-1-2116 (Gondola)
- DURIP Award N00014-19-1-2112 (HDSS)

**National Science Foundation**
- Ship Operations OCE-1827444 (PA, Phones, Transformers, Sea Trials)
- SSSE OCE-1920816 (Workboat, Noise Mitigation, Science Reefers)
- Oceanographic Instrumentation OCE-1728715 (EM712 & EM124)

**Scripps Institution of Oceanography**
- Engineering, shipyard work packages (UC Ship Funds Program)
## Primary goals

### Ship and ship services revitalization

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For July 2020 presentation to UNOLS Council see [www.unols.org/sites/default/files/2007cnc_ap05.pdf](www.unols.org/sites/default/files/2007cnc_ap05.pdf)
Improvements to scientific systems

New / upgraded scientific instruments include:

• **New** Hull-mounted acoustics gondola
• **New** EM712 shallow-water multibeam swath bathymetry
• **New** HiPAP acoustic tracking system
• **New** EK80 midwater imaging system
• **New** continuous underway pCO2 profiling system
• **New** transceiver room, shipboard network, VDI cluster
• **Upgraded** EM122 -> EM124 deep-water multibeam
• **Upgraded** Hydrographic Doppler Sonar System (HDSS)
• **Upgraded** Acoustic Doppler Current Profiler (ADCP) systems
• **Upgraded** Knudsen subbottom profiler system
Improvements to habitability

New / upgraded spaces for human beings

• **New** flooring in main laboratory and Route 66
• **New** carpeting in lounges and staterooms
• **New** mattresses, linens, blankets
• **New** laboratory chairs and bench seats
• **New** stateroom bunk curtains
• **New** cardio workout room and equipment
• **New** weightlifting room equipment
• **Bright** work areas due to new LED lighting throughout
• **Quiet** inside and out (exhaust, engine room, and bow thruster)
• **Comfortable** due to HVAC upgrade and controls that really work!
Gondola = Better Sonar Performance

Gondola home for new EM124, EM712, EK80 and HDSS sonars

- 44 feet long x 17 feet wide
- 36 inches deep
- Quiet platform, rejects bubbles

R/V Roger Revelle
Gondola
View from bottom looking up
Shipboard Network Replacement

Shipboard fiber-optic distribution backbone

Main Lab Distribution Rack
Integrates junction box, patch panels, ethernet switches, and UPS systems

computer lab access

computer lab

First platform FWD

04 level distribution

01 level distribution

Main lab

Hydro lab

First platform transceiver room
Refurbishment of Lab Spaces

New computer lab partition
Laboratory-grade work surfaces
Refurbishment of Lab Spaces
VDI cluster
Stateroom: Science two-person
Gyms: New cardio and weight rooms

Treadmill: Nordic Track 1750
Tread Climber: Bowflex TC10
Spin: Keiser M3i Indoor Magnetic Cycle
Rowing: Concept2 model D
Bowflex Revolution
Squat Rack and Bench Press
Rubber coated plates & dumbbells
Corral Pad flooring
Executive Summary

We prepared to go to sea.

- CAST6 winch and LRS tests; CTD 500m tests
- EM712 Calibration and Verification
- RX noise and RX spectrum test on EM712
- RX noise and RX spectrum test on EM124
- CAST6 winch and LRS tests; CTD 3000m tests
- EM124 Calibration & Verification
- DESH5 winch and LRS tests; CTD 3000 m test (w/HiPAP)
- Trawl Winch Lowering to 3000m (w/ HiPAP)
- DESH5 CTD 500m
- DP tests
- Mooring deployment/recovery
- EM124 Accuracy Survey - 3900m
- EM124 swath width test - 4000m to 1500m
- EM124/EM712 swath width test - 400m to 1500m
- ADCP calibration & tests
- HDSS Tests
- EM124 Accuracy Survey 1275m
- Magnetometer test
- HiPAP calibration & tests
- EK80 Speed Noise Tests
- EK80 Calibration
- Satcomms tests
- Subbottom profiler tests
- 12 kHz transducer tests (comms)
- Shipboard network tests
- WiFi validation
**Executive Summary**

*We prepared to go to sea.*

*We went out to sea.*

*We found problems.*

*We solved them.*

- CAST6 winch and LRS tests; CTD 500m tests
- EM712 Calibration and Verification
- RX noise & spectrum test on EM712
- RX noise and RX spectrum test on EM124
- CAST6 winch and LRS tests; CTD 3000m tests
- EM124 Calibration & Verification
- DESH5 winch and LRS tests; CTD 3000 m test (w/HiPAP)
- Trawl Winch Lowering to 3000m (w/ HiPAP)
- DESH5 CTD 500m
- DP tests
- Mooring deployment/recovery
- EM124 Accuracy Survey - 3900m
- EM124 swath width test - 4000m to 1500m
- EM124/EM712 swath width test - 400m to 1500m
- ADCP calibration & tests
- HDSS Tests
- EM124 Accuracy Survey 1275m
- Magnetometer test
- HiPAP calibration & tests
- EK80 Speed Noise Tests
- EK80 Calibration
- Satcomms tests
- Subbottom profiler tests
- 12 kHz transducer tests (comms)
- Shipboard network tests
- WiFi validation
Satcoms: Maximum test shot pilot project

Shore->ship 60Mbps MIR, 50Mbps CIR

Ship->shore 100Mbps MIR, 60Mbps CIR
EM120: Noise

- **Speed**: A graph showing SOG (kts) vs. Test Number.
- **Azimuth**: Graphs showing RX Noise (dB re 1 μPa/Hz) for azimuth vs. Test Number.
Multibeam mapping: EM712

Clean data = good data

- Need to collect more test data to assess accuracy and swath width vs depth
- Need to assess performance in higher sea states
- COVID-19 prevented the Multibeam Advisory Committee from joining the ship
- Satcoms enabled virtual participation in near-real time
- MAC team at UNH collaborated remotely with shipboard team 24/7 to plan surveys, process data & calibrate systems
- This was a resounding success, made possible by cyberinfrastructure

Big thanks to Kevin Jerram and Paul Johnson of the Multibeam Advisory Committee!
ADCPs

**UH Currents** team collaborated remotely

- 75 kHz calibrated and working well
- 150 kHz has strange hardware problem – but Jules fixed them with software – UHDAS rocks!

*Thanks to Jules Hummon and UH Currents group!*
Acoustics: HiPAP & EK80

Refurbished transducer tube & stem

EK80 calibration system tested: OK
Bow Thruster

New: ZF Marine Retractable L-Drive
Quieter, more powerful operation

Retracted:
Tunnel thruster for maneuvering in port

Extended:
360 degree azimuth thruster
Better DP, quieter, more power

46.9 dB (SPL)
40 dB: quiet library

33.6 dB (SPL)
30 dB: whisper
Questions?

R/V Roger Revelle, La Jolla 2020