Abalones OBS Instrument Platform for Offshore Ocean Science Applications

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Abstract

The versatile and proven Abalones Ocean Bottom System (OBS) platform, licensed from the Scripps Institution of Oceanography, has decades of elapsed operational time. Nanometrics has updated this platform with the low-power and high-performance Pegasus OBS data logger and support for the family of Trillium OBS seismometers. Continued updates in both datalogger and sensor technologies have simultaneously reduced power consumption and size by up to 70% while increasing the performance of this complete platform. The new Pegasus and Trillium technologies can bring the same benefits to refreshed and other new platform designs.

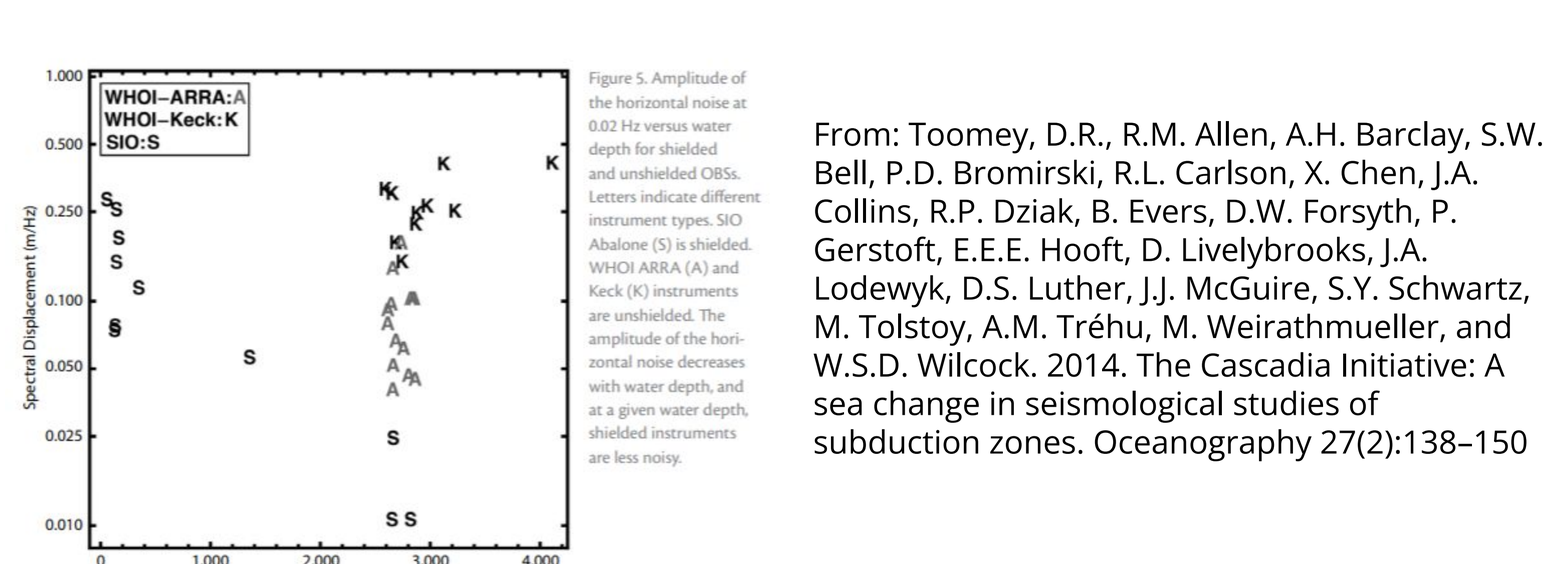
Designed for Flexibility and Performance

With a low profile, truncated pyramid design and no fixed protrusions outside of the main shape, the Abalones is specifically designed to provide excellent resistance to trawling. The same package is used for shallow, intermediate, and deep water deployments enabling users to readily swap sensors dependent upon application (short period, intermediate broadband, very broadband). The depth fatigue-resistant syntactic foam flotation design allows for a lifetime of standard deployments up to 6 km. In addition, the low-power instrumentation provides for a range of battery configurations.

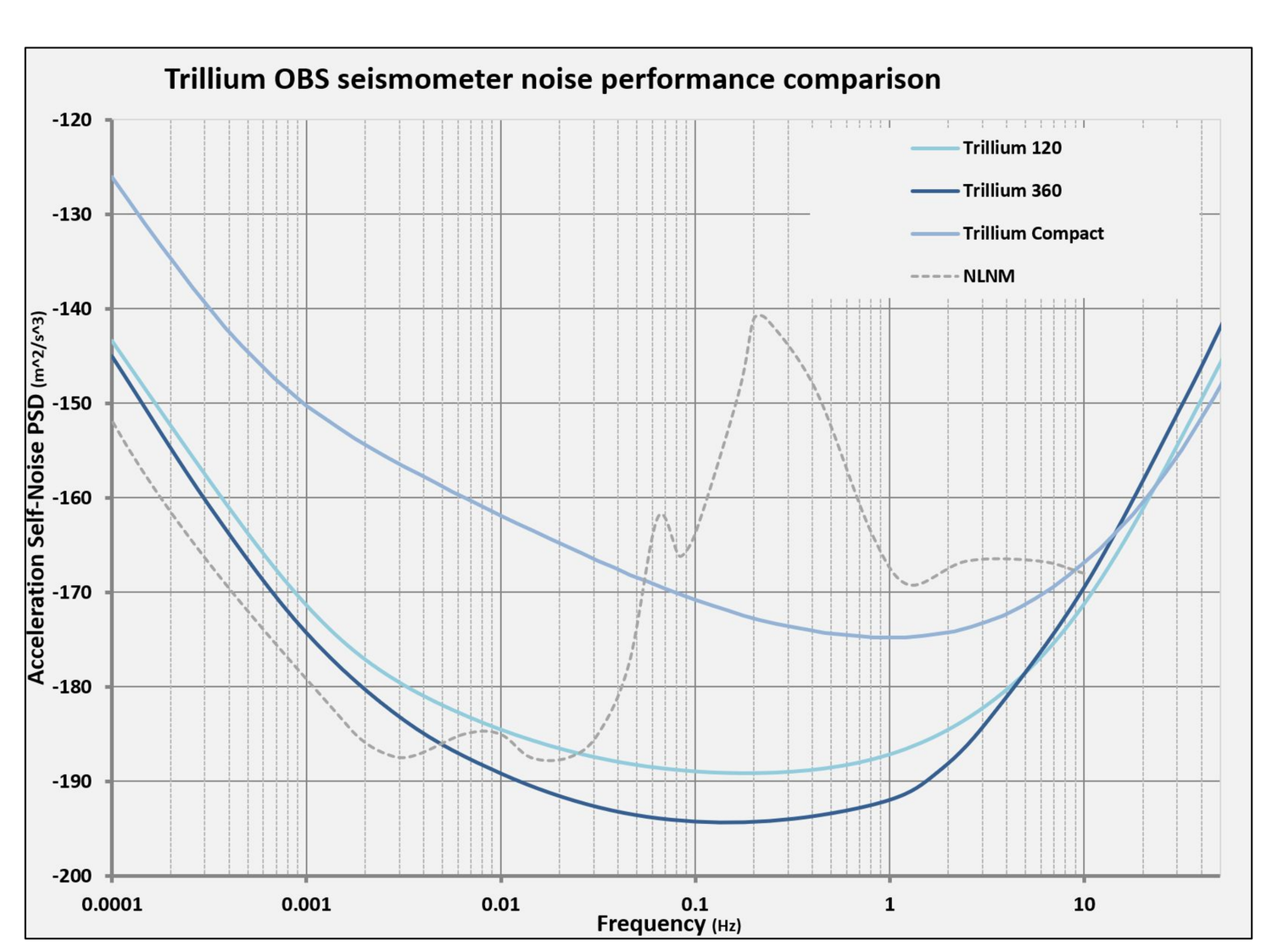
Battery Configuration		Deployment time			
Data Logger Battery Packs	Main Battery Packs	4-Channel (with DPG)		3-Channel (seismic only)	
2	0	1.6	months	1.9	months
3	0	2.4	months	2.8	months
2	1	9.4	months	10.9	months
3	1	10.2	months	11.8	months
2	2	16.9	months	19.6	months
3	2	17.6	months	20.4	months

Flexible Power and Sensor Configurations

The Abalones optimizes seismic recording fidelity by presenting a low profile to ocean currents and shielding the seismometer in a central well, entirely decoupled from the frame. The approach provides a demonstrated minimization of noise due to external environmental noise sources.



From: Toomey, D.R., R.M. Allen, A.H. Barclay, S.W. Bell, P.D. Bromirski, R.L. Carlson, X. Chen, J.A. Collins, R.P. Dziak, B. Evers, D.W. Forsyth, P. Gerstoft, E.E.E. Hooft, D. Livelybrooks, J.A. Lodewyk, D.S. Luther, J.J. McGuire, S.Y. Schwartz, M. Tolstoy, A.M. Tréhu, M. Weirathmueller, and W.S.D. Wilcock. 2014. The Cascadia Initiative: A sea change in seismological studies of subduction zones. Oceanography 27(2):138–150



Sensor support on the Abalones has been expanded to support the full range of Nanometrics ocean bottom seismometers, including the new Trillium OBS 120 and Trillium OBS 360, now with initial customers.

Specifications:

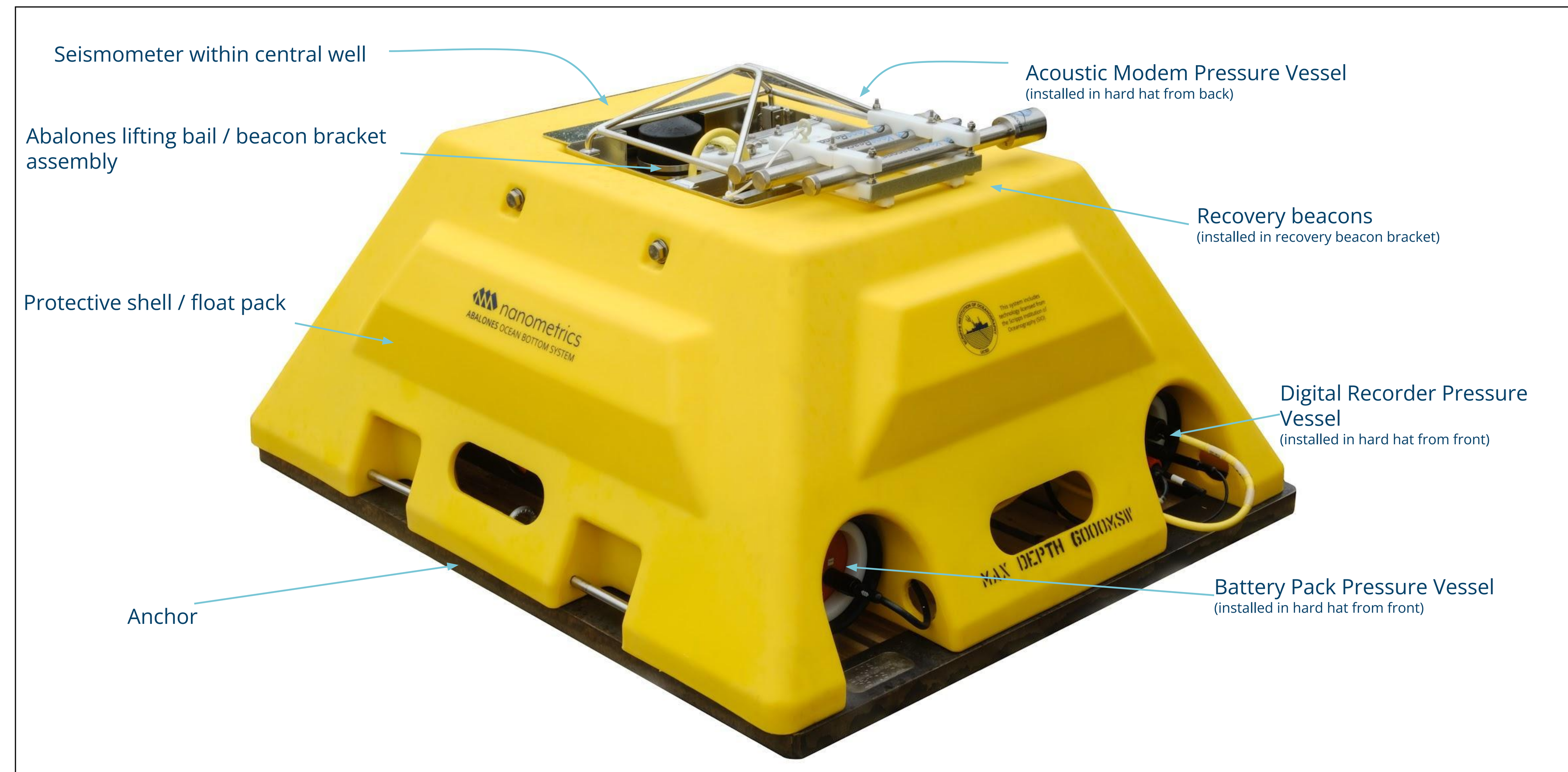
- Power consumption: typical (leveled, quiescent)
  - Trillium Compact OBS: 195mW
  - Trillium 120 OBS: 230 mW
  - Trillium 360 OBS: 250 mW
- Jam-free levelling mechanism, no mass lock/unlock
- Kinematic design preserves full seismometer performance
- Levelling Features
  - Levels to within ±0.5° of true vertical
  - Time-based and automatic initiation
  - Fully configurable three stage levelling check schedule

Trillium Compact OBS

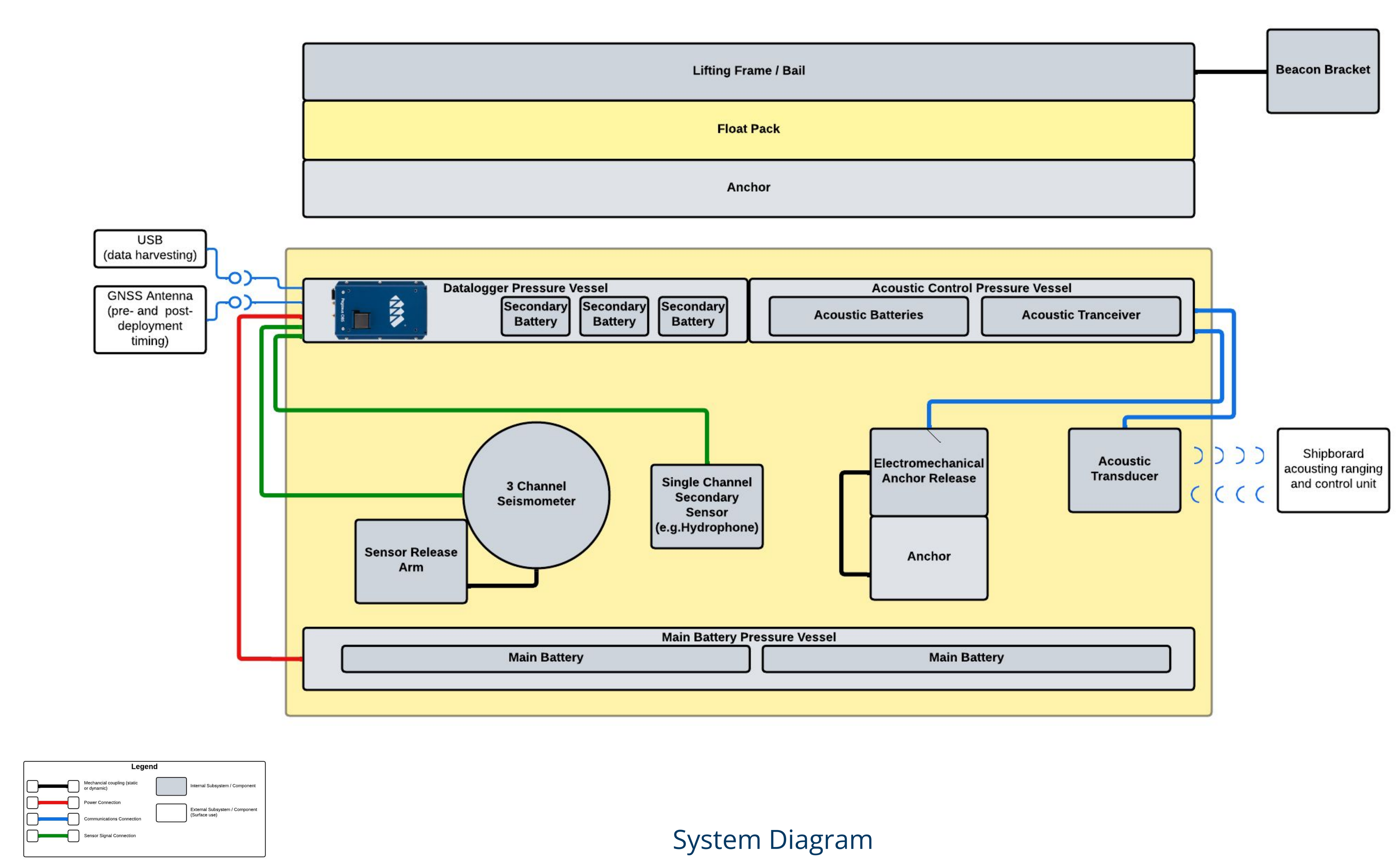
Trillium 120 OBS
Trillium 360 OBS

TrilliumOBS

System Overview



Key System Components



System Diagram

Streamlined Workflow at Scale

Confidence, outcome certainty, ease-of-use and workflow efficiency is realized throughout. Based on the purpose-built Pegasus OBS datalogger, the Abalones workflow is seamless and well-supported, from experiment conception through deployment and recovery to data analysis. Comprehensive Status information is clearly visible, adding confidence and efficiency to deployments.

- Intuitive easy-to-use workflows
- Comprehensive state of health (SOH)
- Simplified GPS timing synchronization shipboard pre- and post-deployment
- Rapid data retrieval of time-corrected ready-to-analyze miniSeed data and StationXML metadata (1 year of 4-channel 100sps data in <2 min)
- Minimized pressure vessel operations

Months Before
- Establish equipment
- Define/Choose Configuration(s)
- Create and iterate Campaign
- Plan Station Locations/ Names

Weeks Before
- Build up OBS Units
- Establish detailed equipment plan
- Arrange equipment for transfer to ship

Days Before
- Deploy Station Configuration
- Confirm deployment in planning tool
- Confirm equipment function
- Power in standby
- Put systems on ship

At Deployment
- Apply power to device
- Verify power & sensor status
- Perform time synchronization
- Ready to deploy

At Recovery
- Bring to ship deck
- Perform post-deployment time synchronization
- Retrieve Data
- Disconnect devices and power down
- Complete dataset of deployment is available

During Analysis
- Datasets are in a format ready to be analyzed
- Available complete station records with metadata including timing synchronizations
- Audit trail for all stations

A View to the Future

Nanometrics continues to expand our range of products enabling new ocean bottom science, reducing integration risk and time to deploy while improving outcome certainty. The Abalones provides a turnkey system incorporating Nanometrics instruments and workflows. These same subsystems that enable the Abalones' performance, efficiency and outcome certainty advantages are also available as OEM components for inclusion into other deployment platform designs.

As the ideal core for autonomous ocean bottom systems, the extremely low-power Pegasus OBS datalogger continues to be updated with features to expand the possibilities for ocean bottom science:

- Remote data access functions enabling low-power access to system status, low-bandwidth data and on-demand retrieval of segments of any recorded historical data
- A complete set of enhancements for active-source experiments, including minimum-phase FIR filters and intuitive programmable configuration changes
- Support for complex multi-clock timing configurations
- Mass configuration and control for large fleet operations

Improvements in Size, Weight and Power (SWaP) in sensors and dataloggers continue to be particularly valuable in the challenging sub-sea environment - bringing efficiency in batteries and allowing new approaches without having to trade it off against performance. All developments follow these principles:

Minimize Size, Weight & Power (SWaP) | No compromise in instrument performance | Easy to use, quick, efficient workflow | Versatility and Modularity | High Precision Timing | Complete, Ready to use Datasets

Our approach to expansion into cabled systems has the same rigour as our autonomous systems. To bring all the performance of land-based instrumentation into a system level approach that incorporates both the best in instrumentation and platform design. We continue working with our partners to develop leading solutions to this challenging environment.