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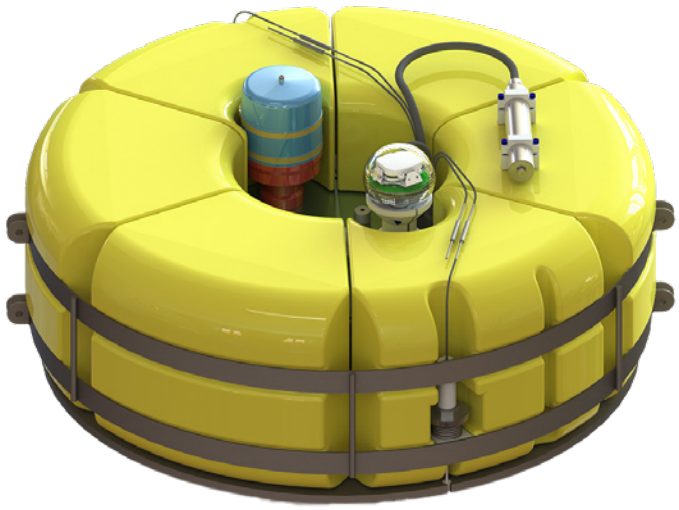
AQUARIUS

OCEAN BOTTOM SEISMOMETER WITH ACOUSTIC TELEMETRY



Compact OBS with multidisciplinary research capabilities and optional features for earthquake or tsunami early warning applications

KEY FEATURES

> Digital feedback triaxial broadband seismometer, operational at any angle, with a flat response between 120s and 100Hz

> Research option - receive State of Health parameters and noise performance data direct from the seabed following deployment for confident seismic recording projects lasting up to 18 months

> Research and alert option - receive triggered (STA/LTA) event notifications to the surface in near real time with options to receive more detailed data, selected by time-frame or by event, for further analysis

> Bi-directional communication and controls between the underwater system and the surface unit

Güralp Aquarius OBS

This revolutionary ocean bottom seismometer (OBS) uses acoustic telemetry capability to deliver near real-time seismic data from the ocean floor to the surface without cables.

The new Güralp Aquarius OBS is a stand-alone free fall OBS with acoustic data telemetry for deployments at depths of up to 6000m for up to 18 months duration.

The Aquarius is equipped with a digital feedback tri-axial broadband seismometer, operational at any angle, with a flat response between 120s and 100Hz. The long period frequency response of this design is user-selectable from 120 sec to 1 sec and can be configured prior to, or post, deployment via acoustic telemetry, allowing the sensor response to be tailored to the environment.

AQUARIUS OPTIONS

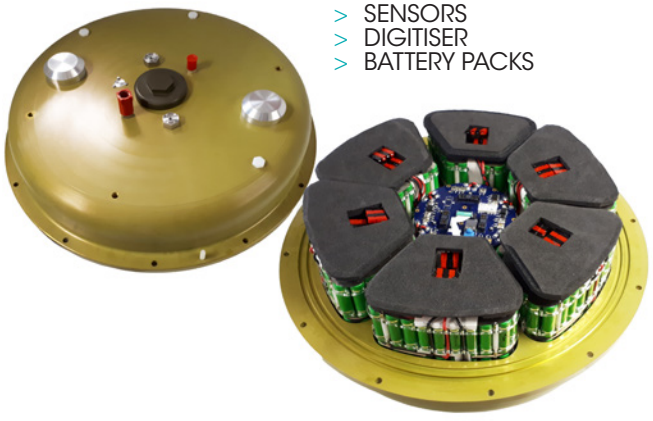
AQUARIUS

Seismic Research

- When data transfer is needed only at the installation and at the recovery of the OBS
- The OBS is equipped with an omnidirectional transducer
- Battery is sized to record seismic data for 18 months
- Data transfer of State of Health parameters and noise performance data from the seabed following installation ensures confident commencement of seismic recording
- The acoustic link activates the burn-wire for release to the surface and an on-board satellite tracking system and LED strobe light guides recovery

AQUARIUS PRESSURE VESSEL HOUSES:

- SENSORS
- DIGITISER
- BATTERY PACKS



AQUARIUS+

Seismic Research and Alert

- A near-real time seismic underwater observatory
- Aquarius+ is equipped with a directional transducer
- The battery is sized to transfer 10-15 MB of data per month for a deployment lasting 12 months. With optional methods of data retrieval as follows:
  - The data logger automatically detects seismic events using a STA/LTA trigger. A compressed list of triggered events is rapidly sent to the surface by the acoustic link with minimum power requirement. The operator can then select which detailed event data is required for energy efficient transmission.
  - Alternatively, the operator can stream portions of seismic data from a time window selected using the Güralp software available on the surface
- Bi-directional communication with the underwater system allows interaction with the datalogger when the OBS is installed on the seabed, making it possible to change configuration parameters (long-period frequency corner, channels sampling rates) and to check fundamental settings during the experiment (i.e. State of Charge of the battery pack).
- The acoustic link activates the burn-wire for release to the surface and an on-board satellite tracking system and LED strobe light guides recovery

A three-axis magnetometer and a MEMS accelerometer record the seismometer's 3D position on the seabed for data rotation during post-processing. The low profile and compact design is optimized to minimise the noise generated by the current flow.

As standard, the Aquarius is fitted with an absolute pressure gauge with accuracy of 0.25% of full scale. If desired additional sensors such a hydrophone and/or an external Absolute Pressure Gauge can be connected.

The system is equipped with rechargeable lithium-ion batteries for fast and easy re-deployments (1 hour to re-charge per 1 month deployment).

Data are stored locally in a dual redundant 128 GB Micro-SD card and can be downloaded using a Gigabit Ethernet link available on one of the top lid connectors. A single cable connecting the OBS to the Güralp deck unit powers the system for data retrieval and system configuration. This allows for separate and concurrent charging of the batteries via a dedicated connector to an external charger, so that the system can be re-deployed as rapidly as possible.

Up to 9000 bps transmission is possible between the surface and the Aquarius(+) on the seafloor using the direct acoustic communication.

Easy and precise deployment

A key consideration in the design of the Aquarius OBS was to minimise transportation and installation costs. Aquarius is the most compact OBS, equipped with an acoustic modem, available in the market. It can be deployed from smaller vessels and once on the seabed, can be accurately located using a compatible USBL system installed on board the installation vessel.

The recovery system

The acoustic link in the Aquarius is also used to activate the burn-wire system and release the ballast for recovery of the instrument. The syntactic foam around the aluminium pressure vessel provides the lifting force to bring the instrument back to the surface.

A satellite tracking system hosted in a pressure glass sphere tracks the instrument on the sea surface, following deliberate release but also in the unlikely event of accidental release. Messages from the tracking system can be automatically sent by e-mail, text messages (to both satellite or standard mobile phones) or on a web platform. For night recoveries, a strobe LED light is installed in the same glass sphere.

Key features

- Compact OBS equipped with an acoustic modem
- Digital feedback tri-axial broadband seismometer, operational at any angle, with a flat response between 120s and 100Hz
- A three-axis magnetometer and a MEMS accelerometer record the seismometer's 3D position on the seabed
- Transmission of State of Health parameters and noise performance data from the seabed following installation (Aquarius/Aquarius+)
- Up to 9000 bps transmission of data between seabed and surface using acoustic communication (Aquarius+)
- Aquarius+ automatically transmits compressed list of events detected using STA/LTA triggers, with option to request full data transmission for selected events
- Dual redundant 128 GB Micro-SD card
- Single cable connection to the Güralp deck unit for Gigabit Ethernet data download, system configuration and external power
- Acoustic burn-wire release mechanism with satellite tracking system and LED strobe light to guide recoveries, with location alerts sent via email, SMS and/or webpage

Applications

Aquarius

> Local and regional seismic research

> Energy exploration

> Noise surveys

> Aftershock monitoring

Aquarius+

> Local and regional seismic research

> Earthquake/Tsunami Early Warning

> Temporary or permanent seismic monitoring via acoustic link connection with buoys or rigs

Aquarius OBS

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SPECIFICATIONS

BROADBAND SEISMOMETER	
Technology	Force-feedback (force-balance) sensor Velocity or acceleration responses available
Configuration / Topology	Triaxial orthogonal (XYZ with ZNE output)
Velocity output band (within -3 dB crossing points)	120 seconds to 100 Hz standard
Output sensitivity	Nominal velocity response: 2000 V/ms^{-1} Nominal acceleration response: 200 V/ms^{-2} Other options available
Self noise below NLNM (New Low Noise Model; Peterson, 1993, USGS)	-175dB re (m/s2)2/Hz @ 10s
Tilt tolerance	±180°
MEMS ACCELEROMETER	
Frequency bandwidth	DC to 100 Hz (0.01 s)
Linear acceleration noise density	150 µg / √ Hz
Clip level	2 g
PRESSURE GAUGE	
Resolution	1mm variation in 1000m of water
Accuracy	0.25% of full-scale
HYDROPHONE (OPTIONAL ALTERNATIVE TO PRESSURE GUAGE)	
STANDARD VERSION	
Frequency response	2 Hz to 30 kHz
Sensitivity	Max -162 dB re: 1 V/µPa (562V/Bar); Min -240 dB re: 1V/µPa (0.1 V/Bar)
ULTRA-LOW FREQUENCY VERSION (OPTIONAL UPGRADE)	
Frequency response	100 s (0.01 Hz) to 8 kHz
Dynamic range	-194 dB (1 V/µPa)
ABSOLUTE PRESSURE GAUGE (OPTIONAL ADDITION TO HYDROPHONE OR PRESSURE GAUGE)	
Accuracy	<0.01% of full-scale
Calibrated temperature	-2 to +40° C
Hysteresis	≤± 0.01% Full Scale
ADDITIONAL CHANNELS & STATE-OF-HEALTH	
Environmental channels	Three component digital compass composed of a MEMS accelerometer and Magnetometer Temperature sensor Humidity sensor Supply voltage
24-BIT DIGITISER	
Primary digitisation channels	Four at 24 bits
ADC converter type	Delta-sigma
Output format	32-bit
Dynamic Range	>136.5 dB at 100 samples per second
Output sample rates available	1 sample per hour up to 250 samples per second for primary channels, user-selectable
Decimation filters	÷2, ÷3, ÷4, ÷5 (Causal / Acausal)
Trigger modes	STA/LTA, level

DATA STORAGE	
Data recording formats	miniSEED (metadata stored in dataless SEED format)
Flash memory and storage	128 GB dual redundant, hot-swappable microSD card storage Up to 2TB cards available upon request
Direct data download	Via Gigabit Ethernet connection
CLOCK AND CALIBRATION	
Typical drift per day	VCXO clock: <1 ms (fully correctable during post-processing) Atomic clock option available.
Timing synchronisation sources	PTP on Ethernet link through Güralp surface deck unit
Calibration signal generator	Sine, step or broadband noise, all with adjustable amplitude and frequency
POWER	
Battery life:	
Aquarius+	12 months
Aquarius	18 months
Battery recharge time	1 hour per month deployment (approx.)
RECOVERY RELEASE	
Release mechanism	Acoustically-operated burnwire release or timed release option
Recovery location tools	Satellite tracking system Strobe light
PHYSICAL / ENVIRONMENTAL	
Operating temperature range	-20 to +75° C
Pressure vessel casing material	Aluminium with corrosion-resistant treatment and anodic protection
Operational depth	6,000 m maximum
Buoyancy	Syntactic foam buoyancy (glass micro-spheres) for extended life and durability
ACCESSORIES	
Deck control unit	Acoustic command module and OBS communications unit for instrument control/ configuration and clock synchronisation
Battery charger	Suitable for on-deck charging

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