



Geo-Sense: a New Stand-Alone Submersible DAS Instrument

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Geo-Sense in Brief

The Challenge:

Most seafloor Distributed Acoustic Sensing (DAS) is limited by the location of existing telecommunications cables and necessity of shore-side station connection.

The Solution: Geo-Sense

Geo-Sense is a stand-alone, submersible DAS system developed by MBARI in collaboration with a commercial partner, Sintela Ltd. By packaging a low-power Sintela Onyx™ nano DAS into a ruggedized, submersible frame, we have created a "deploy-anywhere" system capable of up to 40 days of autonomous sensing.

Results:

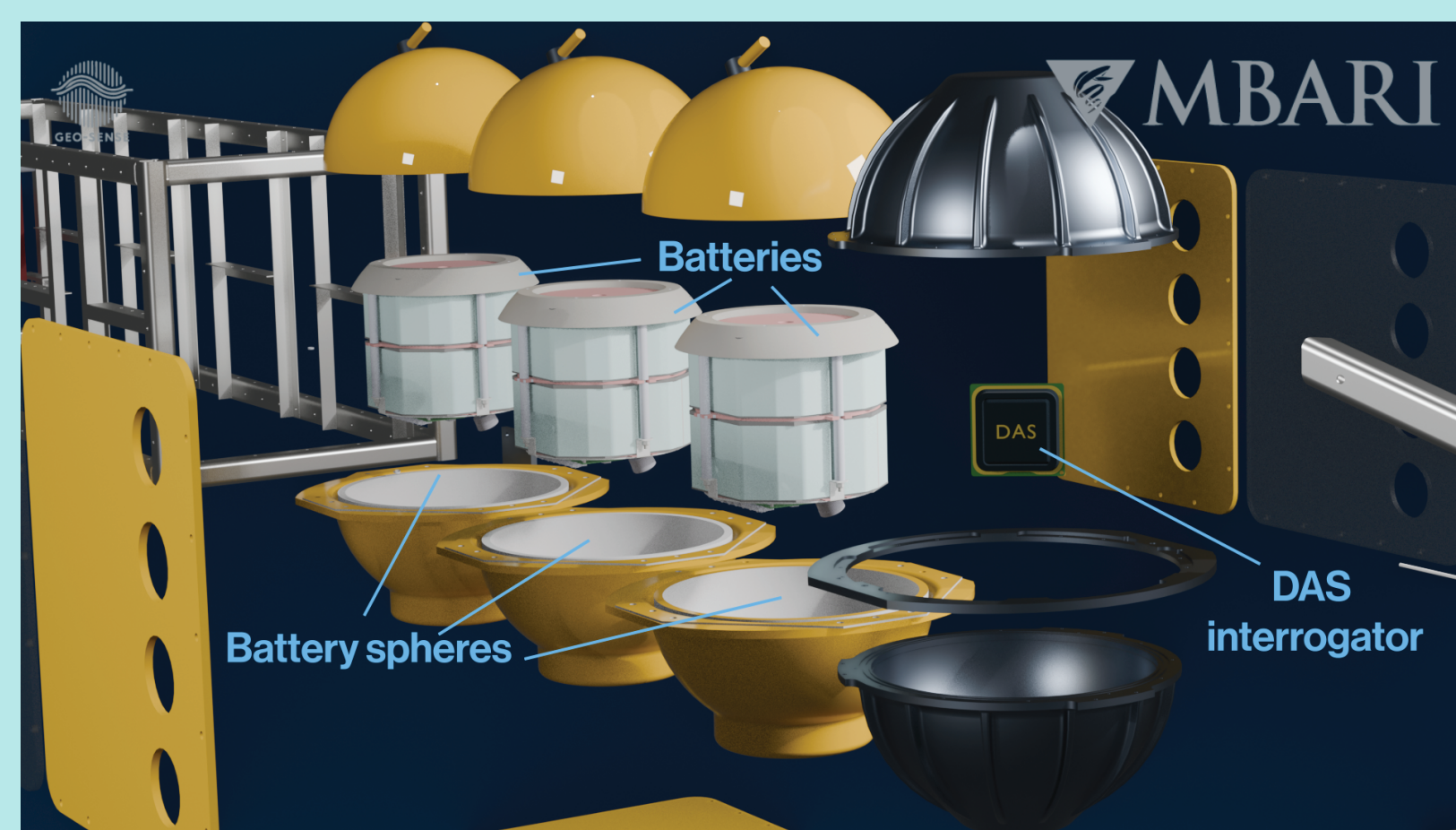
The system was deployed for the first time in the Monterey Canyon where it detected dozens of seismic events.

Distributed Acoustic Sensing

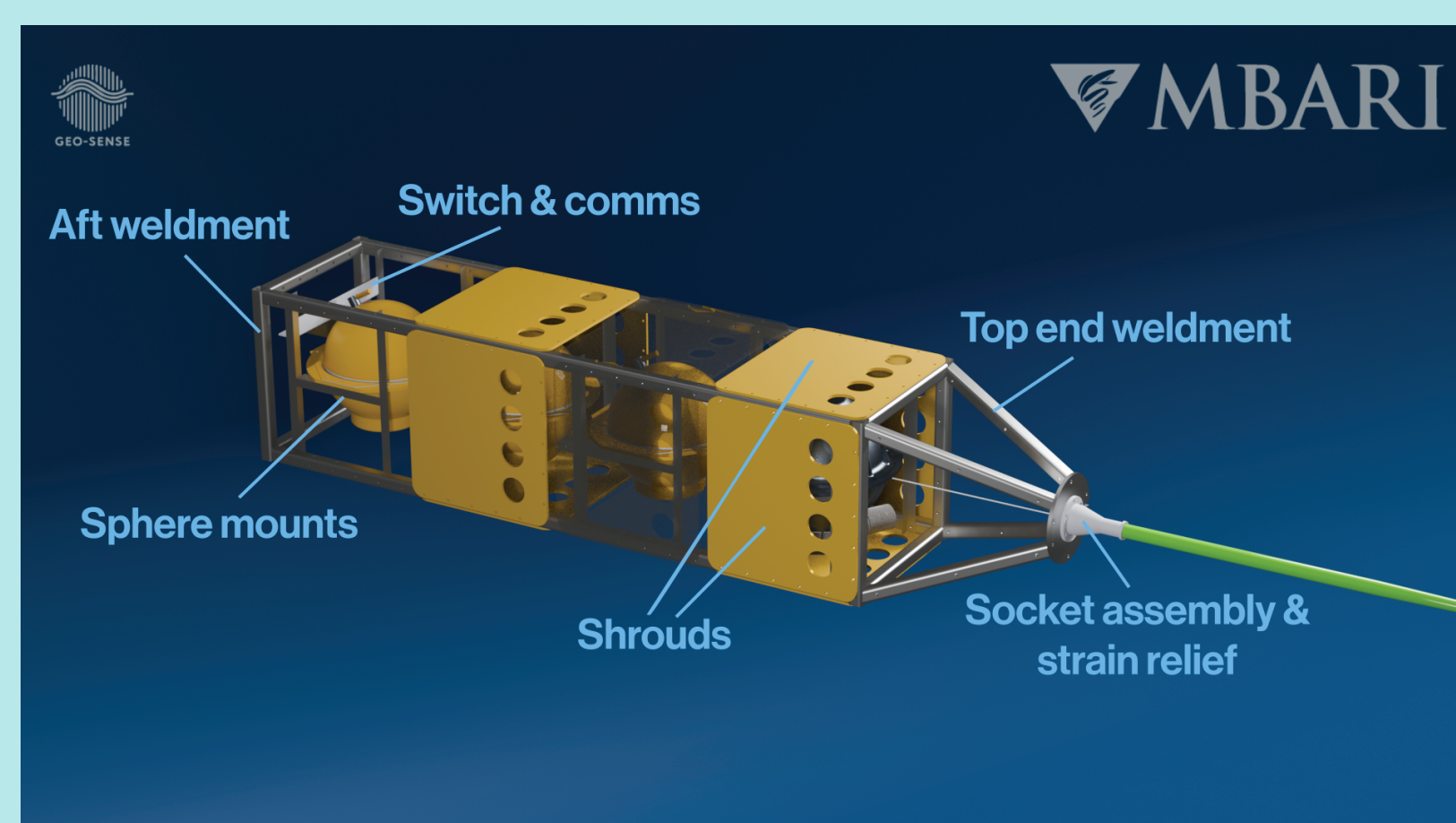


Distributed fiber-optic sensing has emerged as an innovative method for monitoring seafloor processes. Distributed Acoustic Sensing (DAS) uses the backscatter signal from a pulsed laser to measure phase changes in Rayleigh scattering. These changes provide meter-scale spatial resolution and sub-second temporal sampling of axial strain or strain rate, from which ground-vibration signals can be inferred over distances of tens of kilometers.

Geo-Sense: A Marinized DAS System

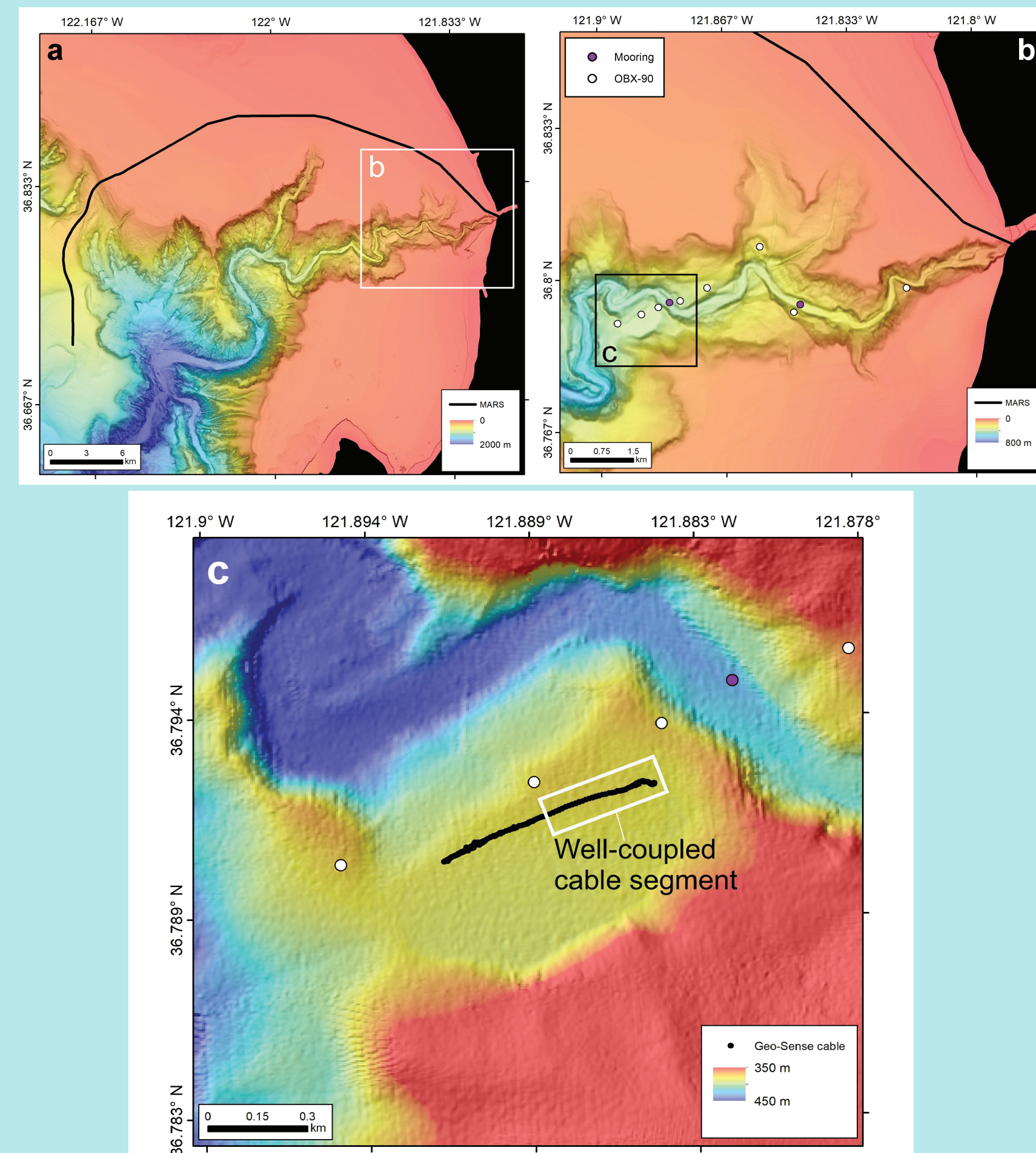


The ONYX™ nano (Sintela, LLC), a compact DAS interrogator, consumes less than 30 watts continuously. The interrogator was housed in a 4000 m rated Titanium sphere. Three 10 kWh lithium primary battery packs provide power for ~40 days of continuous operation.



All four pressure housings were contained in a metal frame specially designed to reduce drag during deployment.

Study Site: Monterey Canyon



Geo-Sense was deployed in the Monterey Canyon in late January 2025. The Geo-Sense instrument including its 1 km cable was placed on a muddy terrace at 381 m water depth (b, c).

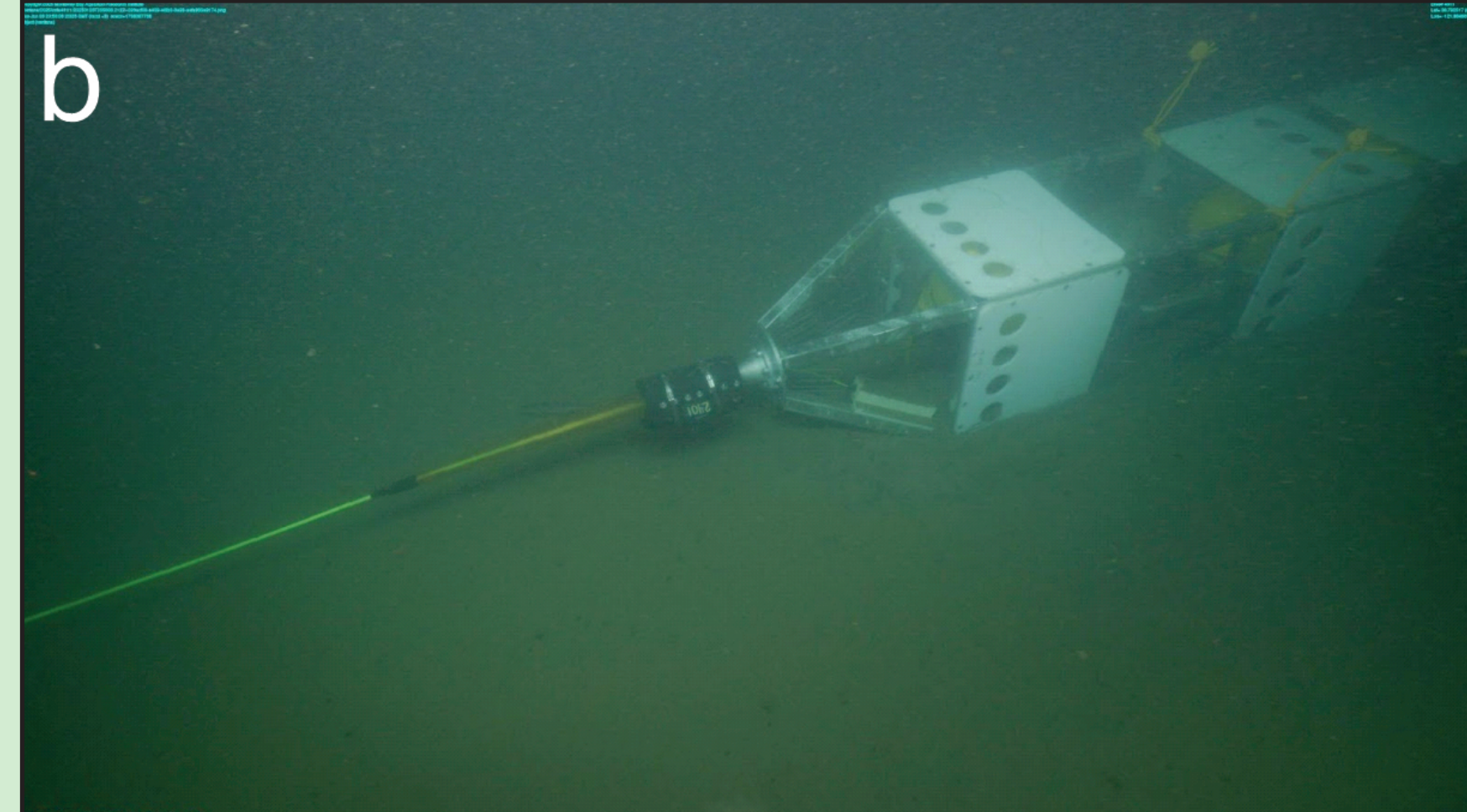
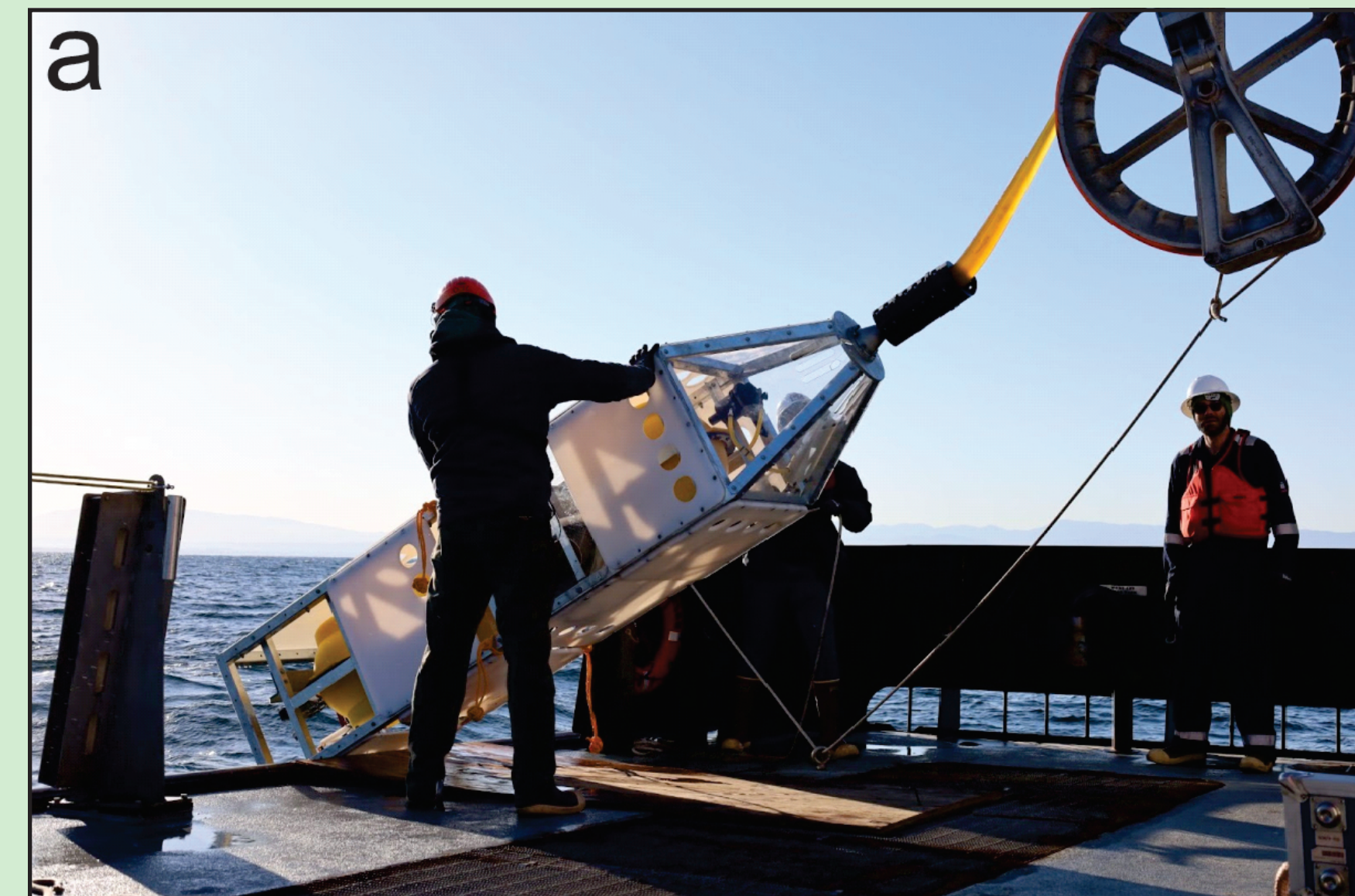
Simultaneous datasets were also collected:

- A shore-based DAS unit was connected to the MARS cabled observatory a 52-km electro-optical cable (a)
- A simultaneous experiment, SeismoSands, deployed 3 Ocean Bottom Seismometers (OBS) on the same terrace (c)

Deployment

1

The instrument is lowered to the seafloor using its sensing cable (a). A flexible strain-relief assembly limits the strain on the cable during the deployment.

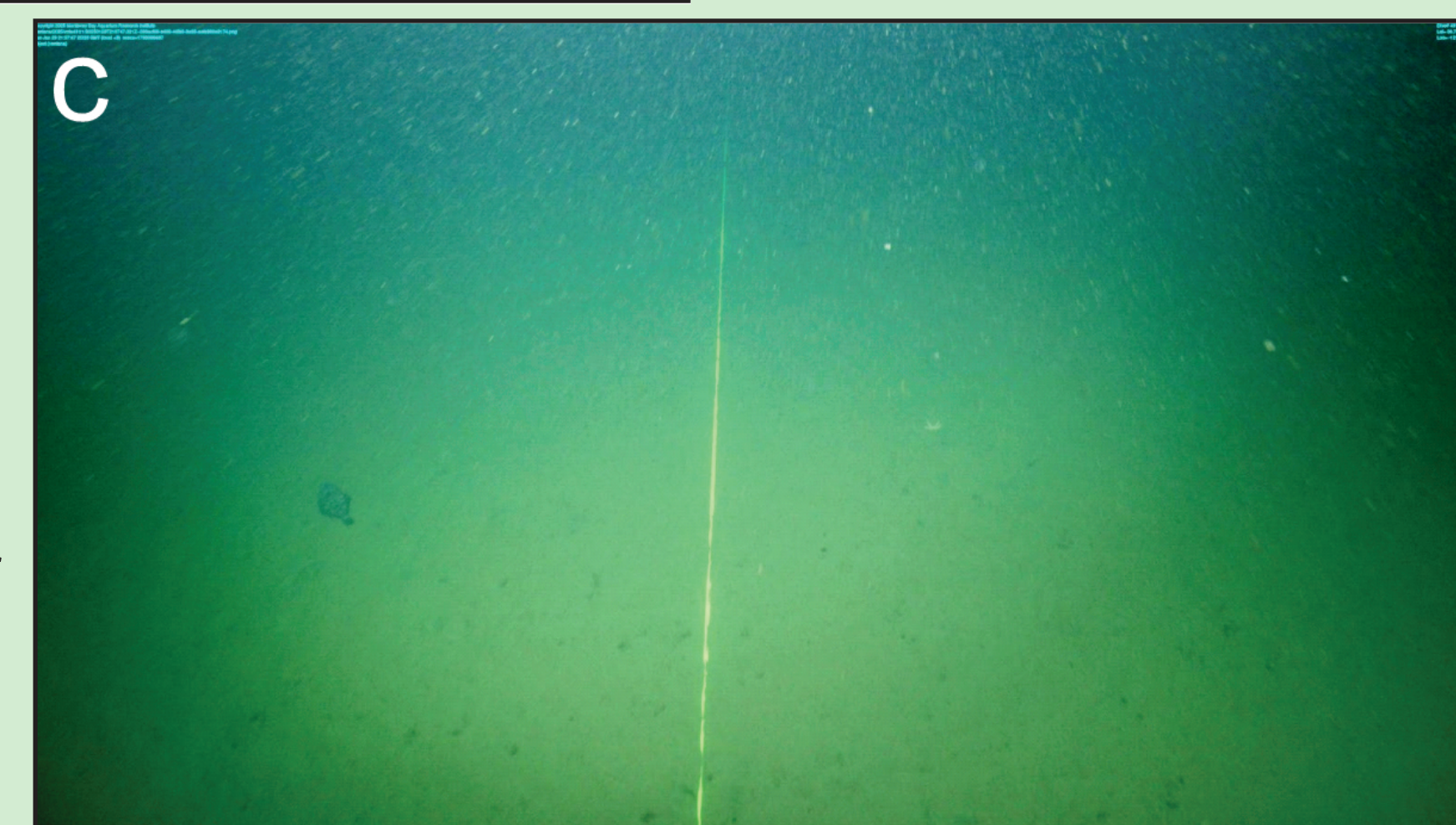


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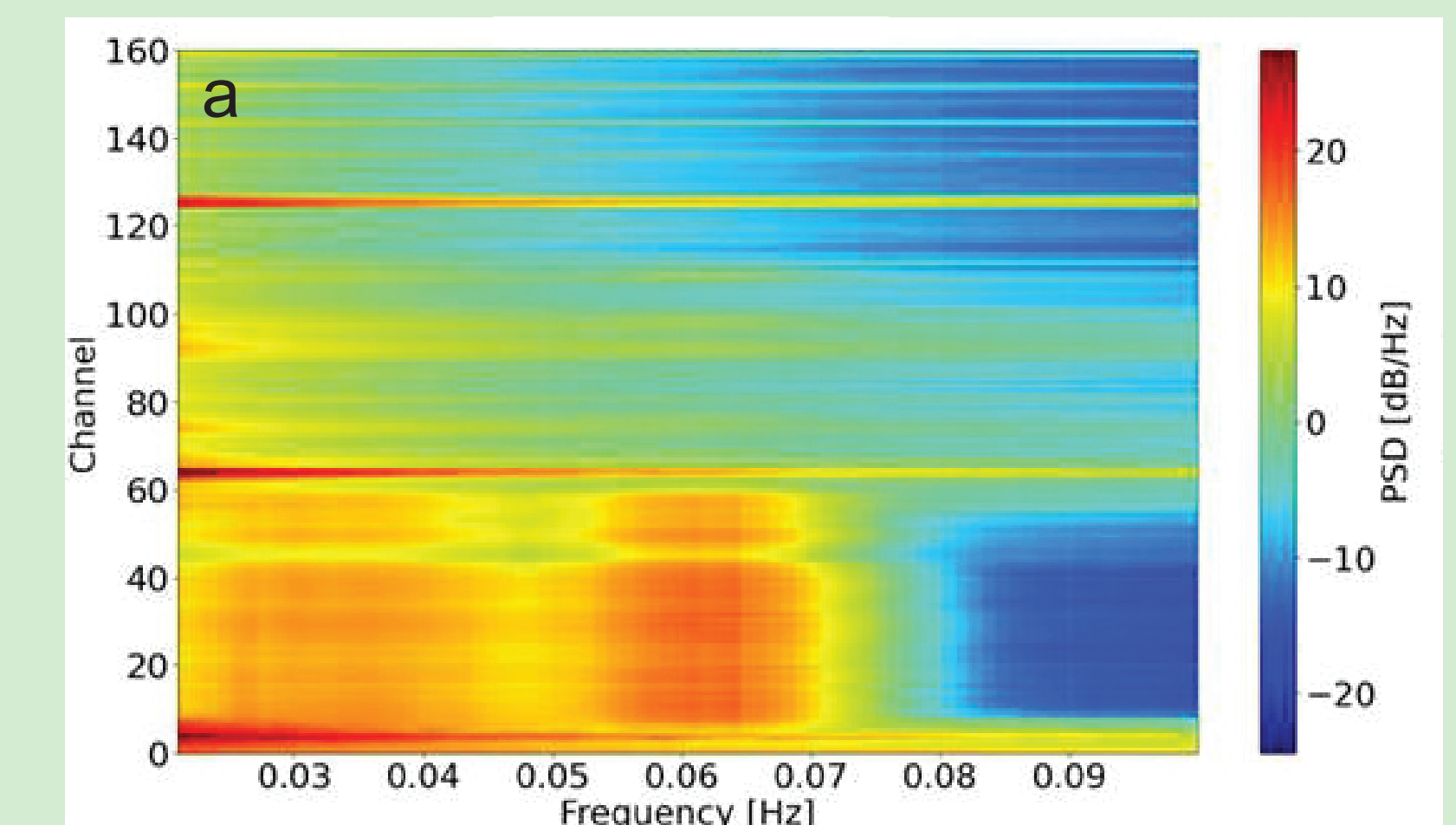
Once the frame reaches the seafloor, the ship heads along the desired 1 km track as cable is paid out.

3

The cable is surveyed with a Remotely Operated Vehicle. Ideally the cable sits well coupled to the seafloor (c). Due to challenges during deployment, some sections of the cable included loops which were not well coupled.

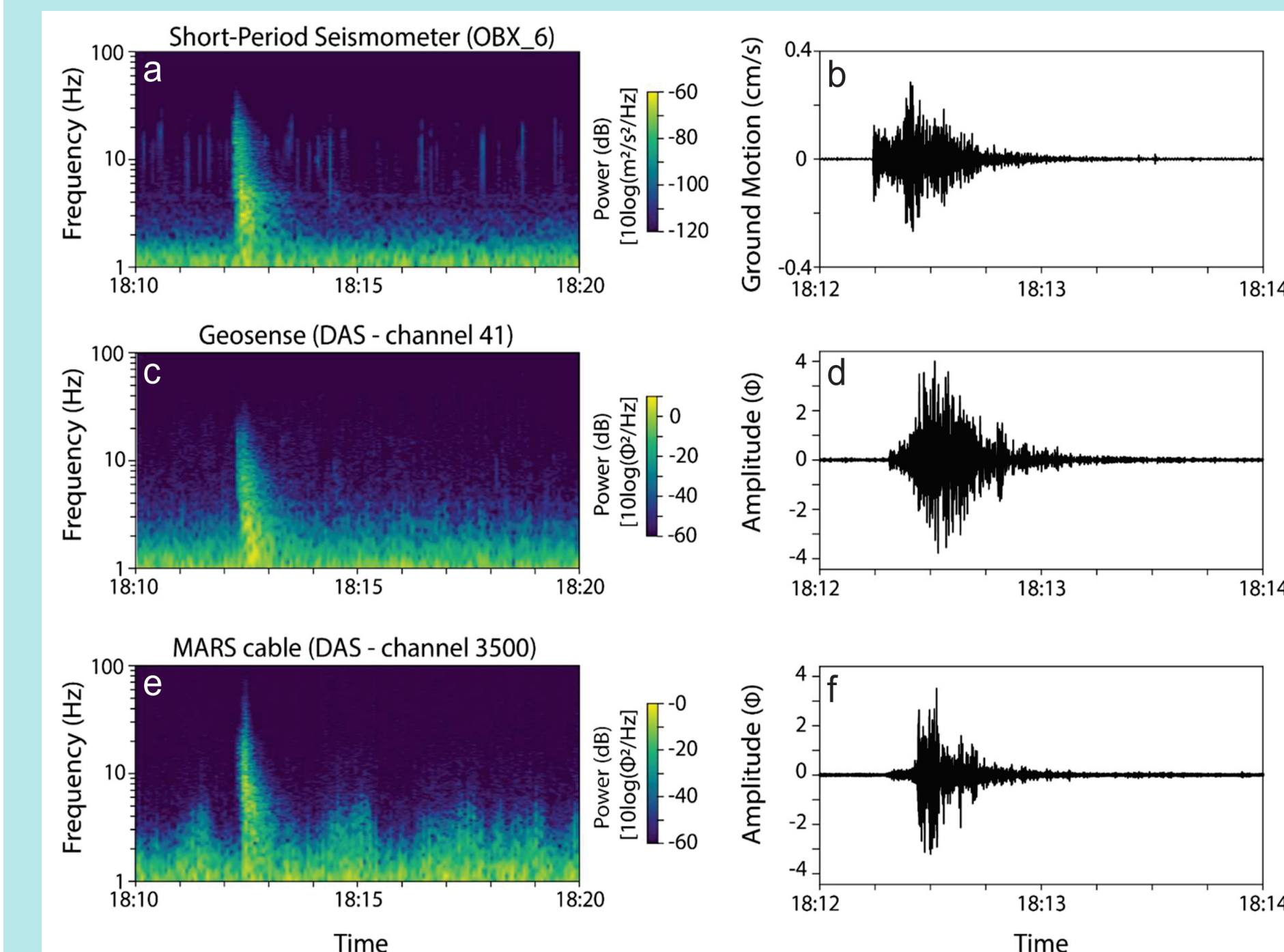


Results: Sensitivity Across Channels

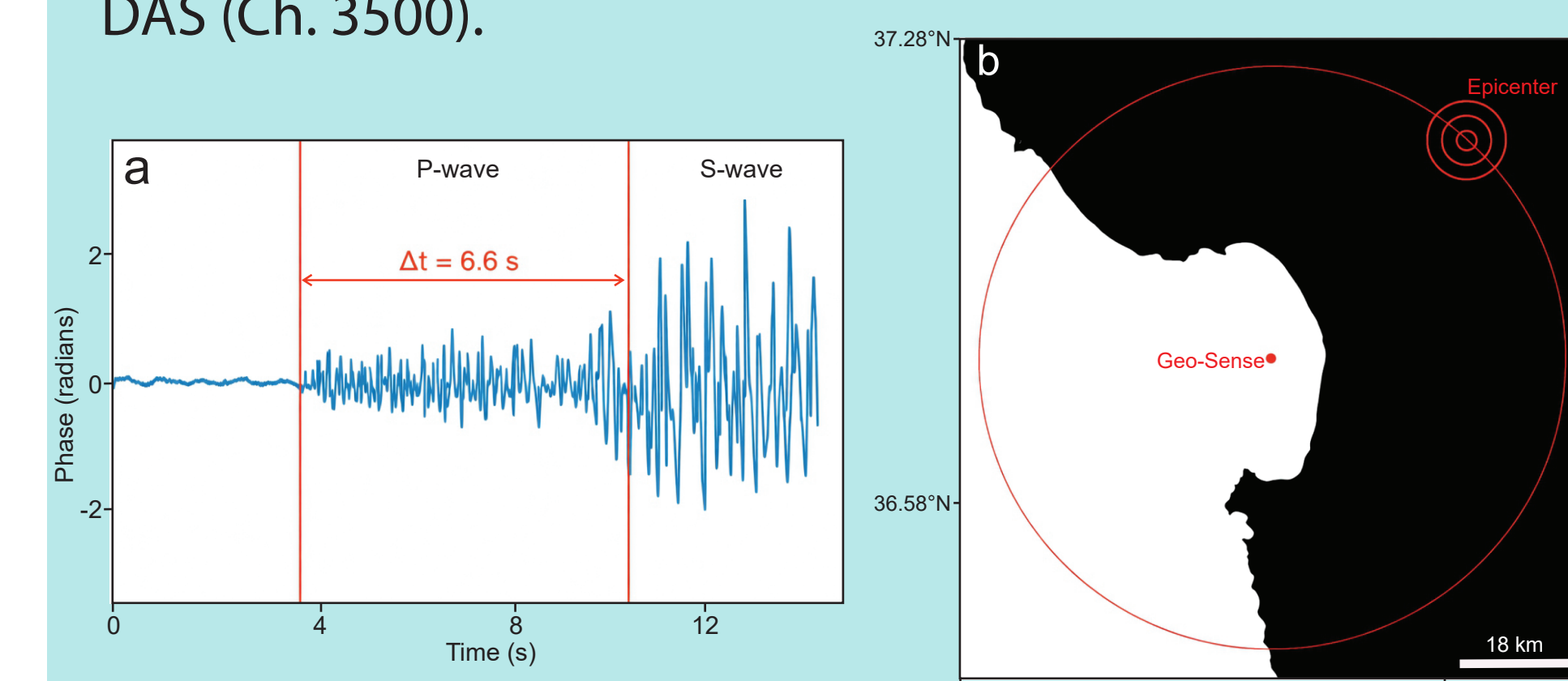


The sensitivity along the cable decreased after the first 60 channels (360 m of 1 km cable length). This is reflected above for low frequency signals and was consistent across higher frequency ranges. This decrease in signal coincides with the observed loops and poor coupling of the cable.

Results: Comparison with Traditional DAS



Comparative seismic recordings of a M 2.89 earthquake in Monterey Bay. Spectrograms and waveforms from three different sensing systems (OBS, Geo-Sense, and MARS DAS) show consistent broadband signals between 1–20 Hz. All amplitude plots are high-pass filtered at 2 Hz. Top (a,b): Ocean-bottom seismometer (OBX-6), Middle (c,d): Geo-Sense phase shift (Ch. 41), Bottom (e-f): MARS DAS (Ch. 3500).



A source-distance estimate was made based on the seismic waveform recorded on Geo-sense channel 162. The calculated 49.5 km earthquake distance corresponds well with the actual earthquake location NE of the instrument.

Next Steps

- February 2026: Second deployment in Monterey Bay Canyon to hopefully record a sedimentary flow event. The instrument was integrated into an elevator-descent system with ROV-assisted cable payout for precise seafloor positioning.
- Fall 2026: Target deployment at Kolumbo submarine volcano to monitor seismic activity.

