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

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Distributed Acoustic Sensing (DAS), an optical measurement technique that uses phase changes in Rayleigh-scattered light along a fiber-optic cable to calculate ground strain, is a highly effective tool for studying geological processes. DAS technology can resolve fine-scale strain generated from a number of sources (seismic, ocean currents, volcanic) over the entire length of a fiber-optic cable tens of kilometers long. Most of the oceanographic studies to date are conducted using a shore-side station housing the DAS instrument, which is then connected to a telecommunication cable. Thus, studies of seafloor geological phenomena using DAS are generally limited to areas with existing cable infrastructure. This abstract presents Geo-Sense, a stand-alone submersible DAS system, capable of continuous operation for 45 days. Geo-Sense can be deployed opportunistically in areas where the most interesting seafloor processes are occurring, regardless of existing infrastructure.

Geo-Sense was developed at the Monterey Bay Aquarium Research Institute (MBARI) in collaboration with a commercial partner, Sintela Ltd. The instrument features Sintela's Onxy™ *nano* DAS, which is more compact and consumes significantly less power than a typical DAS instrument. These critical upgrades enabled the engineering team to design a system that could be packaged for seafloor deployment and powered by an external battery pack. The Geo-Sense instrument comprises four pressure housings contained in a ruggedized metal frame connected to a 1-km submarine fiber-optic cable. The instrument, deployable from the deck of a research vessel, can also wirelessly communicate and transfer data to the ship via a Remotely Operated Vehicle (ROV).

This instrument was deployed in January 2025 on the southern flank of Monterey submarine canyon (offshore California) at a water depth of 380 m. During its first deployment, the instrument recorded nine consecutive days of continuous DAS data. This deployment coincided with an ongoing seafloor experiment at the same location, which utilized multiple seismometers and moorings with ADCPs, providing a dataset for comparison. Geo-Sense successfully detected more than 30 seismic signals from onshore earthquakes as small as magnitude 1.5, as well as tidal currents flowing along the canyon floor.