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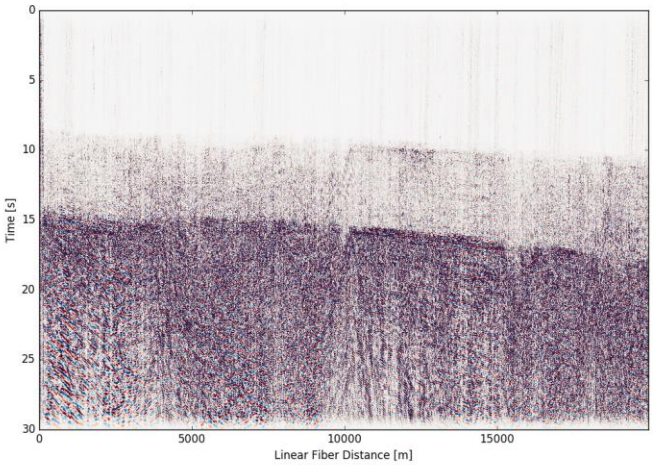
Title:
Illuminating the Seafloor with Dark Fiber Seismology and the MARS cable

Abstract:
Our understanding of the planet suffers from a profound geophysical observation bias: seismometers and other sensors are sparse and clustered on continents. A new seismic recording technology, called distributed fiber-optic acoustic sensing (DAS), transforms standard telecommunication fiber-optic cables into arrays of single-component ground motion sensors that efficiently record unaliased seismic wavefields. The distance between any two sensing points can be as small as 0.25 m, while the total array aperture can be as large as ~20 kilometers. The result is an opportunity to record continuous, dense, long-range seismic array information in large volumes (~ 1 TB / day) wherever fiber-optic cables exist. We are exploring new methodologies that use this new form of seismic array data to quantify Earth structures and processes in space and time, specifically in offshore and urban areas where seismic instrumentation has historically posed a logistical challenge. During 10 – 13 March 2018, we used an existing fiber inside of the Monterey Accelerated Research System (MARS) cable, which traverses a marine shelf setting, to record 3.2 TB of DAS data with a 2 m sensor spacing over 20 km in Monterey Bay, CA. Uniform coupling of the cable approximately 1 meter below the shelf seafloor enables observations that directly test hypotheses about Monterey Bay and the physics of ocean-solid earth interaction, and motivate new opportunities in the fields of seafloor geophysics, marine biology, meteorology, offshore engineering, and subsea infrastructure monitoring.

The "full" image is for the whole recording length from east to west (left to right). The 9_11km" image is a magnification of an interesting vertical reflection.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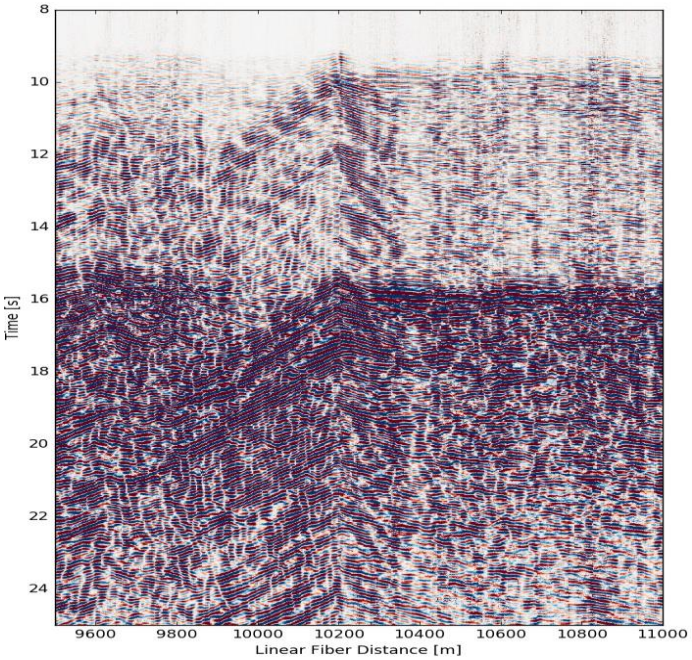
5
10
15
20
25
30
0
5000
10000
15000
Linear Fiber Distance [m]


Time [s]
8
10
12
14
16
18
20
22
24
9600
9800
10000
10200
10400
10600
10800
11000
Linear Fiber Distance [m]