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Application Note
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# Looking for Life in the Hadal Zone

The Hadal Zone refers to the deepest waters on earth, ranging from 6000 to 11,000 m. These areas include deep water trenches often associated with subduction zones in which one tectonic plate slides under another, releasing heat and solutes that support life in the deep. The term "Hadal" comes from the Greek god Hades, brother of Zeus and Poseidon, who ruled the Underworld.

The University of Western Australia in Perth and the Minderoo Foundation have joined forces to establish a multi-disciplinary Deep-Sea Research Centre to increase the understanding of these remote parts of the oceans.

A fleet of bottom landers (Figure 1), developed and built by the center, is used to map hadal species and estimate the abundance of animals on the sea floor. This technology provides access to hadal zones anywhere in the world's oceans, bringing back images, samples, and measurements.

The landers are often deployed for short periods, generally less than 24 hours. The platforms are baited with fish to attract animals which are then captured on camera. An Aanderaa SeaGuard instrument on top of the lander collects information at the seabed (Figure 4), and during descent and ascent (Figure 2 and 3) through the water column.

The baited landers attract animals that are captured on video and still images, gathering species information and abundance. By studying the time it takes for the first animals to arrive, and the number of individuals over time, the researchers can estimate species abundance and understand more about energy use and ecosystem functioning of these remote and rarely-studied habitats.

Figure 1: Landers on deck ready for autonomous missions at the seafloor. These are released from the surface, sink to the bottom at a speed of 50-60 m/min. After landing, they carry out their mission at the bottom. They are recovered again by releasing a weight so that they rise the surface where they are recovered.

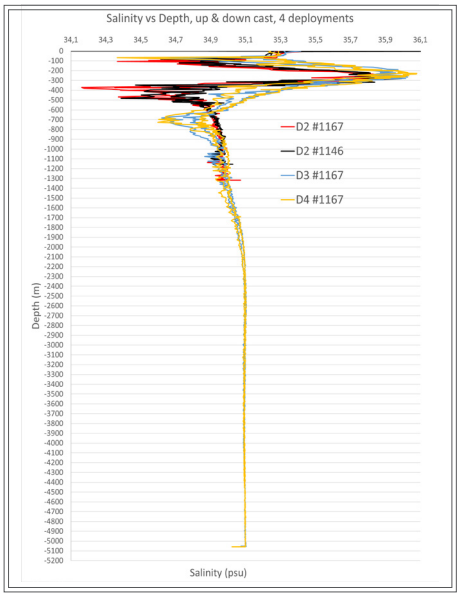

Figure 2: To the left: up/down salinity profiles from 4 deployments at 3 stations. Below 2500 m depth, the salinity is fairly constant. Variations above reflect different water masses.

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Aanderaa's SeaGuard instrument measures several parameters that help to characterize living conditions in the deep, including temperature, salinity, oxygen, currents, pressure/depth and particles. Sensor data is collected together with output from the integrated single point, side-looking, Doppler Current Sensor (DCS) which, of course, provides information about the currents. Additionally, automatically calculating the standard deviation of the current measurements and measuring signals strength, acoustic reflections, enable detection of animals moving around the landers. It is possible to distinguish between echoes created by animals and those created by particles because animals that swim around move at a different speed and direction than the prevailing currents, introducing spikes in the current speed (Figure 4).

The enormous pressure at hadal depths gives limitations for the different species. The research group in Perth have made several ground breaking discoveries. So far, the deepest fish detected by a lander was a snailfish at 8300 m, and the deepest octopus was found at 7000 m. Animals found at 10,000 m and deeper include snails, sea cucumbers, and amphipods (Figure 5). To read more about the hadal research, see Mission Water, issue # 10.

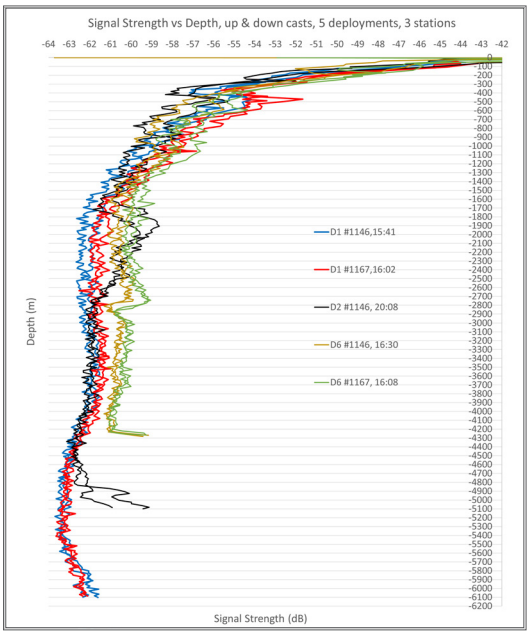


Figure 3: Up/down acoustic signal strength from 5 deployments at 3 stations. There are more particles at the surface, a subsurface peak at 500 m, and a particle increase often starting several hundred meters above the bottom.


Figure 5: A supergiant Amphipod captured at about 7000 m depth. Amphipods are voracious animals that appear in schools and devour any available food quickly.

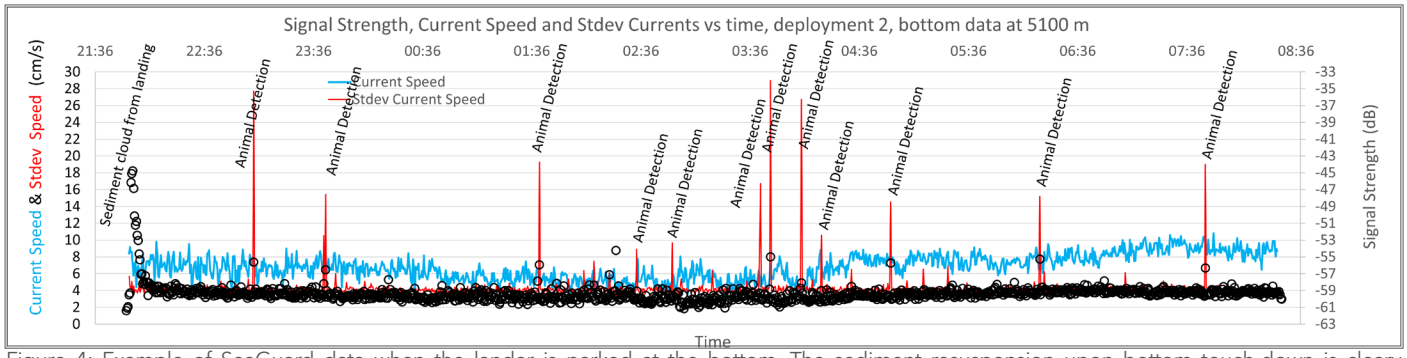


Figure 4: Example of SeaGuard data when the lander is parked at the bottom. The sediment resuspension upon bottom touch-down is cleary visible in the increase in signal strength in the beginning (black dots), but since particles drift with the currents (blue line), no anomalies is registered in the current speed (red line). The animals around the baited lander appear as spikes in signal strength (black dots), and in the standard deviation of current speed which is automatically calculated (red line) by the sensor.

Scientific references with more information:


- Jamieson, Alan (2015). The Hadal Zone: Life in the Deepest Oceans. Cambridge University Press. pp. 18–21, 285–318. ISBN 978-1-107-01674-3. LCCN 2014006998.
- Kolbusz, J., Zika, J., Pattiaratchi, C. & Jamieson, A., (2024). Water properties and bottom water patterns in hadal trench environments. Ocean Science. 20, 1, p. 123–140 18 p.



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