Guarded by Carbonates: The Sentinel Seep of the Norwegian Trench

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Understanding natural methane seepage systems is essential for constraining fluid flow processes, carbon cycling in marine sediments, and the formation of unique seep-associated habitats. On the Norwegian continental shelf, seepage links subsurface hydrocarbon migration with surface expressions such as gas flares, carbonate buildups, and chemosynthetic ecosystems.

The Sentinel Seep was first identified in 2024 during the WELLFATE expedition, when water-column hydroacoustic data revealed active gas release in the Norwegian Trench in the northern North Sea. The site was explored in detail one year later during the 2025 WELLFATE expedition on RV Kronprins Håkon, where ROV dives allowed us to document its morphology, geological setting, and biological communities.

The seep occurs within a prominent ploughmark in an area where the Holocene sediment package is unusually thin. Seismic data show that the site lies at the seafloor at the southwestern margin of a large (~1,800 km^2) amplitude anomaly along the Upper Regional Unconformity (URU), interpreted to represent shallow gas.

The seep area extends ~800 m (N–S) by ~200 m (E–W) and is characterized by widespread carbonate accretions and mounds. Active gas seepage occurs at several locations within this area, accompanied by extensive microbial mats. Lophelia corals are abundant, including individual specimens exceeding 2 m in diameter as well as colonies where several corals occur in close proximity.

The site is heavily littered with entangled fishing gear, some protruding into the water column and posing hazards for underwater operations. This entanglement has likely discouraged further trawling, indirectly allowing the habitat and ecosystem to develop. In effect, diffused methane seepage has resulted in the formations of carbonate mounds that protect the area from being destroyed by fishing activity - a role that inspired the naming of the Sentinel Seep.

The Sentinel Seep provides a new case study for understanding the interplay between shallow gas accumulations, fluid migration pathways, authigenic carbonate formation, and ecosystem development and preservation on the Norwegian margin.