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Polar North Atlantic Margins Methane Pathway and Seabed Gas Expulsion Systems

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Geophysical evidence exists for geologically controlled fluid migration pathways, gas hydrate, and an active seabed gas expulsion system. The complex, interacting system lies between the sedimented ocean ridge and the continental margin of NW Svalbard. The investigated seabed area covers more than 2000 km2 and extents from deep (∼2000 m at the ocean ridge) to shallow water depth (∼250 m at the shelf). Fluid migration pathways towards the seabed can be drawn from sub-seabed acoustic anomalies. Fluid migration towards the upper continental slope appears to be stratigraphically constrained and largely prevails over vertical focused migration at the sedimented ocean ridge. Fluids accumulate in the uppermost part of the slope just westward of the shelf break, where they are trapped beneath a prograding glacigenic sequence. Fluids are expelled on the shelf where the base of the glacigenic sequence outcrops. Gas-charged fluids may originate from deep-seated hydrocarbon reservoirs. Geophysical evidence for hydrates on the uppermost slope is missing but exists at the lower slope. Fluids at the sedimented ocean ridge may originate from serpentinized mantle and gabbro material. Only few sedimented ocean ridges exist worldwide and they may document past and ongoing serpentinization-driven migration of gas-rich fluids. Seismic data suggest a potential link between inferred areas of serpentinization, transfer of carbon from the deep-seated host rocks through the sediments, and methane capture within the gas hydrate stability zone at the eastern flank of the Knipovich Ridge of Svalbard.