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Dynamic plumbing systems along the 100 km long Arctic Vestnesa Ridge

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Vestnesa is a ridge-like contour-current controlled sediment succession that lies above young oceanic crust created during the tectonic opening of Fram Strait. It is surrounded by the Molloy transform fault to the southwest, the Molloy deep to the north-west, the Knipovich oceanic ridge to the south-east, and the continental margin of Svalbard to the northeast. Although interrupted in places, a mostly continuous bottom simulating reflector (BSR), the seismic indicator for the base of the gas hydrate stability zone (GHSZ), extends for tens of kilometers from the crest of the ridge towards its northern and southern flanks. High-resolution P-Cable 2D seismic data show vertical fluid migration pathways, distributed in clusters along the 100 km long ridge, connecting the free gas system beneath the GHSZ through a 160-180 m thick hydrate stability zone to seabed pockmarks at the crest of the ridge. Among these clusters only those lying towards the easternmost end of the ridge have been documented to be periodically active in terms of present-day seafloor gas seepage. The methane release activity shows particularly well on 18 kHz echosounder data over a time period from 2008 to 2013. Gas hydrates have been recovered in shallow sediment cores (<6 mbsf) at the active seafloor seepage site. Gas analyses show heavier gases in addition to methane, as a hydrate-forming gas. Within the framework of CAGE - Center for Arctic Gas Hydrate, Environment and Climate, we are investigating the development of the plumbing systems of the Arctic Vestnesa Ridge in space and time domains. We compare the modeled base of the GHSZ for different gas compositions against the depth of the BSR in the region and discuss the elements of fluid migration systems that could explain observed lateral changes in BSR depths and the switching between active and inactive plumbing systems. The Centre of Excellence is funded by the Norwegian Research Council (grant No. 223259) over a period of ten years.