Geophysical Research Abstracts
Vol. 18, EGU2016-14375, 2016
EGU General Assembly 2016

High-resolution 3D seismic investigation of giant seafloor craters in the Barents Sea

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Multiple giant craters exist on the seafloor in an area of $\sim$ 100 km2 east of Bear Island Trough in the west-central Barents Sea. It has been hypothesized that these craters might have been caused by gas eruptions following the last deglaciation. Gas seepage from the seafloor occurs abundantly in this area. The crater area is still likely to represent one of the largest hot-spots for shallow marine methane release in the arctic. In summer 2015, we acquired high-resolution P-Cable 3D seismic data in this area covering several of the craters and their associated pingo structures. Due to the shallow and hard Triassic bedrock, penetration of the seismic signals is limited to approximately 450 ms bsf. The crater structures are up to 1 km wide and 40 m deep. Pingo structures occur on the rim of some of the craters and are up to 700 m wide and up to 15 m high above the surrounding seafloor. The 3D seismic data reveals faults, fracture networks and weakness zone that resemble pipes or similar vertical, focused fluid-flow structures in the Triassic sedimentary rocks below the craters. The principal orientation of the faults is in a $\sim$ NW-SE direction that coincides with regional faulting from Permo-Triassic extension. The seismic data also show high-amplitude anomalies beneath some of representing shallow gas accumulations that might be the intermediate source of the gas seepage. This might suggest that craters are caused by high pressured gas that migrated from deeper petroleum systems and accumulated in the shallow Triassic rocks during the last glaciation.

Previous work indicate that craters of similar size are likely a cause of enormous blow-outs of gas. Our study discusses the formation mechanisms and timing of these potential blow-out craters and whether they formed during the last deglaciation, when this area was likely quite unstable as severe glacial erosion caused localized high isostatic rebound rates here. We also investigate the role of gas hydrates that might have formed within the Triassic rocks beneath the ice sheet during the last glaciation.