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Hydrocarbons investigations from near-surface sediments of the north and northeastern Barents Sea shelfs

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The Russian portion of the Barents Sea shelf is the largest offshore zone in Russia with high petroleum potential. Numerous offshore oil and gas fields have been discovered in the southern part of the Barents Sea, however little is known about the northern and northeastern sectors. These regions were investigated during the TTR-19 and TTR-20 expeditions with the aim to characterize the gas type and content in the near-surface sediments and to identify potential fluid migration areas.

Sites for seafloor coring were selected based on the acquired geophysical data, targeting seafloor morphologies of obvious interest (e.g. pockmarks, faulted zones or tunnel valleys) or subsurface acoustic anomalies observed on the seismic profiles. Lithological composition and gas extracted from the sampled sediments were analyzed using gas chromatography, pyrolysis, mass-spectrometry.

Results of hydrocarbon (HC) gas molecular studies showed some differences between the northern and northeastern parts of the Barents Sea. Northeastern Barents Sea shelf sediments are characterized by low concentrations of methane up to 28 ppm, and a small amount of C_{2+} compounds. Northern Barents Sea shelf sediments have methane concentrations up to 69.8 ppm and the presence of C_2H_6, C_2H_4, C_3H_8 and C_3H_6 and, in a few cores, also C_4H_{10} and C_5H_{12}. The study of the organic matter (OM) of bottom sediments (upper 2 meters) also showed a difference in the composition of its soluble part. The OM concentrations in northern part are higher than those observed in the northeastern part, and are characterized by the presence of light HC and oily compounds, which may indicate migration processes taking place in sedimentary covers. Geophysical studies conducted in the northern part, show that the complex of dense subglacial sediments is only locally distributed. These deposits are instead ubiquitous in the northeastern part and serve as a lithological barrier preventing the migration of fluids to the surface. Mass-spectrometry studies allowed the identification of the contemporary OM biomarker outlook. Hopanes and steranes with highly characteristic distributions of structural and sterochemical isomers (e.g. like in sediments with mature organic matter) were confidently identified in a few stations. In recent sediments, with poor thermal alteration, such as those studied in this research, organic matter with higher maturity can most likely be attributed to migration of thermogenic HCs.

Overall the bottom sediments collected in the northern and northeastern parts of the Barents Sea showed low concentrations of OM and low amounts of methane from the headspace analyses. These observations may argue against focused active HC seepage in the study areas, nevertheless the molecular and isotopic composition indicates the presence of thermogenic gas. Therefore a fluid migration from deeper units can be inferred. We suggest that the distinct lithological variations and properties of Arctic bottom sediments are responsible for the different compositions (gases and OM) observed in the northern and northeastern parts and for the formation of background and anomalous concentrations of fluids in the near-surface sediments.