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Gas Hydrates as Sources of Huge Methane Seepages (Case Study: Paleo-Dnepr & Dvurechenskii , Black Sea)

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Objectives

The research object is the connection “gas hydrates – huge Methane seepages” which reminds of more popular problem for “the hen or the egg”. The presented results are from the EC 6FP CRIMEA project’s expeditions at 2003 and 2004 and a new model for gas hydrate stability zone (GHSZ) study. Two polygons are studied – the areas of the Paleo-Dnepr delta (West from Crimea) and Dvurechenskii mud volcano (East from Crimea). The model’s new elements are:

- Grids of 10-100 m – for detail visualization of morphological effects;
- Methods for receiving data with higher planar dense from existing measurements using correlation with the seafloor morphology;
- Not only Methane but more realistic hydrocarbon mixes – a 3D model of Methane and his homologies distribution in the studied sedimentary strata;
- 3D models of salinity and hydrogen sulfide of the Quaternary sediments pore waters for more accurate gas hydrates stability curve calculations;
- Simple step climate and sea level change models from the time of the last glaciations – the Valdai epoch.

The gas rises into the hydrate formation zone, taken by streams of fluids. The existence of such streams is indicated by heat flow anomalies, submarine discharge zones, acoustic anomalies, gas concentrations in the water, mud volcanoes, etc.

Context

The approach, theory and 3/4D models input data are described. The model is run for the Paleo-Dnepr area and the results are discussed. A comparison with the Bulgarian offshore is made.

Conclusions

- The areas are with notably appropriate conditions for gas hydrates formation and bottom instability. Model shows that hydrates could start to form in the Dnepr area at minimum water depths in a wide range.
- The new model results are not as intuitive as from a simple model. Easy predicted is only the trend of GHSZ minimum thickness changes with the water depth. The average values of GHSZ thickness have a maximum between water depths of 1,000 and 1,500 m – the range where the total effect of all factors is most suitable for hydrates existence.
- Arguments for the connection "seepages – GHSZ boundary" are their locations in plan; morphological position of the seeps – on the crests of bottom structures – and big rise angles from fresh slumps, which could be result from hydrates instability.
- The analysis of the possible processes of gas seepages formation, scale and stability shows that the clathrates are the most probable source of the huge Methane seepages and they indicated the areas of recent sediment temperature and/or pressure instability.
- The specific location and factors of the Paleo-Dnepr area make changes of seepages the first and most sensitive reaction of the climate change in the Black Sea region.
- Global climate warming and clathrates shape in the Black Sea a sub-parallel to the coastline belt of huge Methane seepages between water depths of 250 and 1,000 m, responsible for the highest Black Sea basin Methane emission.

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