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Laptev Sea: structural study, onshore – to offshore correlation

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The Laptev Sea region is one of the remote and geologically complex areas of the eastern Russian Arctic. The main problem in interpreting the geological architecture of the region is the absence of wells in the area of interest, so all the information on the regional geology is based on a limited amount of marine seismic profiles and knowledge on adjoining near-coastal areas.

We present a new variant of seismic interpretation and key horizons' age definition based on multichannel reflection seismic data acquired by BGR in 1997 and VSEGEI reports on the geology of the East Siberian coastal territory and the New Siberian Islands.

As a result of seismic data reinterpretation five key horizons were defined throughout the Laptev Sea sedimentary basins. These horizons are tentatively assigned to major recognized geodynamic events and regional unconformities known from onshore geology.

The bottom horizon follows a change in the reflection pattern from pronounced chaotic, rarely – sub-parallel to a less reflective, sometimes – transparent sequence. Remains of a Paleozoic carbonate platform are widespread outcropping on the New Siberian Islands and were also penetrated in deep wells along the East Siberian coast. So, defined horizon may indicate the presence of this platform below the rift-related sedimentary successions of the Laptev Sea sedimentary basins. The most popular hypothesis for the formation of the Amerasia ocean basin that of a counter-clockwise rotational opening of. If this hypothesis is correct, somewhere around the New Siberian Islands a global-scale transform fault, or transform fault zone, trending further along the eastern base of the Lomonosov Ridge must be present (Grantz et al. 1990). Our data indicates that a major shear zone cutting across the Laptev Shelf is unlikely.

The second horizon from the bottom, which appears as a peneplain on several structural highs, corresponds to the rift onset. It most likely developed prior to the major Cenozoic stretching episode, following regional uplift and subsequent strong erosion and weathering during the Late Cretaceous.

Another distinct unconformity marks the boundary between sedimentary sequences with divergent wave pattern below and sub-parallel and parallel above. Therefore we interpret it as breakup unconformity (Franke, Hinz 2005). This unconformity marks the onset of the sea floor spreading in the Eurasian basin at 56 Ma.

A distinct horizon in the mainly parallel layered successions above may be correlated with the 18-36 Ma hiatus as found in the ACEX 302 well on the Lomonosov ridge. Numerous regressive intervals are defined above the horizon, which was likely formed due to the major relative sea level fall. This horizon corresponds to a change of the sedimentation conditions from green-house to ice-house.

Another change in the reflection pattern, from pronounced sub-parallel bedding to a less reflective sequence may be attributed to a regression and revival of tectonic activity in the Verkhoyansk-Chukchi region at mid and latest Miocene times.