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The structure and morphology of heterogeneous acoustic basement of the Eastern Arctic

Rekant P.V., Petrov O.V., Khasanova V. A., Sobolev N.N., and Kashubin S.N.

A.P. Karpinsky Russian Geological Research Institute (VSEGEI), Saint-Petersburg, Russia.

A number of regional reflection seismic profiles were collected during Russian High Arctic expeditions "Arktika 2010-2014". These profiles for the first time allowed the creation of the unified seismic dataset and, thus, the correlation of deep-water seismics with boreholes in the American Chukchi Sea shelf [9] and ACEX-302 drill site in the Lomonosov Ridge. The cross-correlation of the entire seismic dataset confirmed by U-Pb age analyses of zircon and paleontological examination of dredged carbonates, offer clear evidence that the acoustic basement in the East Arctic is of heterogeneous origin. The basement heterogeneity is highlighted by differences in faults and basement surface morphology, as well thickness and stratigraphy of the sediment cover. Acoustic basement contains a number of pre-Cambrian, Caledonian and Mesozoic consolidated blocks [2, 3, 4, 5, 7, 8]. Tectonic framework was significantly clarified based on the new-compiled structural map of the basement.

De-Long High, together with Wrangel-Gerald Arc are parts of a united, stable and more extensive once pre-Cambrian tectonic belt, which was significantly deformed during the Caledonian orogeny and then was slightly extended and deformed by Late Mesozoic tectonics.

The deepest basins of the East Arctic – Hanna Trough, North Chukchi and Podvodnikov Basins [1, 6] form a united mega-depression, wedged between pre-Cambrian continental blocks (Chukchi Borderland - Mendeleev Rise – Toll Saddle) on the north and Caledonian deformation front on the south. The initial subsidence within the mega-depression started in Late Devonian with the formation of the Hanna Trough. During the Late Paleozoic, the subsidence was gradually displaced northwestward - first into the North Chukchi Basin and then into the Podvodnikov Basin. The most significant subsidence of the entire mega-depression took place in the North Chukchi Basin in the Late Cretaceous.

Most of morphological boundaries in the modern Arctic differ considerably from the tectonic framework. Only part of the Arctic morphostructures are constrained by tectonic boundaries. They are: eastern slope of the Lomonosov Ridge, continental slope in the Laptev Sea, upper continental slope in the Podvodnikov Basin, southern slope of the North Chukchi Basin and borders of the Chukchi Borderland. The rest are significant parts of modern morphological boundaries as a result of exogenous, mostly accumulative, processes, which lead to migration of the boundaries. The modern shelf break east of 170°E is caused by the position of the edge of the aggradational clinoform prism that infilled the North Chukchi Basin. The western tectonic limitation of the Lomonosov Ridge is located well westward from the modern base of the ridge slope. This boundary can be traced along the 18-20-th linear magnetic anomaly in the Amundsen Basin. The Alpha Ridge/Mendeleev Rise boundary is located considerably southward from the Cooperation Gap, as was supposed earlier. The Late Mesozoic deformation front in the Chukchi and East Siberian seas is not pronounced in recent sea-floor topography due to leveling by erosion.

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