The East Siberian Arctic Shelf: A Tectonic Synthesis

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ABSTRACT

The East Siberian Arctic Shelf (ESAS) stretches for ~2,500 km from the eastern coast of the Taimyr Peninsula to the US/Russia maritime boundary in the Chukchi Sea. Since 2009, there has been increased marine 2D seismic data acquisition in this remote Arctic area by several Russian and other companies in conjunction with exploration activity led by Rosneft. This has resulted in a significant amount of modern 2D seismic data that, in combination with gravity and magnetic data, provide a reliable basis for unravelling the structure and tectonic history of this region. Onshore geological data show that the consolidated basement of the ESAS mainly formed during the late Mesozoic in the course of collision between the north Asian margin of Laurasia and two large microcontinents: Kolyma-Omolon and the Arctic Alaska-Chukotka. The late Mesozoic fold belts extend offshore where, based on seismic data, they underlie the entire Laptev Shelf and southern parts of the East Siberian Sea and Russian Chukchi Shelf. The late Mesozoic consolidated crust was severely thinned as a result of Late Cretaceous and early Cenozoic extension (mainly related to the divergent movement of the Eurasian and North American Plates and the opening of the Eurasian oceanic basin). In the Laptev Sea, the extension formed a vast rift system and resulted in complete rupture of the continental crust and mantle exhumation within the most extended Ust' Lena Rift on the western part of the shelf. The northern parts of the East Siberian and Chukchi Shelves are occupied by the North Chukchi Basin, which extends for ~850 km in a W–E direction from the De Long High to the US Chukchi Sea. Seismic and gravity data show the basin to be underlain by severely attenuated lower continental crust and/or exhumed upper mantle. Sediment thickness reaches ~20 km in the most subsided part of the basin, north of Wrangel Island. We infer that the basin formed as a result of the back-arc extension that preceded the opening of the Canada Basin in the Early–Middle Jurassic. Consequently, the basin's sediment infill mostly consists of Cretaceous–Cenozoic terrestrial siliciclastic sediments, which onlap onto igneous crust of the Mendeleev Ridge (125 Ma). The upper 5–6 km of sediments are represented by a Cenozoic passive margin clastic wedge that progrades towards the Canada Basin.