



Rapid vertical crustal movements in Arctic Eurasia in the Pliocene and Pleistocene and their possible mechanisms

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According to a large volume of data, geomorphological, geological, seismological, paleontological, fission track and pedological ones, strong acceleration of vertical crustal movements occurred on the continents in the Pliocene and Pleistocene. Over about 90% of the continental areas the crustal uplift took place. This occurred over most of Africa, Eurasia, North and South America, Greenland, Australia and East Antarctica. The Neotectonic uplift ranges from 100-200 m on the East European platform to 4-5 km on the Tibetan plateau and in the Pamir and Andes. Pronounced subsidence took concomitantly place in some intracontinental regions, e.g. in the South Caspian and Tarim basins. In most areas these movements evolved long after the termination of shortening and stretching of the crust. This is especially typical of the Precambrian cratons which cover about 70% of the surface of the continents.

As follows from the Neotectonic Map of Northern Eurasia, 1997, edited by A. Grachev, the crustal uplift and subsidence also occurred over most of Arctic Eurasia. Subsidence of several hundreds of meters was typical for most of the present shelf areas. Within them the Franz Josef Land, the Novosibirsk islands and Wrangel island have risen by 100-200 m, the Severnaya Zemlya Archipelago by 400 m and the Novaya Zemlya by 1000 m. At the same time vertical movements took place in the land part of Arctic Eurasia. In the northern Verkhoyansk-Chukchi structural province the Neotectonic uplift reached 1-2 km in some places. In the Taymyr and Pai-Khoi it ranges from several hundreds of meters to 400-800 m. Slight subsidence of ~100 m occurred in the Pechora basin and in the northern West Siberia. Intense subsidence took place on the Laptev shelf and in the Moma rift on the continuation of the Gakkel spreading center into the Asian continent.

In the absence of intense shortening or stretching of the crust, rapid vertical crustal movements in intraplate areas can be produced by convective flows in the mantle and density changes in the lithosphere. The main models of dynamic topography predict a wide and pronounced depression in Northern Eurasia. However, the distribution of the crustal uplift and subsidence is very nonuniform in space there which indicates large role of density changes in the lithosphere. According to the seismic tomography data pronounced asthenospheric upwelling exists under the Verkhoyansk-Chukchi region and the adjacent shelf. In the Barents and Kara seas and on the adjacent land the lithosphere is thick. Neotectonic uplift and subsidence are complicated there by steep slopes which in many places are only several tens of kilometers wide. Such deformations indicate expansion and contraction of rocks at a depth comparable with the slope width, i.e. within the crust. Based on typical phase diagrams such density changes can result from metamorphism under different p,T conditions. We speculate that rapid metamorphism was catalyzed by infiltration of mantle fluids into the crust.