Geophysical Research Abstracts
Vol. 16, EGU2014-1479, 2014
EGU General Assembly 2014

Mechanism of the Plio-Pleistocene crustal uplift in cratonic areas

Eugene Artyushkov (1) and Peter Chekhovich (1,2)

(1) Institut of Physics of the Earth, Russian Federation (arty-evgenij@yandex.ru), (2) The Earth Science Museum at Moscow State University, Russian Federation (p.chekhovich@gmail.com)

Strong acceleration of crustal uplift occurred over 90% of continental areas over the past 2-5 Ma. During the past $\geq$500 Ma no significant shortening occurred in the Precambrian cratons which constitute about 70% of continental areas. The Neotectonic uplift from 100-200 m to 1-2 km, however, occurred over most of them, e.g., on the African continent and in Greenland, in Eastern and Central Australia and in East Siberia. In the absence of significant shortening of the crust, dynamic topography might be a mechanism. In a global scale, mantle flows should produce uplift and subsidence of the lithosphere in regions of comparable total areas. The total area of the Neotectonic uplift is, however, much larger than that of the recent subsidence. Under such circumstances the crustal uplift should be attributed to a density decrease in the lithosphere. A possible cause is partial or complete convective replacement of subcrustal lithosphere by a less dense asthenosphere. The top of the low-velocity layer reaches the depth of $\sim$100 km in many regions of pronounced Neotectonic uplift, e.g. in Central Asia. This is more typical for the Phanerozoic fold belts where subcrustal lithosphere has a high density (Artemieva, The Lithosphere, Cambridge Univ. Press, 2011, 773 p.). It can be replaced by the asthenosphere when weakened by infiltration of mantle fluids. On the Precambrian cratons, subcrustal lithosphere is less dense. The lithospheric thickness reaches there 200-300 km as the East Europian, East Siberian and North American cratons, and in the Southern and Eastern Africa. Yet these regions underwent considerable Neotectonic uplift, from several hundred meters to half a kilometer over most of the area and up to 1 km and more in some places, such as the Northern Greenland, the Kaapvaal craton in South Africa and the Putorana plateau in East Siberia. Density decrease in the lower part of a thick lithosphere would have produced smooth topography variations at the surface, hundreds of kilometers wide. However, on old cratons the Neotectonic uplift is in many places complicated by steep slopes up to 500 m high and only a few tens of kilometers wide. They are observed, e.g., on the Kola Peninsula and on Anabar shield and Putorana plateau. This indicates expansion of rocks at shallow depth comparable with the slope width, i.e. within the crustal layer. It can result from diaphthoresis – superposition of low-grade mineral assemblages on higher grade ones which had been formed in the lower crust at T $\sim$600-800 °C. After intense denudation these dense rocks emerged to a shallower depth with T $\sim$350-400 °C. Under dry conditions they however, remained metastable. Recent infiltration of mantle fluids enhanced metamorphism with the formation of hydrous minerals and produced rapid rock expansion and crustal uplift. Lateral variations of the uplift in cratonic areas result from variations in rock composition and the amount of mantle fluid infiltrated into the crust.