

## **Plate collision and mounting building separated by long periods of time. Possible causes**

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According to a popular scheme of orogenesis, superposition of thick nappe on continental crust results in concomitant mountain building. In many cases plate collision was not accompanied by mountain building which actually occurred 10-100 Myr later. Thus in East Carpathians 12 Ma ago thick nappe was superimposed on the western margin of the East European Craton. The nappe remained near to sea level and mountain building began only 3 myr ago. In the Middle Urals collision developed in a number of phases during 70 Myr since the Late Devonian and until the earliest Permian; however, this produced no high topography. The formation of orogenic granitoids took place at the main stage of collision 306-300 Ma ago. High mountains were formed in the earliest Permian 10 Myr after the end of collision. In the Northern Tien Shan collision with intrusion of large granitic plutons occurred in the Late Ordovician-Middle Devonian. In the Southern Tien Shan these phenomena refer to the Late Carboniferous and Late Jurassic. In both regions collision was not accompanied by mountain building. High mountains were formed in the Tien Shan quite recently.

Shortening of strong lithospheric layer becomes possible only at short epochs of its softening under infiltration of fluids from the mantle. The absence of large uplift during shortening and thickening of the crust indicates a concomitant density increase in this layer. As follows from the analysis of typical phase diagrams of crustal rocks this can be explained by metamorphic reactions taking place in a presence of fluids under the pressure increase due to the nappe emplacement. As follows from the absence of large crustal uplift in shortened regions mantle lithosphere remains preserved in them after plate collision. At the epochs of infiltration from the mantle of large volumes of fluids it becomes softened. This ensures a possibility of convective replacement by the asthenosphere of fertile and dense mantle lithosphere of the Phanerozoic age which should result in a strong isostatic crustal uplift. Pronounced asthenospheric upwelling is indeed observed under high mountains in many Phanerozoic fold belts. New temperature distribution arises in the thickened crust after its shortening. As a result retrograde metamorphism with expansion became possible in dense rocks which underwent deep metamorphism at the preceding epochs of collision. This is another mechanism of mountain building. Analysis of the data on the Tien Shan shows that both these mechanisms are responsible for its uplift by 2 km and more during the last 2 Myr.

In the gravity field the force acting along the lithospheric layer that necessary to shorten the crust increases with the altitude of topography. Termination of shortening after reaching only a very low altitude indicates that the forces which ensure collision are not large. They can be estimated as  $3 \times 10^{12}$  N m which is comparable with the plate driving force of ridge push.