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# Formation of foreland basins in fold belts independent of plate collision

Eugene Artyushkov (1), Peter Chekhovich (1,2), Sergey Korikovsky (3), and Hans-Joachim Massonne (4)

(1) Institute of Physics of the Earth of the Rus. Ac. of Sci. (IPE), Moscow, Russian Federation (arty-evgenij@yandex.ru), (2) Earth Science Museum at Moscow State University (p.chekhovich@gmail.com), (3) Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry of the Rus. Ac. of Sci. (IGEM) , Moscow, Russian Federation (korikovsky@yandex.ru), (4) Universität Stuttgart, Institut für Mineralogie und Kristallchemie

According to popular ideas, foreland basins arise due to elastic bending of lithospheric plates under the load of a thick nappe stack or by a pull of a subducted slab attached to the plate edge. Foreland basins usually form at the outer margin of fold-and-thrust belts at the latest stages of their evolution and long after closure of the oceanic basins within the belts. This excludes an important influence of slab pull acting for a short time after continental collision.

Basins produced by thrust loading should form synchronously with the superposition of a thick nappe stack and deepen towards their front. Shortening of the crust in fold belts usually occurred in a form of short impulses separated by long periods of quiescence. Most foreland basins originated from rapid crustal subsidence, which occurred when no shortening of the crust took place in the adjacent fold belts. This situation is typical of the foreland basins of the Urals, Appalachians, Greater Caucasus, Alps and other ones.

In many basins, their sedimentary fill did not increase towards the nappe front or even increased in the opposite direction. This is observed, e.g., in the Po retroarc basin with the axis located between the Alps and Northern Apennines. Furthermore, in many fold-and-thrust belts emplacement of a thick nappe stack did not produce the crustal subsidence at their front as happened in the Eastern Carpathians in the Late Miocene.

In the absence of strong violations of isostasy in foreland basins, their crustal subsidence should have resulted from a density increase in the lithospheric layer. Large lateral variations in regard of the depth of the basis of the basins indicate that the density decrease occurred at shallow depth, i.e. within the crustal layer. As follows from P-T diagrams of typical crustal rocks, in many continental regions the density of the lower crust is lower than expected according to seismic and gravity data. This can be due to the existence of rocks in a metastable state in the absence of fluids. Large compressive deformations of the crust in fold belts became possible after strong crustal softening by infiltration of fluids from the mantle. These fluids could cause rapid metamorphism in the lower crust accompanied by a density increase. As a result, despite a strong thickening of the crust, the shortened regions would maintain low altitudes whereas the adjacent platform areas would undergo rapid crustal subsidence with the formation of foreland basins.