Geophysical Research Abstracts
Vol. 13, EGU2011-4243-1, 2011
EGU General Assembly 2011

Tajik Basin: structure and kinematics of an external fold-and-thrust belt of the Pamir revealed by cross-section balancing

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The Tajik Basin is a structural depression situated along western periphery of the Pamir orocline. It is a long-living intra-continental basin ultimately filled and deformed during the India-Asia collision. It hosts an up to 9 km thick sequence of Triassic to Recent deposits; since the Miocene it records a growth of surrounding mountain ranges, in particular the Pamir. In terms of structural features the Tajik Basin may be characterized as a fold-and-thrust belt detached along Upper Jurassic evaporites in response to the advance of the Pamir. In the south the dominant structures are N-trending folds and thrust sheets. Northwards the structural trend turns to NE and eventually converges to the ENE-striking southern boundary of the Tien Shan. We have constructed serial balanced cross-sections through the Tajik Basin using archival and field data to understand its present structure and to provide geometric constraints on the large-scale kinematics of the Pamir.

The Tajik Basin represents a spectacular doubly-vergent fold-and-thrust belt with two oppositely verging zones facing each other. The proximal part of the basin, directly adjacent to the Pamir, exhibits a weak vergence towards the foreland, while the distal part, situated away from the Pamir, is verging towards the hinterland. The two zones surround a central depression. The structural geometries of the foreland- and hinterland-verging zones are markedly different: the foreland-verging part is built of slightly asymmetric detachment folds, commonly with faulted forelimbs. The axial zones of some of these folds are pierced by salt diapirs protruding from the basal detachment towards the surface. On contrary, the hinterland-verging zone is built of thrust sheets stacked along low-angle backthrusts with individual displacements reaching 30 km. We attribute the change of vergence and structural style to a thinning/pinching-out of the Jurassic evaporites from (S)E to (N)W.

The thickness of syn-orogenic deposits preserved in synclines increases towards the Pamir. It testifies for an orogenic loading as the main factor controlling the subsidence. This trend, though clear, is not uniform. Local depressions and uplifts have been identified that are believed to reflect a presence of deep contractional structures, concealed beneath the detached and folded supra-Jurassic sedimentary cover.

Thin-skinned shortening determined from serial balanced cross-sections systematically exceeds 100 km. Most of it is accommodated by high-displacement backthrusts situated at the front of the fold-and-thrust belt, within the hinterland-verging zone. The entire shortening within the Tajik Basin must have been driven by a displacement of the backstop (the Pamir) towards west, roughly perpendicularly to the direction of convergence in the India-Asia collision zone. It may be attributed to radial flow of material within the Pamir orocline, temporal variations in the convergence direction or partitioning of the N-S convergence along the oblique Darvaz fault zone separating the Tajik Basin from the Pamir.