Geophysical Research Abstracts
Vol. 13, EGU2011-8993, 2011
EGU General Assembly 2011

The eastern Tajik basin: Late Cretaceous to Neogene basin evolution and exhumation of the Pamir

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The eastern Tajik basin comprises an up to 10 km thick basin-fill spanning the Late Triassic to Quaternary. At the eastern basin margin (Shuroabad region), continuous successions of Cretaceous to Quaternary strata are well exposed and record the change from a pre-tectonic continental sag basin (Cretaceous−Paleogene) to a syn-tectonic foreland basin (Neogene) that has later been transformed into a fold-and-trust belt (late Neogene-Pleistocene).

The pre-tectonic strata record sedimentation rates of «1mm/yr and are characterised by a layer-cake architecture of predominantly continental fine clastics with shallow facies-gradients and transport directions to the west. A pronounced progradation of marginal coarse-clastic facies in the Miocene, accompanied by a spectacular increase in sedimentation rates to 1.5-4 mm/yr, indicates the change to the syn-tectonic foreland basin. The foreland basin evolution is characterised by multi-phased progradation throughout the Miocene with maximum progradation in the lower Chingou Formation of probably early Miocene age. These progradational phases may correspond to phases of hinterland uplift. In general, the syn-tectonic strata exhibit talus-like growth strata with steep facies gradients and transport directions to the west. Facies patterns display a continuous change from debris flow/hyperconcentrated flow dominated alluvial fan systems (early Miocene) to fluvial fan systems (late Miocene/early Pliocene), suggesting an pronounced increase in discharge rates. Small-scale syn-sedimentary thrusts in the early to late Miocene syn-tectonic strata and the large-scale architecture of the late Miocene strata (back stepping of talus-like growth strata, angular unconformities) suggest that contractional deformation was involved in the foreland basin development; these features may record the initial westward propagation of the Pamir in the Miocene.

In the Pliocene/Pleistocene, the Tajik basin was transformed into a fold-and-trust belt with generally N-trending anticlines and synclines that involve pre- and syn-tectonic strata. The fold-and-trust belt topography controlled the sedimentation process and the large-scale architecture. Talus-like coarse clastic growth strata at the flanks of anticlines correspond to transport directions and increasing thicknesses towards the synclines. The transformation of the foreland basin into the fold-and-trust belt points to rapid westward propagation of the Pamir with significant shortening in the Pliocene/Pleistocene. The sedimentary evidence for the young age of major shortening along the eastern margin of the Tajik basin is supported by the ca. 4 Ma age (apatite fission-track) of major exhumation along the Main Pamir thrust zone of the northern Pamir (Alai valley); both sedimentary and geochronologic data support a young age of onset of continental subduction along the leading margin of the Pamir.