Geophysical Research Abstracts
Vol. 14, EGU2012-3394, 2012
EGU General Assembly 2012

Deciphering intracontinental basin evolution: the Fergana depression example.

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Located in the western Tien Shan, the Fergana Basin is an outstanding locality to understand the mechanisms of intracontinental intramontane basin evolution. This study focused on the NW corner of the basin, where we analyzed outcropping Jurassic to Pliocene sediments in an attempt to decipher the evolution of the basin and its related ranges. We measured ∼1000 m of stratigraphic section, interpreted the sedimentary environments, analyzed paleocurrent orientations, collected conglomerate compositional data at 15 localities, and dated 403 detrital zircon (DZ) grains from the Fergana Range foothills with LA-ICP-MS.

Based on the available data, we distinguish at least 3 tectonic episodes that affected deposition in the Fergana basin. There is an important change in the DZ spectra between the upper Jurassic and the Eocene samples from a clear unimodal distribution (peak at ∼ 270 Ma) to a bimodal distribution (peaks at ∼ 330 and ∼ 500 Ma). We interpret this change as reflecting a tectonic event that exposed to erosion early Paleozoic rocks around the Fergana basin between the Cretaceous or lower Paleogene. We plan to date more samples to enhance the chronologic resolution of this event.

A Miocene tectonic episode is recorded by several sources of information. Higher energy fluvial systems are more abundant in the upper part of the Miocene Massaget Formation. This is coupled with a reversal of the paleoflow direction from predominantly northward in the lower Massaget Formation to southward directed in the upper part of the unit. Grey metamorphic and red sandstone clasts also become more abundant in the conglomerate composition at this point. Additionally, the DZ age distribution shifts from bimodal, peaks at ∼ 330 and ∼ 500 Ma, to unimodal with a single the peak at ∼ 500 Ma. We interpret this as a clear change in provenance from a South Tien Shan source (possibly the Alai Range) to a northern source, possibly the Talas Range. This interpretation implies progradation of deformation from south to north.

A regional angular unconformity separates the Miocene Massaget Formation from the Pliocene Baktriy Formation, representing a third tectonic episode in the Fergana basin depositional record. This event is also recorded by a change in the composition of the conglomeratic clasts and a paleocurrent shift. Above the unconformity, sedimentary rocks of the Baktriy Formation show a westward directed paleoflow and grey metamorphic and red sandstone clasts become less abundant. We interpret this event as the exhumation of the Fergana Range, located directly to the east. This would imply that deformation stepped back to the hinterland and shifted eastward, inhibiting a simple 2D interpretation scheme.

The complexity of this setting requires a thorough analysis of inherited structures together with AFT and AHe thermochronology from the ranges surrounding the basin to better constrain the deformation and exhumation pattern of the western Tien Shan and fully comprehend the tectonic evolution of intracontinental basins.