Flexural deformation and basin-mountain coupling in the northern Kyrgyz Tien Shan: transition from the Issyk-Kul basin to the Kumtor plateau

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During the late stage of the India-Asia collision, deformation propagated northwards into the Asian foreland. North of the stable Tarim plate, the Tien Shan range – an old Palaeozoic fold belt – was strongly reactivated. It now accommodates more than one third of the total shortening rate between Stable Eurasia and the Indian continent.

In the northern part of the Kyrgyz Tien Shan Range, the 600 m deep Lake Issyk-Kul occupies a lense-shaped tectonic depression elongated in an E-W direction and bordered on its northern and southern sides by high mountain ranges (> 4000 m high). To the north, the Kungey Alatau range has the structure of an active positive flower structure with the Chon-Kemin – Chilik fault in its middle (location of several Ms > 8.0 historic earthquakes). To the south, the Terskey range forms the frontal scarp of the high and relatively flat Kumtor Plateau whose surface is undulating between 3800 and 5200 m high.

Multidisciplinary investigation was performed during several summer campaigns, involving structural geology, paleostress reconstructions, tectono-stratigraphy and paleoseismology in the mountain ranges and lake shore, as well as high-resolution seismic profiling and heat flow measurements in Lake Issyk-Kul. Investigations included also the seismotectonics analysis of a large number of earthquake focal mechanisms determined from the local seismic network.

All the results are best integrated in a model of lithospheric deformation by flexu-
ral folding and basin-mountain coupling. The Issyk-Kul basin probably formed as a flexural downwarp of the lithosphere rather than as a symmetric ramp basin, as once proposed. South of the Issyk-Kul depression, the Kumtor plateau still show large remains of the pre-Cainozoic flat erosion surface that is widespread in the Central Asia, now strongly uplifted and slightly undulating. Deformation at mountain-basin interface occurs mainly by tilting around a horizontal axis of the pre-Cainozoic basement (up to 60° from the horizontal), and top-to-the south reverse faulting at the southern margin of the basin (basin towards the range), in an opposite sense to what could be expected in the case of a ramp basin. The focal mechanism of a recent earthquake along the southern mountain-basin interface confirms this interpretation (25 December 2006 Ms 5.8).