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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).