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Active Seismicity and Tectonics in Central Asia from Seismological Data Recorded in the Pamir and Tien Shan Mountain Ranges

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Active tectonics in the Pamir mountains in central Asia, the westernmost part of the India-Eurasia collision zone, are controlled by ongoing convergence (about 20 mm/yr), causing substantial crustal shortening and compressional deformation. This leads to high seismicity rates throughout the region. Whereas seismic activity along the rim of the Pamir plateau is mostly compressional and concentrated along the Main Pamir Thrust, the distribution and focal mechanisms of earthquakes in its interior are more diffuse, with extensional events occurring along North-South trending rift zones (Kara Kul, Wachan). Seismicity in the south-western Pamir and in the Hindu Kush features frequent intermediate-depth earthquakes, reaching hypocentral depths of 300 km, which is rare for regions not obviously related to active subduction of oceanic lithosphere. These mantle earthquakes, which are not observed beneath the Himalayas and Tibet further east, form a rather well-defined Wadati-Benioff zone that was readily interpreted as subducted lithosphere present below the current collisional orogen. Earlier seismological studies showed the presence of a northward-dipping lithospheric slab under the Hindu Kush and a southward-dipping one beneath the Pamirs, with a small seismic gap in-between. Different hypotheses concerning the nature of these slabs (oceanic or continental lithosphere) and tectonic geometry in general (two slabs subducting in opposite directions or a single, hugely contorted slab) have been proposed in literature. Political instability in the region in the last two decades hampered on-site studies and field work, leaving many key issues poorly understood.

In the framework of the multidisciplinary project TIPAGE (Tien Shan Pamir Geodynamic Programme), for the first time, new field campaigns collecting high quality data have been made possible. Local seismicity in the Pamir and Tien Shan mountain ranges (Tajikistan and Kyrgyzstan) is currently being recorded by a temporary installation of 40 seismic stations, 30 in Tajikistan and 10 in Kyrgyzstan, for a total time of two years starting summer 2008. In 2009, the configuration of the stations was changed from a 24-station North-South profile plus 16 additional stations distributed throughout the Pamirs to a 40-station 2D setup evenly covering the whole study region. Moreover, the first half of the data was retrieved, for which we will present preliminary results. The high density of seismic stations allows precise location of earthquake hypocenters and determination of source mechanisms for selected events. So far we detected some 10,000 events, a significant proportion of which are related to aftershocks of a M_w 6.6 earthquake that occurred in October 2008 in the border triangle of Kyrgyzstan, Tajikistan and China, directly beneath one of our stations. The hypocenter distribution of a selection of detected events provides a good indication on active faults in the region, thus enabling us to interpret ongoing tectonic activity. We will also present seismicity cross-sections through interesting subparts of the study region that will shed a new light on the complex geometry of mantle deformation.