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Seismotectonics of the Pamir

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The Pamir Mountains form a complex orographic node north of the western Himalayan Syntaxis. Due to the Pamir's remote location, crustal tectonics of the region is not well studied. We report new data on distribution and kinematics of crustal earthquakes in the Pamir and its surroundings. Our data set stems from a deployment of seismometers between 2008-2010 that covered the SW Tien Shan, Pamir and Tajik basin. We detected and carefully relocated several thousand crustal earthquakes that are confined to the uppermost 20 km of the crust and thereby clearly separated from Pamir's unique intermediate depth seismicity. For the larger earthquakes (M<3) we use both full waveform inversion and first motion polarities to determine source mechanisms.
A string of earthquakes outlines the thrust system along the northern Pamir's perimeter. In the east, where the Pamir collides with the Tien Shan, the M6.7 Nura earthquake activated several faults. Whereas the main shock shows almost pure reverse faulting on a south dipping thrust, many aftershocks also show sinistral strike-slip faulting along a NE striking lineamnet. In the centre, where the Pamir overthrusts the intramontane Alai valley, micro-seismicity recedes southward from the Frontal and Trans Alai thrust systems. The largest of these earthquakes show mostly strike-slip mechanisms. Further west, where the Pamir thrust system bends southward, earthquakes show thrust mechanisms again with strikes following the oroclinal structures. Inside the Pamir a NE striking lineament runs from the eastern end of Lake Sarez across Lake Kara Kul to the Pamir thrust system. Source mechanisms along the lineament are sinistral strike slip and transtensional. This lineament approximately separates the deeply incised western Pamir, which shows significant seismic deformation, from the relatively aseismic eastern Pamir. In the western Pamir earthquakes cluster along approximately the Vanch valley and near Lake Sarez. Diffuse seismicity is also visible beneath the SW Pamir's basement domes. Source mechanisms exhibit mostly sinistral strike slip faulting on NE striking or conjugate planes indicating north-south compression and east-west extension. At the Pamir's western margin, where the mountains merge into the Tajik basin's fold and thrust belt, we observe numerous earthquakes with mechanisms exhibiting EW slip on subhorizontal planes. We interpret this as movement along the Jurassic evaporite decollement that detaches the sedimentary section from the basement. Our data indicate that in the western Pamir NS compression is accommodated by westward escape, i.e. the western Pamir is pushed into the Tajik depression ontop of a weak evaporite detachment. This is in accordance with the observed GPS displacement vectors rotating anticlockwise from NS to EW when traversing from the eastern Pamir into the Tajik depression.