



The Ahar-Varzaghan (Iran) double earthquakes (Mw 6.5 and 6.2) of August 11th, 2012: A seismotectonic interpretation from regional moment tensors and kinematic parameters

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The region of northwestern Iran is exceptional within the Arabian-Eurasian continental collision zone. Tectonics is dominated by the NW-SE striking right-lateral North Tabriz Fault (NTF) where regional seismicity (historical and modern one) concentrates. North of the NTF seismicity is rare and almost nothing is known about active structures so far. Here, GPS velocity records are directed to North-East, while the direction changes to direct North south of the NTF.

On 11th of August 2012 the region was surprisingly struck by a shallow Mw 6.5 earthquake with pure right-lateral strike-slip character only about 50 km north of the NTF. An east-west striking surface rupture of about 18 km length was observed in the field. Only 11 minutes later and about 6 km further NW a second shallow event with Mw 6.2 occurred. It showed an NE-SW oriented oblique thrust mechanism. Until the end of August, 409 earthquakes with $ML \geq 2.0$ were observed. In the eastern part of the earthquake sequence, along 3/4 of the rupture length, the aftershocks concentrated in a depth of about 14 km. In the western part they became shallower with about 7 km depth. On 7th of November a strong aftershock (Mw 5.4) occurred at the western edge of the sequence. Here, we present point source moment tensor solutions obtained from inversion of regional waveform data for the two mainshocks and larger aftershocks, including the one from 7th of November. We use 3-component broadband data of the Iranian National Seismic Network (INSN) operated by the International Institute of Earthquake Engineering and Seismology (IIEES) in Tehran. For half of the studied aftershocks we obtain pure E-W / N-S oriented strike-slip mechanisms. The other half shows oblique thrust mechanisms with an orientation of NE-SW. The analysed aftershocks are located in depths between 5 and 18 km. In addition, we show the kinematic parameters of the rupture plane for the two mainshocks and the aftershock of 7th of November.

We propose that more than one fault must have been activated during the sequence assembling a complex structure of strike-slip and thrust faults. This sequence was a surprise in an area, where recent seismicity on active faults has not been observed so far. Due to the lack of knowledge about such structures in the region, seismic hazard analyses must underestimate the risk. This earthquake sequence provides an opportunity to better understand the processes of active deformation and their causes in NE Iran.