Geophysical Research Abstracts
Vol. 12, EGU2010-497-1, 2010
EGU General Assembly 2010

Enhanced moment tensor retrieval: a case study in the Alborz Mountains, Northern Iran

Stefanie Donner (1), Dirk Rößler (1), Abdolreza Ghods (2), Frank Krüger (1), Manfred Strecker (1), Angela Landgraf (1), and Paolo Ballato (1)

(1) Potsdam University, Potsdam, Germany, (2) Institute for Advanced Studies in Basic Sciences, Zanjan, Iran

Seismotectonic and seismic hazard analysis are crucial tasks in, often increasingly, densely populated, seismically active regions. The understanding of earthquake source mechanisms is an important key element for such analyses. Seismic moment tensors provide a general description of the physical processes and the magnitude of earthquakes. The feasibility of moment tensor retrieval is controlled by several factors, such as wavefield modelling, source location, and station distribution. Inappropriate velocity models and inhomogeneous station distribution limits the inversion and the availability of seismic moment tensors in many regions worldwide.

The Alborz Mountains of northern Iran are a tectonically active, bivergent orogen in the Arabia-Eurasia collision zone. It is located between the aseismic blocks of the South Caspian Basin and Central Iran. A complex and not well understood system of strike-slip and thrust faults accommodates NNE-SSW oriented shortening. There are indicators that deformation in the high sectors of the Alborz Mountains is partitioned into reverse and left-lateral strike-slip faulting. Studies of earthquake source mechanisms will provide further insights in the complex fault geometry, their kinematic behaviour, and the tectonics of this intracontinental orogen. In addition, the internal domain of the central Alborz seems to be affected by very young, active transtension.

To date, a heterogeneous seismic network with non-uniform distribution and a lack of appropriate methods have prevented detailed and comprehensive moment tensor studies in this region. So far, only 26 seismic moment tensors are available in the Harvard CMT catalogue since 1976. This restriction is due to the magnitude threshold of M4.5 for data processing and due to low data availability. Uncertainties in earthquake location are significant. Depth determination is sometimes impossible. Therefore, earthquakes cannot be associated with faults and the recent kinematic behaviour of faults is often not understood. The assessment of the tectonic activity in the Alborz is mainly restricted to structural and geomorphic information. Consequently, many seismotectonic questions cannot be addressed properly.

We study source mechanisms for earthquakes in the Alborz Mountains using local and regional seismic network data. Thus we want to provide an extended data base for seismotectonic and seismic hazard studies. To overcome the difficulties in moment tensor inversion, we have been developing a conceptually new algorithm. This approach for moment tensor retrieval combines waveform data as well as first motion polarities and amplitude ratios of P- and S-waves of broadband and short period stations as well as accelerometers. The latter are especially densely distributed. The normalized moment tensor is retrieved by a grid search. Thereafter, the seismic moment is obtained by a linear regression. During inversion we also obtain resolution of epicentres and focal depths of the investigated earthquakes. Based on this algorithm we determine a new and representative number of seismic moment tensors in the greater Alborz region. Tests based on synthetic data indicate the robustness and the uncertainties of the retrieved parameters.