THE ANALYSIS OF SEISMIC STRESS REGIME IN AHAR - VARZEGHAN REGION, NORTHWESTERN IRAN

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Northwestern Iran is one of the seismically active regions with a high seismic risk in the world endorsed by historical background and instrumental earthquakes. Studying the present day stress regime in the crust is very important for understanding the current deformation in each area. Using Earthquake focal mechanisms could help us investigating the stress regime. The big advantage of the focal mechanism solutions is the ability to study the stress regime at depth in the lithosphere. By inversion of all the available solutions we determine the best fitted stress tensor with grouping focal mechanisms. In this study, we analyze stress state in Ahar-Varzeghan region which includes the northern part of the North-Tabriz fault in northwest Iran by determining the focal mechanisms of 15 earthquakes using the moment tensor inversion method of ISOLA and also by focal mechanisms of other large and moderate earthquakes determined by GCMT. The events have moment magnitudes higher than 4 and encompass latitudes between 34- 40° N, and longitudes between 43- 51° E, during the period 1976-2013. We calculate the principal orientations of stresses in the region by multiple inverse methods and present an stress analysis.

We use ISOLA software for moment tensor inversion in time domain using waveform modelling to determine focal mechanisms. The method was first offered to calculate the source parameters at teleseismic distances (Kikuchi and Kanamori, 1991). It was developed later for regional and local distances by Zahradnik et al. (2005). In this method, Green's functions are calculated by discrete wave number method (Bouchon, 1981). We used the broadband stations of Iranian Seismological Center (IRSC), International Institute of Earthquake Engineering and Seismology (IIEES) and also stations of several other countries bordering -northwestern Iran. We employ the 5- layer crustal model of IRSC and determine the source parameters of 15 earthquakes by waveform modelling. The acquired and GCMT focal mechanisms are shown in figure 1, respectively in blue and red. Using the information of these events containing strike, dip and rake angles, we study the state of stress in the region. For this purpose, we use multiple inverse methods that was originally proposed by Yamaji (2000). The method is a numerical technique to separate stresses from heterogeneous fault– slip and focal mechanism data. The method employs the inversion of earthquake focal mechanism to determine the principal stress orientations. The regions of azimuth and plunge of principal stresses; σ_1 and σ_3; and also stress ratio for the specified regions are depicted by blue lines in Figure 1, and numbered in Table 1. The green arrows present the direction of principal stress; σ_1; in each specified region.

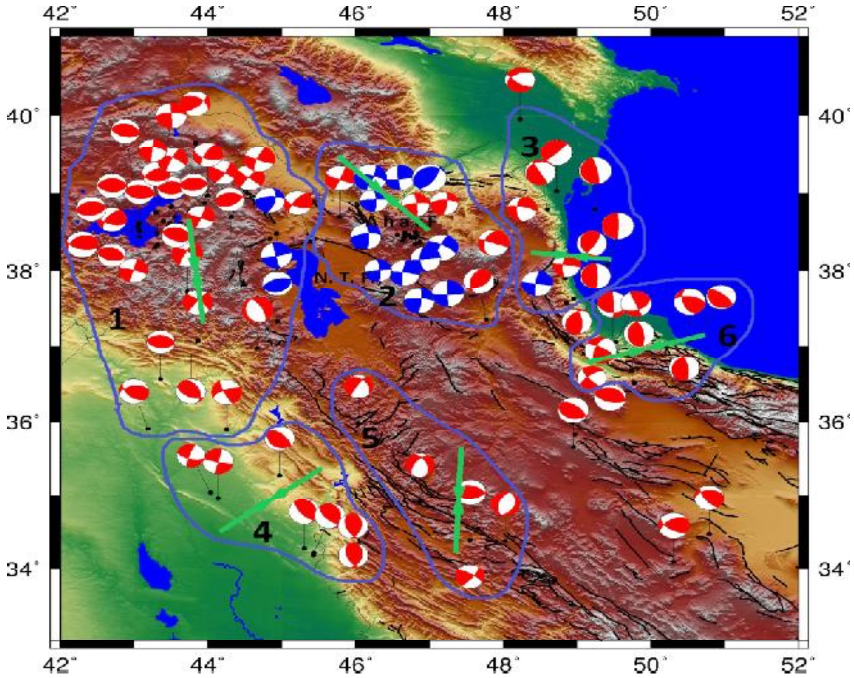

Figure 1. The determined focal mechanisms in this study (blue) and by GCMT (red). The blue lines present determined regions of different stress states in this study. The green arrows depict the directions of principal stress, σ_1, in each region

Table 1. The calculated azimuth and plunge of principal stresses, σ_1, σ_3 and also stress ratio in each specified region of figure 1

Region	Azimuth σ1	Plunge σ1	Azimuth σ3	Plunge σ3	stress ratio
1	173.6	4.7	60.3	78.2	0.27
2	136.7	0.1	46.7	4.8	0.34
3	96.1	51.4	256.6	37	0.18
4	53.1	3.2	315	68.1	0.26
5	182.4	0.6	272.6	13.8	0.64
6	74.1	17	191.8	56.7	0.34

As it is presented in Figure 1 and Table 1, the stress regime in Ahar- Varzeghan region is completely different from other surrounding areas. Most of the focal mechanisms are right lateral strike- slip and the direction of principal stress, σ_1, is 136.7°. In contrast, the direction of this principal stress is almost north-south in eastern Anatolia and east-west in western Caspian sea. This difference in geodynamic regimes in the study area can be attributed to the north Tabriz fault.

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