Analysis and routing of basic parameters of foreshocks and aftershocks in Zohan earthquake, 2012 in south khorasan

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Extended Abstract

Introduction

Analysis of time, location and magnitude of foreshocks and aftershocks has been one of the most important cases for experts in various scientific fields such as: seismology, structural engineering and crisis management, and other interrelated fields. Since this analysis and the result of studies on seismotectonic and cases of earthquakes help us identify the foreshocks and aftershocks with the goal of decreasing losses and nervious stress of the injured community in quake-stricken areas and skilled crisis management. The cause fault of earthquake plays the important role in foreshocks and aftershocks of the earthquake. So, study on fault behaviour is a suitable method for analyzing and routing the basic parameters of foreshocks and aftershocks. Also, foreshocks and aftershock are important parts of any earthquake in a seismic area. The analysis of the basic parameters of the foreshocks is one of the most practical researches for reducing the risk of earthquakes. The identification of behavioral pattern of foreshocks can help researchers detect the active fault conditions for the occurrence of earthquakes in different areas. The present study is concerned with the study of behavioral patterns earthquakes, foreshocks, and aftershock of

Zohan earthquake. Experience of large aftershocks in different parts of the world indicates that, following earthquakes and depending on seismic-tectonic conditions, large aftershocks are likely to occur in the earthquake-effected zone, which will aggravate the damage caused by earthquakes (Omi et al., 2013). The main factor contributing to the worsening of damage caused by aftershocks is the performance of structures that are weakened but not destroyed by main earthquakes and are, thus, highly likely to be destroyed by large aftershocks (Saket and Fatemi Aghda, 2006).

Material and methods

The present paper makes use of data collected in a real earthquake and similar expriences in other earthquakes for presenting a practical pattern for predicting primary earthquake patterns, determining the location, magnitude, and time of aftershocks. The target of this case is decreasing the effects of earthquake. To this end, we used the results from studies on basic parameters of foreshocks and aftershocks of Zohan earthquake, and 2012 earthquake in South Khorasan province. The rationale for selecting the aforementioned studies is: location of event, the Zohan earthquake, had been identificated as an area with high risk for the occurrence of earthquakes, although there has been no wide-scale earthquake in this area in the last two decades. These conditions are important causes for more concentrated studies on this area because there is a high chance for wide-scale earthquakes striking this area.

Result and Discussion

In this part of research, we conduct a study on the location, magnitude and depth of foeshocks. Some of the world-wide research suggested that these data can help to predict the time of mainshocks. Studies conducted on the variations of frequency in foreshocks can follow this goal.

In this paper, the available statistical data such as periodical variations of seismicity in the weeks leading up to the main shock can be used as a tool for estimating the approximate time of a future important earthquake. The

weekly variations of seismicity before Zohan earthquake indicate a relative increase and then decrease within a 100 km radius around the epicenter of the main shock.

Table 1. Variations of frequency of foreshock based magnitude before Zohan earthquake

Week before main shock	Frequency of foreshock in the Radius of 100Km from main shock	Frequency of foreshock(with M>2.5) in the Radius of 100Km from main shock
6	0	0
5	1	1
4	1	0
3	2	0
2	5	3
1	2	0

Studies on numerous earthquakes in Iran and other regions in the world show that the distribution of aftershocks can be related to fault type or the direction of principal stress (Saket and Fatemi Aghda, 2006) and (King et al., 1994). Whereas maximum Coulomb stress change is related to maximum principal stress in earthquakes, the concentration of aftershocks can coincide with the direction of maximum principal stress (σ_1) of the causative fault in mainshock. Considering the direction of maximum principal stress and its adaptation to the scattering of aftershocks, the above hypothesis is confirmed.

Also studies on frequency changes and seismic quiescence of small aftershocks help us in predicting future aftershocks. The results the of presented research by Itawa (2008) on the World earthquake catalogue suggest that seismic quiescence theory is true for different regions of the world. Based on the results of the study mentioned above, this case can be used as a tool for predicting large aftershocks in Zohan earthquake.

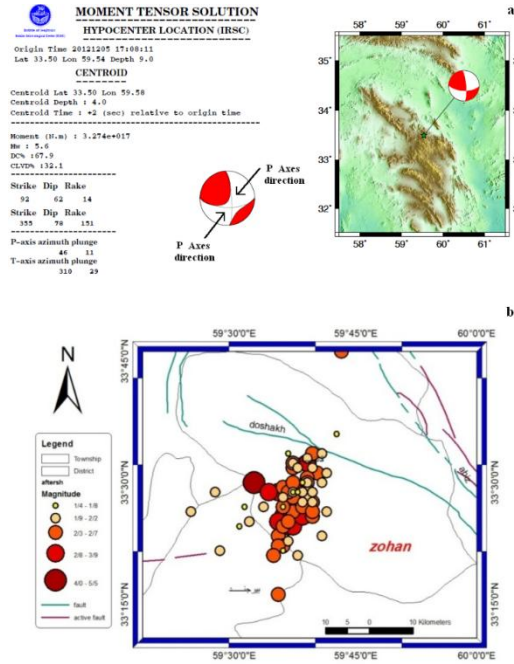

Figure 1. Adaptation of direction of maximum principal stress with scatering of the aftershocks of Zohan earthquake. a: direction of maximum principal stress (σ_1) of the causative fault in mainshock. b-scaterring of the aftershocks

Table 2. Seismic sequience versus magnitude of aftershocks

Row	Seismic Quiescence for aftershocks	Aftershock Magnitude	Data and Time of aftershocks
1	13	3.0	2012/12/05 17:21:03
2	36	3.4	2012/12/05 17:57:03
3	161	3.1	2012/12/05 20:38:09
4	3906	3.9	2012/12/08 13:44:19

In addation, frequency of aftershocks and certain time distance (seismic quiescence) between their can use precursors for detecting the time of large aftershocks. The relevant analysis in this study showed that methods such as: time series beside seismic quiescence can help in conducting a more accurate time forecast of large aftershocks.

Conclusion

- The results of this research suggest that we can identify some of the charactristics of the main shock by focusing on location, magnitude and depth of foeshocks.
- In Zohan earthquake, the direction of maximum principal stress is adpated to the scattering of aftershocks, and this case suggests that there is a specific relationship between them.
- The relevant analysis in this study showed that the methods such as: time series beside seismic quiescence can help conduct a more accurate time forecast of large aftershocks.

Keywords: Zohan earthquake; Routing aftershock; Foreshock; Seismic quiescence; Causative fault; Maximum main stress; Risk management

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