Two source faults of Ahar-Varzaghan Earthquakes, August 11, 2012, NW- Iran

دو گسل مسبب زمینلرزه‌های اهر – ورزقان، ۲۱ مرداد ۱۳۹۱، شمال غرب ایران

Sayyed Keivan Hosseini

سید کیوان حسینی

Earthquake Research Center, Ferdowsi University of Mashhad, Iran

k-hosseini@um.ac.ir

2012-08-18

Abstract

In this study, I proposed the causative faults of Ahar-Varzaghan double earthquakes, August 11, 2012 (mb 6.2 and 6.0). Epicentral distribution of 300 aftershocks located by Iranian seismological center during four days after the main events, show a nearly E-W trend which is compatible well with one of the nodal planes of focal mechanisms of each related main shocks. Two preexisting linearity in the region which covered by the aftershocks distribution were good reason to assume them as the two causative faults. The strike of these faults has a good coincidence with the strike of the nodal planes obtained by the fault plane solutions of Harvard University. Also, the dip angle of the fault planes and the hypocentral locations of the main shocks both confirm the right surface trace of the seismic faults of Ahar – Varzaghan earthquakes.

چکیده

در این تحقیق، گسل‌های مسبب زوک زمینلرزه‌های اهر – ورزقان، ۲۱ مرداد ۱۳۹۱، با بزرگی ۶/۲ و ۶/۰ در مقیاس امواج درونی زمین را معرفی کرده‌ایم. توزیع کانون‌های سطحی ۳۰۰ پیلزله‌که توسط مرکز لرزه‌ها در نزدیکی کشور در طول چهار روز اول پس از زلزله‌های اصلی نشان دهنده یک راستای تقیبی شرقی - غربی می‌باشد که با امتیاز دادن جزئیات گرفتار حاصل از حل مکانیزم کانون‌های پیش‌بینی شده‌ای از زلزله‌های هامخوانی خویشی را نشان می‌دهد. حضور دو خط واره از قبل موجود در منطقه که با توزیع کانون‌ها در سطحی پیلزله‌ها پوشیده می‌شوند، می‌تواند دلیل خویشی برای توجه گرفتن آنها به عنوان گسل‌های مسبب این دو زمینلرزه باشد. امتیاز داده‌های داده‌های این دو گسل تداخل خویشی با امتیاز دادن جزئیات گرفتار همچنین، مقادیر زوایای شبیه صفحات گسلی و موقعیت‌های کانون غمی زلزله‌های اصلی، با تأیید کننده موقعیت صحیح اثر سطحی گسل‌های مسبب زمینلرزه‌های اهر – ورزقان می‌باشد.
Proposed seismic faults

Two relatively large shallow earthquakes struck NW-Iran, about 60 and 50 km northwest of Tabriz city, on August 11, 2012. It caused about 306 dead and 3037 wounded people (Press TV, reported from the health minister of Iran). The first earthquake (mb 6.2) occurred at 16:53 in local time and the second one (mb 6.0) happened with about 11 minutes later (Tables 1 & 2).

To determine the trace of the seismic faults in the region, 300 aftershocks located by Iranian seismological center during August 11 to 14, were overlaid on satellite imagery. The epicentral locations of the main shocks and aftershocks distribution (IRSC bulletin) (Fig.1) show that, the recent large earthquake in Iran, Ahar-Varzaghan earthquake, may have other source(s) than Tabriz and Ahar faults which are two main active faults in NW-Iran. The strike of the earthquake fault(s) seems to be nearly E-W in contrast of NW-SE strike of Tabriz and Ahar faults. Using satellite images I found two lineaments that fell inside of the aftershock region and also their strike surprisingly had a good coincidence with the trend of them. The double earthquakes occurred by activation of two nearly parallel faults (No. 1 and 2 in fig.1). The fault plane solutions of these earthquakes
(GCMT catalogue), have a good compatibility with the location of hypocenters and the strike of proposed seismic faults (Table 3).

Table 3: The source parameters obtain by the fault plane solutions of the two events (Harvard GCMT) and the results of this study.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>GCMT1</th>
<th>Proposed Fault1</th>
<th>GCMT2</th>
<th>Proposed Fault2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strike</td>
<td>82</td>
<td>87</td>
<td>256</td>
<td>261</td>
</tr>
<tr>
<td>Dip</td>
<td>89</td>
<td>-</td>
<td>67</td>
<td>-</td>
</tr>
<tr>
<td>Slip</td>
<td>164</td>
<td>-</td>
<td>135</td>
<td>-</td>
</tr>
<tr>
<td>Length (km)</td>
<td>-</td>
<td>26</td>
<td>-</td>
<td>28</td>
</tr>
</tbody>
</table>

The location of the first event may be incorrect due to its uncertainty and should move about 3.5 km toward south to match well with its mechanism and the position of fault trace 1. The mechanism of the first event shows a right lateral strike slip faulting while for the second one the reverse motion component is dominant. Considering the tectonics of the region, we may conclude that these two faults are branches of a main strike slip fault at the depth of more than 10 km (Positive flower structure). Sattar-Khan Dam, one of a main structure in earthquake region is in the way of fault trace 1. The axes of this dam have only about 1.3 km distance southward from the fault 1 which is passed through its lake (Fig. 2).
Figure 1: Distribution of 300 aftershocks of Ahar - Varzaghan double earthquakes. Numbers 1 & 2 refers to the causative earthquake faults and their mechanisms. Red stars show the epicenters of main shocks located by IRSC (Iranian Seismological Center). Also the P and T axes of each earthquake are shown.
Figure 2: Satellite image (Google maps, 2012) of study area overlaid by the proposed causative faults of Ahar – Varzaghan earthquakes (red lines) and the location of some important cities (large rectangle) and villages (small rectangles). The location of SattarKhan Dam is shown by a triangle around the center of the image and about 1.3 km south of fault 1.

References

Global Centroid Moment Tensor catalogue (GCMT), http://www.globalcmt.org/CMTsearch.html

