Seismicity and Seismotectonic in the Strait of Hormuz

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Abstract

The Iranian plateau lies along a broad zone of deformation that forms part of Alpine-Himalayan orogenic belt. It located between Arabian plate in southwest and Eurasian plate in northeast. Neotectonic activities and seismotectonic parts effects at each other produce a great seismicity in Iran. The Strait of Hormuz region was bounded by latitudes 26.00ºN – 29.50ºN and longitudes 55.00ºE - 59.00ºE, in south of Iran. This region located between three seismotectonic provinces (Zagros, Makran and Central-East Iran). In this article for study of seismicity and seismotectonic in the Strait of Hormuz region is used modern instrumental earthquake data from International Seismological Centre (ISC) catalog, Harvard Centroid Moment Tensor (CMT) catalog and historical earthquakes catalog (Ambraseys & Melville, 1982). Shuttle Radar Topography Mission (SRTM) data is used for topography map. Geographic Information System (Arc-GIS) and Analysis of Earthquake Data (Zmap) softwares are used in this research. Analyses of seismicity in the Strait of Hormuz region indicate active seismicity in this region. The most of modern instrumental earthquakes have magnitudes about 4.0 to 4.5 in m_b scale. Magnitude 4.3 has most frequency. Earthquakes epicenters compression and the greatest earthquakes (m_b=6.2, 6.1, 6.0) were recorded in the area that located in the Zagros seismotectonic province. The earthquakes were occurred in crust. In the area of the Makran seismotectonic province, the most magnitude is m_b=5.5 and subduction phenomenon is active. In the area of the Central-East Iran seismotectonic province, many earthquakes were recorded in vicinity of Bam fault that the most magnitude is m_b=5.9. Bandar Abbas and Qeshm cities have high seismicity activity in the Strait of Hormuz region because the greatest earthquakes (modern instrumental, early instrumental and historical) were recorded in environs of these cities.

Keywords: *Seismicity, Seismotectonic Province, Strait of Hormuz, ISC Catalog.*

1- Introduction

The Iranian plateau is a relatively wide zone of compressional deformation along the Alpine-Himalayan active mountain belt, which is entrapped between two plates, the Arabian plate in the southwest and the Eurasian plate in the northeast. Its deformation is related to the continuing convergent movement between the Arabian plate and the Eurasian plate, by north-northeastward drift Arabian plate against Eurasian plate. Lithospheric movement has led Iran to be one of the seismically active areas of the world and frequently affected by destructive earthquakes, imposing heavy losses in human lives and widespread damage. Studied region is the Strait of Hormuz region that bounded by latitudes 26.00ºN – 29.50ºN and longitudes 55.00ºE - 59.00ºE, in south of Iran (Figure 1).

2- Geology of Region

The Strait of Hormuz region included area that located between three seismotectonic provinces (Zagros, Makran and Central-East Iran). In the area that located in the Zagros

seismotectonic province, bedrock was continental crustal type and included two distinctive structures (High Zagros fault and Main Zagros Reverse fault). In this area, the sequence of parallel anticline and syncline was located that have an east-west trend. Because of continuous convergent between Iranian plateau and Arabian plate, effective factors folding of the Zagros mountains are still active. So, upward movements in the Zagros mountains are associated with crustal shortening and energy centralization. Energy freeing is almost constant. In this area, numerous earthquakes were occurred. Some of these earthquakes were caused destruction and human casualties. Some of the major faults in this area are Main Zagros Reverse Fault (MZRF), High Zagros Fault (HZF), Zagros Foredeep Fault (ZFF) and Mountain Front Fault (MFF).

In another area that located in the Makran seismotectonic province, oceanic crust of Arabian plate driven down continental crust of Iranian plateau by phenomenon of Subduction. So type of bedrock is oceanic crust. Subduction phenomenon is active now. Structures have east-west trend. Minab fault system is the most important system in this area that caused considerable deformation in its adjacent structures. Jiroft and Sabzevaran faults were located in this area.

The Central-East seismotectonic province was located in the northern and northeastern areas of the Strait of Hormuz. The type of bedrock is continental crust that may be transformed ultramafics. Golbaf, Bam and Jebal Barez faults are important faults in this area.

3- Seismicity and Seismotectonic of Region

Seismotectonic map of studied region is showed in figure 2. Earthquake parameters (epicenter and magnitude) for modern instrumental earthquakes are according to International Seismological Centre (ISC) catalog from 1964/03/11 to 2007/10/18. In this interval time 1147 earthquakes were recorded with magnitude from 3.1 to 6.2 in m_b scal. The greatest modern instrumental earthquakes recorded in this region, were showed in tables 1, 2 and 3 for each seismotectonic province. Earthquakes epicenters compression in the Strait of Hormuz region was located in the Zagros seismotectonic province. Earthquakes focal mechanisms were gotten from Harvard Centroid Moment Tensor (CMT) catalog and the most of them are strike-slip and reverse faulting that adapted with local faults. Earthquake parameters for early instrumental and historical earthquakes are according to Ambraseys & Melville (1982) catalog. The greatest early instrumental and historical earthquakes were showed in tables 4 and 5. In this region, 12 early instrumental earthquakes were recorded from 1900 to 1964 in M_s scale. The greatest one was occurred in 1902 with M_s=6.4. Also 7 historical earthquakes were recorded before 1900. The greatest one was occurred in 1497 with M_s=6.5.

Figure 3 shows Frequency of modern instrumental earthquakes versus magnitude. The most of earthquakes have magnitudes about 4.0 to 4.5. The most frequency is associated with m_b=4.3. Figure 4 shows depth distribution of modern instrumental earthquakes. In this figure, five earthquakes with the greatest magnitudes were denoted. The most of recorded earthquakes are in low focal depths, but in southeastern of region, focal depths are increased in upper latitudes.

4- Conclusion

The Strait of Hormuz region is very active in seismicity. With ISC catalog, the most of earthquakes have magnitudes about 4.0 to 4.5 in m_b scale and the most frequency is associated

with m_b=4.3. The greatest earthquakes (m_b=6.2, 6.1, 6.0) were recorded in the area of the Zagros seismotectonic province. The most of earthquakes were accrued in this area. So this area has the greatest seismicity activity. The most of earthquakes are in low depths and they were occurred in crust. In southeastern of the Strait of Hormuz region (Makran seismotectonic province), focal depths are increased in upper latitudes. Therefore subduction phenomenon is active in this area. In other area that located in the Central-East Iran seismotectonic province, many earthquakes were occurred in the vicinity of Bam fault.

The greatest earthquakes were recorded in environs of Bandar Abbas and Qeshm cities. Therefore these cities have high seismicity activity.

References

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Table 1: The greatest modern instrumental earthquakes recorded in the Zagros seismotectonic province.

Event	Time (yr)	Latitude (deg)	Longitude (deg)	Magnitude (m_b)	Epicenter
1	1977	27.59	56.38	6.2	45 km in north of Bandar Abbas
2	1990	28.23	55.47	6.1	43 km in west of Hajiabad
3	1999	28.28	57.20	6.1	68 km in southwest of Jiroft
4	1971	28.30	55.61	6.0	30 km in west of Hajiabad
5	2005	26.75	55.83	6.0	50 km in southwest of Qeshm

Table 2: The greatest modern instrumental earthquake recorded in the Makran seismotectonic province.

Event	Time (yr)	Latitude (deg)	Longitude (deg)	Magnitude (m_b)	Epicenter
1	1983	26.89	57.59	5.5	57 km in south eastern of Minab

Table 3: The greatest modern instrumental earthquake recorded in the Central-East Iran seismotectonic province.

Event	Time (yr)	Latitude (deg)	Longitude (deg)	Magnitude (m_b)	Epicenter
1	2003	28.97	58.30	5.9	15 km in southwest of Bam

Table 4: The greatest early instrumental earthquakes recorded in the Strait of Hormuz region.

Event	Time (yr)	Latitude (deg)	Longitude (deg)	Magnitude (M_s)	Epicenter
1	1902	27.00	56.00	6.4	27 km in west of Qeshm
2	1949	27.22	56.42	6.3	15 km in east of Bandar Abbas
3	1930	27.88	55.02	6.1	100 km in southwest of Hajiabad

Table 5: The greatest historical earthquakes recorded in the Strait of Hormuz region.

Event	Time (yr)	Latitude (deg)	Longitude (deg)	Magnitude (M_s)	Epicenter
1	1497	27.20	56.30	6.5	3 km in east of Bandar Abbas
2	1897	26.90	56.00	6.4	27 km in west of Qeshm

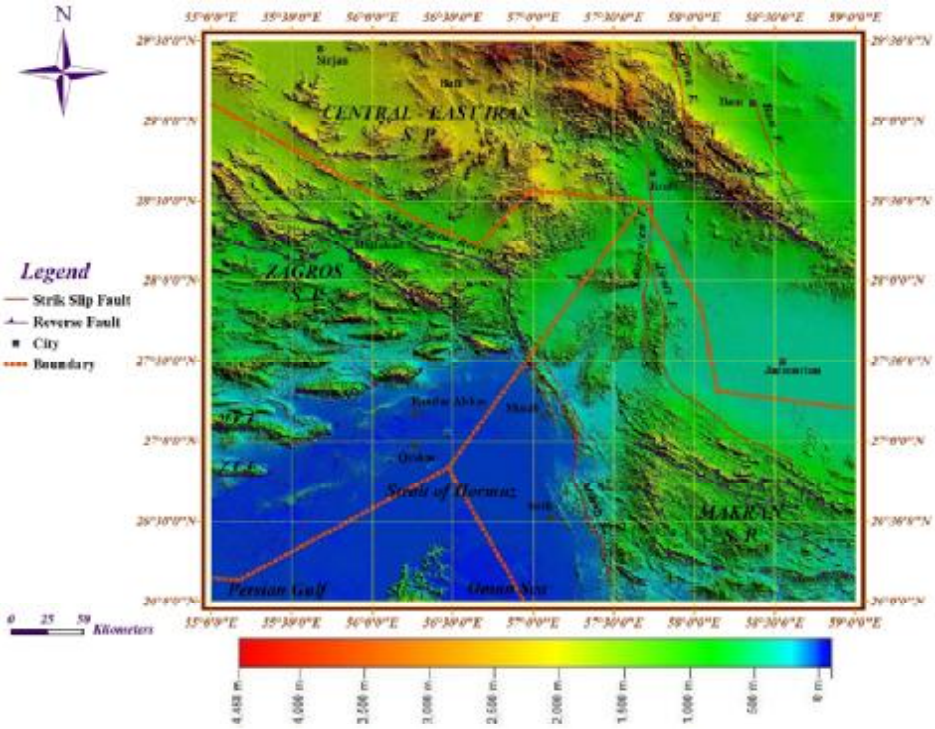

Figure 1: Topographic map of the Strait of Hormuz region by SRTM data.

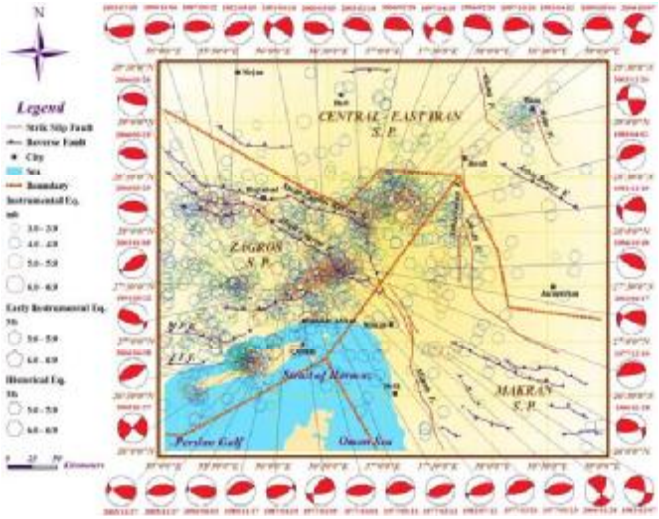

Figure 2: Seismotectonic map of the Strait of Hormuz region.

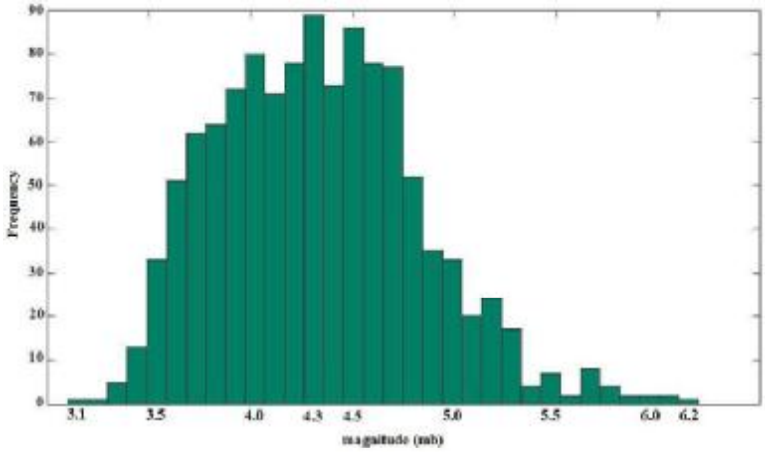

Figure 3: Modern instrumental earthquakes frequency versus magnitude.

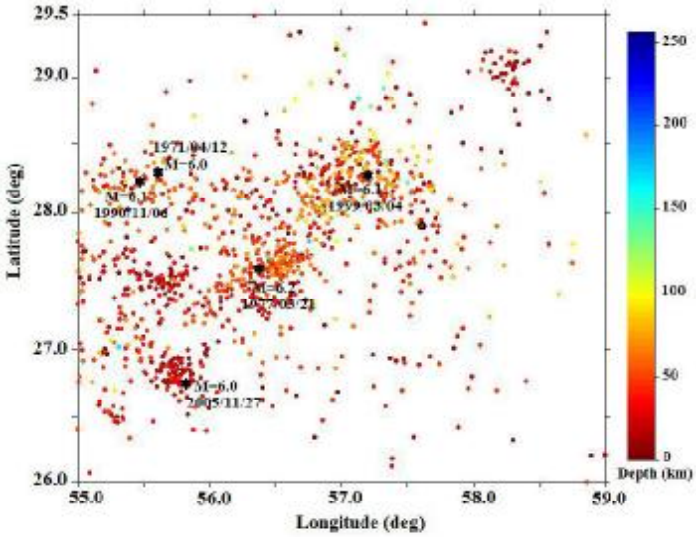

Figure 4: Depth distribution of modern instrumental earthquakes in the Strait of Hormuz region.