

## **MACROSEISMIC EPICENTRES OF IRANIAN EARTHQUAKES**

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### **ABSTRACT**

Examination of instrumental data of Iranian earthquakes, especially the early 20th century events, reveals considerable deficiencies in the determination of hypocentres, magnitudes and focal depths for the earthquakes. The study of macroseismic data is essential for the understanding of seismicity in the country, choosing the best data, and minimizing the mislocations of earthquake epicentres. In this study the macroseismic epicentres of the large earthquakes (historical and 20th century), together with two maps, are given, for further research into the seismotectonics of Iran.

### **INTRODUCTION**

The Iranian plateau has long been known as one of the seismically active areas of the world and it frequently suffers destructive and catastrophic earthquakes that cause heavy loss of human life and widespread damage. Since prediction of the time and magnitude of future earthquakes is at present impossible, study of the seismic history of the country is of great importance. The relative simplicity of the pattern of distribution of epicentres, and its relationship to the geological features and the tectonic history of the area, is very important.

There is little published information on earthquakes prior to 1900. More information is to be found between the years 1900 to 1930 from newspapers and recording stations then existing. From 1930 to the present, the progress of technology, the increase in the number of seismic stations, and the improvement of newspapers and other news media, have gradually resulted in more reliable and uniform information.

The earthquakes for the whole instrumental period of Iran (1900-1977) are not covered by any single set of determinations. Various seismological centres sometimes recorded different epicentral determinations for the same event. No single earthquake catalogue lists all the events in Iran, particularly the ones of lower magnitudes. There

are also frequent discrepancies in the epicentre location, magnitude, focal depth and origin time. Due to the lack of adequate seismological networks throughout the world prior to 1930, instrumental data is neither accurate nor complete. For data prior to 1960, the latitudes and longitudes are not very accurate, and the origin time not better than five seconds. The accuracy for most hypocentres prior to 1960 is within approximately one-half degree of latitude and 30 to 50 km of focal depth. Since 1960, most hypocentres have been routinely determined by computer, with an accuracy within approximately one-quarter degree of location and 20–30 km of focal depth. McKenzie (1972) stated that there is a large uncertainty in the determination of the depth of foci and that the focal depths could be in error by at least  $\pm 30$  km.

The Silakhor (Iran) earthquake of 23 January 1909 of magnitude 7.4, which caused between 5,000 to 6,000 deaths and was associated with a fault break over 40 km long, is an interesting example, where the differences between macroseismic and instrumental positions of epicentre are more than 100 km. Several attempts were made at that time to calculate the instrumental epicentre, resulting in several locations all at some distance from the true epicentre. The first epicentre was calculated at  $36^{\circ}\text{N}$ ,  $56^{\circ}\text{E}$  on the basis of arrival times at the stations of Irkutsk, Pulkovo and Tibilisi (Golitsin 1909 a). This was subsequently modified to  $33.9^{\circ}\text{N}$ ,  $48.8^{\circ}\text{E}$  when the press reported destruction in southwestern Persia (Golitsin 1909 b). Later, after the macroseismic effects had been investigated in the field, it was decided to place the epicentre at the mid-point between Borujerd and Esfahan, i.e. at  $33.3^{\circ}\text{N}$ ,  $50.2^{\circ}\text{E}$  (Shtelling 1910). The correct macroseismic epicentre (taken as the centre of the area of maximum destruction) is approximately located at  $33.5^{\circ}\text{N}$ ,  $49.0^{\circ}\text{E}$ , (Tchalenko et al. 1974; Tchalenko and Braud 1974; Ambraseys and Moinfar 1973; Berberian 1976).

In recent years many recalculations have been done to minimize the mislocation of the Iranian earthquake epicentres (Nowroozi 1971, 1976, McKenzie 1972, Nabavi 1972, Dewey and Grantz 1973). Comparison of the positions of the reported instrumental data, relocated epicentres and the macroseismic epicentres of the events in Iran, shows that no great improvement has been achieved in epicentre location and focal depth determination.

Improved assessment of earthquake risk in Iran cannot be achieved by relying solely on the local or world-wide seismograph data available. Despite being one of the most active seismic countries in the world, there are only six seismological stations regularly working in Iran to date: at Tehran, Tabriz, Kermanshah, Mashhad, Shiraz and Sefid Rud. The average distance between adjacent stations exceeds 500 km, which makes it very difficult to study those earthquakes that are not sufficiently strong to be recorded by international agencies situated outside Iran. Hence twentieth century epicentre maps may be dangerously unsuitable for the purpose of subdivision of the country into active and non-active regions. Known historical (pre 1900) earthquakes are so few as to be of little help. The five first class seismic stations at present existing in Iran are insufficient to locate with accuracy small to moderate local earthquakes, which can be equally as damaging as larger shocks.

Further, the distribution of stations around the country is such that for earthquakes in the southern part of Iran, control from the south and southeast quadrangles is very limited, so that the use of teleseismic arrival time data for the determination

of focal locations on a routine basis is unlikely to give results more reliable than those computed by USCGS during the last ten years. Ambraseys et al. (1972) stated that the use of computer techniques for handling teleseismic network data based solely on arrival-time does not solve the problem of depth determination, which still remains an open question in seismicity studies of Iran.

The only possible improvement in the relocation of earthquakes in Iran would be the use of macroseismic data for fixing initial iteration co-ordinates and the study of suitable records from distant stations for relative depth characteristics and classification of shocks. The identification and assessment of macroseismic effects, therefore, both contributes to the information available and is invaluable, in combination with the instrumental data, in reducing bias in the determination of seismic parameters for earlier events.

Ambraseys (1976) demonstrated that routine computer relocations of pre-1950 epicentres in Iran seldom result in new positions which are much more reliable than the original instrumental locations. He added that this is because the early arrival data are generally of such poor accuracy and azimuthal distribution that the epicentre can be resolved only to the average limits given by the data. The resolution of focal depth is likely to be even worse.

In this study, I present the macroseismic epicentres (taken as the centre of the area of maximum destruction) of some historical (pre 1900) and major 20th century earthquakes of Iran, which give a better picture of the seismotectonics of Iran and help in joint epicentre determination programmes to minimize bias (see Tables 1 and 2; Maps No 1 and 3). Of course the true source of the earthquake may not be the central part of the macroseismic epicentre, but at least such a method would not be subject to the large mislocations which are possible with instrumental relocations. It would be interesting to reconstruct the macroseismic epicentres of the all major earthquakes in Iran, but some of them are missing. For the historical earthquakes (recorded before the instruments were installed, i.e., before 1900), only very approximate locations of epicentres are available. These data are generally very unhomogeneous in space as well as in time. This is also true for the earthquakes of the beginning of this century. Only scanty data about some major shocks are available, since there was no adequate coverage of the country by suitable instruments. In this way, many shocks have gone unrecorded.

The research for completing the macroseismic data, together with a relocation programme based on a joint epicentre determination technique using macroseismic data, is already in progress at the Tectonic and Seismotectonic Research Section of the Geological Survey of Iran. It is hoped that this research will fill a major gap in the seismotectonic studies in Iran.

The macroseismic epicentres of the important historical and 20th century earthquakes of Iran are plotted on maps No 1 and 3: "*Historical Seismicity (pre 1900) Map of Iran*" and "*Maximum Intensity of Earthquakes in Iran (1900-1977)*".

On the "*Historical Seismicity (pre 1900) Map of Iran*", the major known historical earthquakes of the country are plotted and are divided into two categories: a - earthquakes with approximate estimated magnitude equal to and greater than 7 (on the Richter Scale), and b- earthquakes with approximate estimated magnitude equal to

or greater than 6 and smaller than 7. The date of each individual earthquake is given on its approximate macroseismic epicentre location.

On the first "*Map of Maximum Intensity of Earthquakes in Iran (1900-1977)*" the maximum intensities of some of the twentieth century earthquakes are given, based on the Modified Mercalli Intensity Scale. The maximum intensity of earthquakes on this map are divided into six categories ranging from V to X (MMI).



**TABLE 1. Major Historical (Pre-1900) Earthquakes in Iran and their approximate Macroseismic Epicentres**  
By : M. Berberian

Date	Macroseismic Epi.	Mb >	Epicentral Region	Reference
4th Century B.C.			Rey, Eivan-c-Kay destroyed	Ambraseys 1974
735 A.D.	39.77N, 45.51E		NW Zangezur	Schmit 1974
743 Spring	35.33N, 52.06E		Eivan-c-Kay destroyed	Ambraseys 1974
810	31.02N, 60.55E	6.5	Sistan region (E. Zabol)	Ambraseys 1976
851	40.12N, 44.45E		South Yerevan	Schmit 1974
855	35.60N, 51.43E		Rey destroyed	Ambraseys 1974
856 Dec. 22	35.90N, 54.05E	6.5	Damghan-Kumis destroyed	Ambraseys 1974
856 Dec.	34.60N, 58.13E		Tun (Ferdows) destroyed. Damage from Neyshabur to Qaen (VIII)	Ambraseys et al., 1969
858	38.08N, 46.26E		Tabriz destroyed (VIII)	Wilson 1930
858	39.95N, 44.20E(?)		NE Ararat, Araxes River	Schmit 1974
863	39.95N, 44.20E(?)		NE Ararat, Araxes River (VII)	Schmit 1974
864 Jan. 15-Feb. 12			Rey partly destroyed	Ambraseys 1974
869	39.95N, 44.20E(?)		NE Ararat, Araxes River (VIII)	Schmit 1974
872 Jun. 21	33.17N, 47.40E		Seimareh, Dareh-Shahr destroyed	Tabari
893	39.95N, 44.20E(?)		NE Ararat, Araxes River (VIII)	Schmit 1974
893-4	38.28N, 48.30E		Ardabil destroyed (X)	Ambraseys 1961
898-9			Tehran Valley (north Rey)	Ambraseys 1974
906	39.97N, 45.41E		NW Zangezur	Schmit 1974
912 Apr.-May	34.58N, 47.80E		Dinavar destroyed	Ambraseys 1974 Tchalenko, Braud 1974

Date	Macroseismic Epi.	Mb>	Epicentral Region	Reference
942-3			Nessa (Dareh Gaz? or south of Eshghabad) destroyed	Ambraseys et al. 1972
956-7			Hamadan (and Assadabad?) damaged	Ambraseys 1974
957			Qom districts damaged	Ambraseys 1974
958 Feb. 23	36.22N, 51.12E	6.5	Rey, Tehran, Taleqan destroyed	Ambraseys 1974
978 Jun. 17	27.66N, 52.33E		Siraf (Taheri) destroyed	Razani, Lee, 1973
1008 April 1008	34.58N, 47.80E		Dinavar destroyed Inundation caused by earthquake at Siraf Port	Ambraseys 1974 Razani, Lee, 1973
1042 Aug. 21 1052	38.0 N, 46.5 E 30.58N, 50.33E		Tabriz destroyed (VIII) Arajan (40Km E of Behbahan) destroyed	Nasser Khosrow Razani, Lee, 1973
1052-3	36.21N, 57.66E		Sabzevar (Beihaq) destroyed	Ambraseys et al., 1973
1058	30.58N, 50.33E		Arajan destroyed	Razani, Lee, 1973
1058			W. Marivan	
1119 Dec. 10	36.28N, 50.00E	6.5	Qazvin destroyed	Ambraseys 1974
1176-7			Rey-Qazvin region destroyed	Ambraseys 1974
1208	36.35N, 57.65E ?	6.5	Neishabur (and Firrim) destroyed	Ambraseys 1961 1974
1237			Dasht-e-Bayaz-Gonabad region destroyed	Ambraseys 1976

1267			Neishabur damaged	Wilson	1930
1272			Tabriz damaged	Wilson	1930
1280			Jurjan (Gonbad Qabus) destructive earthquake, Neishabur-Shadyak destroyed	Wilson	1930
1291			Shiraz damaged	Razani, Lee,	1973
1300	36.78N, 56.00E ?	6.5	Neishabur, Firrim destroyed	Ambraseys	1976
1301	36.16N, 53.41E		Firrim (Farim, SE Sari) destroyed	Ambraseys	1974
1308	39.69N, 46.71E		N. Zangezur	Schmit	1974
1319	39.05N, 44.50E ?		St. Thaddeus destroyed (VII)	Der-Grigorian,	
	or 39.85N, 44.20E			Kleiss	1971
1336 Oct 20-1	34.5 N, 59.6 E	6.5	Khaf destroyed	Ambraseys	1974
1360-1	26.81N, 55.91E		Qeshm Island destroyed	Razani, Lee,	1973
1367	37.30N, 49.66E		Kuchesfahan damaged	Ambraseys	1974
1389	36.20N, 58.80E		Neyshabur destroyed	Ambraseys	1971
1390			Shahr-e-Rey damaged	Ambraseys	1974
1400	37.16N, 50.26E		Rudsar damaged	Ambraseys	1974
1400	27.66N, 54.33E		Lar damaged	Ambraseys et al.,	1972
1440	28.33N, 53.13E	6.5	Karzin destroyed	Ambraseys	1976
1482-3	26.15N, 56.90E ?	6.5	Strait of Hormoz destructive earthquake. Hormoz damaged	Ambraseys	1976
1485 Aug. 14	36.92N, 49.90E	6.5	Alamut-Jenat Rudbar- Dailaman destructive earth- quake (VIII)	Ambraseys	1976
1493 Jan. 10	32.96N, 59.76E	6.5	Nowzad-Mask destroyed	Berberian	1976

Date	Macroscopic Epi.	Mb>	Epicentral Region	Reference
1549 Feb.			Qaen region destroyed (VIII)	Ambraseys 1974
1566	27.68N, 54.33E		Lar destroyed	Ambraseys et al., 1972
1574	51.40N, 33.95E		Fin (Kashan region) destroyed	Ambraseys 1974
1588-9			Shiraz damaged	Razani, Lee, 1973
1608 Apr. 20	36.50N, 50.62E	6.5	Gilan-W.Mazandaran destroyed	Ambraseys 1976
1611 Dec. 09	35.1 N, 58.86E		Dughabad (SE Kashmar) destroyed (VIII)	Wilson 1930
1639			Qazvin region destroyed	Ambraseys 1974
1641 Feb. 05	38.06N, 46.30E		Tabriz, Osku, Khosroshah (IX) destroyed	Berberian 1976
1648 Mar. 31	38.40N, 43.65E	6.5	Van region	Arakel
1665 Jun.			Damavand region destroyed	Ambraseys 1974
1667 Feb. 03	37.16N, 50.01E		Lahijan destroyed	Ambraseys 1974
1670			Lar-Evaz region destroyed	Razani, Lee, 1973
1673 Jul. 30	36.30N, 58.80E ?	6.5	Mashad and Neyshabur partly destroyed (VII)	Ambraseys 1976
1679 Winter			Dasht-e-Bayaz-Gonbad region destroyed	Ambraseys 1976
1679 Jun.	40.40N, 44.50E		North Yerevan (VIII)	Schmit 1974
1683 Nov. 27			Lar-Biriz-Banarud destroyed	Ambraseys et al., 1972
1687 Apr.			Turshiz destroyed, Mashad damaged (VII)	Wilson 1930, Ambraseys et al., 1969



1696 May		St. Thaddeus damaged	Grigorian, Kleiss 1971
1703-4		Kish, Hengan destroyed	Razani, Lee, 1973
1715 Mar. 08	38.41N, 44.16E	South Salmanis (Turkey- Iran border) destroyed	Tchalenko 1977
1721 Apr. 26	38.0 N, 46.5 E	Tabriz destroyed (XI)	Wilson 1930
1727 Nov. 18	38.0 N, 46.5 E	Tabriz destroyed (VIII)	Wilson 1930
1755 Jun. 07	33.98N, 51.45E	Kashan destroyed	Ambraseys 1974
1766 Jun. 09	27.68N, 54.33E	Lar destroyed	Ambraseys et al., 1972
1769-70		Shiraz damaged	Razani, Lee, 1973
1770		Gowdeh (E. Bastak) destroyed	Razani, Lee, 1973
1778	33.98N, 51.45E	Kashan destroyed	Ambraseys 1974
1779 Dec. 27	38.00N, 46.70E	6.5 Tabriz region destroyed (VII)	Ambraseys 1976
1794 Mar. 14	33.98N, 51.45E	Kashan damaged	Ambraseys 1974
1800 (1802) ?	36.20N, 53.35E	6.5 Damavand region destroyed	Ambraseys 1974
1805-6		Babol damaged	Ambraseys 1974
1808 Oct. 09		Dodangeh and E. Mazandaran destroyed	Ambraseys 1976
1808 Dec. 16		Qazvin-Taleqan destroyed	Ambraseys 1974
1809 Dec. 07		Sari-Amol destroyed	Ambraseys 1974
1813		Shiraz damaged	Razani, Lee, 1973
1820		Babol damaged	Ambraseys 1974
1820	29.63N, 52.53E	Shiraz damaged	Sani-al-Dowleh 1298 AH; Shirvani 1315 H, 1338 AH
1823	29.63N, 52.53E	Shiraz destroyed	Sani-al-Dowleh 1298 H; Shirvani 1315 H, 1338 AH

Date	Macroseismic Epi.	Mb>	Epicentral Region	Reference
1824 Jun. 25			Shiraz destroyed, Kazerun damaged (VII)	Wilson 1930
1825 Oct. 24			Shiraz damaged (VII)	Wilson 1930
1830 Apr. 03	36.41N, 54.25E	6.5	Chahardangeh region destroyed Semnan, Damghan damaged	Ambraseys 1974
1830 May 09	35.66N, 52.08E		Damavand town destroyed	Ambraseys 1974
1840 Jul. 02	39.53N, 44.91E(?)		NE Ararat, Araxes River (VIII)	Schmit 1974
	or 39.95N, 44.20E			Tchalenko 1977
1843 Apr. 18	38.58N, 44.91E		Khoy destroyed (VIII)	
1844 Apr. 23			Mianeh, Aghkand, Armaghan-Khaneh destroyed	Ambraseys 1974
1844 May 11	33.65N, 51.33E		Qamsar, Kuhrud, Kamu, Chuken destroyed	Ambraseys 1974
1844 May 12			Esfahan damaged	Ambraseys 1974
1851 Apr. 19			Gavater partly destroyed (VII)	Wilson 1930
1852 Feb. 22			Khabushan (NW Quchan) destroyed (?)	Ambraseys et al., 1972
1853 May 04	29.60N, 52.50E	6.5	Shiraz destroyed (VIII)	Wilson 1930
1853 Jul. 11			Esfahan damaged (VII)	Wilson 1930
1857 Oct. 27	38.33N, 45.40E		Tasuj destroyed (VII)	Wilson 1930
1862 Aug. 13			Kuhrud damaged	Wilson 1930
1863 Dec. 30			Qert, Nir, Nowshah (S. Ardabil) destroyed	Ambraseys 1974
1864 Jan. 02			Bulgavar (SE Ardabil) damaged (VIII)	Ambraseys 1974

1865			Darreh Asu (near Muqam) destroyed	Wilson	1930
1868 Jan. 20	36.33N, 56.33E		Alhak (70 km South of Jajarm) destroyed	Ambraseys et al.,	1971
1871 Dec. 23	37.30N, 58.26E		Quchan destroyed (VIII)	Tchalenko	1975
1872 Jan. 06	37.30N, 58.26E		Quchan destroyed	Tchalenko	1975
1872 Jun.			Hamadan region destroyed	Ambraseys	1974
1872 Sept. 16			Songhor region destroyed	Ambraseys	1974
1879 Mar. 22	37.70N, 47.90E		Bozqush region destroyed (VIII)	Ambraseys	1974
1879 Apr. 02			Bojnurd destroyed (?)	Ambraseys et al.,	1971
1880 Aug.			Bastak, Jonah (21 km SW of Bastak) destroyed	Razani, Lee,	1973
1881 Aug. 28			Khoy damaged (VII)	Sani-al-Dowleh	1298 AH
1883 May 03			Khoy damaged (VII)	Sani-al-Dowleh	1298 AH
1883 Oct. 16			Kangan damaged	Wilson	1930
1883-4			Kish, Hengam destroyed	Razani, Lee	1973
1884 May 19	26.81N, 55.91E		Qeshm, Central part, destroyed (VIII)	Wilson	1930
Before 1889	33.30N, 49.28E		Lake Irene destroyed	Tchalenko, Braud	1974
1890 Jul. 11	36.5 N, 54.6 E	6.5	Tash region destroyed	Ambraseys	1974
1893 Nov. 17	37.15N, 58.33E	6.5	Quchan destroyed (VII-VIII)	Tchalenko	1975
1894 Jan. 17			Additional damage to Qucahn	Tchalenko	1975
1894 Feb. 28			Shiraz damaged	Wilson	1930
1895 Jan. 17	37.15N, 58.33E		Quchan destroyed (VIII)	Tchalenko	1975
1895 Jul. 09	40.0 N, 53.0 E(?)	6.5	Krasnovodsk (southern margin of Turan Plate) destroyed	Tchalenko	1975

Date	Macroseismic Epi.	Mb>	Epicentral Region	Reference
1895 Dec. 25	35.70N, 51.40E		Tehran damaged	Ambraseys 1974
1896 Jan. 02	37.75N, 48.26E		Sangabad (Senjabad) destroyed (VIII)	Ambraseys 1974
1896 Jan. 05	38.53N, 44.96E		Khoy destroyed	Ambraseys 1974
1896	30.33N, 57.08E		Qobeh-e-Sabz (Kerman) destroyed	Wilson 1930
1897 Jan. 11	26.95N, 56.26E		Qeshm town destroyed (VII-VIII)	Berberian 1976
1898 Jan. 15	37.6 N, 54.0 E		Gorgan region damaged, Chikishlar destructive earthquake	Ambraseys 1974

**TABLE 2 . Macroseismic Epicentres of Iranian Earthquakes (1900-1977)**  
**By: M. Berberian**

Date	Time G.M.T.	Macroseismic Epicentre		Mb	H Km	Io MMI	Epicentral Region
		Lat.	Long.				
1902 Feb. 13	093406	40.72N	48.71E	6		VIII+	Shemakha (Caucasus)
1902 Jul. 09	0338	27.08N	56.29E				Bandar Abbas - Qeshm
1903 Mar. 22	1435	31.3 N	56.6 E	6.3		VIII	Ravar
1903 Jun. 24	1656						Bandar Pahlavi
1903 Sept. 25	0120	35.23N	58.45E	6.2		IX	Turshiz (Kashmar)
1903 Sept. 30	35.2 N	58.2 E				VII	Turshiz region
1903 Oct. 17	35.1 N	58.0 E				VIII	Turshiz region
1903 Nov. 03	35.2 N	58.2 E				VII	Turshiz region
1903 Nov. 15		28.35N	53.11E				Qir
1903 Dec. 17		32.5 N	58.2 E			VI	Turshiz region
1904 Nov. 09		37.4 N	59.6 E	(Approx.)			Kaakhka (USSR)
1905 Jan. 09	0617	33.1 N	50.0 E	6.3		VIII	Faridan
1905 Apr. 25-27		27.36N	56.26E				Isins-Genu
1907 Mar. 29	2057	34.7 N	60.2 E	6.2		VIII	Bakharz
1909 Jan. 23	024818	33.5 N	49.0 E	7.4		X	Silakhor
1909 Apr. 11	0402	33.2 N	49.4 E	5.6		VII	Arjanak
1909 Nov. 01	0916	33.2 N	49.4 E	5.1		VI+	Arjanak
1911 Apr. 18	181436	31.1 N	56.7 E	6.7	50	VIII	Ravar
1916 Feb. 11		36.0 N	59.5 E			VII	S. Mashad
1917 Jul. 15	175830.6	33.4 N	45.9 E	6	9-33	VIII	Turshaq (Iraq)
1918 Mar. 24	231457			5.75-6		VII	Bajestan region

Date	Time G.M.T.	Macroseismic Epicentre		Mb	H Km	Io MMI	Epicentral Region
		Lat.	Long.				
1923 Feb. 04-05		37.5 N	57.3 E				Bojnurd
1923 May 25	222125	35.21N	59.10E	5.6	33	VIII	Torbat Heydariyeh (South)
1923 Sept. 17	070904	37.7 N	57.3 E	6.5	14	VIII	Qaleh Jaq, Bojnurd
1923 Sept. 22	204733	29.65N	56.50E	6.9	33	VIII	Qaleh Asgar
1924 Feb. 19	065954	38.90N	47.60E?	5.75-6	33-50	VII	NE Ahar
1925 Dec. 10	045940	37.41E	57.86N	5		VI	Shirvan
1925 Dec. 14		34.50N	58.16E			VIII	Bajestan region
1925 Dec. 18	055320	28.54N	51.21E	5.6		VII	Ahram
1927 May 09	103140			6.3	16-33	VIII	Dowlatabad
1927 Jul. 07	200621			6.25-6.5	N-100		Baluchestan (Zaboli region)
1927 Jul. 22	035454	35.2 N	54.2 E	6.5	33	VIII	Reshm
1928 Mar. 08	181354	31.46N	60.10E	5.25	33	VII	Nehbandan
1928 Aug. 21	190152	36.20N	58.83E	5.25	33	VII	Neishabur
1929 May 01	153722	37.8 N	57.8 E	7.1	33	X	Baghan-Germab
1929 May 03	1620	37.93N	57.66E	5.0	13	VI	S. Germab
1929 May 13	0632			4.5	12	V	Prokhlandoy (USSR)
1929 Jul. 15	074407	31.6 N	50.3 E	6.5	N-65	VIII	Londeh
1929 Sept. 03	120732			6.5	N-110		Baluchestan
1930 May 06	070322	38.15N	44.75E	5.5	N	VII	Salmas foreshock
1930 May 06	223427	38.2 N	44.7 E	7.4	N	X	Salmas
1930 Aug. 23	105318			6-6.25	N	VIII	
1930 Oct. 02	153312	35.78N	51.96E	5.5	N	VII	Ah-Mobarakabad
1931 Apr. 27	165054	39.45N	46.00E	6.5	15	VIII	Zangezur
1933 Nov. 28	110924	32.01N	55.86E	6.25	33	VIII	Behabad

1934 Feb. 04	132720			6-6.25	N	VIII	Kazerun region
1934 Jul. 13	221024			6.9-7	N-80	VIII+	
1935 Mar. 05	102637			5.8-6	N	VIII	Alborz
1935 Apr. 11	231449			6.75	N	VIII	Alborz (Kiassar region)
1936 Jun. 30	192607			6-6.25	N	VIII	Sarbisheh region
1937 Jan. 07	204742	40.23N	44.30E	4.25		VII	Yerevan
1939 Nov. 04	101519			5.75-6	N	VII+	
1940 May 04	210155			6.4	N	VIII	
1941 Feb. 16	163859	33.33N	58.91E	6.25	N	IX	Chahak
1941 Apr. 13		28.66N	54.33				Dowlatabad (SW Darab)
1943 Feb. 06	023558			6.25	N	VIII	Baluchestan
1944 Apr. 05	180602	36.7 N	54.5 E	4.5-5.4	13	VIII	Gorgan
1945 May 11	201728	35.18N	52.40E	4.75	N	VII	Garmsar
1945 Jul. 21	013321	38.47N	43.3 E	4.8	N	VII	Van
1945 Jul. 29	085649	38.47N	43.3 E	4.9	N	VII	Van
1945 Sept. 27							Hariman-Hassanabad (Qazvin)
1945 Nov. 20	062753	38.47N	43.3 E	5.5	N	VIII	Van
1945 Nov. 27	215649	24.90N	62.80E(?)	8.25	N	X+	Makran Coast, Pakistan
1946 Feb. 10	131325	32.55N	59.26E	4.5-5.5	N	VIII	Giv
1946 Feb. 12		32.6 N	59.8 E			VI	Sarbisheh region
1946 Mar. 12	022154	29.61N	51.65E	5.75	N	VII	Kazerun
1946 Aug. 17				5.25-5.5	N	VII	Penjevin (Iraq)
1946 Nov. 04	214744	39.30N	55.20E	6.5-7.5		IX	Kazanjik (Southern margin of Turan Plate)
1947 Mar. 03		32.9 N	59.2 E			VI	Birjand region
1947 Apr. 09		32.9 N	59.2 E			VI	Birjand region
1947 Aug. 05	142407			7.3	N	IX	Arabian Sea, Baluchestan
1947 Sept. 23	122810	33.70N	58.70E	7	N	IX	Dustabad
1947 Sept. 25	182510	33.7 N	58.7 E	5		VII	Dustabad

Date	Time G.M.T.	Macroseismic Epicentre		Mb	H Km	Io MMI	Epicentral Region
		Lat.	Long.				
1947 Sept. 26	030431	33.5 N	58.7 E	4.5		VI	Dustabad region
1947 Oct. 03	061346			6.75	N-65	VIII	
1947 Oct. 06	151814	33.70N	58.70E	5.25	N	VII	Dustabad aftershock
1948 Jan. 30	084348			6.4	N	VIII	Makran Coast
1948 Aug.							Firuzabad
1948 Oct. 05	201204	37.80N	58.53E	7.5	25-30	X	Eshghabad
1949 Apr. 24	042208	27.16N	56.36E	6.5	50-100	VIII	Nakhl-e-Nakhoda
1949 Jul. 04	034038			5.75-6.1	N-110	VII	Bandar Abbas region
1950 Jan. 22	040715	27.40N	52.76E	5.75		VIII	Dehno (Assalu)
1950 Feb. 02	224513	27.45N	52.71E	4.75		VI	Dehno aftershock
1950 May 09	111656			6		VII	North of Eshghabad
1952 Mar. 10	10	35.2 N	58.4 E			VI	Kashmar region
1953 Jan. 15	2006	29.60N	57.36E				Rayen
1953 Feb. 12	081529	35.43N	55.01E	6.5	N	VIII	Torud
1953 Feb. 14		35.1 N	58.2 E			VI	Kashmar region
1953 Apr. 18	063234	36.83N	54.41E	4.8	12	VII	Gorgan-Aliabad
1953 Jun. 06	000224	35.3 N	58.6 E	4.5		V	Kashmar region
1954 Aug. 20	152930	27.73N	52.16E				Tonbak
1955 Aug. 29		35.5 N	58.9 E			V	Torbat region
1955 Sept. 17	07	35.5 N	58.8 E			VI	Torbat region
1955 Nov. 24		35.76N	52.05E	4		VI	Musha
1956 Oct. 31	140338	27.20N	54.66E	6.8	N	VIII	Gowdeh
1957 Apr. 23		33.53N	52.25E				Kachu Mesqal
1957 Jul. 02	004223	36.06N	52.56E	7.3	10	X	Sangechal
1957 Sept. 05	113607	28.50N	53.32E	5½	N	VII	Jahrom



1957 Dec. 13	014505	34.50N	47.83E	7.2	N-42	IX	Farsinaj
1958 Jan. 22		35.6 N	58.7 E	5		VI	Kashmar region
1958 Jan. 30		35.3 N	58.5 E			V	Kashmar region
1958 Aug. 14	112659			6	N	VII+	Nahavand region
1958 Aug. 16	191345	34.33N	48.16E	6.7-7.1	N	VIII	Nahavand (Firuzabad)
1958 Sept. 21	161830	34.60N	47.50E	4½	N	VI	Karkasar
1959 Feb. 11	1155	38.25N	58.00E	4		V	Bolshevik
1960 Apr. 24	121426	27.68N	54.33E	6.1	N	VIII	Lar
1960 Aug. 01	022050			6	62	VII+	North of Lar region
1960 Aug. 16		38.00N	58.55E				Porsikuyu
1961 Jun. 11	051028	27.75N	54.33E	6.8	37	VIII	Dehkuyeh
1961 Oct. 14	070039.4	34.02N	48.52E		N	VI+	Aliabad-Magh
1961 Oct. 28	104642.2	33.70N	48.84E	5	52	VII	Heydarabad
1962 Apr. 01	004514.6	33.33N	58.83E	5.8-6	N	VII	Mussavieh
1962 Sept. 01	192038.7	35.66N	49.85E	7¼	20	X	Buyin Zahra
1962 Sept. 04	225919.5	39.9 E	43.9 E	5.8	N	VII	Igdir
1962 Oct. 05	200227.6	35.10N	55.72E	5	N	VII	SW. Torbat Heydariyeh
1962 Oct. 16	0724	35.2 N	58.4 E			VI	Kashmar region
1962 Nov. 03	15.37	35.2 N	58.5 E			V	Kashmar region
1962 Nov. 06	000947.7	28.16N	55.78E	5.8	N	VII	Gahkom
1963 Jan. 01	192736.8	35.1 N	58.4 E	4.6		VI	Kashmar region
1963 Mar. 01	032002.3	35.5 N	59.5 E	4.9		VI	Fariman region
1963 Mar. 24	124400.5	34.50N	48.08E	5.9	10	VII	Karkhaneh
1963 Mar. 31	022706.5	36.91N	57.78E	4.9	N	VII	Dahaneh Ojaq
1963 Jul. 29	061022.6	28.16N	55.91E	5.2	37	VII	Gahkom
1963 Sept. 18	154202.7	38.55N	57.15E	4.4		V	Archman
1963 Sept. 20	103243	38.70N	56.80E	4.2			Bami
1963 Oct. 13	06	32.5 N	59.0 E			V	Birjand region
1964 Jan. 11		38.4 N	57.05E	3.8			Nokhur
1964 Feb. 12	081919	38.98N	56.25E	4¼	N	VI	Kizyl Arvat

Date	Time G. M. T	Macroseismic Epicentre		Mb	H Km	Io MMI	Epicentral Region
		Lat.	Long.				
1964 Apr. 14		38.18N	58.20E	3.5			Izgant
1964 Apr. 18		38.40N	57.45E	3.5			Bakharden
1964 May 13		37.80N	58.21E	3.5			Yablovonsky
1964 Aug. 27	125646.1	28.16N	55.91E	5.3	N-51	VII	Gahkom
1965 Feb. 10	160954.1	37.73N	47.00E	5.1	52	VII	Alikhalaj
1965 Jun. 21							Hajiabad-Sarchahan (2 shocks)
1966 Mar. 20	140627	39.35N	44.53E			VI	Danalu (N. Maku)
1966 Jun. 29	054009	39.60N	54.38E	3.7			Nebit Dagh
1966 Aug. 18		38.40N	57.45E				Bakharden
1966 Sept. 24	100047.5	27.16N	54.36E	5.3	38	VII	Bastak
1966 Oct. 24	143116	37.30N	59.65E	4.8	14	VI	Kaakhka
1966 Nov. 26	134930.4	37.71N	58.72E	4.0	31	V	Shamli
1966 Dec. 02	030750.7	28.2 N	53.6 E	4.9	N-35	VI	Jahrom region
1967 Jan. 09	015514	27.83N	54.33E	5.3	30	VII	Lar
1967 Jan. 15	000314.3	29.63N	51.48E	4.7	N-90	VI	Kamaraj
1967 Mar. 30		38.25N	57.20E				Tagarevo
1968 Apr. 29	170157.6	39.28N	44.30E	5.5	34	VII+	Bedavli
1968 Jun. 09	005632	39.2 N	46.1 E	5.0	31	VII+	Zangezur
1968 Jun. 23	091618.6	29.56N	51.33E	5.3	34	VII	Khesht
1968 Jul. 14	223438	39.20N	55.60E	3.7	33		Kazanjik
1968 Aug. 31	104737.4	34.03N	58.78E	7.3	13	X	Dasht-e-Bayaz
1968 Sept. 01	072730.2	33.9 N	58.2 E	6.1	15	VIII	Ferdows
1968 Sept. 04	232447.2	34.0 N	58.2 E	5.4	15	VI	Ferdows region
1968 Sept. 14	134832	28.38N	53.21E	5.8	34	VII	Barikhun-Tang Rain
1968 Sept. 14	192022.7	28.35N	53.31E	5.1-6	44	VII+	Mobarakabad(SW Jahrom)
1968 Nov. 15	062539	38.10N	58.20E	5.6	22	VII	Eshghabad

1969 Jan. 03	031638.1	36.91N	57.78E	5.6	11	VIII	Dahaneh Ojaq
1969 Mar. 26		39.45N	54.42E	3.8		V	Nebit Dagh
1969 Nov. 07	183359.9	27.18N	60.60E	6.1	74	VI+	Bampur
1969 Nov. 23		38.18N	55.68E	5	38	VII	Sharluk
1970 Feb. 25	150751.0	37.25N	55.66E	5	36	VII	Farsian
1970 Mar. 14	015144.4	38.60N	44.70E	5.3	23	VII	Badalan
1970 Apr. 04	105808.8	37.1 N	59.58E	4.8	8	VI+	Archigan
1970 Jun. 27	075753.3	35.33N	50.53E	4.8	52	VI	Mamuniyeh
1970 Jul. 11	224115.6	37.53N	49.23E	5.2	65	VI+	Kapurchal
1970 Jul. 30	005219.5	37.66N	55.95E	6.7	19	VIII	Maraveh Tapeh
1970 Oct. 03	065702.0	35.86N	51.53E	4.1	68	V	Qasran
1970 Oct. 25	112218.2	36.80N	45.26E	5.5	19	VI+	Pasveh
1971 Feb. 14	162736.1			5.3	39	VII	Hunestan-Jailan
1971 Apr. 06	064952.9	29.66N	52.16E	5.2	10	VII	Dasht-e-Arzhan
1971 Apr. 12	190325.9	28.28N	55.75E	6	44	VIII	Tazarj
1971 May 26	024146			5.4	26	VI+	Kashmar-Feyzabad
1971 Aug. 09	025436.7	36.33N	52.75E	5.3	27	VII	Babol Kenar
1971 Sept. 02	182447.3			5.1	45	VI+	Gachsaran-Babachelu
1972 Apr. 10	020653.2	28.35N	53.11E	6.9	N	IX	Qir
1972 Jul. 02	125606.7	29.98N	50.95E	5.4	31	VII	Mishan
1973 Feb. 07	052720.0			5.2	51	VI+	Masjed Soleyman-Shushtar
1973 Nov. 11	071451.5	30.56N	53.03E	5.5	11	VII	Qeshlaq
1974 Dec. 02	090544.2	28.08N	55.88E	5.4	36	VII	Sarchahan
1975 Mar. 07	070442.6	27.40N	56.41E	5.8	27	VII	Sarkhun
1975 Sept. 01	231552.5	33.51N	49.08E	4.9	16	VI+	Taghiabad (Dorud)
1975 Sept. 21	141637.8	31.63N	51.13E	5.2	33	VII	Sarpir
1976 Nov. 07	040051.6			5.6-6.2	13	VIII	Qaen
1977 Jan. 05	054439.9	27.45N	56.30E	5.5	29	VII	Genu
1977 Mar. 21	211857.6	27.58N	56.43E	7	N	VIII+	Khurgu
1977 Apr. 06	133635.5	31.85N	50.76E	6	N	VIII	Naghan

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