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***Research Article***

# ANALYSIS OF SEISMICITY STATUS OF TABAS REGION, CENTRAL PART OF IRAN PLATEAU

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## ABSTRACT
Analysis of seismological data in Iran is indicative of two earthquake-prone strips; one in the south (Zagros Mountains) and another in the north (Alborz and Kopet Dag Mountains). Hence, keeping in mind the vast extent of damages inflicted during long yeas and highly active seismicity of Iran's territory, identification and analysis of seismicity status in different regions of Iran gains further necessity. Analysis of statistical data related to device-recorded and historical earthquakes in the "1900-2005" interval reflects the fact that earthquakes in Tabas Region are mainly shallow and the major tectonic activities have occurred during 1975 to 1985. Also, the conducted statistical analyses suggest that the tectonic activities feature low frequency and large magnitude (such as Tabas Earthquake of 1978).

***Keywords:*** *Earthquake, Tabas, Seismicity, Depth of focus*

## INTRODUCTION
Iran with approximate longitudes of eastern 44-64 degrees and latitudes of northern 24-40 degrees is situated in western part of Asia between Arabian Plate in the southwest and Turan Plate in the northeast. This country embraces central part of folded Alp-Himalayan mountain ranges (Aghanabati, 2004). These mountain ranges - which start from Western Europe and extend up to probably Myanmar and Indonesia after passing through Turkey (Gupta, 2006), Iran and Afghanistan are result of convergence and collision of continental plates.
During the twentieth century, more than 20 huge earthquakes led to death of thousands of people, destruction of cities and extensive losses and damages to Iran's infrastructure. These damages include instances like fire (conflagration), devastation of buildings and bridges and highways, landslides, ground rupture, mass wasting and so on (Poorkermani& Arian, 1997; Nowroozi, 2012).

## MATERIALS AND METHODS
Taking into account the vast extent of damages inflicted during long years and highly active seismicity of Iran's territory, identification and analysis of seismicity status in different regions of Iran was required. For this purpose, using the seismological data within the "1900-2005" interval, the respective seismological zone will be investigated through the current study. In fact, in order to study seismicity status of Tabas Region, a zone with a radius of 200 km centered at Tabas City was chosen, and, the seismicity of the region was studied based on statistical analysis of the historical earthquakes during the last century.

## RESULTS AND DISCUSSION
### *Seismicity of Iran's Territory*
In an overall view, three plates were identified from north to south in Iran's territory (Aghanabi, 2004):

- The northern plate as the southern edge of Turan Plate which encompasses peripheral Kopet Dag folds and southern Caspian depression with a basaltic crust.

- The middle plate which is confined to Paleo-Tethys and Neo-Tethys rifts, comprising a mosaic of blocks in northern part of Gondwana supercontinent which hosts Alborz Mountain Range as well as different expanses of Central Iran and Eastern Iran.

- Apart from the aforementioned plates, Makran Mountain Chain can be regarded as a sort of intra-continental detachment in Iran's Paleozoic platform, which exhibits characteristics of a gently dipping subduction zone. The subduction zones have caused the greatest and most detrimental earthquakes throughout the human history such as Sumatra Earthquake ($M_w$ = 9.2) (Aghanabati, 2004; Wallace *et al.*, 2009).

Analysis of seismological data in Iran's territory reveals two tectonically active strips (Nowroozi, 2012):
- The southern strip (Zagros Mountains) which has a northwestern-southeastern trend
- The northern strip which consists of Alborz and Kopet Dag Mountains.

As illustrated in the Figure 1, few earthquakes are observed with large intensities in Central Iran.

***Historical and Device-recorded Earthquakes in Tabas Region***

Meticulous analysis of seismological data implies the fact that specific characteristics of a seismological process are associated with distributions of magnitude, epicenters and occurrence along the time. Generally, two categories of occurrences *i.e.* historical and device-recorded earthquakes can be considered in investigation of such events. These earthquakes in Tabas Region include (Berberian, 1976, 1995; Ambraseys & Melville, 1982; Ahmadi, 2008):

- Earthquake of 736 in QOHESTÄN Region
- Earthquake of 856 in QOUMES Region and Western Khorasan
- Earthquake of 1066 in QOHESTÄN Region
- Earthquake of 1238 in GONÄBÄD Region
- Earthquake of 1941 in MOHAMMAD-ÄBÄD with a magnitude of 6.5 Richter degrees, which according to Ambraseys (1975), was associated with CHÄHAK Fault
- Earthquake of 1947 in DOUST-ÄBÄD Region with a magnitude of 7 Richter degrees
- Earthquake of 1962 in MOUSAVIYYEH Region with a magnitude of 5.5 Richter degrees
- Earthquake of 1968 in BIÄZ Plain with a magnitude of 7.4 Richter degrees
- Earthquake of 1968 in FERDOWS Region with a magnitude of 5.8 Richter degrees
- Earthquake of 1978 in Tabas Region with a magnitude of 7.4 Richter degrees, in which 85% of Tabas City's people were killed.

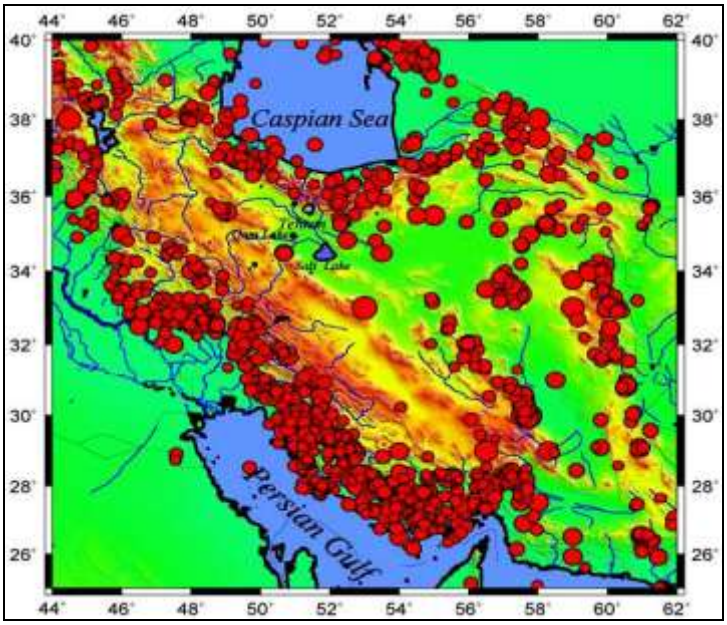


**Figure 1: Seismicity map of Iran's territory based on device-recorded data (Ashtari Jafari, 2008).**

***The Relationship between Magnitudes of Bulk and Surface Waves in Tabas Region***

In order to find a linear correlation between $M_s$ and $M_b$ in the region under study, the researchers analyzed nearly 20 earthquakes during the recent century with known $M_b$ and $M_s$. A linear equality was derived between the variables, as illustrated in Figure 2.

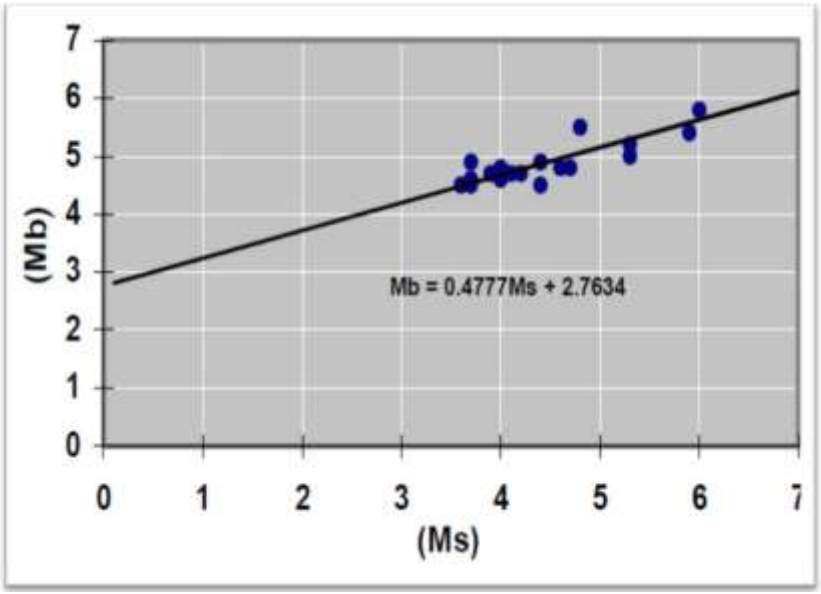


**Figure 2: The relationship between magnitudes of Bulk and Surface Waves**

**Depth of focus of Earthquakes in Tabas Region**

For this purpose, focal depths of 118 earthquakes during the last century were analyzed; the results indicate that the largest distribution for depth of focus (52.5%) is in the interval of 30-35 km from the ground surface. These results are illustrated in Figure 3.

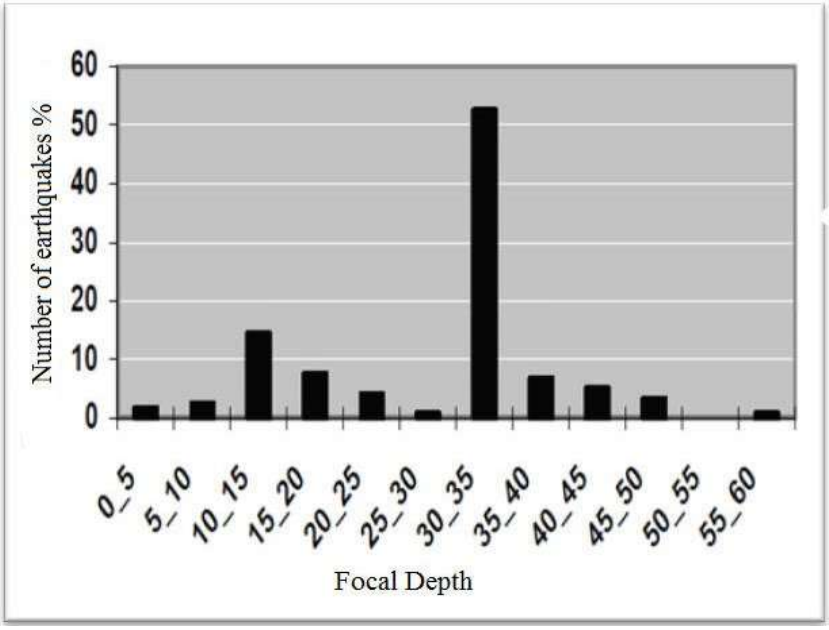


**Figure 3: Depths of focus distribution of earthquakes in Tabas Region**

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***Time Distribution of Earthquakes during the Recent Century in Tabas Region***

This study was also conducted on the time interval of focal depth distribution (analysis of 118 earthquakes) and demonstrated that the largest percentage of earthquakes in the last century occurred during 1975 to 1985 (Figure 4).

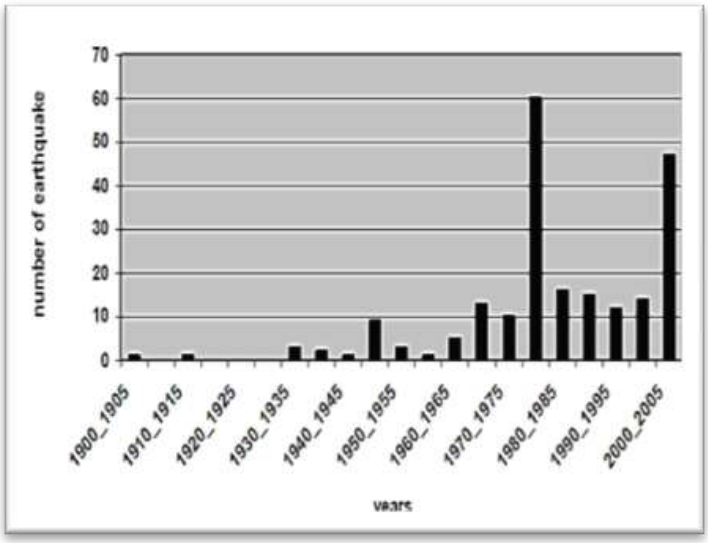


**Figure 4: Time distribution of the last century earthquakes**

***The Relationship between Magnitude of Earthquakes and their Cumulative Frequency***

Frequency analysis of earthquakes with respect to their magnitude in different time and space intervals leads to establishment of a logarithmic empirical correlation between magnitude and frequency of earthquakes. This relationship is expressed by Gutenberg and Richter as below (Gutenberg & Richter, 1954):

Equation (1): $Log_{10} N = a - bM$

In the analysis on Tabas Region, the following linear relationship was achieved, based on which, in fact, the higher frequency of earthquakes in a region would be accompanied with smaller magnitudes (Figure 5).

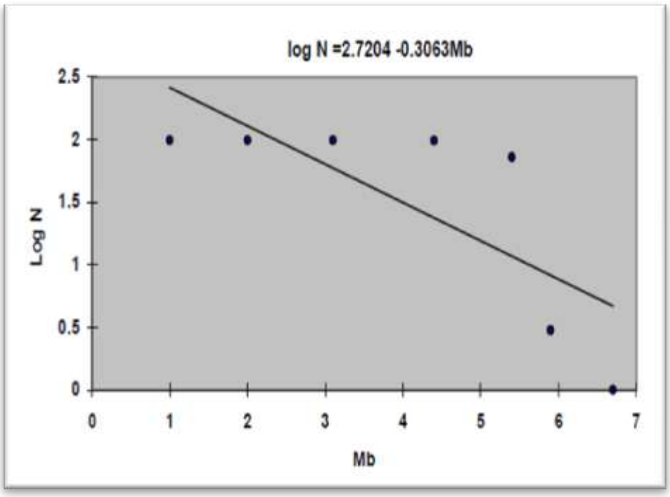


**Figure 5: Relationship between earthquakes and their cumulative frequency**

**RESULTS AND DISCUSSION**

1- Earthquakes of Tabas Region are mainly classified as shallow earthquakes (average 30 km).
2- The majority of earthquakes occurred during 1975 to 1985.
3- The majority of the earthquakes had large magnitudes and low frequencies.

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