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EARTHQUAKE HAZARD EVALUATION IN THE ALGIERS REGION

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SUMMARY

The Algiers region has experienced moderate to large earthquakes many times in the past 280 years. Algiers is in a tectonically and seismically active area near a major convergent plate boundary. The preliminary results show a reasonably good relationship between the tectonic structures and the seismic sources reported by the catalog of historical seismicity. The historical seismicity map and the map showing the maximum historic intensities indicate that the general picture is dominated by two zones where the intensity reaches its maximum values. These are the well known region of Algiers and that of Mouzaia-Blida very close to Algiers where lie the main earthquake generating faults in the area.

INTRODUCTION

The largest event in the area took place in 1716 (Algiers) and 1825 (Blida) and since the Algerian catalog goes back only 280 years, the derivation of a reliable seismic hazard model cannot rely solely on historical seismicity, although an attempt was done in 1978 by Shah and Mortgat (Ref.1). In this situation an extensive seismic geology study is mandatory.

Based on detailed seismic geology investigations and a review of historical seismicity, seismic source zones will be defined for the Algiers region in order to derive a seismic hazard model that will lead to a better understanding as to where potentially damaging earthquakes can take place, how big they can be and how often they occur.

This paper is a preliminary report of the seismotectonic investigations carried out in the Algiers region to define the seismic sources and their characteristics.

GEOLOGIC AND TECTONIC SETTING

Algeria is situated in the African plate. To the north, the Eurasian plate is thought to be colliding with the African plate which is overriding it. A wide belt of folded mountains (the Atlas

Mountains) and a zone of crustal shortening up to 400 km (250 miles) wide is being produced along the collision zone. Reverse faults are the dominant structures in the region and trend East-West to East-Northeast parallel to the plate boundary and normal to the direction of plate convergence (Ref.2).

In the area of concern, major topographic breaks, faults scarps and/or anticlines dominate the terrain :

- In the northern part, evidence for tectonic activity was reported in 1984 by Saadallah and Slemmons (Ref.3,4) along the "Bains Romains" and "Agha" faults near the coastline and in 1979 by Bonneton (Ref.5) in the Mitidja plain, between Blida and Algiers.
- A second major zone is a East-West valley that appears to have borders with scarps and anticlines, lies in the Southern part of the Mitidja plain.
- Shorter, but very steep and prominent trends are shown in several areas closer to Algiers.

EVALUATION OF SEISMIC HAZARDS

The current research to define the earthquake hazard in the Algiers region focuses on a 100 km x 140 km area surrounding the main cities of Algiers and Blida. The borders of this region are set as to include all sources capable of generating earthquakes that might threaten the main urban centers.

Based on the answers to the key questions as to where and when have past earthquakes taken place and how big they were, the study underway at this time, will evaluate the seismic hazards the Algiers region will face in the future.

The ability to answer these questions depends on the ability to define and characterize seismic sources. Delineation of individual seismic sources is being done on the basis of identification of the most important faults and characterizations of their seismic potential through geologic mapping, trenching and age dating. The basic assumption used in delineating the seismic sources is that most historic surface faulting and other tectonic deformation have occurred in the geologically recent past and have been of a similar nature to that of previous events in the area. The physical parameters of individual seismic sources are defined by integrating geologic studies and historical seismicity.

Although the seismic record goes back only 280 years, it is anticipated that the seismotectonic studies will reveal that this province that has late Quaternary folding, faulting and coastline deformation and which lies in a seismotectonic environment similar to that prevailing in the Ech-Cheliff (formerly El Asnam) region, has experienced major events in the past and that the return period of major events is of 300 years.

Geological Investigations The present work relies on neotectonics studies which make use of different techniques such as:

- Analysis of photosatellite and aerial photos to draw a lineament map.
- Detailed field investigations to define the active faults through the observation of fault scarps, distribution of recent deposits, etc...
- Recognition of active faults and the classification of their activity through trenching.

The analysis of photosatellite show the presence of major tectonic accidents in the Mitidja Plain. These accidents are responsible for most of the seismic activity in the Algiers-Blida region. Other accidents in the region are presently under investigation.

Aerial photos of the immediate vicinity of Algiers show many lineaments that are suspected of being of tectonic origin. Many such lineaments proved to be active faults.

Three or more meters of displacement along the Bains Romains reverse fault and an uplift of the area to about 100 meters above sea level were probably the result of repeated earthquakes. These offsets were obtained through the repetition of large earthquakes ($M_s \geq 6.5$) which are part of the coastal zone of rupturing that include the offshore fault zone reported in 1984 by Woodward-Clyde Consultants (Ref.6).

The Mouzaïa fault zone at the West of the "Atlas de Blida" forms the limit between this range and the bassin of Médéa. These faults are generally oriented N45°W to N50°W with important vertical offsets.

The normal fault of Agha borders the Mitidja bassin to the North and constitutes the limit between this bassin and the "Massif d'Alger" characterized by a complex structural fracturation.

Historical Seismicity The Algerian catalog of historical seismicity (Ref.7 to 12) shows that the epicenters are equally distributed through the Tellian Atlas with few areas of relatively higher concentrations such as the region of Algiers.

Although covering only a short interval of 280 years, the catalog shows that many towns suffered from earthquakes, the major ones in the region being:

- Algiers on February the 2nd, 1716. This earthquake which is among the first major events reported by the catalog reached an intensity of IX and caused great damage in the town and its surroundings.
- Blida on March the 2nd, 1825. This earthquake destroyed the entire city and caused the death of 7000.

Other events that have threatened the area, as reported by Benhallou (Ref.6), are: August 5, 1717 in Algiers. In 1722 many strong shocks were felt in Algiers. On November 7, 1802 the area of Blida-Algiers was shaken. On November 18, 1807 violent shocks were felt in Algiers. During the year 1846-1847, a series of shocks have been reported in Algiers, Blida, and Cherchell. In 1895, a violent shock was felt in Algiers. On November 5, 1924 and June the 2nd, two earthquakes shook Algiers, their epicenters were located

respectively in Bouzareah (Algiers) and in the west of Algiers. More than 40 other events, ranging from medium to strong, were recorded from 1972 to 1988.

The map of maximum historical intensity (fig.1) is characterized by relatively high historical intensities which reach the maximum value of VIII (MM) in the two zones of Algiers and Mouzaïa-Blida. The later one seems to coincide with the area where the Mouzaïa fault lies.

The map of historical seismicity of the region of Algiers (fig.2) shows a particular concentration of repeated earthquakes in a broad band 30 km wide, trending approximately N45°E and running from the Southwest of the region to Algiers and its vicinity. Some of these earthquakes are very strong. A similar situation, although covering a smaller area, is encountered near Tablat.

CONCLUSION

The areas shown by the map as having a relatively higher concentration of epicenters coincide with the areas where recent tectonic accidents are present. The results from the seismological investigations and the geological investigations underway at the present time will help delineate the seismic source zones. The trenching that will be performed right after will yield the data for the assessment of: 1) the potential size (maximum magnitude) earthquake that can occur on the various seismic sources, and 2) the frequency of earthquakes (recurrence intervals).

The analysis of the already completed historical seismicity along with the preliminary results of field work show that the Algiers region has been seismically active during the Quaternary. The peak ground acceleration vary from 250 cm/sec² for a return period of 50 years to 450 cm/sec² for a return period of 300 years. These assessments along with the estimated magnitude of 7.25-7.5 are provisional and will be changed on the basis of the results of the current studies.

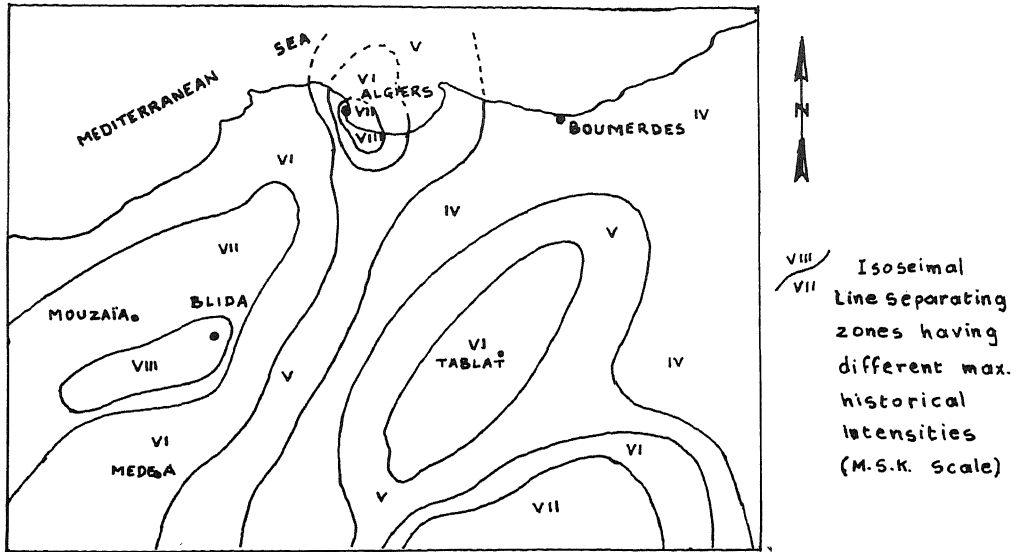


fig.1: Map of maximum historical intensity

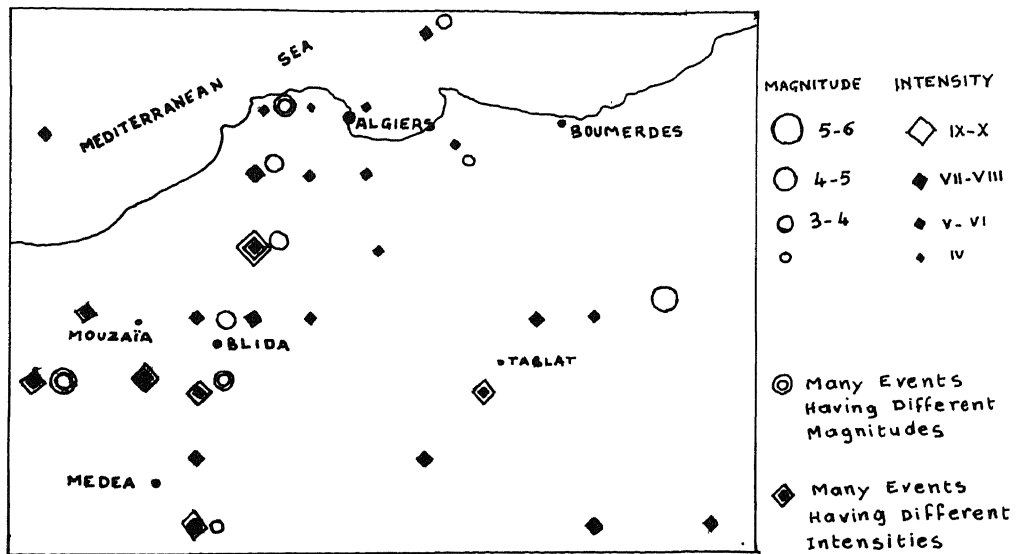


fig.2: Map of historical seismicity

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