

# Overview of Recent Seismic Activity in Northeastern Algeria

Issam Abacha and AbdelKarim Yelles-Chaouche

## Abstract

This work was devoted to recent seismicity of Northeastern Algeria. It was achieved after the installation of the new Algerian seismological network. This study showed clearly that this region is the most active because almost 2/3 of seismic events occur there. Recently, several important events occurred in this region such as, the 2007 Mila crisis, the 2010 Beni-Ilmane earthquake sequence, the 2012–2013 Bejaia earthquake sequence, the 2015 Ain Azel earthquake and the 2017 earthquake sequence along North Constantine Fault (NCF). We determined the physical parameters of these events in order to understand their rupture processes. We also calculated the reorientation of the stress tensor in some regions. Finally, this work could be considered as the most representative contribution to the knowledge of seismic hazard of the North-East region of Algeria.

## Keywords

Tellian Chain • Focal mechanism • Source parameters • Scaling la seismic sequence

## 1 Introduction

The earthquakes occurrence in Northern Algeria remains an important research topic for many reasons that are both scientific and societal due to their disastrous impacts on the socio-economic development of the country.

Through the development of the Algerian seismological network since 2000 [1], the first maps of reliable seismicity as well as the first hazard studies have appeared [2].

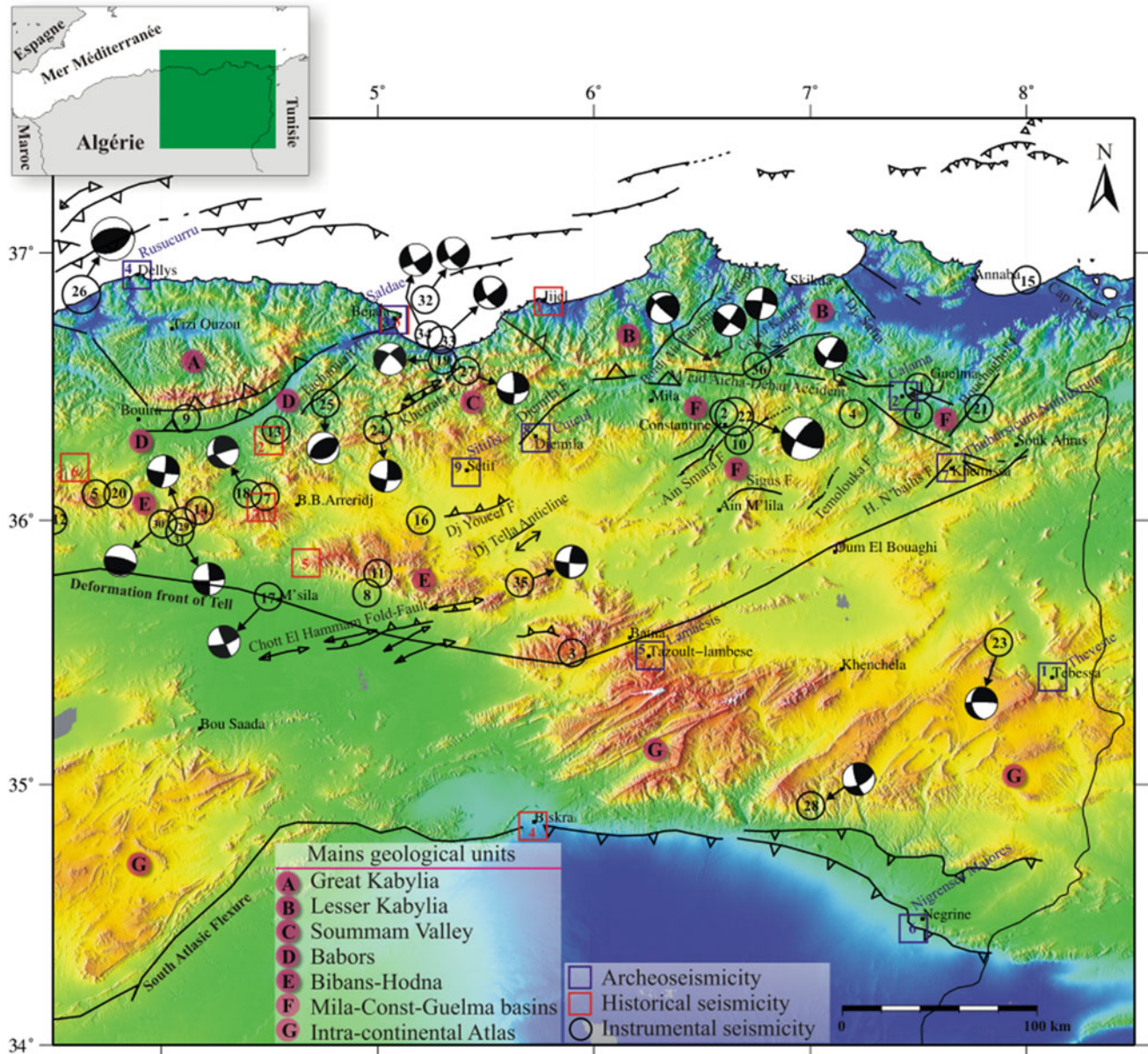
One of the important characteristics of Algeria seismicity is its concentration in the Eastern part of the country. Indeed,

almost 2/3 of the Algerian seismic events occur in this region which remained poorly studied until recent time despite its lively seismic activity (Fig. 1). This region has witnessed many moderate seismic events in several parts during the last twenty years. Among these events, we can cite the 2000 Beni-Ouartilane earthquake of  $M_d = 5.3$ , the 2006 Lalaam earthquake  $M_d = 5.2$  [3], the 2010 Beni-Ilmane earthquake sequence  $M_d = 5.2$  [4], the 2012–2013 Bejaia earthquake sequence [5], the 2015 Ain Azel earthquake [6] and the 2017 seismic sequence along the North Constantine Fault (NCF) [7]. Induced seismicity has also been detected for some events such as, the 2007 Mila seismic crisis [8], or seismic events around Grouz (2003–2007) and Beni-Haroun dams (2011–2012). In this study, we focused on all these main moderate events, presented their source parameters and the stress pattern in order to understand the rupture process in the studied area.

## 2 Methodology Analysis

The purpose of this research work is to study the main recent seismic events of northeastern Algeria. The seismic data were acquired through the Algerian seismic network and also during the several seismic surveys made after the occurrence of several moderate shocks. The first step was to locate precisely all these seismic events using several location and relocation programs with their focal mechanisms calculation. In the second step, we performed statistical tests on the time intervals between successive earthquakes to better understand the physical correlation among the seismic events from the same cluster. In the last step we determined the source parameters and the scaling laws of these seismic parameters.

I. Abacha (✉) · A. Yelles-Chaouche  
Centre de Recherche en Astronomie Astrophysique et  
Géophysique, CRAAG, BP 63, Bouzaréah, Algiers, Algeria  
e-mail: [i.abacha@craag.dz](mailto:i.abacha@craag.dz)



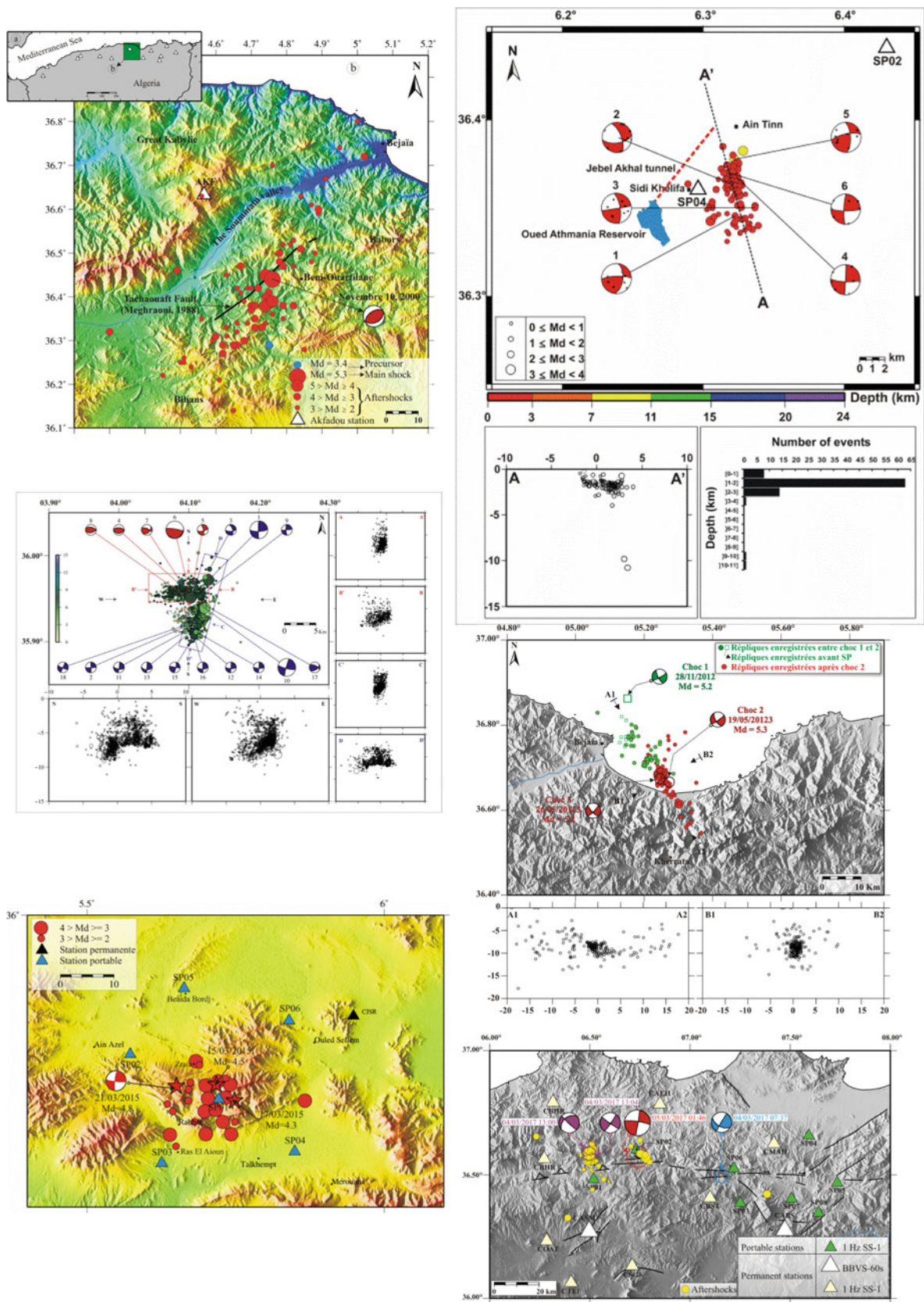
**Fig. 1** The main geological units (capital letters); historical and instrumental earthquakes ( $M \geq 4.7$ ) with their focal solutions in our study area and the major active fault in the area

### 3 Results

In the following, we present the analysis of the main seismic events that occurred in our study area (Fig. 2).

### 4 Discussion

This study which covers a large part of the North Algerian territory allowed integrating these new results for understanding of the seismicity of the eastern region of Algeria.



**Fig. 2** Spatial distribution: (1) the 2000 Beni-Ouartilane earthquake (up left), (2) the 2007 Mila seismic crisis [2] (up right), (3) the 2010 Beni-Ilmane seismic sequence (middle left). (4) The 2012–2013 Bejaia seismic sequence (middle right). (5) The 2015 Ain Azel earthquake (bottom left) and the 2017 seismic sequence along NCF (bottom right)

Through this study, we tried to understand better the spatial distribution of the events, their rupture process to improve the previous seismic hazard models carried out. On the other hand, it is important to outline that several seismic sequences occurred with two or three main shocks of the same magnitude. This pattern suggests that the energy released in these events was split on at least two main faults may be avoided for a large earthquake.

## 5 Conclusion

This study allowed us to establish new seismic map for the northeastern region characterized by recent events which occurred there and to determine their source parameters. The main events which are in general superficial, happened along newly revealed active faults like the NCF or the Beni-Ouartilane fault system. The rupture process of these main events involves in general a segmented fault system with a repartition of the energy release. The determination of these new seismogenic zones remains an important contribution to the seismic hazard assessment of the Northeastern region of Algeria.

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