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The evolution of pre-existing structures during the tectonic inversion process of the Atlas chain of Tunisia

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ABSTRACT

Previous studies on the plate movement between Africa and Eurasia have pointed out the evidence of successive phases of transtension and transpression. The transtensional regime was active between Jurassic and Cretaceous times. It led to extensional structures which were reactivated during the Cenozoic transpressional regime as consequence of the Africa–Europe convergence. In this paper, we used satellite images and field observations from Central Tunisia to demonstrate the role of the previous extension tectonics in the structural evolution of the Atlassic chain for the tectonic inversion process. In the study area, the geometry of structures and fault kinematics is used to document transition from transtension to transpression. The tectono-sedimentary record reflects the mechanical influence of reactivation of previous tectonics in the structural evolution of the study area and points out the significant role of the tectonic inheritance in the development of the Atlassic chain of Tunisia.

1. Introduction

The Africa–Eurasia plate movements have been detailed by Dercourt et al. (1986), Philip et al. (1986), Soyer and Tricart (1987), Ben Ayed (1986), Dewey et al. (1986), Martinez et al. (1991), Boukadi (1994), Piqué et al. (1998) and Abbes (2004). These authors described the episodes of divergence, convergence and lateral displacement between both plates. The major movements resulted in the development of major structural entities (Betics, Pyrenees, Apennines, Dinaric and Maghrebian chains) in the Tethyan domain. Numerous studies (Robertson and Grasso, 1995; Stampfli and Borel, 2002; Laville et al., 2004; Abrajevitch et al., 2005) have argued that the tectonic history of this domain exemplifies the process of ocean basin closure and plate convergence leading to a continental subduction and collision. They demonstrate that the Neotethys ocean widened during the Mesozoic–Early Tertiary with a rapid Tertiary closure induced by plate convergence. At the Tethys scale, this convergence led to the reactivation of previous structures and generalized tectonic inversion which was the cause of the main Tethyan orogenies (Zargouni, 1985; Ben Ayed, 1986; Boukadi, 1994; Catalano et al., 1996; Belayouni et al., 2009).

The eastern extend of the Maghreb mountains in the Tunisian domain occupies a privileged position within the North of the African craton adjacent to the alpine domain (Fig. 1A). From Morocco to Tunisia, Atlassic structures record the early transtensional phase of the Triassic–Jurassic times relevant for both, Tethyan and the Tunisian scales (Richert, 1971; Dercourt et al., 1986; Soyer and Tricart, 1987; Martinez et al., 1991; Boukadi et al., 1992; Boukadi, 1994; Boukadi and Bédir, 1996; Piqué et al., 1998; Bédir et al., 2000; Brunet and Cloetingh, 2003; Abbes, 2004). The structural development of the geological structures is linked to African plate drift and the opening of Tethys due to sinistral slip between the Europe and Africa plates (Dercourt et al., 1986; Soyer and Tricart, 1987; Piqué et al., 1998; Brunet and Cloetingh, 2003; Laville et al., 2004). This development results in rifting, normal and strike-slip faulting, graben formation, subsidence and halokinesis.

The tectonic inversion started after the Cretaceous time in Tunisia and is characterized by two main shortening episodes in Eocene and Mio-Pliocene times as a result of the Africa–Europe convergence (Piqué et al., 1998). In Central Tunisia, the maximum principal horizontal stress which led to the shortening is oriented NW–SE and Mio-Pliocene in age (Rabhi, 1999; Boukadi, 1994). It created mainly NE–SW folds and NW–SE grabens in the Tunisian Atlassic domain. During the Atlassic events (Mio-Pliocene), tectonic inversion became evident on the Tethyan scale (Brunet and Cloetingh, 2003; Morgan et al., 1992).

Laville et al. (2004) describe homologous and contemporary deformation within the High and Middle Atlas of Morocco, with synrift subsiding marine basins inverted and uplifted since the Miocene as a result of the Atlassic shortening. In Tunisia, the

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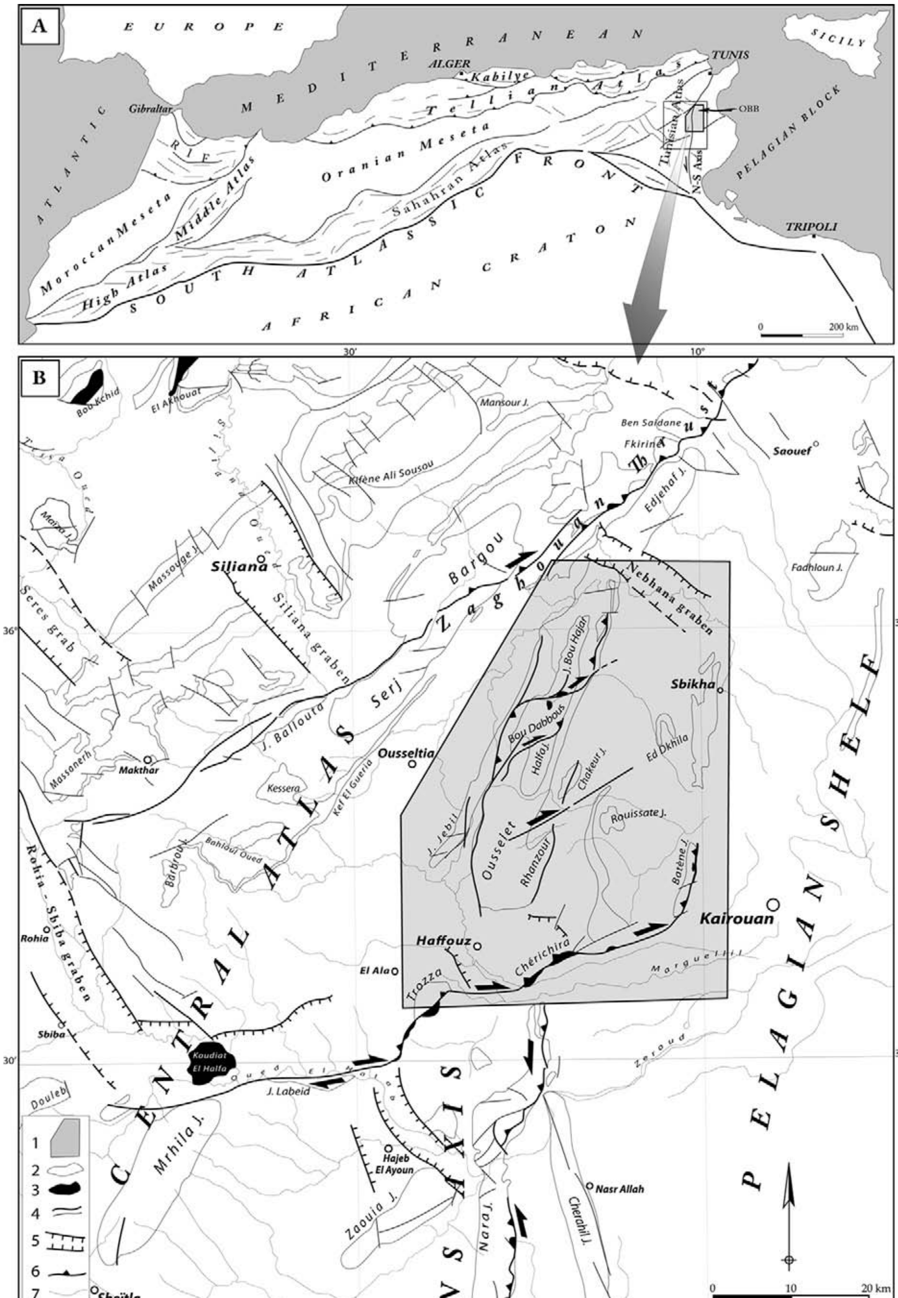

Fig. 1. A. Structural sketch of the Maghreb with location of OBB (Ousselet-Bou Dabbous-Bou Hajar) in Central Tunisia. B. Tectonic background of the study area and neighbouring domains: (1) studied area, (2) contour of structures, (3) trias, (4) outcropping fault, (5) graben, (6) thrust and reverse fault, (7) hydrographic network.

Mio-Pliocene compressional phase accentuated earlier folds with thrusting towards the SE. It was responsible also for the SE nappes migration in the north of Tunisia (Brunet and Cloetingh, 2003). This tectonic phase can be correlated with the initiation of the Europe–Africa collision.

The aim of this work is to specify the role of the previous tectonics in the structural development of the Ousselet-Bou Hajar belt (OBB) which is part of the Tunisian Atlassic domain (Fig. 1). It is also an attempt to correlate the kinematics of regional structures to the major events within the Atlassic chain. We started our study with the interpretation of satellite imageres. Thereafter, tectono-sedimentary observations and field mapping are undertaken to provide the structural setting and the kinematic model for the studied area. Seismic data consulted in *Hydrocarbure Tunisia Corporation* (HTC) shows evidences from depth.

2. Geological setting

The study area is located in Central Tunisia (Fig. 1). It is comprised of the fault-bounded orographic chain of the OBB (Fig. 2) which is made of several cretaceous blocs largely deformed by Tertiary to Quaternary faults, strike-slips and thrusts (Dhahri and Boukadi, 2007; Dhahri, 2009). This composite chain separates the Ousseltia syncline, in the west, from the Bou Morra-Saouaf syncline, in the east. And it forms a transition zone between the Zaghouan thrust (Delteil and Turki, 1986; Morgan et al., 1992)