Journal of African Earth Sciences 96 (2014) 51–59

Contents lists available at ScienceDirect

Journal of African Earth Sciences

journal homepage: www.elsevier.com/locate/jafrearsci

The role of inherited structures in the evolution of the Meknassy Basin, Central Tunisia, based on geological–geophysical transects

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ARTICLE INFO

Article history:
Received 19 June 2013
Received in revised form 17 March 2014
Accepted 18 March 2014
Available online 28 March 2014

Keywords:
Tunisia
Atlas
Folds and thrust belt
Pull-apart basin
Meknassy
Triassic

ABSTRACT

This paper uses seismic data, well data, and surface geologic data to present a detailed description of the Meknassy Basin in the Atlas fold and thrust belt of central Tunisia. These data reveal that the Meknassy Basin is bounded by major faults, along which Triassic evaporites have been intruded. The anticlines and synclines of the basin are delimited by two N–S main faults (the North–South Axis and the Sidi Ali Ben Oun fault) and are subdivided by associated N120° and N45° trending fault-related anticlines.

The Meknassy Basin is characterized by brittle structures associated with a deep asymmetric geometry that is organized into depressions and uplifts. Halokinesis of Triassic evaporites began during the Jurassic and continued during the Cretaceous period. During extensional deformation, salt movement controlled the sediment accumulation and the location of pre-compressional structures. During compressional deformation, the remobilization of evaporites accentuated the folded uplifts. A zone of decollement is located within the Triassic evaporites.

The coeval strike-slip motion along the bounding master faults suggests that the Meknassy Basin was initiated as a pull-apart basin with intrusion of Triassic evaporites. The lozenge structure of the basin was caused by synchronous movements of the Sidi Ali Ben Oun fault and the North–South Axis (sinistral wrench faults) with movement of NW–SE first-order dextral strike-slip faults. Sediment distribution and structural features indicate that a major tectonic inversion has occurred at least since Late Cretaceous and Cenozoic. The transpressional movements are marked by reverse faults and folds associated with unconformities and with remobilization of Triassic evaporites. The formation of different structural features and the evolution of the Meknassy Basin and its neighboring uplifts have been controlled by conjugate dextral and sinistral strike-slip movements and thrust displacement.

1. Introduction

The Atlas fold and thrust belt in North Africa is characterized by numerous small basins bounded by strike-slip faults and anticlines (Fig. 1). In Tunisia, which is located on eastern margin of the Atlas fold and thrust belt, the direction of thrusting has been predominantly from northwest to southeast, and many of the basins are associated with intrusive evaporites of Triassic age (e.g., Boukadi and Bédir, 1996; Zitouni, 1997; Hlaiem, 1999; Bédir et al., 2001; Zouaghi et al., 2005, 2011). Prominent strike-slip faults within the Tunisian Atlas region include the Gafsa Fault and the North–South Axis (Fig. 1). The estern side of the North–South Axis is a relatively undeformed region that is referred to as the Pelagian Platform.

The structure of the Atlas fold and thrust belt in Tunisia is the consequence of Late Cretaceous and Cenozoic events related to the collision of the African and Eurasian plates (Dercourt et al., 1985; Martinez et al., 1990). Many of the Atlas structural features developed during the Middle to Late Miocene Alpine orogeny, and show heterogeneous deformation with variable structural styles. The Atlas orogenic events are marked by syn-sedimentary deformation related to tectonic activity and halokinetic movement (Bédir et al., 2001; Zouaghi et al., 2011; Haji et al., 2014).

This paper provides a detailed description of the Meknassy Basin, which is located in the Atlas fold and thrust belt of Tunisia near the southern termination of the North–South Axis (Fig. 1C). Some previous studies of the basin used only surface data for geometrical basin modeling (Khessibi, 1978; Boukadi, 1994), whereas other previous studies used only subsurface data for interpretation of structural history and the definition of petroleum prospects (Bédir et al., 2001; Tanfous-Amri et al., 2005; Azaiez

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http://dx.doi.org/10.1016/j.jafrearsci.2014.03.016
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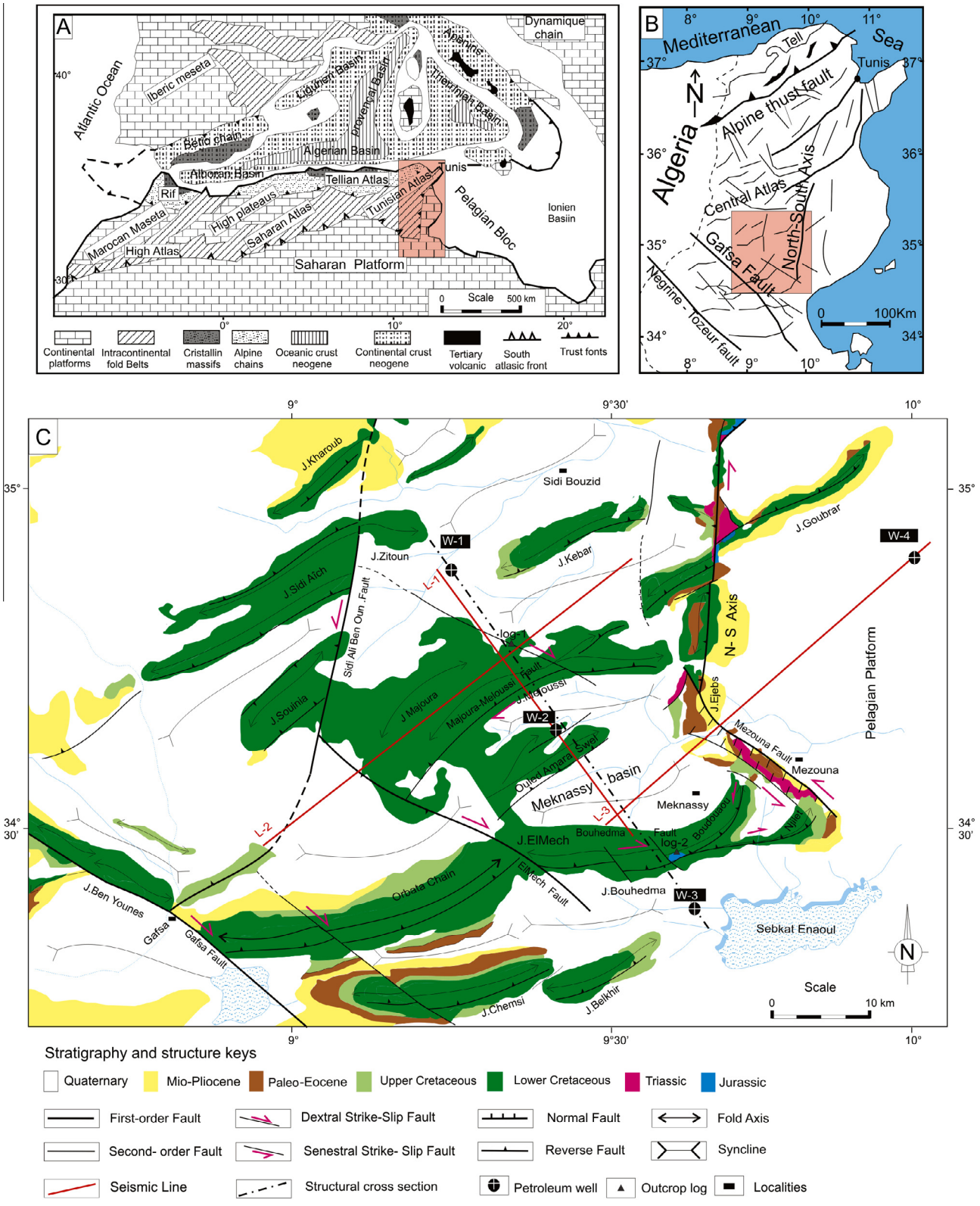

Fig. 1. (A) Tectonic framework of the western Mediterranean domain; (B) simplified structural map of northern and central Tunisia; (C) structural map of the Meknassy area that shows surface and subsurface features represented by first-order and second-order faults and their relation with the main Mesozoic and Cenozoic outcrops, with location of microtectonics stations, structural cross sections and used subsurface data (wells and seismic profiles).

et al., 2008; Zouaghi et al., 2009, 2011). In this paper, the combination of surface and subsurface data reveals an assortment of unconformities and structural features, caused by the reactivation of bordering conjugate dextral (E–W, NW–SE, NE–SW) and (N–S, NW–SE) sinistral faults. In addition, this paper clarifies the structural disposition of Meknassy Basin with respect to bordering master strike-slip faults and situates the basin in a regional geodynamic context.