



# Sedimentary evolution and palaeogeography of mid-Jurassic deposits of the Central High Atlas, Morocco



Abdellah Ait Addi\*, Driss Chafiki

Cadi Ayyad University, Faculty of Sciences and Techniques, Earth Sciences Department, Geo-Sciences & Environmental Research Laboratory, Abdelkarim EL Khattabi Street, P.O. Box 549-Guéliz, Marrakesh 40 000, Morocco

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## ABSTRACT

In the axis of the Moroccan Central High Atlas rift basin, Toarcian–Middle Jurassic deposits, excepting the early Toarcian Tagoudite Formation, are represented by two formations – Agoudim and Tazigzaout – comprising clays, marls and limestones. On the margins of the basin, the lateral equivalents of these two formations are dolostone-dominated and show the lithological and environmental characteristics of the Bin El Ouidane Group recognized in the NW part of the Central High Atlas (Beni-Mellal/Azilal area). This group is overlain by clays and limestones of the Tillouguite Formation and by Bathonian red beds (silt, sandstones and conglomerates) of the Anemzi Formation. From the Toarcian to Aalenian (Agoudim Members I and II) the contrasting palaeogeographical evolution is marked by a relatively deep central basin bordered by shallow marine carbonates. The Aalenian–Lower Bajocian interval (Agoudim Member II) contains lenticular biodetritic limestones within hemipelagic deposits. These facies resulted from recurrent faulting (tectonic pulses), which was at the origin of the individualization of a series of ridges and depocentres within the High Atlas trough. During the Bajocian (Agoudim Members III and IV) the palaeogeography became homogeneous across the Central High Atlas and corresponded to a carbonate ramp with coral patch reefs. During the ?Late Bajocian (Tazigzaout Lower Member) a new palaeogeography developed with reappearance of the central depocentres. During the latest Bajocian–earliest Bathonian (Tazigzaout Upper Member) a very homogeneous carbonate ramp was again established. These times of uniform palaeogeography are interpreted as relative stable tectonic periods that were progressive stages leading to the ending of the Toarcian–Middle Jurassic sedimentary cycles in the Central High Atlas rift basin of Morocco.

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## 1. Introduction

The Moroccan Atlas Mountains form the western margin of the Maghrebian Tethys Realm (Figs. 1 and 2). During their evolution, they have experienced two separate tectonic events: (1) the opening of the Central Atlantic in Early Triassic times (Huon et al., 1993), with the emergence of structures oriented NE–SW; and (2) the appearance of Tethyan margins in the Late Triassic–Early Jurassic (Fig. 1), with fracture directions approximately parallel to those of the Atlantic Rift (normal faults: N20–45°E; transfer faults N70–90°E) (Piqué et al., 1998).

This last episode is the best characterized in the High and Middle Atlas rift basins (Figs. 1 and 2). Syntectonic tectonism is everywhere marked by facies and thickness variations and reflects individual syndimentary highs (ridges: current anticlines), separated by several smaller depocentre troughs (current synclines) adjacent to earlier fractures (Fig. 2b). The High Atlas of Morocco is

characterized by a Palaeozoic basement, capped by Jurassic rocks (mostly Early and Middle Jurassic), which are visible in exceptionally well-exposed outcrops of marl and limestone that evolved in an intracratonic rift basin during a short-lived Mesozoic rifting phase (Warme, 1988). This basin maintained a high rate of subsidence throughout the Early Jurassic (Jacobshagen et al., 1988), and displays a variety of marine depositional environments (Ait Addi, 1994, 2002, 2009; Crevello, 1990; Evans and Kendall, 1977), recording a number of carbonate buildup events (Ait Addi, 2006; Ait Addi et al., 1998; Chafiki et al., 2004; Du Dresnay, 1971b, 1976, 1977; Du Dresnay et al., 1978; Neuweiler et al., 2001).

The Middle Toarcian–Lowermost Bathonian series, comprising mostly marls, marly limestones and carbonate buildups, is represented by the Agoudim (Toarcian to Bajocian) and Tazigzaout (Bajocian–Early Bathonian) formations in the central basin areas (Ait Addi, 2002); on the southern edge the age-equivalent Amellago (Late Toarcian to Early Bajocian age) and Assoul formations (middle to Late Bajocian age; Milhi et al., 2002; Pierre, 2006) of the Amellago area; and in the northern platform areas the Bin El Ouidane Group (Monbaron, 1981) (Figs. 3 and 4).

\* Corresponding author. Tel.: +212 5 24 43 34 04; fax: +212 5 24 43 31 70.

E-mail addresses: [aitaddia@yahoo.fr](mailto:aitaddia@yahoo.fr), [aitaddi@fstg-marrakech.ac.ma](mailto:aitaddi@fstg-marrakech.ac.ma) (A. Ait Addi).

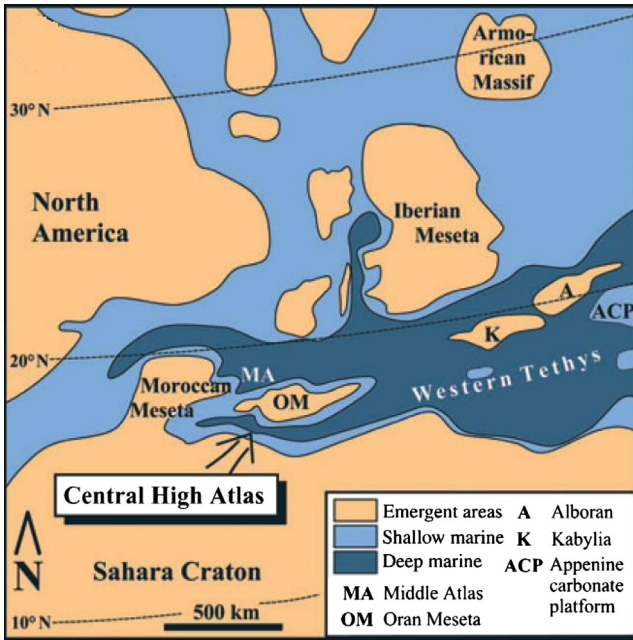


Fig. 1. Early Jurassic palaeogeography of the Central High Atlas rift basin, illustrating its proximity to the western Tethyan realm [adapted from Wilmsen and Neuweiler (2008) after Bassoullet et al. (1993)].

The High Atlas rift basin of Morocco has been the subject of numerous geological works (tectonic, stratigraphical, sedimentological, etc.; Ait Addi, 2002; Brede, 1988; Du Dresnay, 1979, 1987; El Kochri, 1996; Laville, 1985; Laville et al., 1995, 2004; Mat-tauer et al., 1977; Michard, 1976; Sadki, 1992; Warme et al., 1988; Wilmsen and Neuweiler, 2008). The general palaeogeographical pattern during the Early Jurassic is described as relatively deep marine in the centre, shallowing towards the northern and southern basin margins (Choubert and Faure-Muret, 1960–62; Du Dresnay, 1971a, 1976; Dubar, 1960–62; Dubar and Mouterde, 1978; Michard, 1976; Piqué et al., 1998; Souhel et al., 2000). Several

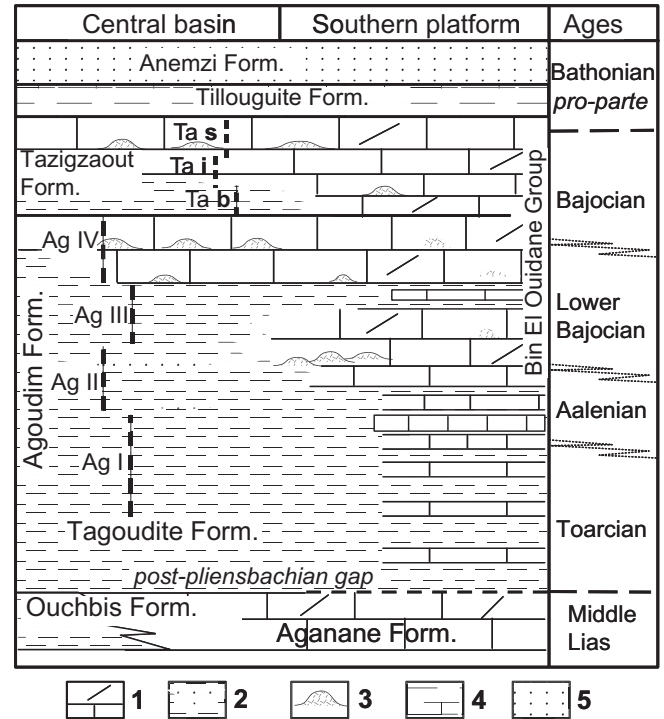
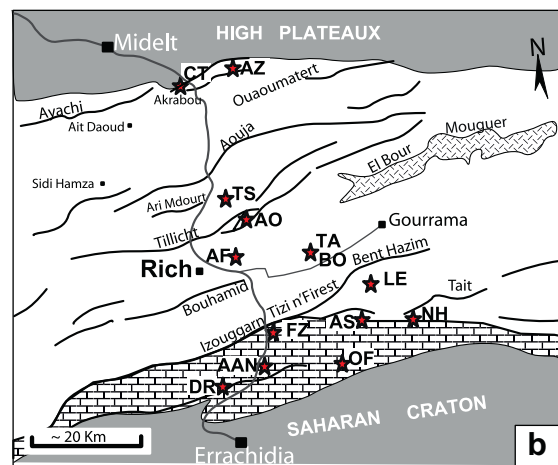
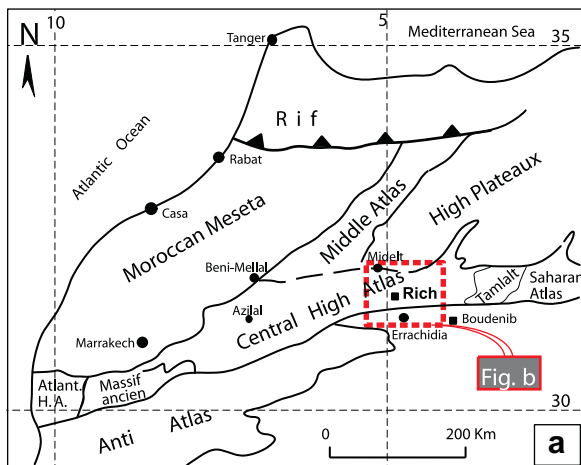


Fig. 3. Stratigraphic succession of Toarcian to Middle Jurassic in the Moroccan High Atlas. (1) limestones and dolostones, (2) marls and claystones with locally bioterritic chanel, (3) buildup mounds and patch reefs, (4) marls, claystones and limestones, (5) silts, sandstones and conglomerates, (Ag I to Ag IV) Agoudim members, (Ta b, Ta i, and Ta s) lower, middle and upper members of Tazigzaout Formation.

interesting works focusing on Early Jurassic (Blomeier and Reijmer, 1999, 2002; Kenter and Campbell, 1991; Scheibner and Reijmer, 1999; Verwer et al., 2009a,b) and Middle Jurassic (Amour et al., 2012; Christ et al., 2012; Homann, 2010; Merino-Tomé et al., 2012; Pierre et al., 2010) carbonate platform complexes, have been published respectively toward the east, at the Jbel Bou Dahar



Legend of Fig. b: AF: Assameur n'Ait Fergane, AAN: Ait Athman Nord, AO: Azag n'Offouloussen, AS: Assrem, AZ: Azroual, BO: Boukendil, CT: Col Talghemt, DR: Dremchane, FZ: Foug Zabel, OF: Ouaoufillis, LE: Lemdouar, NH: n'Hakht, TA: Tazigzaout, TS: Tassalaht ★ studied sections — fault and liassic ridges  
 ■ stable blocks ▨ southern platform complex □ central basin complex ▩ El Bour Mouguer Paleozoic basement

Fig. 2. (a) Structural provinces of northern Morocco, (b) simplified geologic map of the Central and Eastern High Atlas trough.

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