



# Sedimentary dynamics and palaeotectonic structuring during the Toarcian–Aalenian in the southwestern Middle Atlas (Morocco)



Fatima El Hammichi\*, Hassan Tabyaoui

Ressources Naturels and Environment Laboratory, Sidi Mohamed Ben Abdellah University, Polydisciplinary Faculty of Taza, B.P. 1223, Taza-Gare, Taza, Morocco

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## ABSTRACT

The southwestern Middle Atlas (Morocco), which has long been regarded as a southern extension of the Tabular Middle Atlas (Ain Leuh Causse), actually consists of a broad syncline and narrow anticlinal ridges that were folded between the Liassic and Dogger epochs. Using lithostratigraphic, biostratigraphic and structural analysis, we draw the geometry of structures during the Late Liassic–Early Dogger epoch and reconstruct the various stages of their evolution. This area, which has been considered a coastal border of the tethyan atlasic trough, corresponds to a distinct basin composed of a mosaic of sub-basins tilting to the west (i.e., toward the Atlantic). These sub-basins are attributable to a double-structuring: (1) SW–NE superimposed on existing anticlinal ridges and (2) submeridian which original direction SSW–NNE seems to indicate an influence of the Atlantic coast. Tectonic segmentation preceded the Early Toarcian anoxic crisis, and tectono-eustatic interactions continued during the Late Liassic and Early Dogger epochs. Sub-basins subsequently functioned alternately as depressions in the early Late Toarcian and early- and -middle Aalenian epochs or as depocentres in the Late Toarcian and Late Aalenian epochs. Tectonics and eustasy caused a palaeobiological subdivision during the Early and Middle Aalenian epochs, as indicated by significant SE–NW segregation between ammonite faunas of Tethyan and northwestern European origin. This study indicates that the original palaeogeographic position of the southwestern Middle Atlas was at the crossroads of the Tethyan and Atlantic margins.

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\* Corresponding author.

E-mail addresses: [fatima.elhammichi@usmba.ac.ma](mailto:fatima.elhammichi@usmba.ac.ma) (F. El Hammichi), [hassan.tabyaoui@usmba.ac.ma](mailto:hassan.tabyaoui@usmba.ac.ma) (H. Tabyaoui).

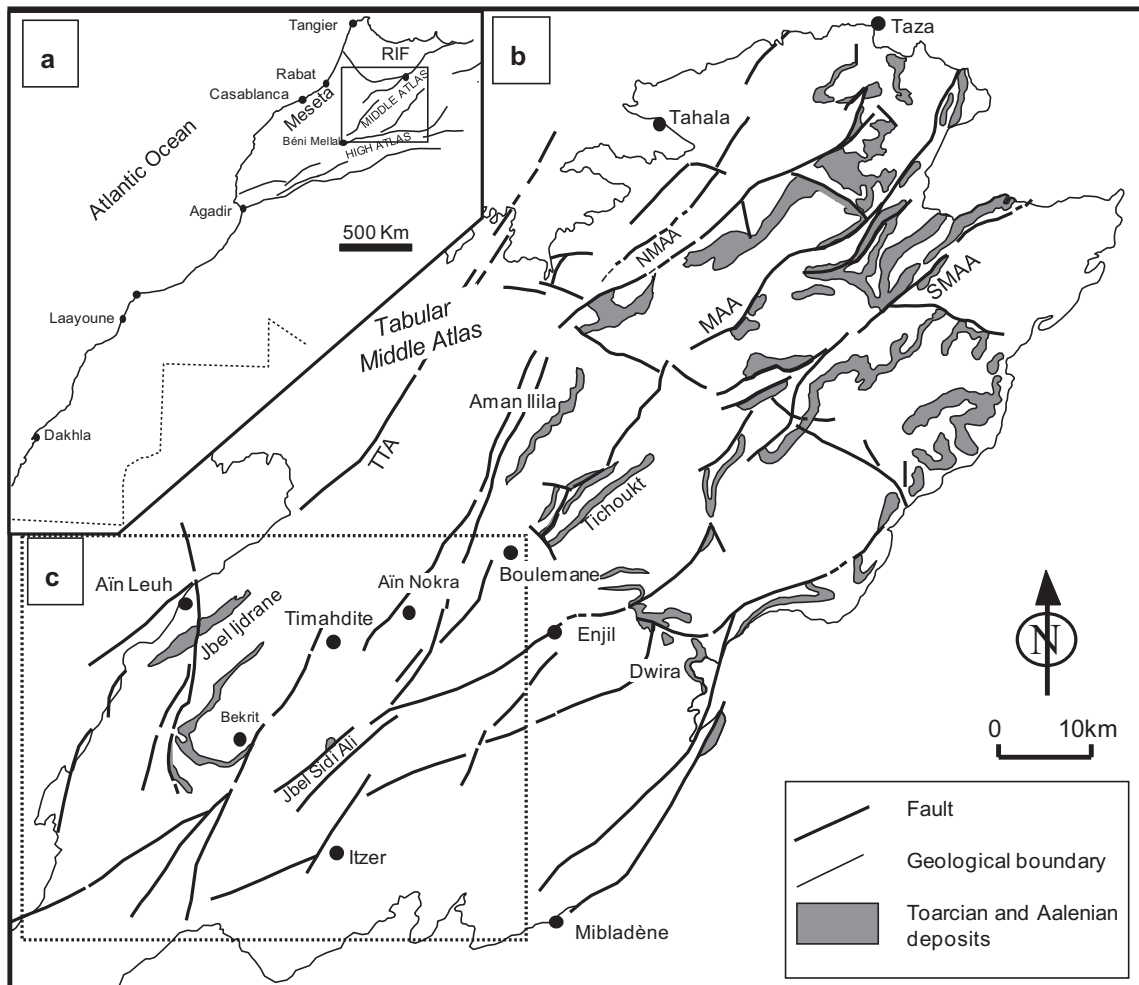
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**1. Introduction**

The southwestern Middle Atlas (Morocco) (Fig. 1) has long been regarded as an extension of the Tabular Middle Atlas (Ain Leuh Cause) (Termier, 1936; Martin, 1981). In fact, the southwestern Middle Atlas is structurally more complex, with wide synclines and narrow anticlinal ridges marking the transition from the Tabular Cause to the anticlinal ridge of Jbel Sidi Ali located in the Middle Atlas accident (MAA) (Fig. 1) (Ennslin, 1992; Herbig, 1988). This structure is the southern section of the Tabular Cause according to Colo (1961), who recognized a structural unit “more wavy” than the northern sector. In the northwest, the Iguer Awragh-Afennourir syncline (A and B, Fig. 2a), which is equivalent to the Kissaria-Afennourir syncline of Termier (1936), marks the border with the Middle Atlas Cause. It is cut by the submeridian strike-slip Mermel Accident (Fig. 2a). The Bekrit syncline (C,

Fig. 2a) (Termier, 1936; Colo, 1961), which is equivalent to the El Koubbat syncline (Charrière, 1990), lies to the southeast between the Iguer Awragh-Afennourir syncline and the Bou Angar Syncline (D, Fig. 2a) which includes a central, well-developed portion and a significantly upright southeastern flank. This latter structure is the prolongation of the “northern synclinal zone of the Middle Atlas” (Colo, 1961), including the synclines of Nokra (E, Fig. 2a) and Skoura (G, Fig. 2a), which is offset by submeridional strike-slip faults. At the palaeogeographic level, El Arabi et al. (2001) and El Hammichi et al. (2002) have demonstrated that this region, also called the Selloum block, was not a simple gulf terminating the Middle Atlas to the southwest, but a basin (or a set of sub-basins) separated from the eastern Middle Atlas by a meridional shoal, the “Boulemane shoal”.

Our purpose here is to retrace the main palaeotectonic directions from Late-Liassic and Early-Dogger sedimentation. We use



**Fig. 1.** (a) General situation map, (b) structural sketch of the Middle Atlas, (c) position of the studied area. TTA: Tizi N'Trettene Accident, MAA: Middle Atlas Accident, NMAA: North Middle Atlas Accident, SMAA: South Middle Atlas Accident.

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