The Lower and Middle Jurassic of the Western Mediterranean Tethys (Morocco, Algeria, and Tunisia)

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Abstract This work summarizes the lithostratigraphic and palaeogeodynamic data of the Lower and Middle Jurassic margin of the Tethys Maghreb (Morocco, Algeria, and Tunisia). Comparative analysis of these successions conducted thus far has allowed us to establish correlations, and to propose a geodynamic evolution of this margin for the Early and Middle Jurassic, which can be summarized as follows: (1) construction and development of a Liassic carbonate platform (early and middle Lias); (2) individualization and compartmentalization of basins (Pliensbachian–early Toarcian); (3) filling of basins (late Lias–Bajocian); and (4) senescence of basins (Bathonian–Callovian).

Keywords Lower and Middle Jurassic · Western Mediterranean Tethys · Atlas domain · Morocco–Algeria–Tunisia · Lithostratigraphy · Palaeogeodynamic evolution

Introduction

Located on the southern border of Tethys, the Atlasic Maghreb domain constitutes an E–W-oriented intracratonic chain crossing the Maghreb from Morocco to Tunisia (Fig. 1). The Atlasic Maghreban domain was structured during the

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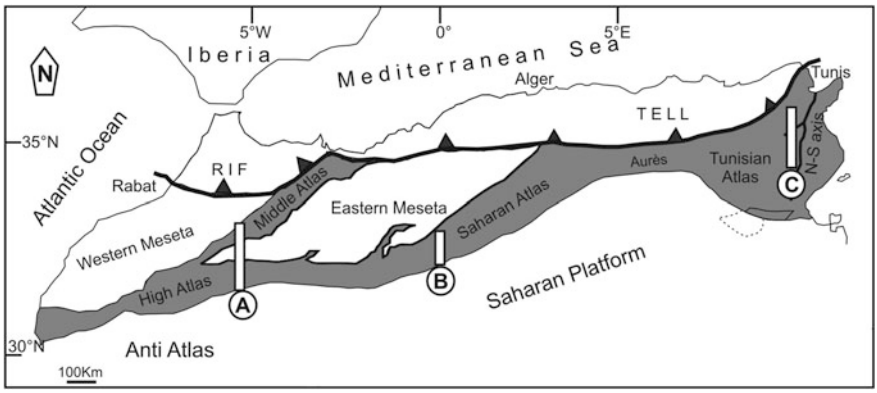

Fig. 1 Sketch map of the Maghreb showing the Atlas range (modified from Frizon de Lamotte et al. 2009)

Jurassic, and thus created several palaeogeographical domains organized in subsiding basins (e.g., the Middle Atlas and High Atlas in Morocco, the Saharan Atlas in Algeria, and the Tunisian Trough in Tunisia) bordered by residual platforms as more resistant blocks (e.g., the Moroccan and Oranese Mesetas in Morocco and Algeria, respectively, and the North–South Axis and Tunisian Dorsale in Tunisia).

Data synthesized according to N–S transverses (Elmi et al. 1998; Soussi et al. 2000; Sadki and Benshili 2002) across different palaeogeographical domains of the Maghreb Atlases (Fig. 2a–c), allow similarities and differences to be highlighted and a geodynamic evolution for this margin during the Lower and Middle Jurassic to be proposed.

Palaeogeodynamic Evolution

Construction and Development of Liassic Carbonate Platform (Lower and Middle Lias)

In the Atlasic Maghreb domain, the deposits of the lower Lias (Hettangian–Hettangian) correspond to the construction of an initial platform. These platform deposits are diachronous from NE towards the SW, according to the progressive advance of the western Tethys.

The early Sinemurian (Lotharingian) corresponded to a stage of rifting, responsible for the division of the Liassic carbonate platform, and creating the first structural imprint and forming the first palaeogeographical differentiation. This division was accompanied by eustatic rises that accompanied the rifting of Tethys and the opening of the Atlantic.

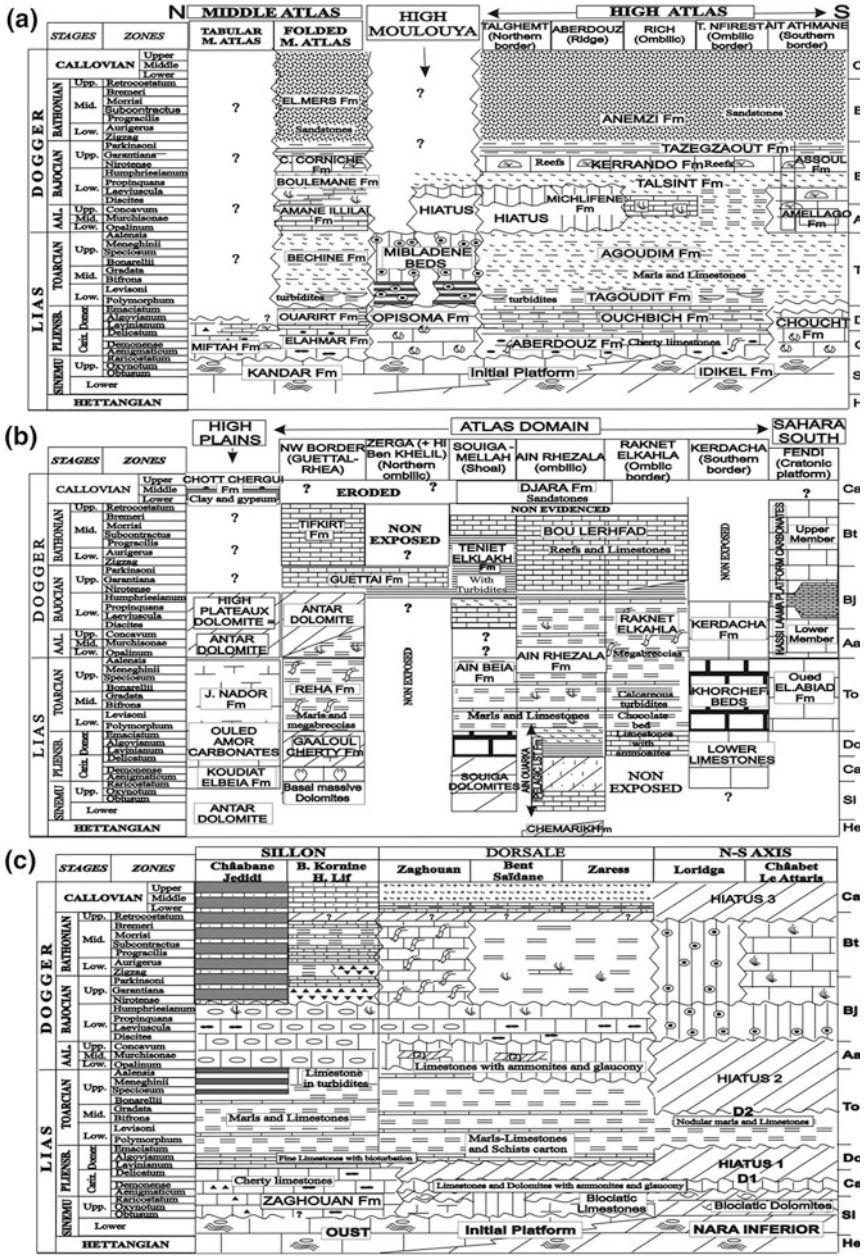

Fig. 2 Major formal Lower and Middle Jurassic Lithostratigraphic units: **a** along the N–S transect trough the Middle and High Atlas (Sadki, present work); **b** along the NW–SE transect Saharian Atlas (Elmi et al. 1998, modified); **c** in the Tunisian Trough Dorsale and N–S Axis (Soussi et al. 2000, modifed)

During the middle Lias (Pliensbachian), under the combined influence of tectonics and eustatic processes, a differentiation occurred in the main palaeogeographical domains of the Atlasic Maghreb domain, in which diverse carbonate deposits are found.

Individualization and Compartmentalization of Basins (Pliensbachian–Early Toarcian)

The Pliensbachian–Toarcian interval represents an episode of extension, corresponding to the paroxysm of Liassic platform dislocation. This tectonic phase, linked to a new rifting stage, was responsible for the general shape of the basins in a mosaic of palaeoenvironments, and in which the nature and thickness of deposits show wide variability.

Filling of Basins (Late Lias to Bajocian)

The Toarcian represented an episode of palaeogeographical differentiation. This period was represented by changes in the sedimentary regime and palaeogeographical individualization. The Liassic sedimentation, which had hitherto been carbonate based, became mostly marly at the beginning of the early Toarcian, signalling an end to the carbonate episode of the early and middle Lias.

During the late Toarcian and Aalenian, a new episode of extensive structuring occurred, common also to other basins of the Tethys perimeter. It was a period that showed important sedimentary disturbances manifested by the levels of some ridges and on borders, by lacunas, or by the extreme reduction of represented deposits (sometimes ferruginous and oolithic).

In the period of the late Aalenian to early Bajocian, the Atlasic Maghreb domain showed a diversification of palaeogeographical contrasts, as revealed by the variations in facies types and thicknesses. The subsidence of the basins was accompanied by the development of sedimentation dominated by limestone containing *Zoophycos* and by marls. Thus, in ridges, sedimentary instability is indicated by lacunas and the development of condensed facies with ferruginous ooliths and phosphates. During this stage, the construction and development of a new carbonate platform took place.

During the late Bajocian, a palaeogeographical and nonsynchronous differentiation occurred. In Morocco and Algeria, a generalized sinking led to the homogenization of the marly sedimentation prior to the construction of a new carbonate platform. In contrast, in Tunisia, the Niortense Zone of the upper Bajocian records the collapse of only a part of the margin and the individualization of very deep areas of deposits (siliceous limestone).

Senescence of Basins (Bathonian–Callovian)

The senescence of western Atlasic basins was caused by the slowing down and stopping of the extension of the Maghreb Tethys. This brought about the filling of depressions by sandstones and continental red marls during the Bathonian. This evolution was brought forward in the Tunisian Atlas, which remained under marine influence until the Tithonian. The Tithonian corresponds to the regression near the end of the Jurassic giving way to a general continentalisation.

Conclusion

In the evolution established here for the Atlasic Maghreb domain, the inferred spatio–temporal distribution of palaeogeographical elements as well as sedimentation patterns indicate that the onset of Liassic–Dogger deposition was controlled by general fluctuations in sea level and tectonic activity related to Tethyan rifting and the opening of the Atlantic.

References

Elmi, S., Almeras, Y., Ameur, M., Bassoullet, J. P., Boutakiout, M., Benhamou, M., et al. (1998). Stratigraphic and palaeogeographic survey of the Lower and Middle Jurassic along a north–south transect in western Algeria. In S. Crasquin-Solleau, E. Barrier (Eds.). *Péri-Téthys Memoir. 4: Epicratonic basins of Peri-Tethyan platforms* (Vol. 179, pp. 145–211). France: Mémoires du Muséum National d'Histoire Naturelle.

Frizon de Lamotte, D., Leturmy, P., Missenard, Y., Khomsi, S., Ruiz, G., Saddiqi, O., et al. (2009). Mesozoic and Cenozoic vertical movements in the Atlas system (Algeria, Morocco, Tunisia): An overview. *Tectonophysics, 475*, 9–28.

Sadki, D., & Benshili, K. (2002). Stratigraphie et sédimentologie du Jurassique du Haut-Atlas et du Moyen Atlas marocains. *ATEIG-GFEJ International Workshop sur le Jurassique de la marge maghrébine de la Téthys* (pp. 16–20), Tunis.

Soussi, M., Mangold, C., Enay, R., Boughdiri, M., & Ben Ismail, M. H. (2000). Le Jurassique inférieur et moyen de la Tunisie septentrionale; corrélations avec l'axe Nord-Sud et paléogéographie. *Geobios, 33*(4), 437–446.