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## Title

### ***Miocene evolution of the External Rif Zone (Morocco): Comparison with similar and lateral southern Mediterranean Tethyan margins***

## Abstract

The Miocene evolution of the External Rif Zone (NW Africa Plate) was determined through multidisciplinary analysis of fourteen successions. The updated stratigraphic framework shows how Miocene sediments rest on the Cretaceous–Paleogene terrains through unconformity surfaces, whereas it rests with sedimentary continuity in two sectors. After recognition of lithofacies and three unconformities located near the Oligocene–Aquitania, Aquitania–Burdigalian and Serravallian–Tortonian boundaries, the Miocene sedimentary record was divided into three stratigraphic intervals representing deep to shallow marine deposits as Aquitania–Burdigalian, Langhian and Upper Serravallian–Missinian. The two oldest unconformities are restricted to the central sector, while the upper one is generalized and probably related to the nappe tectonics registered in all sectors of the External Rif. Data from analysis of tectofacies, petrology, mineralogy, meaning and implications of unconformities, and subsidence indicate that: (i) mass flow deposits (turbidites, slumps, olistostromes) are common in all successions but more frequent during the Lower Miocene; (ii) petrology of the detrital components of the arenites indicates recycled orogen-derived sediments, with quartz coming from erosion of metamorphic rocks of the Atlas orogen and/or the African craton; (iii) mineralogy of mudstones suggests a complex erosional evolution of local emerged areas derived from a mixture of contributions coming from the erosion of Upper Jurassic to Paleogene suites, and especially from kaolinite-rich Albian–Cenomanian to Paleogene successions with absence of a clear unroofing. The conjunction of all these clues reinforces the idea of a syndimentary tectonics affecting the

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margin/basin system during the Miocene. A thickness analysis of the studied sedimentary successions allows proposing the evolution of the orogenic front and main depozones (foredeep, bulges, wedge-top and intramontane sub-basins) integrated in a complex foreland system migrating from north to south with the Atlas-Mesetas area acting as foreland during Miocene. The orogenic front moved from the Internal Intra-rif to Mesorif and later to Internal Prerif. The main wedge-top basin also migrated from the Internal Intra-rif to External Intra-rif. The foredeep migrated from the Mesorif to the Internal Prerif, while the main forebulge was located in the External Prerif and a secondary bulge developed in the External Intra-rif. Intramontane basins developed behind the orogenic front in relative extensional conditions moving from the Internal Intra-rif to External Intra-rif. The reconstructed Miocene evolution was inserted into a 2D paleogeographic-geodynamic evolutionary model using GPlates software, and then compared to those reported in other external margins of the western Tethys (Betic Chain, Tunisian Tell, Sicilian Maghrebids and Apennines), revealing important similarities and local differences. © 2024 The Author(s)

## Authors

Martín-Martín M.; Guerrera F.; Cañaveras J.C.; Alcalá F.J.; Serrano F.; Maaté A.; Hlila R.; Maaté S.; Sánchez-Navas A.; Miclăus C.; Tent-Manclús J.E.; Bullejos M.

## Author full names

Martín-Martín, Manuel (6701606003); Guerrera, Francesco (7004042415); Cañaveras, Juan Carlos (6603853899); Alcalá, Francisco Javier (6603128699); Serrano, Francisco (57200253280); Maaté, Alí (6508283910); Hlila, Rachid (8357495600); Maaté, Soufian (57194502455); Sánchez-Navas, Antonio

---

(55664564300); Miclăus, Crina (7801366997); Tent-Manclús, José Enrique  
(6507756352); Bullejos, Manuel (6701718197)

### **Author(s) ID**

6701606003; 7004042415; 6603853899; 6603128699; 57200253280; 6508283910;  
8357495600; 57194502455; 55664564300; 7801366997; 6507756352;  
6701718197

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## Affiliations

Departamento de Ciencias de la Tierra y Medio Ambiente, University of Alicante, AP 99, Alicante, 03080, Spain; Dipartimento di Scienze Pure e Applicate (DiSPeA), Università degli Studi di Urbino Carlo Bo, Campus Scientifico E. Mattei, Urbino, 61029, Italy; Departamento de Desertificación y Geo-Ecología, Estación Experimental de Zonas Áridas (EEZA-CSIC), Almería, 04120, Spain; Instituto de Ciencias Químicas, Universidad Autónoma de Chile, Santiago, 7500138, Chile; Departamento de Ecología y Geología, University of Málaga, Málaga, 28071, Spain; Laboratoire de Géologie de l'Environnement et Ressources Naturelles, FS, Abdelmalek Essaâdi University, B.P. 2121, Mhannech II, Tetouan, 93002, Morocco; Université Moulay Ismaïl, Laboratoire de Géologie Appliquée, Faculté des Sciences et Techniques, BP. 509, Boutalamine, Errachidia, 52000, Morocco; Departamento de Mineralogía y Petrografía, University of Granada, Granada, 18071, Spain; Departmentul de Geologie, Universitatea "Alexandru Ioan Cuza" din Iași, 20A, Carol I, Iași, 700505, Romania; Departamento de Algebra, University of Granada, Granada, 18071, Spain

---

## Authors with affiliations

Martín-Martín M., Departamento de Ciencias de la Tierra y Medio Ambiente, University of Alicante, AP 99, Alicante, 03080, Spain; Guerrera F., Dipartimento di Scienze Pure e Applicate (DiSPeA), Università degli Studi di Urbino Carlo Bo, Campus Scientifico E. Mattei, Urbino, 61029, Italy; Cañaveras J.C., Departamento de Ciencias de la Tierra y Medio Ambiente, University of Alicante, AP 99, Alicante, 03080, Spain; Alcalá F.J., Departamento de Desertificación y Geo-Ecología, Estación Experimental de Zonas Áridas (EEZA-CSIC), Almería, 04120, Spain, Instituto de Ciencias Químicas, Universidad Autónoma de Chile, Santiago, 7500138, Chile; Serrano F., Departamento de Ecología y Geología, University of Málaga, Málaga, 28071, Spain; Maaté A., Laboratoire de Géologie de l'Environnement et Ressources Naturelles, FS, Abdelmalek Essaâdi University, B.P. 2121, Mhannech II, Tetouan, 93002, Morocco; Hlila R., Laboratoire de Géologie de l'Environnement et Ressources Naturelles, FS, Abdelmalek Essaâdi University, B.P. 2121, Mhannech II, Tetouan, 93002, Morocco; Maaté S., Université Moulay Ismaïl, Laboratoire de Géologie Appliquée, Faculté des Sciences et Techniques, BP. 509, Boutalamine, Errachidia, 52000, Morocco; Sánchez-Navas A., Departamento de Mineralogía y Petrografía, University of Granada, Granada, 18071, Spain; Miclăus C., Departmentul de Geologie, Universitatea "Alexandru Ioan Cuza" din Iași, 20A, Carol I, Iași, 700505, Romania; Tent-Manclús J.E., Departamento de Ciencias de la Tierra y Medio Ambiente, University of Alicante, AP 99, Alicante, 03080, Spain; Ballejos M., Departamento de Algebra, University of Granada, Granada, 18071, Spain

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## **Correspondence Address**

M. Martín-Martín; Departamento de Ciencias de la Tierra y del Medio Ambiente, Universidad de Alicante, Alicante, Campus San Vicente, San Vicente del Raspeig, 03080, Spain; email: manuel.martin@ua.es

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