

# The Cenozoic evolution of the Intrarif (Rif, Morocco)

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## Abstract

This paper provides an understanding of the sedimentary-tectonic evolution of the Cenozoic strata of the El Habt and Ouezzane Tectonic Units (Intrarif, External Rif) in Morocco. New data provide information about the depositional architecture and enable a correlation of the evolution of the External Rif in Morocco with that of the Betic Cordillera in Spain and the Tunisian Tell, which provides new insights for hydrocarbon exploration in the region regarding possible source, reservoir, and seal rocks. The reconstructed Cenozoic succession was bio-chronologically defined, and the major unconformities and stratigraphic gaps were identified. The presence of these unconformities allowed three main stratigraphic sequences to be defined by age: Danian p.p., early Ypresian-early Bartonian p.p., and the early Rupelian-early Serravallian p.p. Three secondary stratigraphic sequences in the former upper main sequence were also defined by age: early Rupelian-late Chattian p.p., Burdigalian p.p., and the Langhian-Serravallian p.p. The depositional setting evolved from deep basin during the Late Cretaceous-Paleocene to external platform-slope during the Eocene-Miocene. The Cenozoic sandstones contain metamorphic and sedimentary rock fragments derived from a recycled orogen source area. The clay mineralogy in the Cenozoic strata consists of associations of Ill+(I-S) ± Sme, Ill+(I-S) ± Sme+Kln and Ill+(I-S) ± Sme+Kln+Chl. These associations indicate an initial unroofing in the Paleogene period, then in the Cretaceous period, and finally in the Late Jurassic period during the Eocene-Oligocene. This detritus was followed by variable amounts of a sedimentary mix of Paleogene to Late Jurassic terrains due to several phases of erosion and deposition partly related to syn-sedimentary tectonics during the Miocene. Equivalent features (similar types of sediments, tectofacies, gaps, and unroofing) were also recognized along the Betic Cordillera in Spain and Maghreb Chain (Morocco and Tunisia) and interpreted as related to a pre-nappe tectonic activity of soft basement folding, which occurred during the Paleogene after the generalized tectonic inversion (from extension to compression) occurred in the Late Cretaceous. The Upper Cretaceous is considered to be the hydrocarbon source rock, while the fractured

Eocene and the porous Oligo-Miocene suites are proposed as possible hydrocarbon reservoirs. The Cenozoic stratigraphic architecture and the nappe structure of the region could provide the necessary trap structures. © 2022. The Authors. All Rights Reserved.