

The Prérif Domain and its Forelands, Northern Morocco: Geology and Petroleum Play Concepts

M. Dakki, M. Hssain, M. El Alji, and R. El Abib

ONHYM

The Prérif area, located in northern Morocco, constitutes the most external structural units of the Rif Alpine domain which includes essentially Mesozoic and Tertiary folded sediments overlaying the Palaeozoic basement. The Gharb, Saiss and Guercif basins constitute the main foreland basin of the Rif folded belt.

Sedimentary deposits, consisting of about 6000 m of Mesozoic and Cenozoic sediments, covered by the complex of nappes overlain by Upper Miocene clastic sediments, resulted essentially, from the relative sea level changes during the complex successive tectonic phases of continental collision and plate divergence inducing the deposition of various sedimentary series ranging from continental and lagoonal carbonate and clastics to open marine deposits.

From tectonic point of view, normal faults initiated during the rifting period were reactivated into high to medium angle reverse faults, during Late Cretaceous to Early Tertiary times, inducing the development of various thrusts, folds and imbricates.

Petroleum exploration started as early as 1910 around surface oil seeps and surface anticlines, using mostly surface geology, electrical profiles and poor single fold seismic data. Exploration programs were concentrated within the southern edge of the Prérif leading to the discovery of small oil and gas fields in Ain Hamra, along Sidi Fili fault and in the Prérif Ridges (Haricha, Tselfat and Boudraa). The increase of Exploration activities between the early 1960's and the early 1970's resulted in the discovery of biogenic gas fields in the Gharb basin.

Successive integrated studies using new seismic programmes and new reprocessing such as PSTM and AVO show that more oil and gas to be discovered in prospects similar to the producing ones and in plays which have not been tested such as Triassic salt structures, sub thrusts and Tertiary folded sandstones.

From geochemistry point of view, many mature source rocks exist within the Prérif area as proven by hydrocarbon productions, shows and oil seeps.

The Lower Jurassic marls and shale (Domerian-Toarcian) and the Upper Cretaceous shale seem to be the main source-rocks in the area. TOC values taken from wells data are up to 2 % for the Lower Jurassic source rock. The outcropping Upper Cretaceous formations have TOC values up to 15%. Maturation of Lower Jurassic source rock may have started as early as end of Jurassic-Lower Cretaceous in deeper zones (troughs). On the other hand, maturity modelling indicates that maturation and generation of hydrocarbons in the Prérif area, started after the emplacement of the complex of nappes. Maturation of the Upper Cretaceous source-rock has occurred recently during the Mio-Pliocene time.

Wells drilled up to now and field studies in the Prérif, the Gharb and Guercif basins have shown formations with good petrophysical characteristics and favourable for hydrocarbon accumulation. Recorded porosities are good to excellent reaching 35% in the Miocene sands.

The defined play concepts consist of Subsalt alluvial and fluvial Triassic sandstones, Jurassic sub thrusts sandstones and carbonates, Jurassic and Tertiary folded sandstones and carbonates and Upper Miocene Low stand system tracks sands (LST) in Gharb and Guercif basins.