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Potential source rocks of Late Triassic-Early Jurassic Synrift deposits in Morocco.

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Petroleum exploration, in several Central Atlantic Margin (CAM) basins, has demonstrated that Mesozoic synrift lacustrine sediment can source rocks for a petroleum system.

In Morocco, the Triassic/Jurassic rifting of Pangea resulted in several extensional basins centered in arid climates over a palaeolatitude of about 23°N in earliest Jurassic coordinates. Presently, these basins are found in the Moroccan offshore domain, the continental shelf/coastal plain areas and in the inverted Atlas system. They have facies broadly similar to the Fundy basin (Nova Scotia, Canada) but also show some similarities to the Triassic age sequences of the Newark basin (New Jersey, USA).

The synrift infill is typically formed by continental red beds with cyclic arid lacustrine deposits and evaporites interbedded with lavas flows of Moroccan CAMP. Their generalized sections are divided in four tectonostratigraphic sequences (TS I-TS IV) that are at least locally separated by synrift unconformities corresponding to presumed lags and subsequent acceleration in extension rates. TS I and TSII are present in the Central and Western High Atlas stratigraphic sections and maybe also in Essaouira, Souss-Ifni, and Tarfaya-Laayoun basins; but totally absent elsewhere in Morocco where the basins appear to consist nearly entirely of TS Ill and TS IV, therefore demonstrating that basin accumulation during rifting was clearly diachronous. Furthermore, TSI, of Late Permian in age, may have deposited in basins that did not form in association with the final breakup of Pangea, as indicated by the absence of evidence of coeval normal faulting and the regional data from the Central Atlantic.

In Western High Atlas, TS I comprises alluvial fan conglomerates that grade into fluvial sandstones and mudstones with calcic vertisols showing that there is no chance for Late Permian source rock. In contrast, the Anisian-Carnian TSII consists of fluvial and lacustrine clastic rocks with an especially well developed cyclical lacustrine sequence in the Argana basin. TS II, which was deposited in this basin at same latitude as Lockatong Formation (Newark basin), but older, may yield good non-marine lacustrine source rock in deeper parts of Moroccan Atlantic coastal basins. TS III, which underlies the CAMP flows, is Norian-Rheatian in age and consists mainly of massive evaporitic mudstones and sandstones arranged into distinctive sand patch cycles with no or few organic-rich shales and no or little source potential. This apparent increasing aridity during the deposition of TS III is a consequence of the northward drift of central Pangea during Late Triassic and Early Jurassic. The uppermost few meters of the pre-basalt sediments has a well-developed cyclicity with very thin black and gray shales. This sequence, present throughout Morocco, represents the lower part of TS IV and was deposited, at least in the Argana, Romani, and Central High Atlas basins, just prior to the end Triassic extinction event, which itself precedes the Triassic-Jurassic boundary, based on palynology. These black shales which have been tested is in the Romani Basin have TOC values in the range of 2%. Strata interbedded with the lower CAMP flows also have a few very thin dark gray to black shales, generally intebedded with limestone and red mudstones, but surface weathering has prevented an assessment of source rock quality.