Upper Triassic-Middle Jurassic Salt Deposits of the Saharan Platform*

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Abstract

The Upper Triassic to Middle Jurassic evaporites of the Saharan Platform in eastern Algeria, Tunisia and western Libya are a key element of the North African petroleum systems. They form a regional seal to both Palaeozoic (Hassi Messouad) and Triassic (TAGI) hydrocarbon reservoirs. The restricted conditions needed for evaporate formation were controlled by deep crustal lineaments and Palaeozoic intraplate tectonics. Deformation of the evaporite sequence is restricted to the area north of the Medenine-Jifarah High.

Sequence 1 consists of five evaporitic cycles dominated by mudstone and halite, which represent the main salt deposits of the Berkine Basin. At this time the Berkine-Ghadames Basin was a restricted evaporitic basin with a barrier to the north (Medenine-Jifarah High) separating it from peri-Tethys. These evaporites were formed by the marine flooding of the eastern margin of Pangaea. Sequence 2 saw the basin-wide development of a carbonate platform (‘B Marker’) in Pliensbachian times in response to relative sea level rise and tectonic adjustment associated with the emplacement of magmatic rocks of the Central Atlantic Magmatic Province (CAMP). Sequence 3 comprises five cycles that are predominantly mudstones, fine-grained carbonates and anhydrites and were formed as global sea level rose. They show cyclostratigraphic changes on a variety of scales which probably relate to astronomical fluctuations. The depositional style contrasts with Sequence 1, the presence of carbonates, occasional patch reefs and sabkha-type anhydrites indicating a marine carbonate-evaporite ramp setting. Similar thickness variations to those observed in Sequence 1 continued through Sequence 3 and reflect the on-going influence of differential subsidence along basement lineaments. Sequence 3 salt deposits are restricted to Algeria and progressive westward onlap resulted in Liassic salt being deposited on north-south basement ridges. A number of factors controlled the development of this evaporite basin. These include Late Triassic sea level rise and flooding of a sub-sea level fluvio-lacustrine basin, combined with globally warm climatic conditions, on-going break up of Pangaea and the emplacement of the CAMP. The evaporite deposits contain the records of these major global tectonic and climatic changes at the Triassic-Jurassic boundary.
Selected References


Busson, G., 1971b, Principes, méthodes et résultats d’une étude stratigraphique du Mésozoïque saharien: These, Université Pierre et Marie Curie, Paris.


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Summary

- Palaeozoic and Mesozoic Intraplate Basins
- Over 7km sedimentary record with a number of world class source rocks and petroleum systems with > 39bboe
- Triassic-Jurassic comprises ~1.5km clastic and carbonate-evaporite sequences
- The evaporites form important seals to both Palaeozoic and Triassic (TAG-I) reservoirs
- They also show complex internal stratigraphy and basin geometries which mimic intraplate tectonic activity and the major Palaeozoic lineaments
- Mainly un-deformed, in contrast to the northerly Atlas zones, but localised thickness variations occur in response to Triassic faulting
- Major changes through late Triassic-Mid Jurassic reflect the opening of the central Atlantic and peri-Tethys
Mesozoic Basins and Regional Structure

Illustrates the two Supercycles:

TETHYAN
HERCYNIAN

African Plate: Gargaf High - Southern Sicily

Classic Oil Accumulations

Study Area and Database

Stratigraphy - NW Libya - NE Algeria
Southern Margin of Salt Basin in Tunisia
10 Major Cycles average duration 6Ma contain up to 20 evaporitic units/cycle- Eccentricity Cycles?

Triassic-Jurassic Boundary?

Cycle Correlation W-E
Onlap of Salt Deposits onto Idjarene Ridge

Onlap toward the Gargaf High

Isopach maps and Palaeozoic Lineaments

Summary Chart of Main Global Events

- **Global Sea Level**
- **Climatic Character**
- **Global Temperature**
- **Tropical sea surface temperature anomaly**
- **Global atmospheric CO₂**

- **Tithonian**
- **Kimmeridgian**
- **Oxfordian**
- **Callovian**
- **Bathonian**
- **Bajocian**
- **Aalenian**
- **Toarcian**
- **Pliensbachian**
- **Sinemurian**
- **Hettangian**
- **Rhaetian**
- **Norian**
- **Carnian**
- **Ladinian**
- **Anisian**
- **Olenekian**
- **Induan**

- **Greenhouse**
- **Hothouse**

- **Tectonic events**
- **Marine transgression**
- **Oceanic anoxic event**
- **Evaporite deposition**

- **Bathonian marine transgression**
- **Final evaporite deposition**
- **Sinistral faulting N. African margin**
- **OAE**
- **Opening of western Mediterranean and link to peri-Tethys. Deposition B-Marker**
- **CAMP SW Algeria 198Ma**
- **Global sea level low. S4 salt deposition**
- **Norian marine transgression. Flooding of the Berknine basin**
- **Start of Pangaea Break Up**
Conclusions

• Accumulation controlled by differential intraplate sag
• Palaeozoic lineaments (Jifarah, El Biod, Idjarene, Gargaf) acted as basin margins and sills to inflow
• Salts largely un-deformed but localised subsidence and reactivation in response to Triassic faulting and inversion
• Sequence 1A, 1B due to marine flooding of a sub-sea level basin
• Sequence 2 (Pliensbachian ‘B Marker’) was a period of carbonate deposition following the link-up of peri-Tethys with western Mediterranean
• Sequence 3 reflects carbonate ramp type deposition with a high frequency of evaporitic units. 10 Megacycles are formed of 10-20 multiple evaporitic units which are likely eccentricity cycles