

SEDIMENTOLOGY OF LAAYOUNE-DAKHLA AREA WESTERN SAHARA DESERT, SOUTH MOROCCO

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Direction des Ressources Hydrauliques (DRH) drilled water well in Boujdour N° ANGER 1181/120, located at approximately 2.7 km in the North-East of Boujdour and at 50-100 m in the east of the Laâyoune-Boujdour road; Western Sahara Desert, Morocco. On test oil was encountered along with water, as a direct result PETRONAS Carigali Morocco Sdn Bhd. in collaboration with state owned oil company ONHYM decided to evaluate this area geologically for its hydrocarbon potential.

The aims and objectives of the study were to carryout detailed sedimentological and basin modelling study to determine the depositional environment of expected reservoirs, hydrocarbon

generation, migration and accumulation within reservoir horizons. But here we will discuss only sedimentology of the basin that will explain reservoir characterisation, distribution and geometry within the study area.

Sedimentological investigation was planned in onshore Laayoune-Tarfaya area, in-order to understand the reservoir distribution, facies interpretation and depositional environment of major synrift and post rift mega sequences.

As a part of sedimentological investigations, reconnaissance geological field trip to Laayoune-Tarfaya area of Western Sahara organised by ONHYM in joint collaboration with PETRONAS

Carigali in May 2006, and a detailed field geological report was submitted to PETRONAS Carigali Morocco exploration team and ONHYM Morocco (Ali. Z, 2006). Drilled well data for study was provided by Geoatlas and ONHYM. Very brief lithological information's were provided but a good attempt is made to utilise all available data in present study, whereas petrographic and palaeontological data was not available.

Detailed stratigraphic and sedimentological analysis of available data reveals that sediment thickness progressively increases from onshore Western Sahara Margin Basin to offshore Western Atlantic of the Laayoune Dakhla Area, which is located both onshore and offshore the passive Atlantic margin of southern Morocco and extends southwards throughout Western Sahara. To the south and southeast area merges with the Senegal Basin and limited to the east by Precambrian basement, to the east by Palaeozoic strata of the Tindouf Basin and to the north and northeast by the Precambrian of the Anti-Atlas Mountains, western limit of the area is considered as the present day shelf break located approximately 20-50 km offshore (Fig-1). These westwards dipping continental to shallow marine sediments of Mesozoic to Cenozoic age are lying on pririft Palaeozoic basement.

Rifting probably commenced in Early Triassic whereas sedimentation begins in Middle to Late Triassic and Lower Jurassic with deposition of continental/lacustrine as major synrift sequence occur in close proximity to provenance in eastern part of the study area. Triassic and Lower Jurassic sandstone can be a possible reservoir as hydrocarbon shows are reported in Triassic from wells (UETAT.A2-41 and UETAT A1-41).

Basin subsidence in Triassic and possibly in Lower Jurassic time makes a way for post rift carbonate deposition. This post rift mega sequence started with the opening of Atlantic during Middle to Upper Jurassic. With the marine transgression, carbonate platform is established in the south-eastern limit of the area whereas more open marine condition is established in north and north western part of the area. Carbonate deposition prograded offshore Western Atlantic probably forming carbonate shoals/reefal build-up that can be a possible reservoir, as Jurassic petroleum system has been proved from onshore PC-1 and off shore Cap Juby wells (MO-2, MO-8 and Cap Juby-1).

Second post rift mega sequence deposited in Lower Cretaceous when the carbonate sedimentation ceased and platform drowned, as a result fluvial system got active over drowned carbonate platform depositing clastic sedimentation of fluvial channel to marginal marine deltaic nature. This post rift sequence is mainly composed of silty-shaly-marly marine sediments to the west offshore Atlantic and sandy to very coarse grained conglomeritic red sandstone in the eastern part of the area. Sediments progressively showing facies variations and prograded from east to west as evident from westwards increase in sediment thickness.

The third major post rift sequence is related to the major transgression that began in the Middle Albian reaching its maximum in the Cenomanian Turonian. This sequence is mainly composed of marls, very calcareous shale that is rich in organic matter and associated by chert and limestone nodules, as has been noticed in outcrops of famous Tarfaya Oil Shale in Laayun-Tarfaya along coastal area of western Atlantic, Sahara Desert. Thickness of these rocks progressively increases from east to west, but in Tarfaya North its erosional limit can be marked along present day shoreline, which shows uplifting and erosion to certain limit possibly at Maastrichtian has been

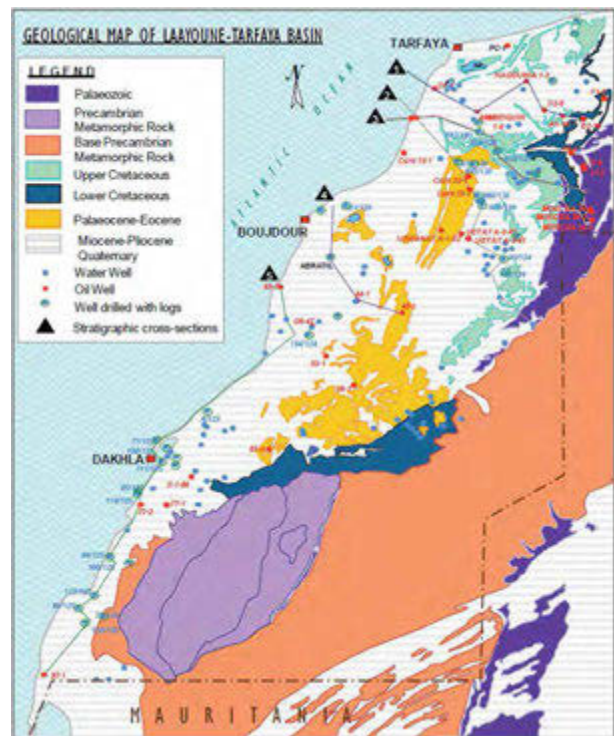


Figure 1: Location and geological map of the area.

uplifted and eroded. These marls are interpreted as possible reservoirs if well developed fractures system and hydrocarbon migration path is established. Oil reported from Cretaceous marl in Boujdour water Well#1181/120, which is most probably assumed as subsurface extension of oil shale horizons exposed in Tarfaya area.

Extensive Tertiary sedimentation in offshore Atlantic is noticed, whereas it is uplifted and eroded in onshore eastern part of the Laayoune-Dakhla Area because most of the cross section reveals thinning of Tertiary sequence towards eastern most limit of the study area. The basin fill was affected by uplift and erosion particularly along the eastern margin between 40 Ma and 20 Ma westward (IHS Energy, 2005). Sediment thickness decrease southward to Dakhla, where only one km of sediments is present onshore. The broadest part of the margin is located between Boujdour and Dakhla, where shelf reach up to 150 km wide in water depth less than 200m. (Ranke et al; 1982, Heyman, 1989, Davidson, 2005).

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