EA24

Reappraisal of Nacala Jurassic Outcrop (onshore Mozambique): A Key to Understanding Offshore Stratigraphy and Petroleum Systems

J.L. Rubino* (Total), N. Pendkar (Petronas), G. Baby (University of Maputo), C. Blanpied (Total SA), L. Vasconcelos (Geosciences Rennes), M. Achimo (Geosciences Rennes), G. Bardin (UPMC) & S. Sia Seak Lung (Petronas)

SUMMARY

New investigations carried out onshore Nacala in Mozambique prove the occurrence of Oxfordian to Kimmeridgian marine series. This series overlies an older series (Jurassic?) with a marked angular unconformity. These two units demonstrate the occurrence of a proto Mozambique marine channel West of the Davies Ridge and are in line with the results of the offshore exploration wells and help to improve the seismic interpretation at depth.

Jurassic rocks have been reported longtime ago in Mozambique, by Da Silva (1966) in the Nacala vicinity and were dated as Jurassic by pelycipods with some uncertainties. Surprisingly this important outcrop does not appear on the latest geological map (Direcção Nacional De Geologia., 2006). In the framework of the offshore areas 3 & 6 evaluation, we recently carried out a geological survey and we revisited these outcrops which appear of paramount importance for the evaluation of the offshore prospectivity.

These outcrops of limited extension occur on the southern edge of Nacala salina; stratigraphic succession consists of two superimposed units separated by a major angular unconformity.

The lower unit of at least 50 m thick and consists of meters thick stacked upward fining sandy sequences or blocky sandy units of medium to coarse grained sandstones with sharp to erosional base; occurrence of bioturbations suggest a marine character of this undated unit. Cross stratifications occasionally occur. The whole unit displays an aggrading pattern and it is interpreted as a regressive sand rich delta. The unit dips 55° toward the SE and it is topped by a weathering profile. This first unit is truncated and it is overlain by a basal transgressive lag including conglomerates and large scale shells mainly *Astarte Kringeli* as well as numerous ammonites of various genus. This basal transgressive unit is condensed and it is overlain by thin storm sandy beds interbedded with marls and then marls with nodular limestone band. The exposed part of the series is around 20m thick and it dips 10° toward the E-SE.

Large ammonites belong to *Aspidoceras* and *Pachysphinctes* genus and indicate a clear Oxfordian to Kimmeridgian age. These fauna cross validate the previous ages giving more confidence on the Upper Jurassic age. It also means that the underlying series is older and could be middle Jurassic in age. They also validate the palaeogeography and the southward extension of the Jurassic sea as proposed by Raillard (1990) or more recently by Salman & Abduala (2005). Similar fauna have reported in Tanzania by Kapilina (2003). All these data clearly indicate that a proto Mozambique channel is running between Madagascar and Africa as early as upper Jurassic and most likely earlier.

This series also appears as a key to interpret the results of recent offshore wells which also found upper Jurassic sandstones demonstrating that a quite thick accumulation is deposited on the proximal part of the margin West of Davie Ridge.

Finally within this upper Jurassic mudstones unit, plurimeters conical calcareous cemented concretions shows typical features commonly reported in gas chimneys and vents, including open conduits. Unfortunately Carbon and Oxygen isotopes analysis we perform do not allow to prove than these carbonates concretions are methane derived. However the character of the chimneys shows real similarities with methane derived vents, its means that probably our sampling as well as the isotopes analysis are not accurate and probably need to be done again with a selective sampling rather than a

bulk rock analysis. In addition offshore gas discovery tends to confirm that a deeply buried petroleum system occurs West of the Davie Ridge possibly already in the gas window during the upper Jurassic in order to explain the vents and may be explain the gas discovery.

References

Da Silva, G.H. [1966] Sobre a ocorrência do Jurássico marinha da norte do Moçambique. *Revista dos Estudos Gerais Universitários de Moçambique*, série VI, Ciências Geológicas, Vol.III, Lourenço Marques.

Direcção Nacional De Geologia [2006] República De Moçambique Ministério Dos Recursos Minerais E Energia, Folha No. 1440, Nacala, Serie' Geologica 1:250000.

Kapilina, S. [2003] Ammonite biostratigraphy of Jurassic of Tanzania. *Tanz. J. Sc.*, **29**(2), 27-34.

Raillard, S. [1990] *Les Marges de l'Afrique de l'Est et les Zones de Fracture Associées: Chaine Davie et Ride du Mozambique*. Univ. Pierre et Marie Curie, Paris, 272.

Salman, G. and Abdula, L. [2005] Development of the Mozambique and Rovuma sedimentary basins, offshore Mozambique. *Sedimentary Geology*, **96**, 7-41.