

Finding New Exploration Targets in ‘Mature’ Petroleum Basins Offshore Thailand: All About Nuance*

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Abstract

Thailand's offshore Tertiary basins have yielded nearly five BBOE. Exploration initiated in the 1970s and peaked by mid 1990s. Volumetrically the discoveries are dominantly gas (~80%). Some important discoveries within the northern Pattani Basin have significant oil reserves e.g. Jasmine 60 MMBO. Basins offshore Thailand consist of Eocene-Oligocene NW-SE grabens, overprinted by narrow N-S fault depocenters developed during Miocene back-arc stretching of continental Sundaland crust. These are filled by lower synrift lake/fluvial deposits, post rift fluvial sequences and drowning brackish intertidal to marine succession. Hydrocarbons are sourced from synrift lacustrine shales. Internally the basins are heavily dissected and compartmentalized by faulting generating numerous traps; consequently, exploration targets have consisted primarily of structural traps. With the exception of the disputed boundary zone straddling Thailand / Cambodian waters exploration offshore Thailand is considered to be in a mature stage of exploration. Nevertheless, fields currently being developed reveal a level of complexity that suggest significant additional exploration upside: complex trapping mechanisms related to combined structural and stratigraphic elements rarely targeted in past ventures. We present a rejuvenated play portfolio for offshore Thailand, within the context of a regional structural and biostratigraphic recalibration. In addition, we illustrate examples of several complex play-trap systems that we consider still worth significant exploration potential. Our view is that Thailand's perception of exploration maturity may be more related to the operational approach taken till now to finding hydrocarbons, rather than actual depletion of the resource. Current “exploration maturity” is related to old ideas and innovative complex / subtle trapping models and play-types as presented here should generate a step-change in the gulf of Thailand creaming curve.

Discussion

Structurally, the Gulf of Thailand basins (and many others within Sundaland) consist of elongate narrow extensional features that comprise complex internal stratigraphy. The early stages of extension is generally characterized by the development of lake related sediments, sometimes inter-fingering with fluvial systems and ultimately drowned by marine transgressive sediments. Correlations between distinct rifts/lakes have been fraught with difficulty due to poor calibration at their depocenters and/or by limitations in correlating sequences across lake shoulders and

rift margin paleo-highs. High-resolution biostratigraphic recalibration using pollen and spore derived information, has been reexamined at high-resolution to constrain the extent (time/space) of paleolakes and marginal swamps. These have shown a close correlation to δO_{18} climate maxima (Figure 1a) and therefore improve play predictability. Subsidence curves have been refined and as result, estimations of earliest rift development from sedimentation rates, the latter ultimately improving maturation modeling. Furthermore, the identification of mountain pollen pulses, together with structural mapping constraints on rift margin elevations, provides possible sediment sources (Figure 1b). Gross depositional environment maps are now better constrained providing the basic framework for the identification of successful plays in time and space and the identification of additional plays with potential running room.

Results

The detailed biostratigraphy framework in conjunction to regional mapping of an extensive 2D/3D seismic database has resulted in identifying additional plays that have not been targeted by the drill bit to date. These include near field targets with complex trapping mechanisms as illustrated in (Figure 2).

Conclusion

Our view is that Thailand's perception of exploration maturity may be more related to the operational approach taken until now to finding hydrocarbons, rather than actual depletion of the resource. Current "exploration maturity" is related to old ideas and innovative complex / subtle trapping models and play-types should generate a step-change in the gulf of Thailand creaming curve.

Reference Cited

Lelono E.B., and R.J. Morley, 2011, Oligocene palynological succession from East Java Sea: in R. Hall and M. Wilson (eds.), Southeast Asian gateway evolution, Geological Society of London Publication, p.333-345.

Thermal maximum, widespread transgression but southward expansion of seasonal climates 15 Ma

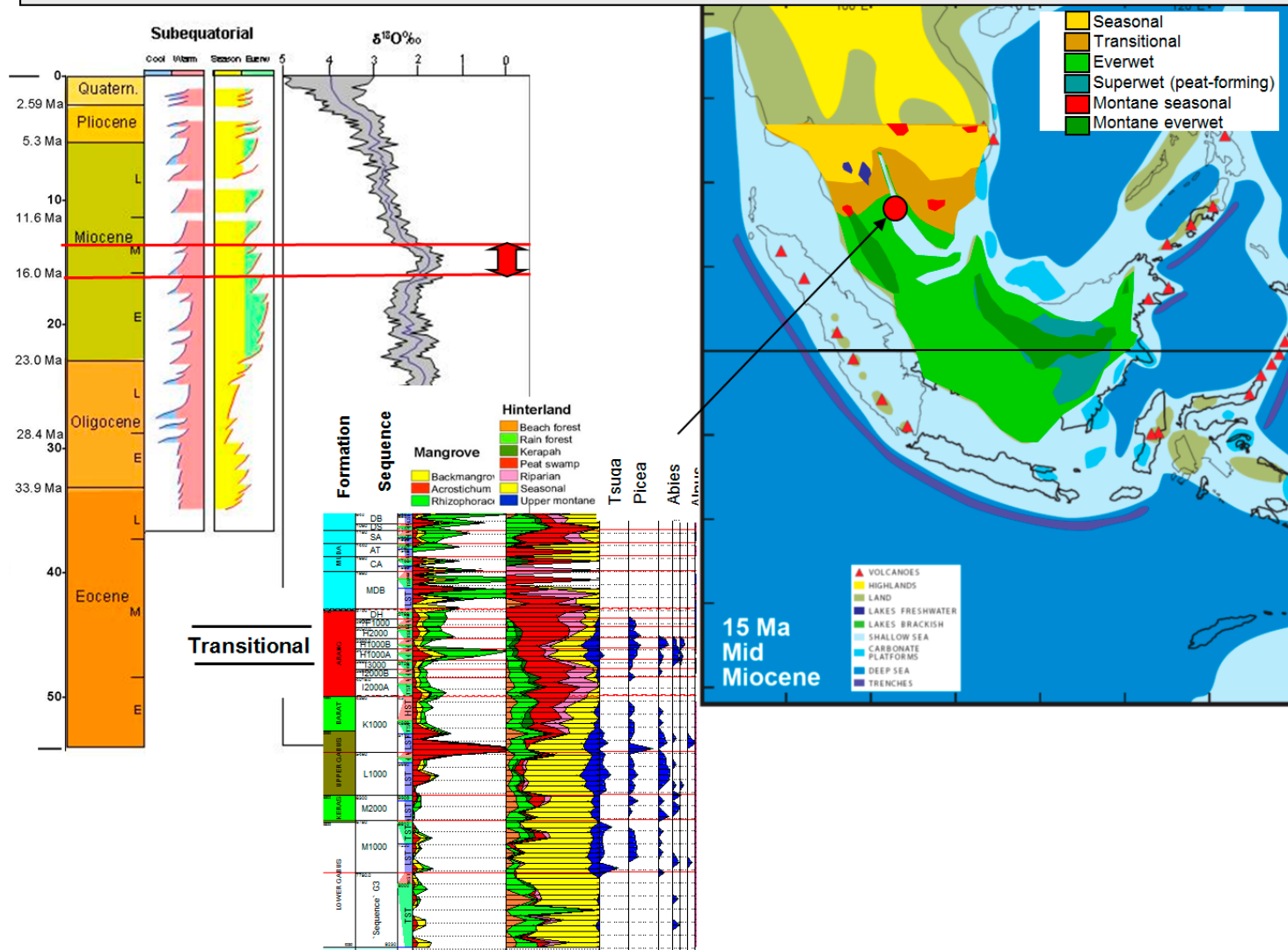


Figure 1a. Detailed biostratigraphic analysis and correlation with thermal maxima as derived from δO_{18} curve (cf. Modified from Lelono and Morley, 2011). This level of detail allows for a meticulous breakdown of plays (reservoir/seal pairs) and to drive its predictability by mapping it from well control.

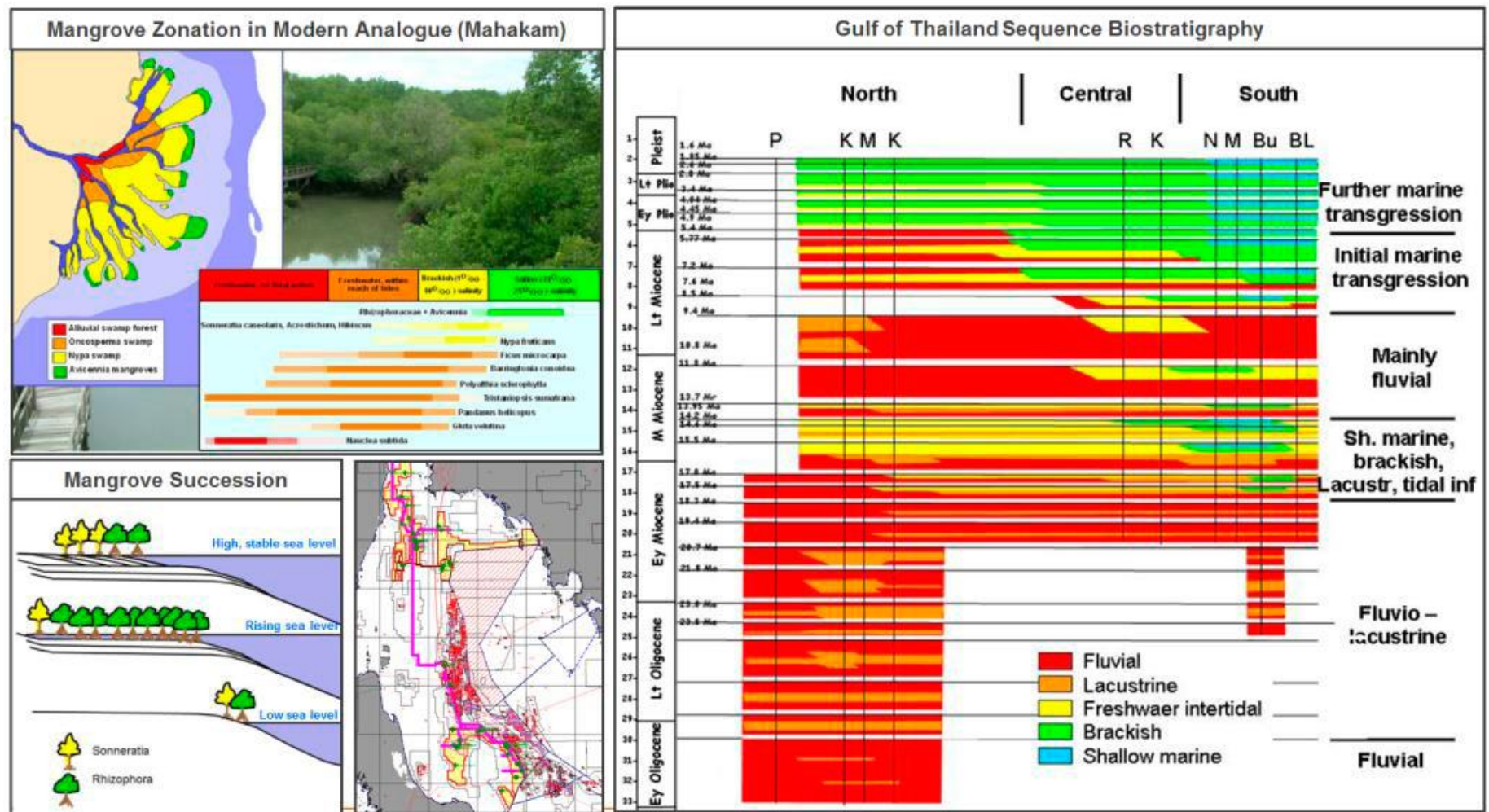


Figure 1b. Detailed Regional chronostratigraphic correlation across Thailand basins based on pollen-spores and nanofossils. Continental to transitional depositional environments are constrained by reconstructing the mangrove successions. Marine influence established via nanofossil appearances.

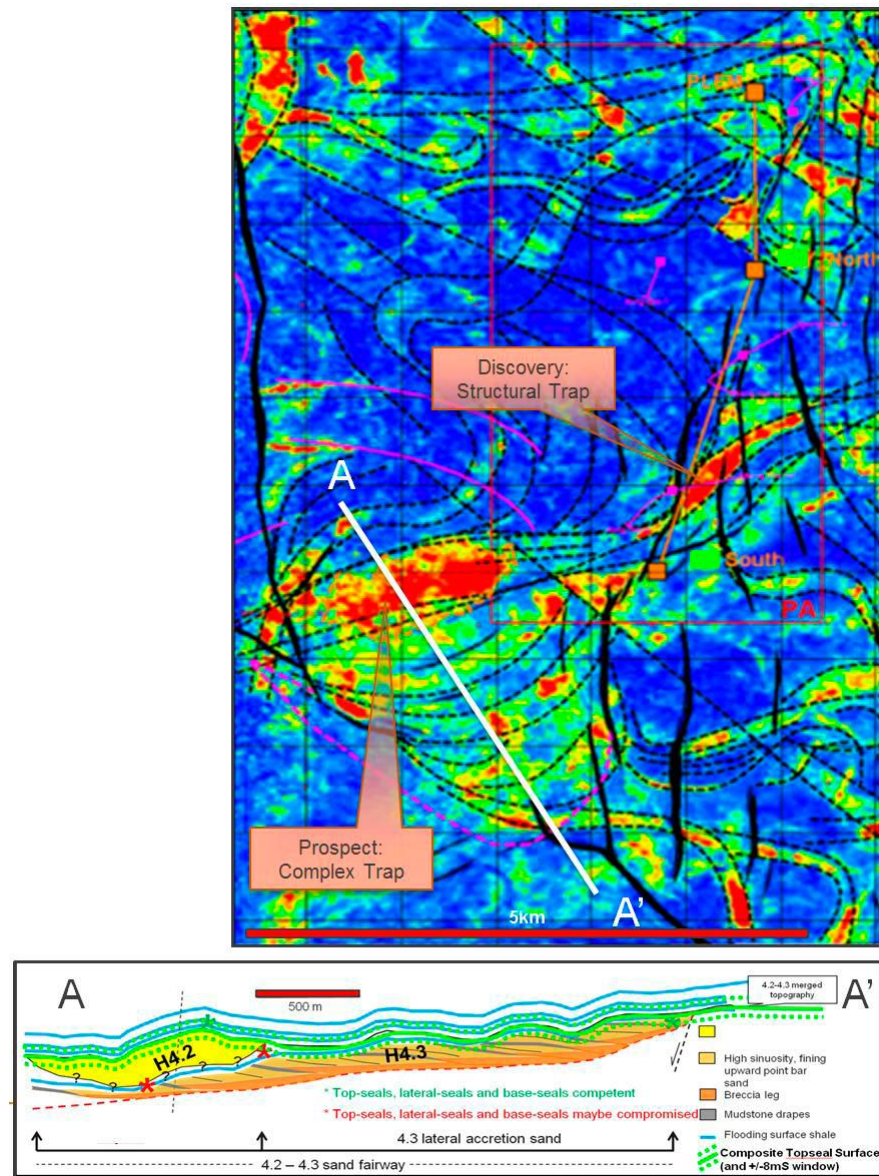


Figure 2. Complex trap example in the immediacy of a discovery. To date Thailand exploration targets have consisted of three way fault dependent closures or drape over basement highs. With detailed mapping at the play resolution here suggested, complex stratigraphic-structural traps emerge. This detailed mapping is achieved not only via improved seismic quality but also by defining higher resolution sequences and plays. The latter methodology provides better geological underpinning to the play identified.