

# **Marginal Marine Mudstones in the Pattani Basin, Gulf of Thailand: Implications for Stratigraphic Development, Reservoir Characterization and Correlation Potential\***

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Search and Discovery Article #51366 (2017)\*\*

Posted March 13, 2017

\*Adapted from oral presentation given at AAPG/SPE 2016 International Conference & Exhibition, Barcelona, Spain, April 3-6, 2016

See similar article [Search and Discovery Article #51266 \(2016\)](#)

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## **Abstract**

The lower to middle Miocene late syn-rift to early post-rift sand-dominant strata in the Gulf of Thailand are traditionally viewed as almost exclusively fluvial. The succession includes relatively common, thin "coals" that have been interpreted as floodplain swamp deposits and used extensively for stratigraphic correlation based on their wireline log signatures. Conventional cores from 9 wells across 200 km of the Pattani Basin, and integrated with biostratigraphic and petrographic data, indicate that the "coals" actually comprise three distinct facies, each with a different wireline signature. They are marginal marine mudstones, which are 0.6 - 5.0 m thick laminated clayey siltstones with interbedded thin coals and coaly mudstones, common burrows, organic matter, inner neritic foraminifera, and gradational contacts with various adjacent tide-dominant sandy facies. Their log signature includes low resistivity and moderately high density and it can be correlated. Marginal marine coaly mudstones are 0.3 - 1.1 m thick interbedded mudstones and coals with abundant nodular pyrite that have gradational contacts with sandy estuarine deposits. This facies has a distinctive wireline signature featuring high gamma ray values (especially uranium) and spiky transit time curves that can be easily correlated. Nonmarine coaly mudstones are 0.2 - 0.6 m thick with gradational upper and lower contacts with floodplain deposits. Plant debris is abundant and thin coal beds are common. Bed thickness in this facies is often below wireline resolution and it has petrophysical properties that are very similar to floodplain deposits; therefore, it is difficult to identify and correlate with logs. Based on a wireline correlation of 157 wells, marine strata are far more common than previously recognized. There are a number of minor transgressive events within the fluvial-dominant succession plus significant

marine transgressions in the lower and middle Miocene. This affects reservoir characterization as many of the stratigraphically adjacent sandstones are tide-dominant or tidally influenced, which affects sand body geometry, connectivity and heterogeneity. Marginal marine mudstones are widely distributed and are good regional markers while marginal marine coaly mudstones and non-marine coaly mudstones are poor markers because they have limited lateral extent and/or are laterally discontinuous.

### **Selected Reference**

Jardine, E., 1997, Dual Petroleum Systems Governing the Prolific Pattani Basin, Offshore Thailand: Proceedings of the International Conference on Stratigraphic and Tectonic Evolution of Southeast Asia and the South Pacific (Geothai'97), 19-24 August 1997, Department of Mineral Resources, Bangkok, p. 525-534.

# Marginal Marine Mudstones in the Pattani Basin, Gulf of Thailand: Implications for Stratigraphic Development, Reservoir Characterization and Correlation Potential

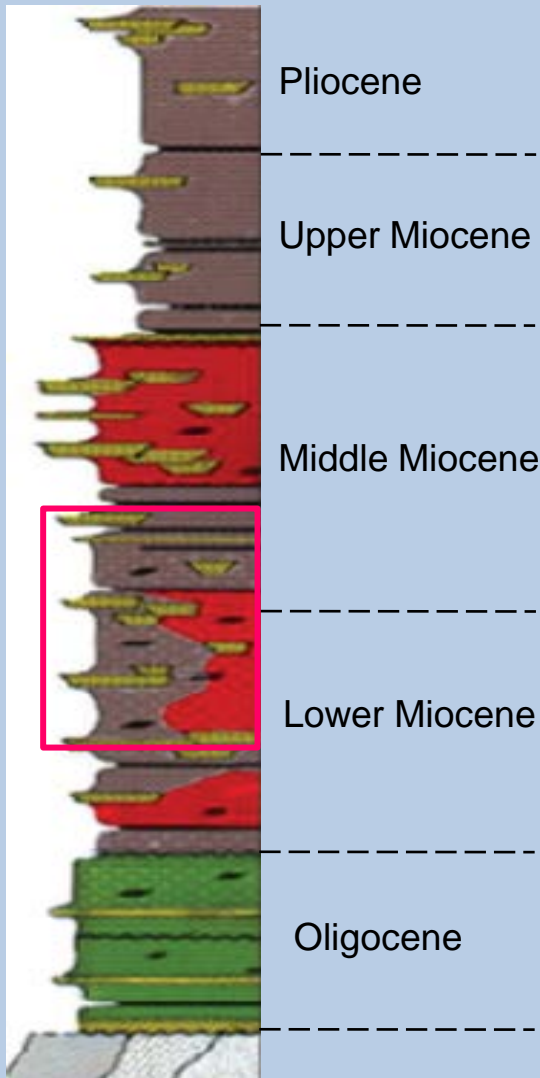
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and Patcharaporn Champasa<sup>1,2</sup>

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## Gulf of Thailand Stratigraphy

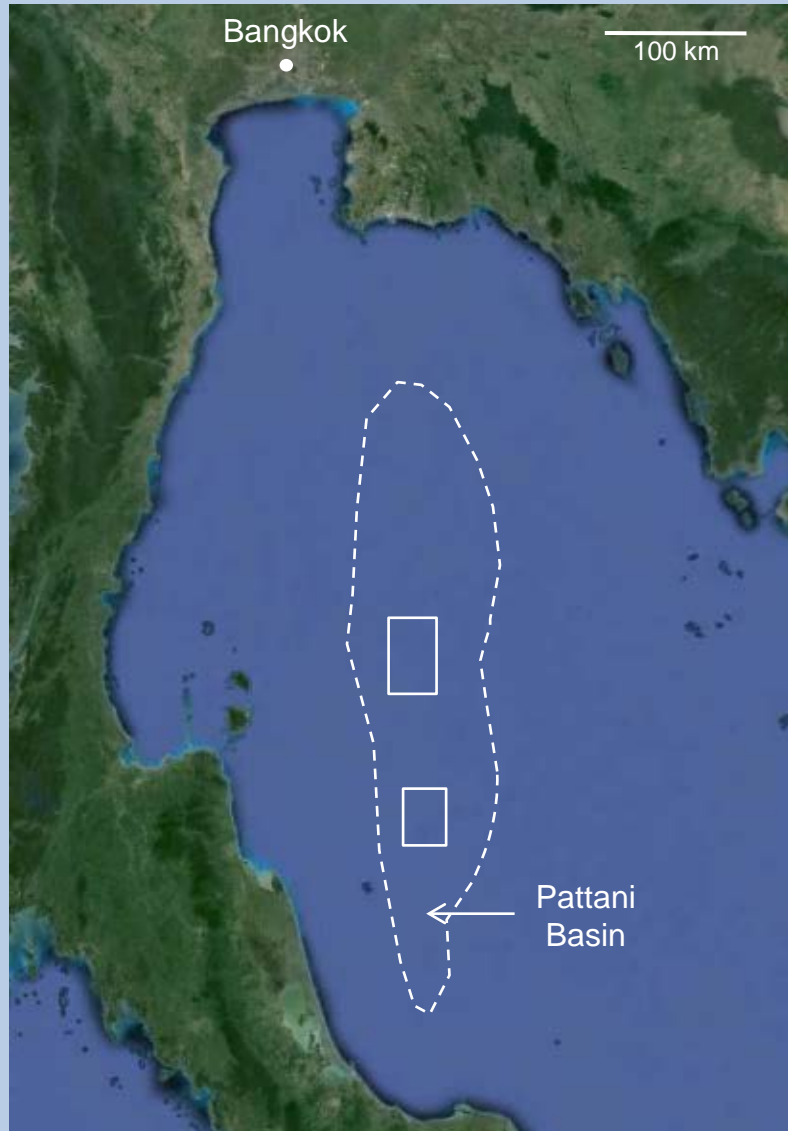
(after Jardine 1997)



## *Stratigraphic Interval*

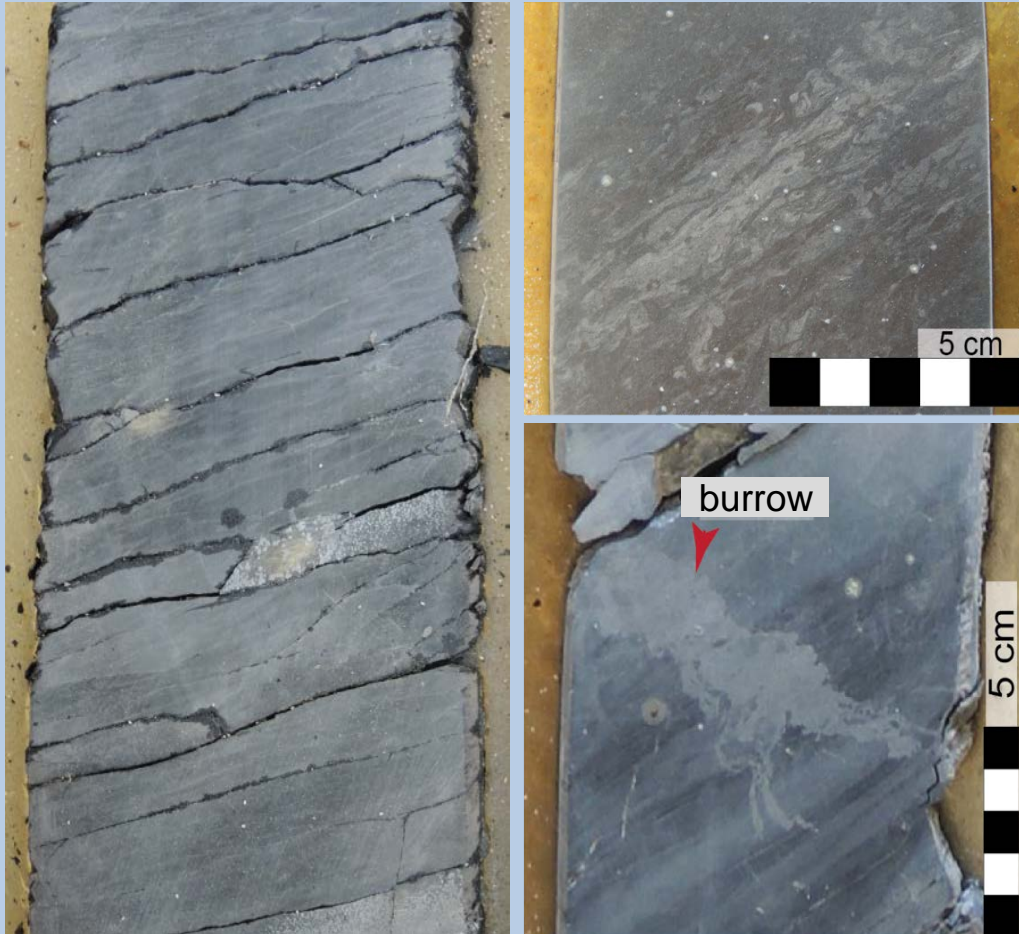
- Lower to middle Miocene, late syn-rift to early post-rift, sand-dominant succession
- Economically significant as it includes important petroleum reservoirs
- Traditionally interpreted as mostly fluvial sediments with minor estuarine deposits
- Includes relatively common, thin "coals" regarded as floodplain swamp deposits
- "Coals" used for stratigraphic correlation based on wireline log signature
- Thin units deposited during short-lived transgressions are common

# *Study Area and Database*



- Northern and southern areas within Pattani Basin
- Conventional cores from 9 wells
- Wireline logs from 157 wells
- Integrated with biostratigraphic and petrographic data
- "Coals" comprise three distinct facies of coaly mudstone
- Each facies has a different wireline log signature

# *Shallow Marine Coaly Mudstone*



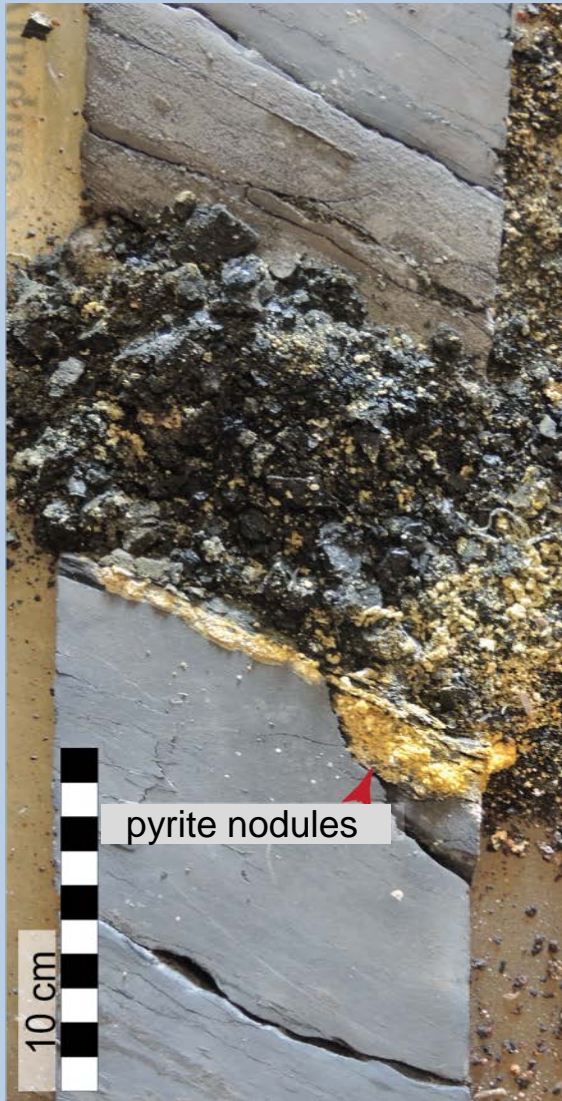
- 0.6 - 5.0 m thick laminated clayey siltstones
- Interbedded thin coals and coaly mudstones
- Burrows and organic matter are common
- Inner neritic foraminifera
- Gradational contacts with tidal sandstones

# Shallow Marine Coaly Mudstone Log Signature

- Low resistivity and moderately high density
- Can be easily correlated
- Good regional markers



# *Marginal Marine Coaly Mudstone*



- 0.3 - 1.1 m thick interbedded mudstones and coals
- Abundant pyrite nodules
- Gradational contacts with tidal sandstone and/or estuarine deposits

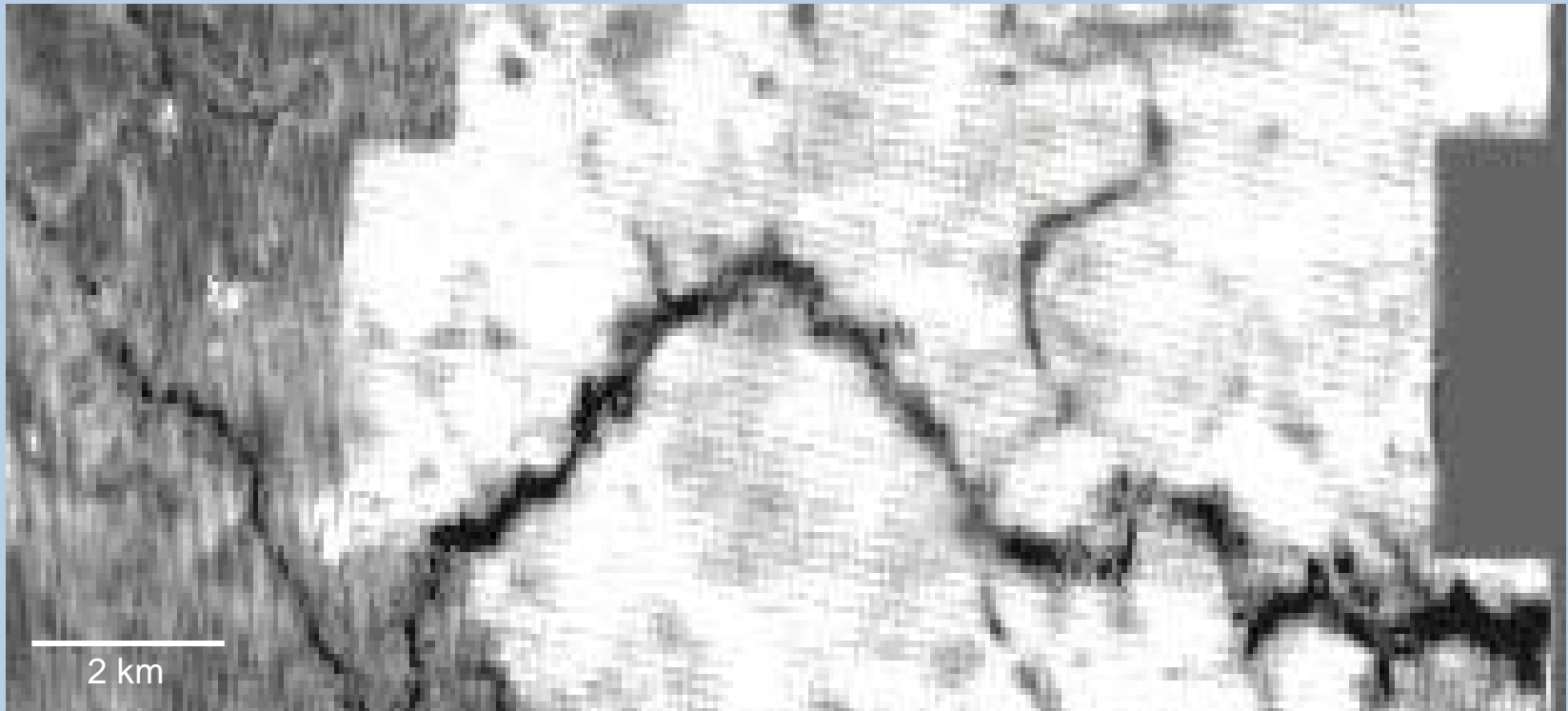
# Marginal Marine Coaly Mudstone Log Signature

- Distinctive high gamma ray (especially high uranium)
- Spiky transit time curves
- Easily correlated but not regionally extensive



# *Early Miocene Estuary*

- Drowned fluvial channel
- Decreased sinuosity
- Tidal scouring
- Flared mouth



(after Firmansyah 2011)

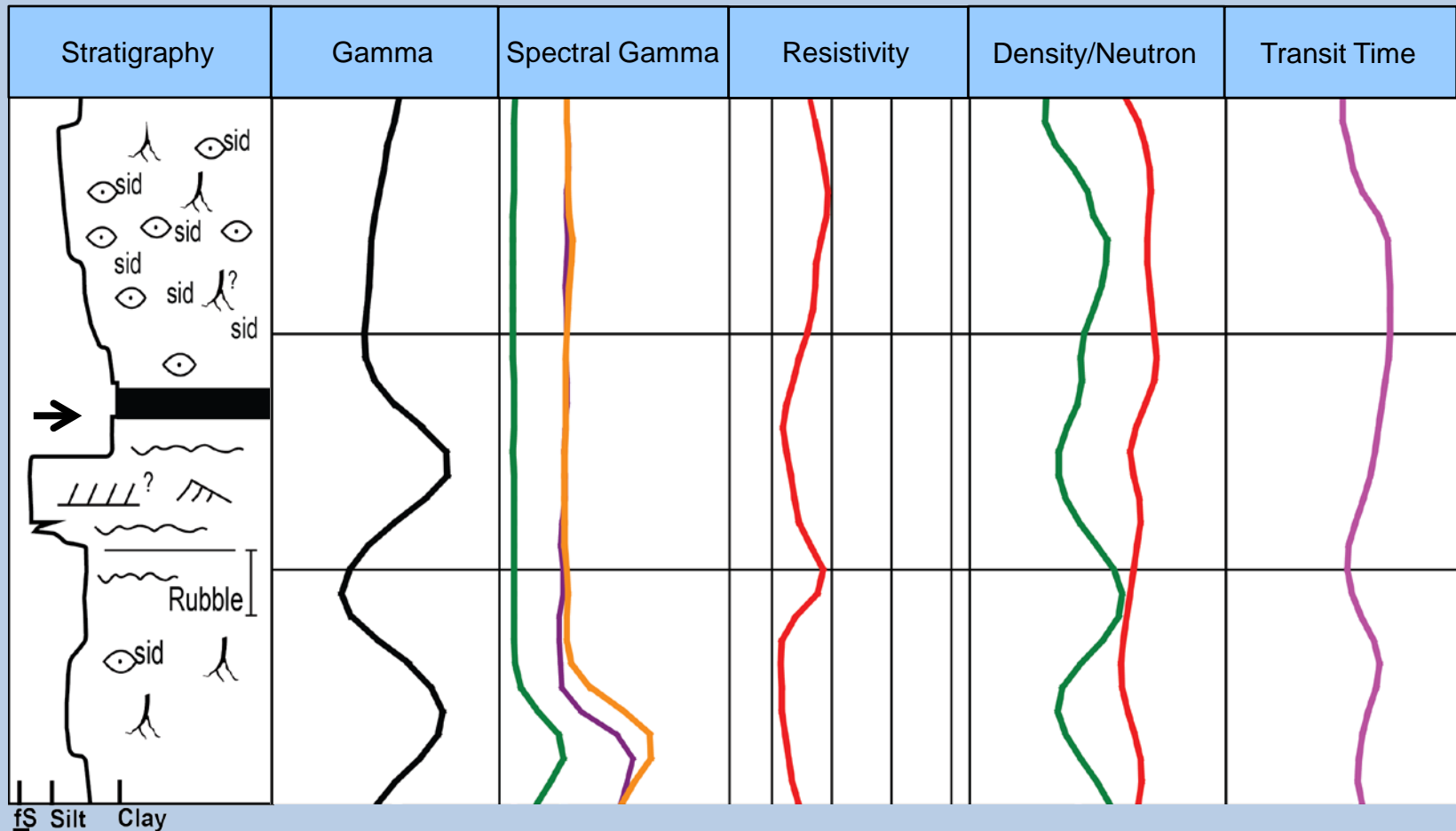
# *Non-Marine Coaly Mudstone*



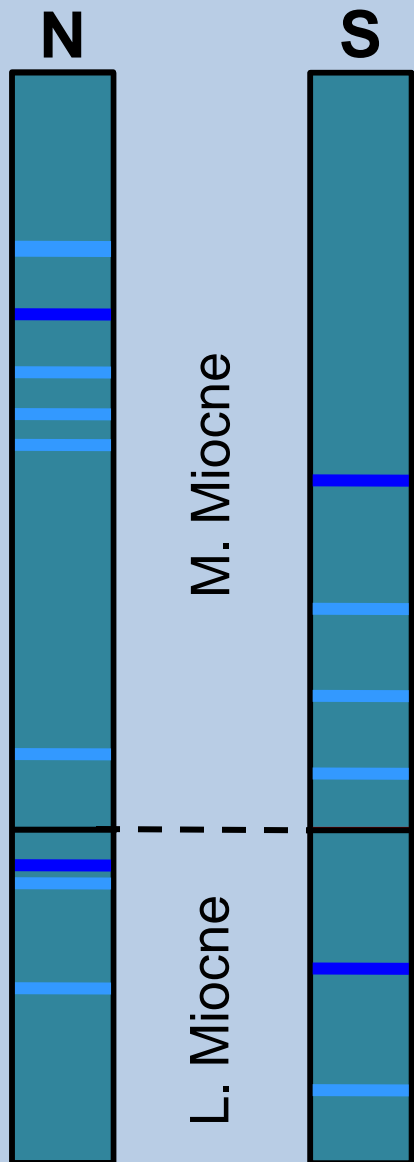
- 0.2 - 0.6 m thick mudstone
- Abundant plant debris
- Thin coal beds common
- Gradational contacts with floodplain mudstones

# *Non-Marine Coaly Mudstone Log Signature*

- Bed thickness is often below wireline log resolution
- Very similar to floodplain mudstones
- Difficult to identify and correlate



# *Stratigraphic Abundance*



- Available cores do not provide complete stratigraphic coverage
- Supplemented with wireline log correlation
- Marine strata are much more common than previously recognized
- At least 9 transgressive events in the northern study area and 6 in the south
- Several transgressions in the supposedly all non-marine lower Miocene
- At least one significant marine transgression in the late lower Miocene and another in the middle Miocene
- Abundance underestimated because wells are drilled on structural highs

# *Lower Miocene Transgression*



- Shallow marine coaly mudstone in the south
- Shallow marine coaly mudstone and marginal marine coaly mudstone in the north
- Up to 6 m thick in the north and 8 m thick in the south

# *Middle Miocene Transgression*



- Extended across most of Pattani Basin
- Shallow marine coaly mudstone in the north and south
- Up to 8 m thick in the south and 6 m thick in the north

# *Implications for Stratigraphic Development*



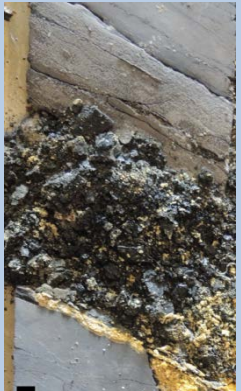
- Relatively thin transgressive successions are common
- They reflect minor, short-lived transgressions
- There may be several other significant transgressions that remain unrecognized
- Some may have effected the entire Gulf of Thailand from the late Oligocene onward

# *Implications for Stratigraphic Correlation*



## Shallow Marine Coaly Mudstone

- Widely distributed and easy to correlate
- Good regional markers



## Marginal Marine Coaly Mudstone

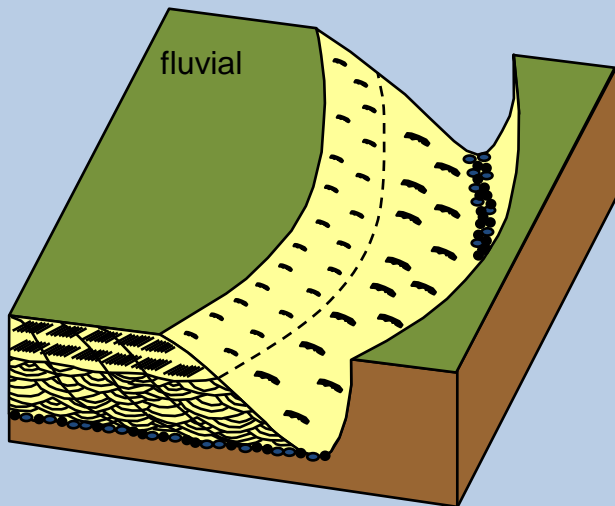
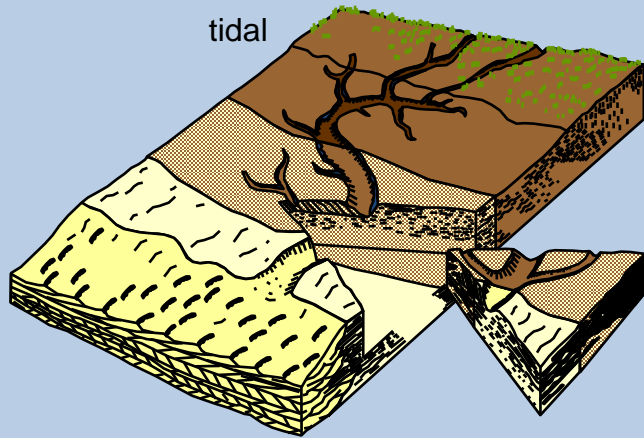
- Can have limited lateral extent and/or be laterally discontinuous
- Good local markers but not very good regionally



## Non-Marine Coaly Mudstone

- Limited lateral extent and/or laterally discontinuous
- Very similar to floodplain mudstones
- Difficult to identify and are poor markers

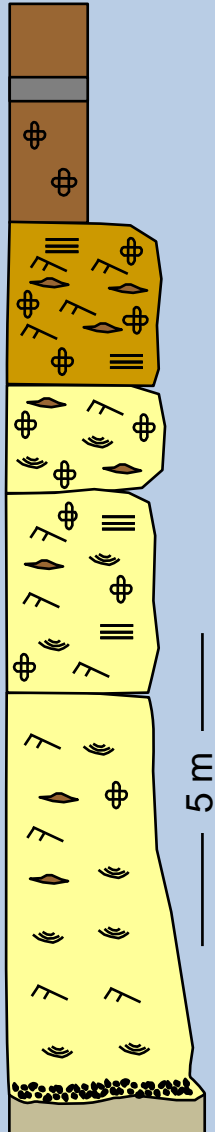
# *Implications for Reservoir Characterization*



- Many tidal sandstones stratigraphically adjacent to marine mudstones
- Tidal sandstones fine upward as do fluvial sandstones
- Sand body size and geometry in tidal sandstones is very different from fluvial point bar sandstones
- Porosity and permeability are usually lower in tidal sandstones
- Generally, fluvial sandstones are much better reservoirs than tidal sandstones

# *Implications for Reservoir Characterization*

- Sand-filled channels are often underlie marine mudstones
- Fining and more marine upward, onlapping bed geometry
- Fluvial channels filled during transgression events



- Important petroleum reservoirs
- Variable sedimentary character that reflects distance from the paleo-shoreline
- Variable sand body geometry, thickness, porosity and permeability

# *Conclusions*

- Marginal marine and shallow marine coaly mudstones are more abundant than previously recognized
- Relatively thin successions that reflect minor, short-lived transgressions are common
- At least one significant marine transgression in the late lower Miocene and another in the middle Miocene
- Shallow marine coaly mudstones are widely distributed and are good regional markers for well correlation
- Marginal marine coaly mudstones are easily correlated locally
- Adjacent sandstones are channel-fill, tidal and shoreline with reservoir properties that are significantly different from fluvial sandstones

# *Acknowledgements*

- A contribution to the research by former student Jirach Kamvan
- Chevron Thailand Exploration and Production Ltd., PTTEP and Chulalongkorn University for financial support
- Access to subsurface data and images from Chevron Thailand Exploration and Production Ltd.