The Relationship between Deepwater Deposition and an Active Accretionary Wedge, Ultra Deepwater Trinidad*

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Abstract

The Trinidad Ultra-deepwater (UDW) area lies on today's continental slope off the eastern coast of Trinidad; it overlies oceanic crust and is part of the Barbados Fold Belt. Sedimentation has been rapid due to the constant feeding of clastic material from the Orinoco River. Deepwater turbidite sands are interbedded with shales, possibly providing both reservoir and seals. Deepwater channels and lobes have been identified and mapped in the existing 2D seismic. There are 13 wells that reached the lowest Pliocene, immediately to the west of the UDW area, providing a direct tie to the seismic stratigraphy interpretation. Priority for reservoir was given to the late middle Miocene to Pliocene, if only because deeper sections are increasingly overpressured and therefore difficult and risky to drill. Clastic composition and texture are interpreted to be mature, with mainly quartzose sands of continental affinity, consisting of amalgamated sand in the lobes and fine sand/silt interbedded with silty shales, in predominantly distal turbidites or overbank deposits. Most of the structures identified were active during the Upper Miocene and Plio-Pleistocene, so no areas are expected to show sheet like, unconfined basin floor fans. The ongoing development of the accretionary wedge will have focused sediments in a NNE direction, in contrast to the SW-NE basinal axis trends which would dominate slightly older sediments. The growth of mud diapirs, probably initiated in the Plio-Pleistocene as increased amount of sediments were deposited, further complicated the depositional pattern. Turbidite deposition of upper and middle Miocene age is interpreted to be of distal fans facies, while in the Plio-Pleistocene, they respond more to a minibasin setting and channel-levee facies.

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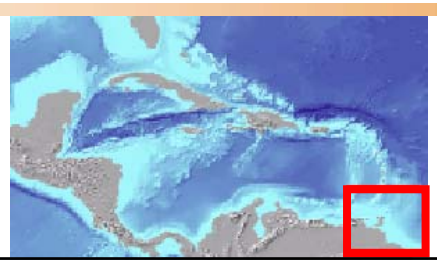
RepsolYPF Northern Latin America Exploration

The Woodlands, TX



AAPG, April 2008

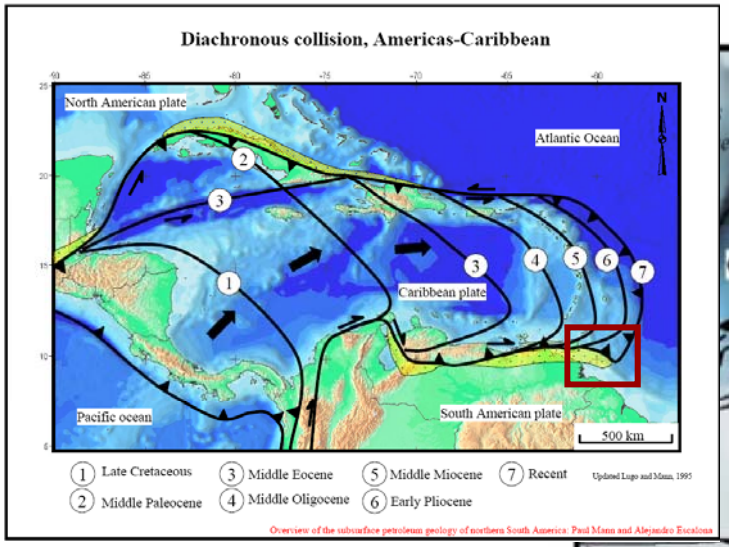
Conclusions

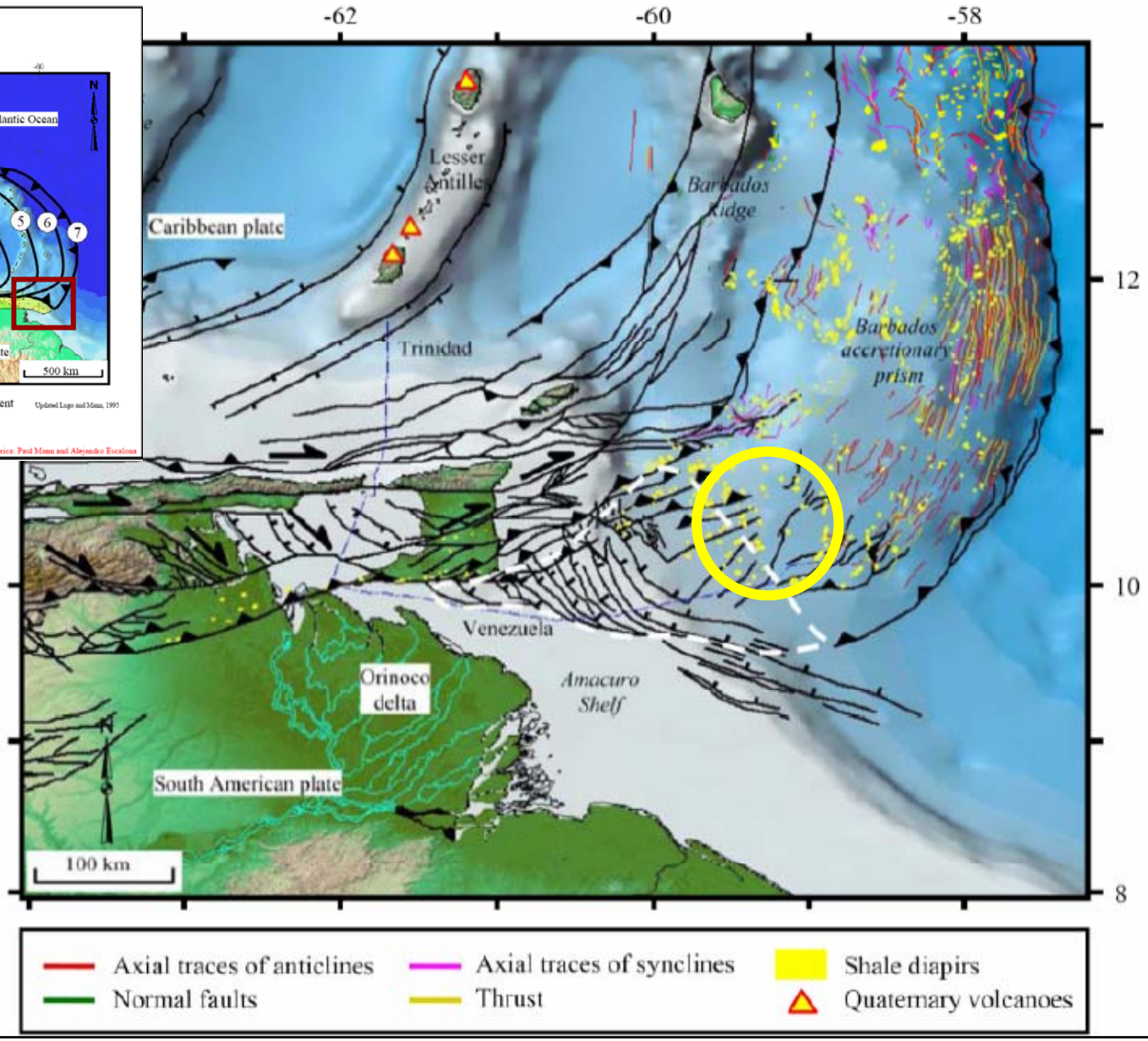
Deepwater sediments were deposited by flows running parallel to structural axis

GOM minibasin facies understanding can be applied to synclines in an active accretionary wedge

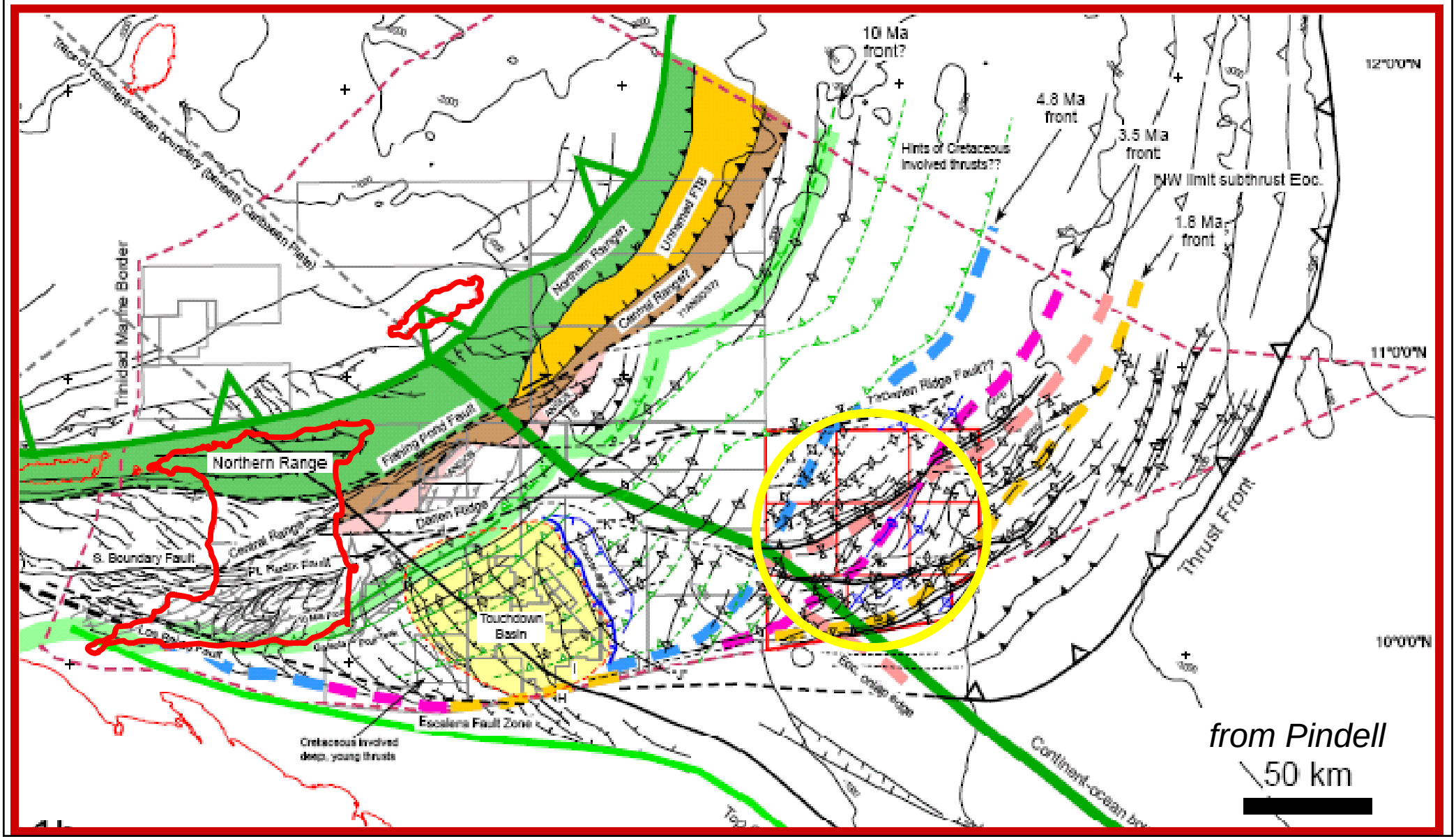
Distribution of facies evolved with structural growth

Regional location

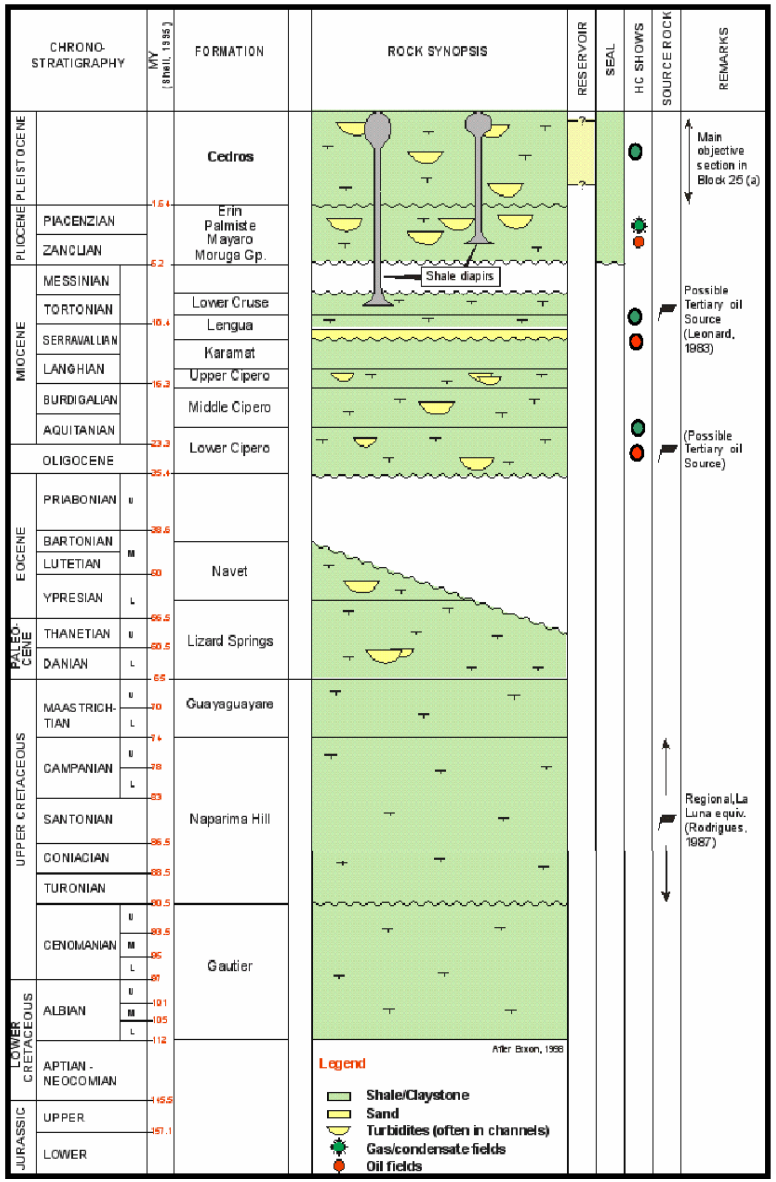




Eastward accretionary wedge front propagation



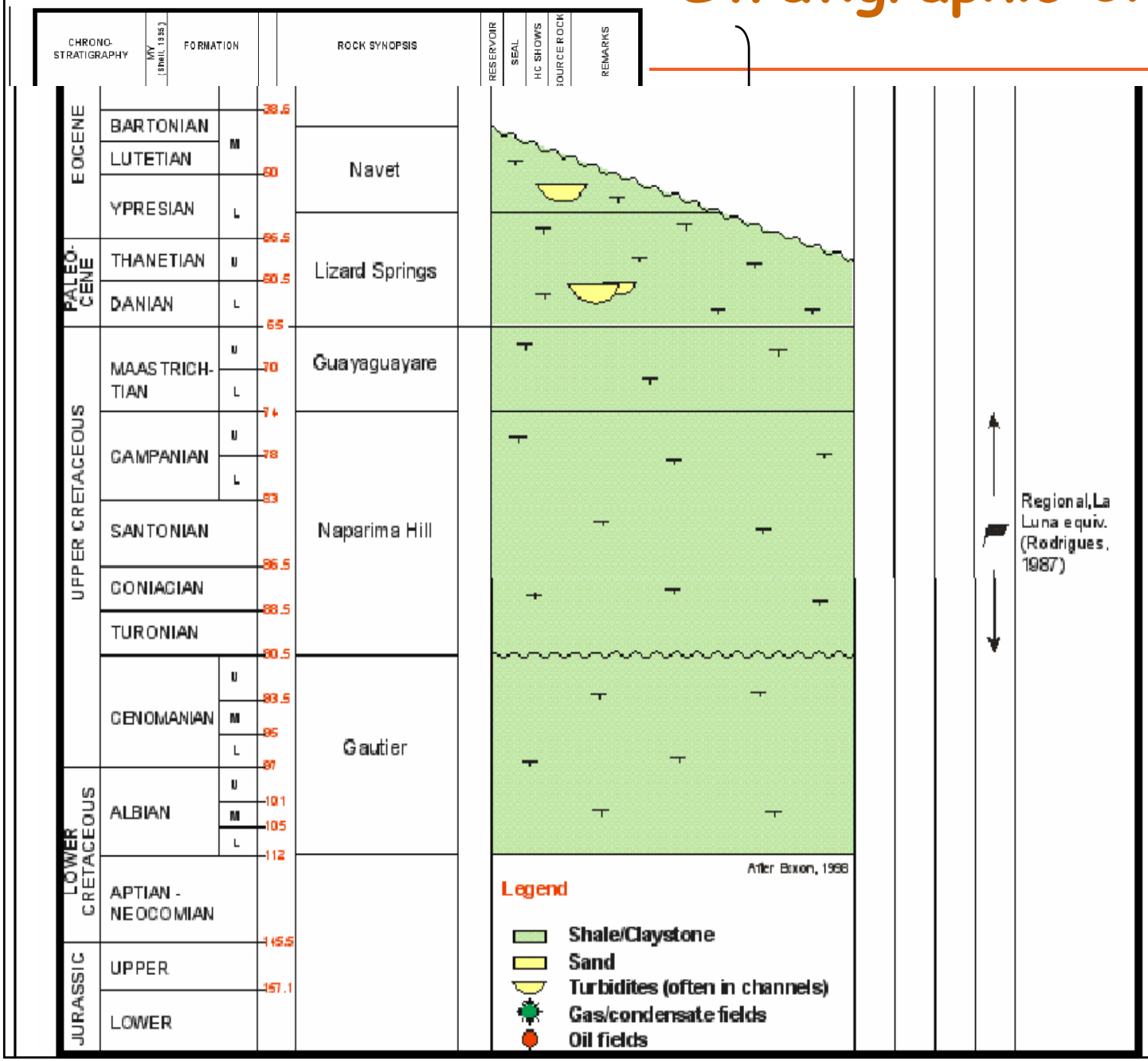
Stratigraphic Chart



Transpressive Margin Phase: encroachment of Caribbean Plate

Passive Margin Phase

Stratigraphic Chart



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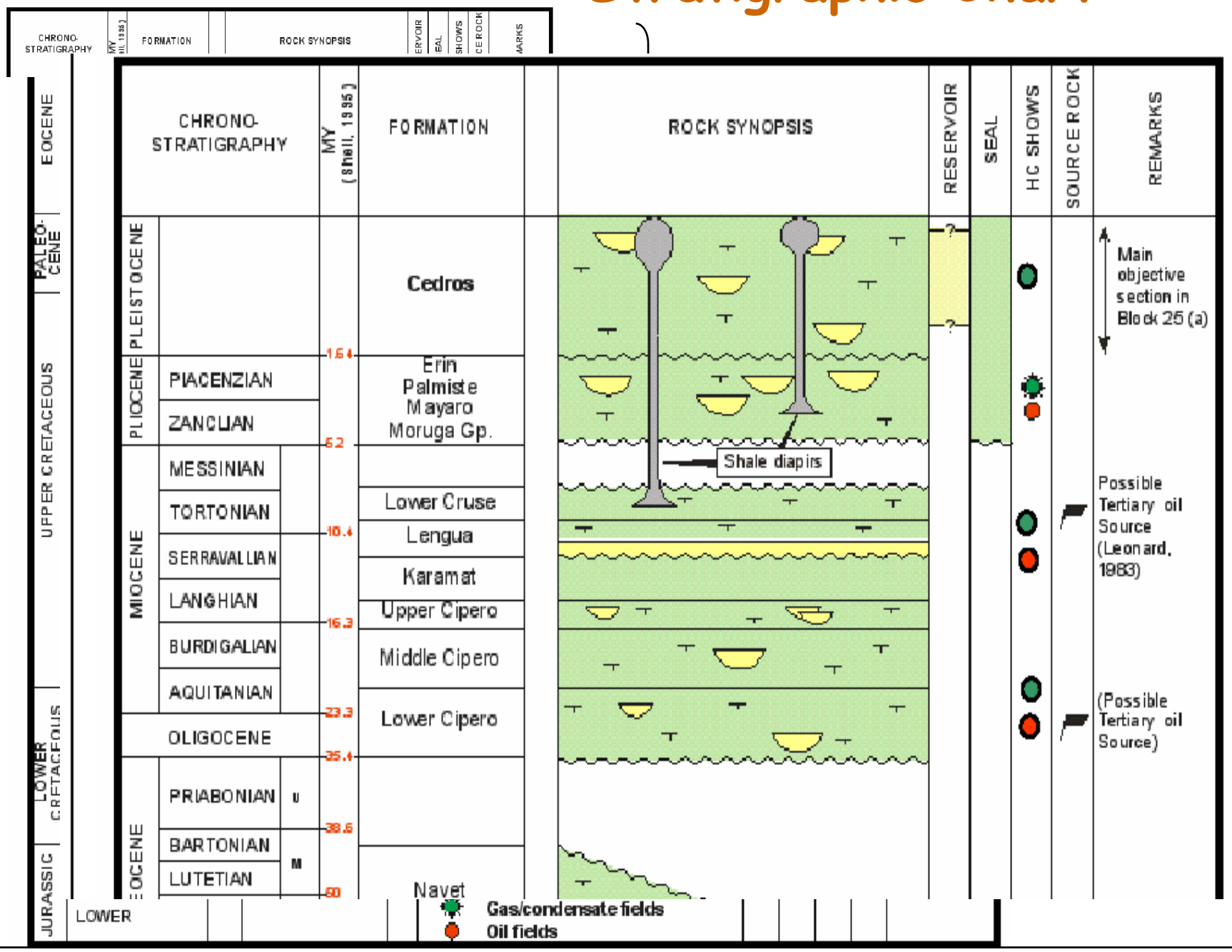
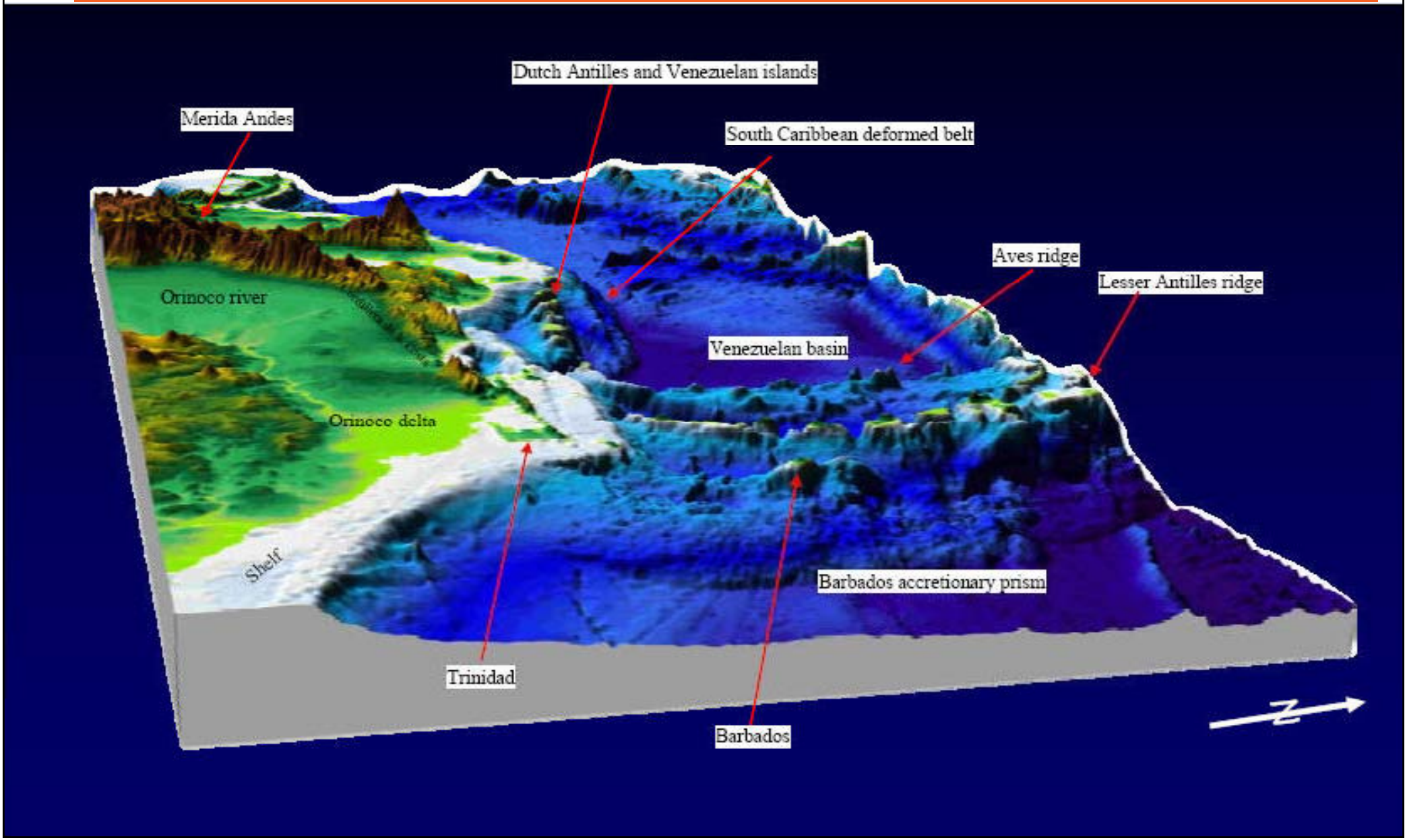
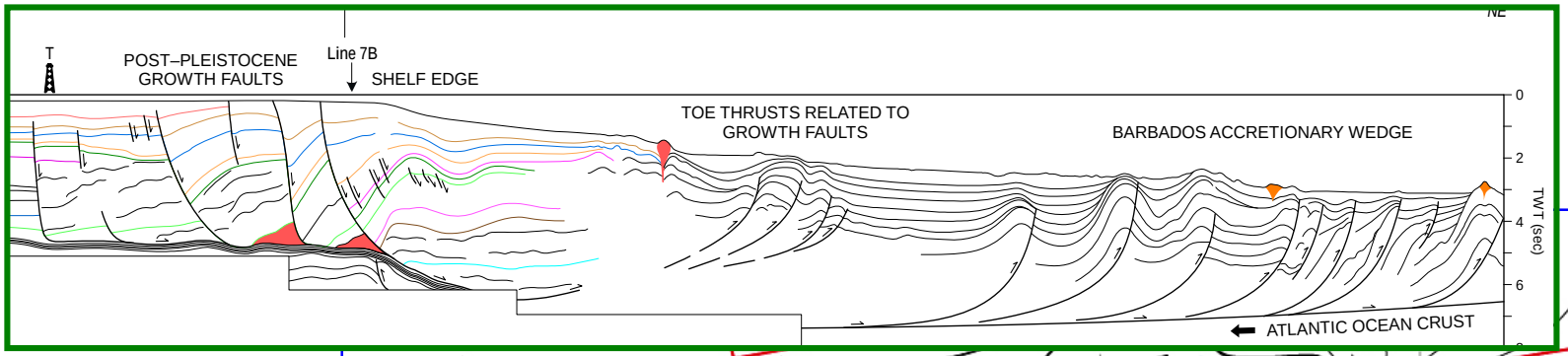
Stratigraphic Chart

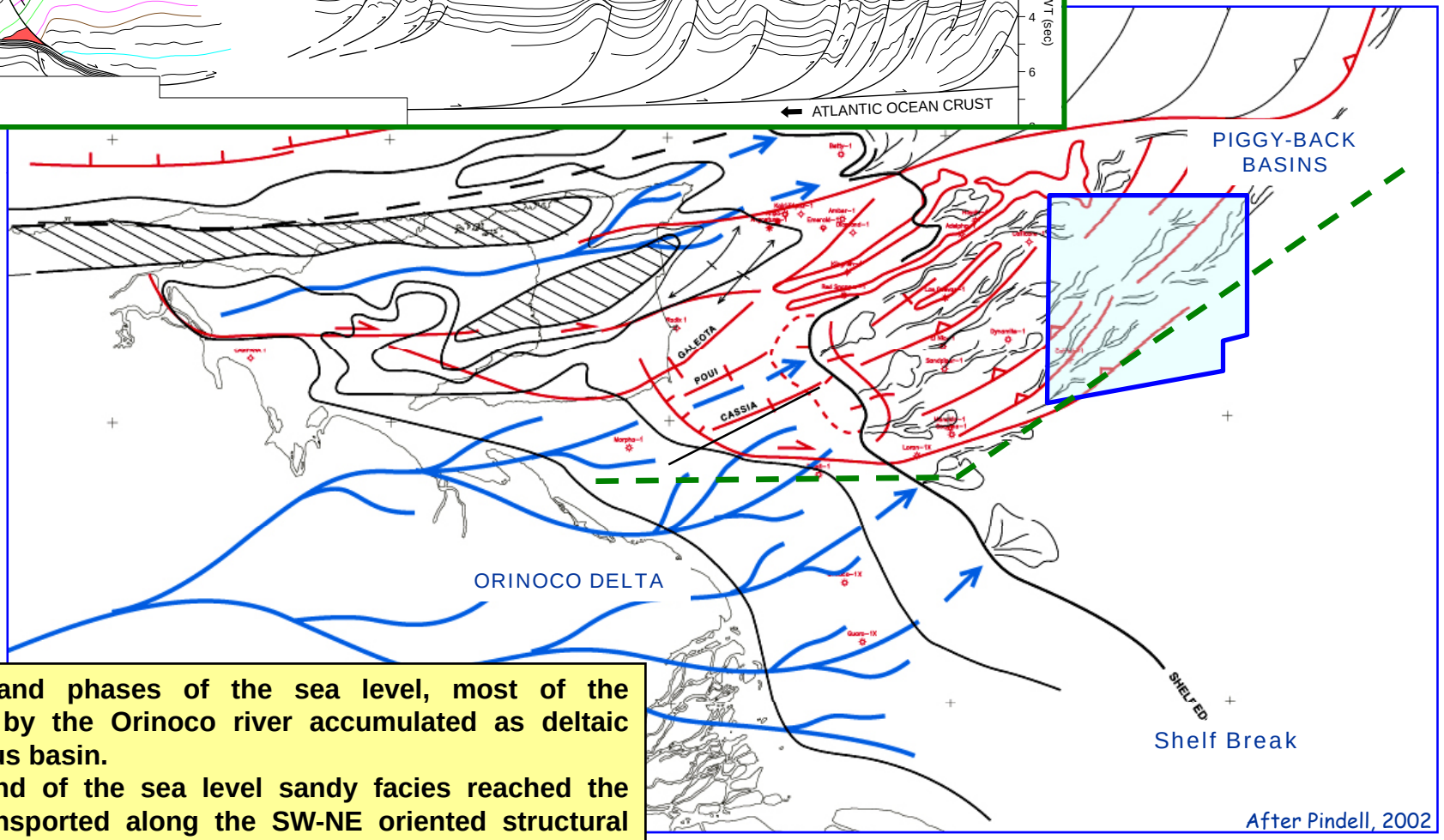


Orinoco drains into and in front of the migrating accretionary wedge



U. Pliocene – L. Pleistocene (3-1 Ma)
Pathways of the Sediments from Shelf to Basin

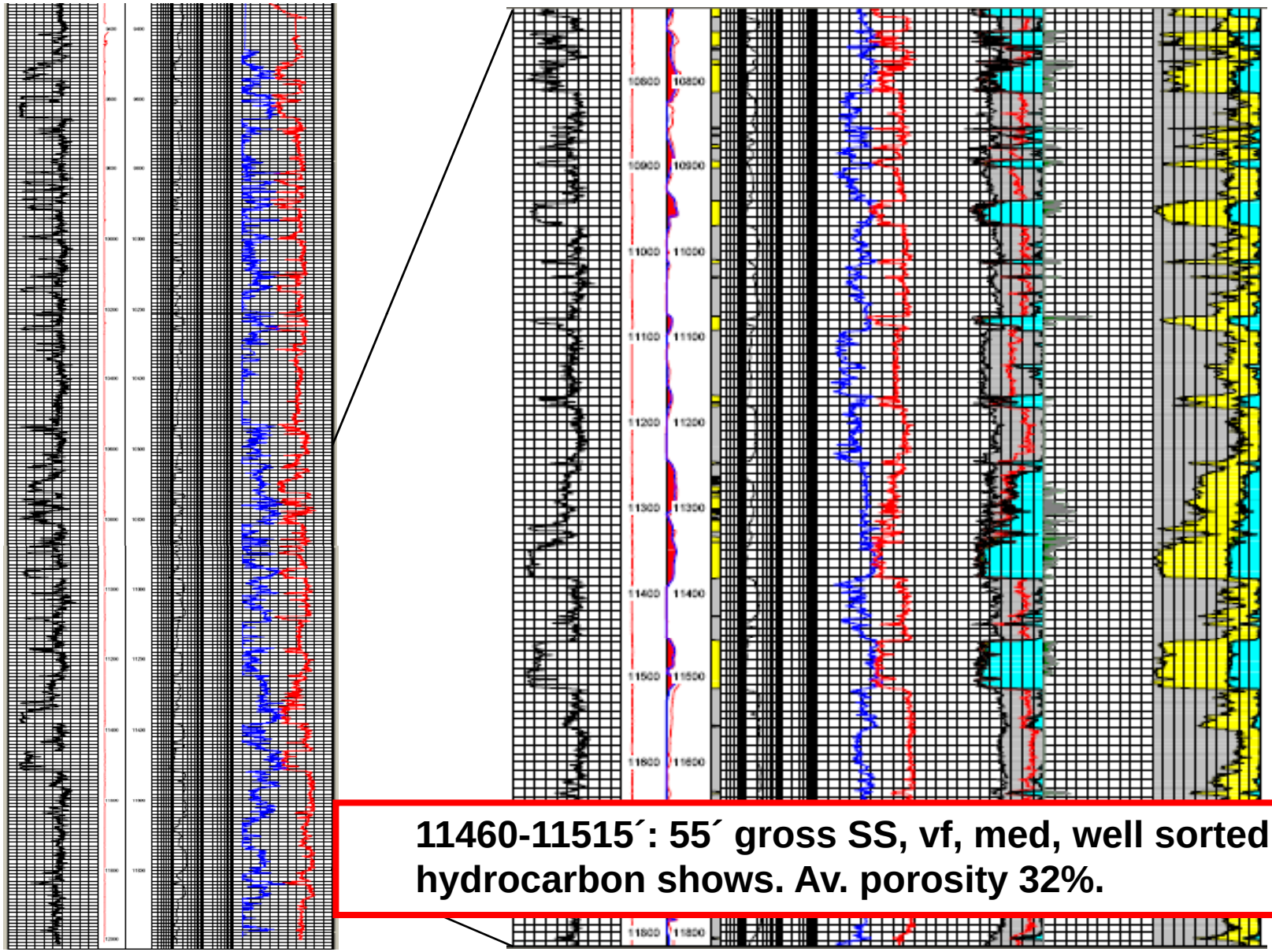




During highstand phases of the sea level, most of the sediments supplied by the Orinoco river accumulated as deltaic facies in the Columbus basin.

During lowstand of the sea level sandy facies reached the deepwater zone, transported along the SW-NE oriented structural lows and accumulated within ponds or "minibasins"

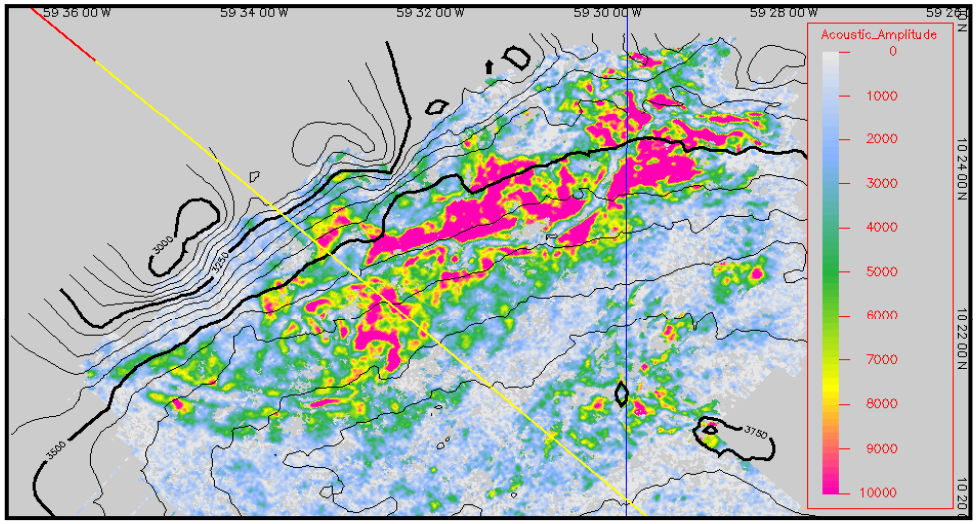
Heliconius – 1, Pleistocene

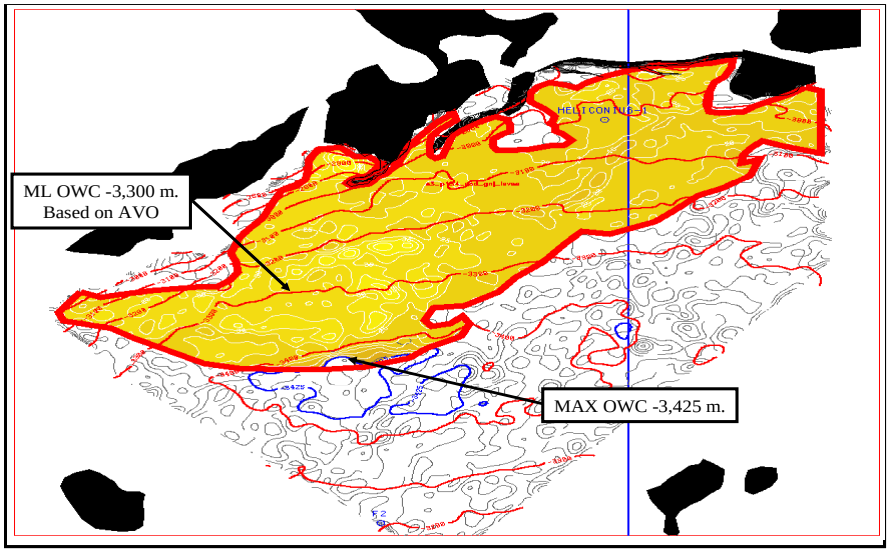


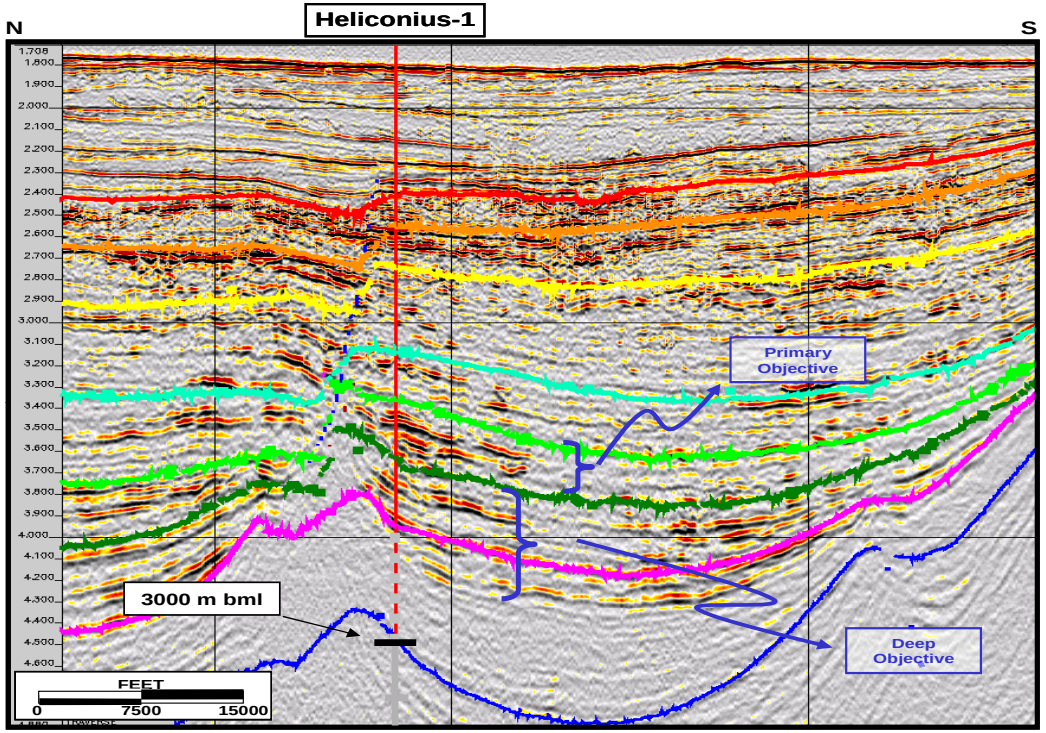
11460-11515´: 55´ gross SS, vf, med, well sorted, friable. No hydrocarbon shows. Av. porosity 32%.

ExxonMobil Heliconius-1
Lesson Learned

P134 Anomaly: Far offset data show bright amplitudes down to -3,425m







Contains a relatively thick sand-rich section within the lower part of the well.

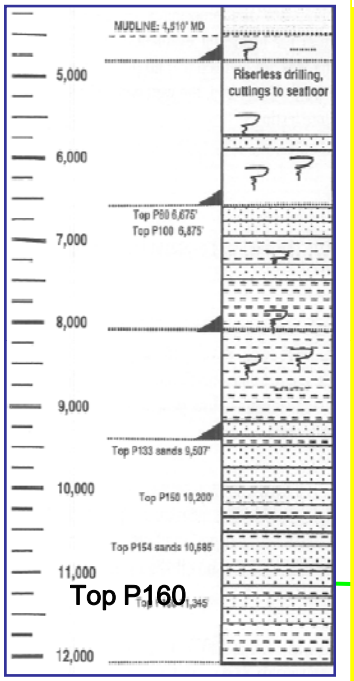
Sandstones are interpreted as channelized facies deposition

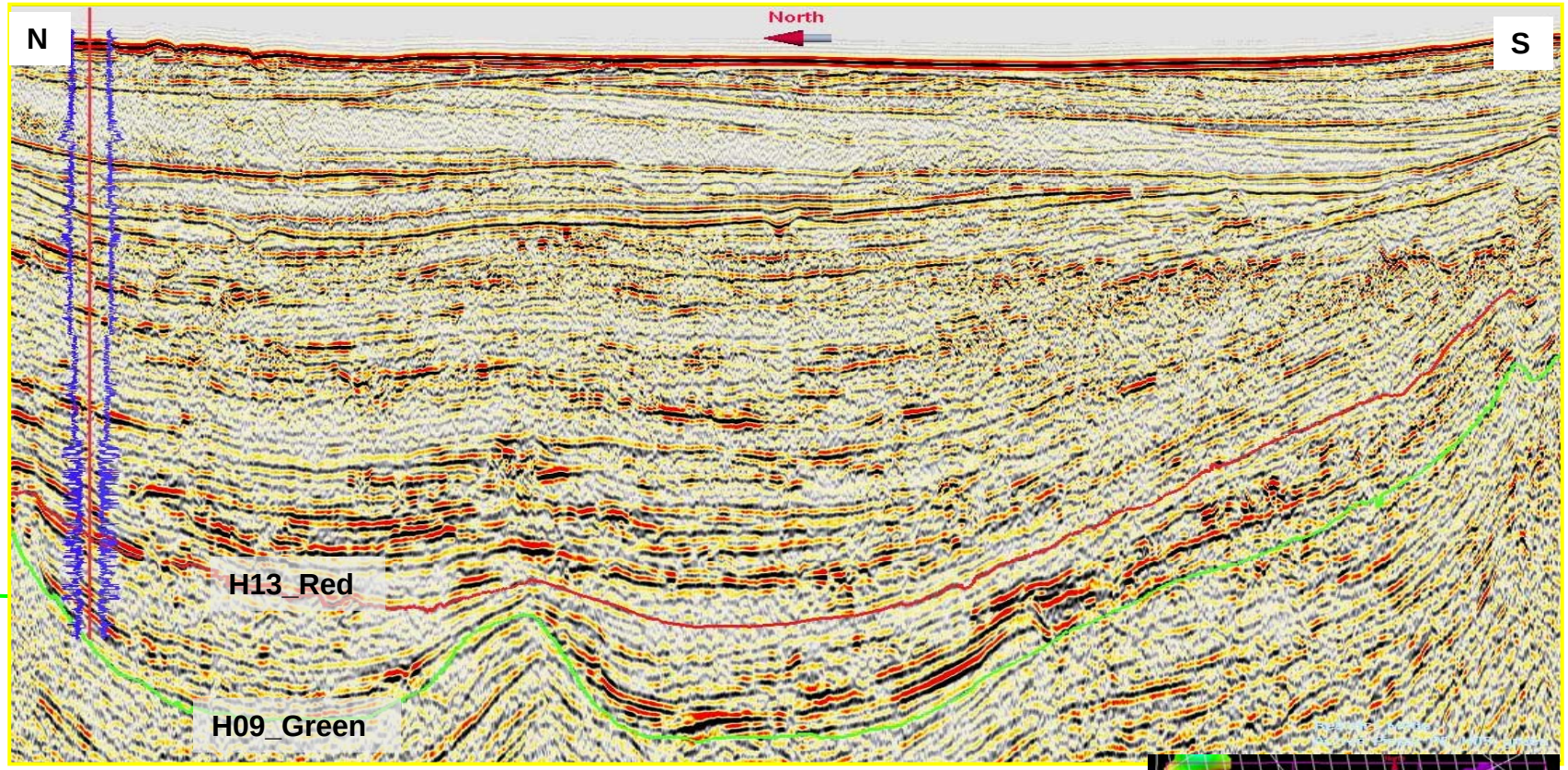
No hydrocarbon shows

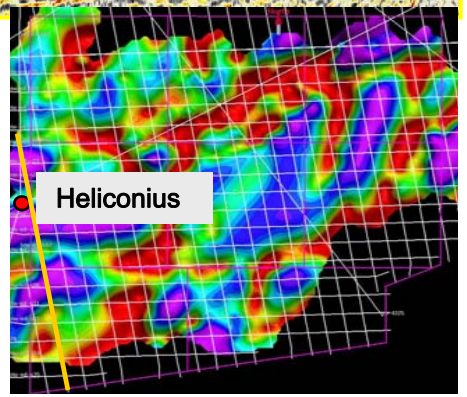
(Source: ExxonMobil-2002 Presentation)

UDW Blocks – Pleistocene Units

Heliconius



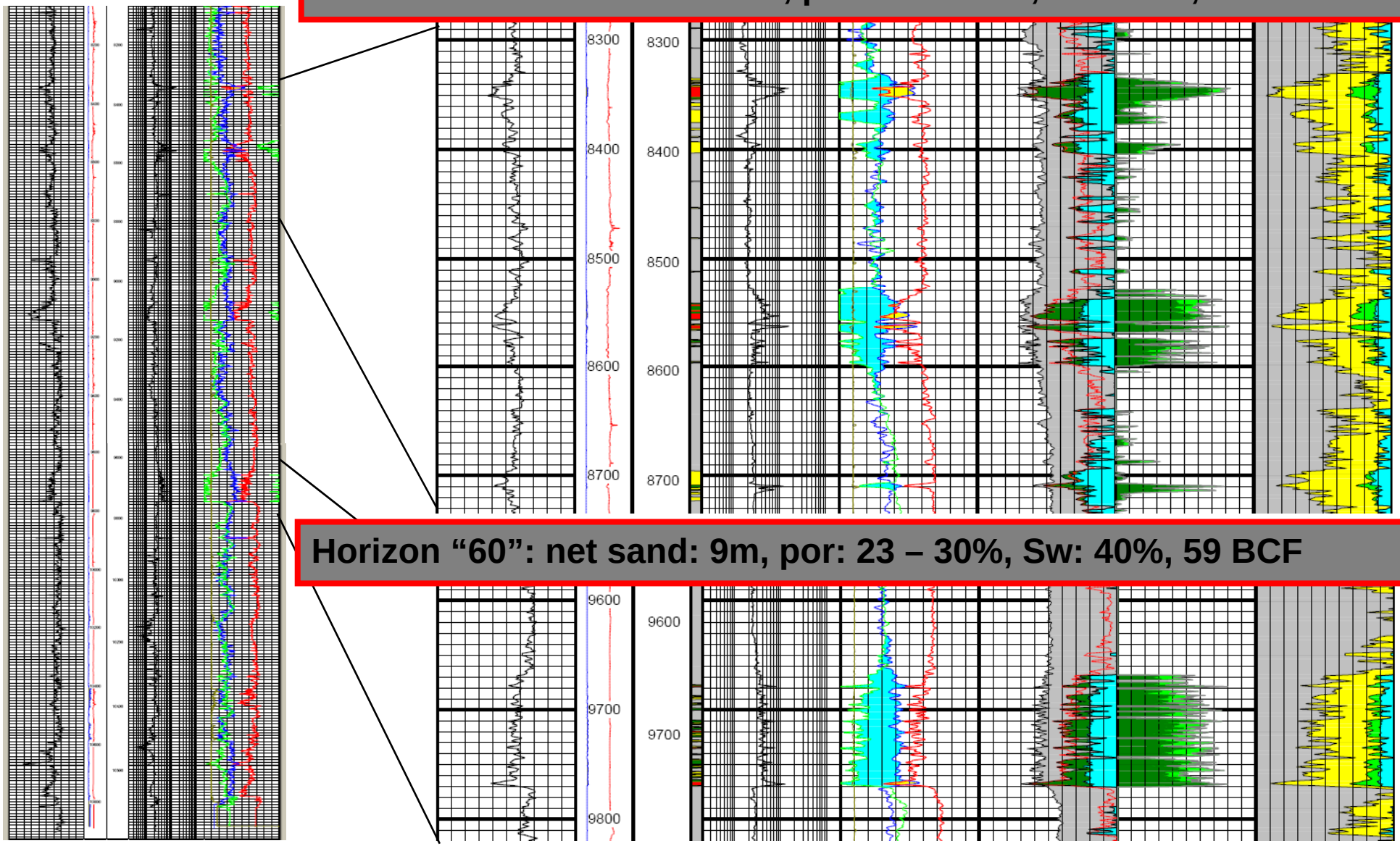




Isochrons were created of sandier intervals

Haydn – 1, Pleistocene

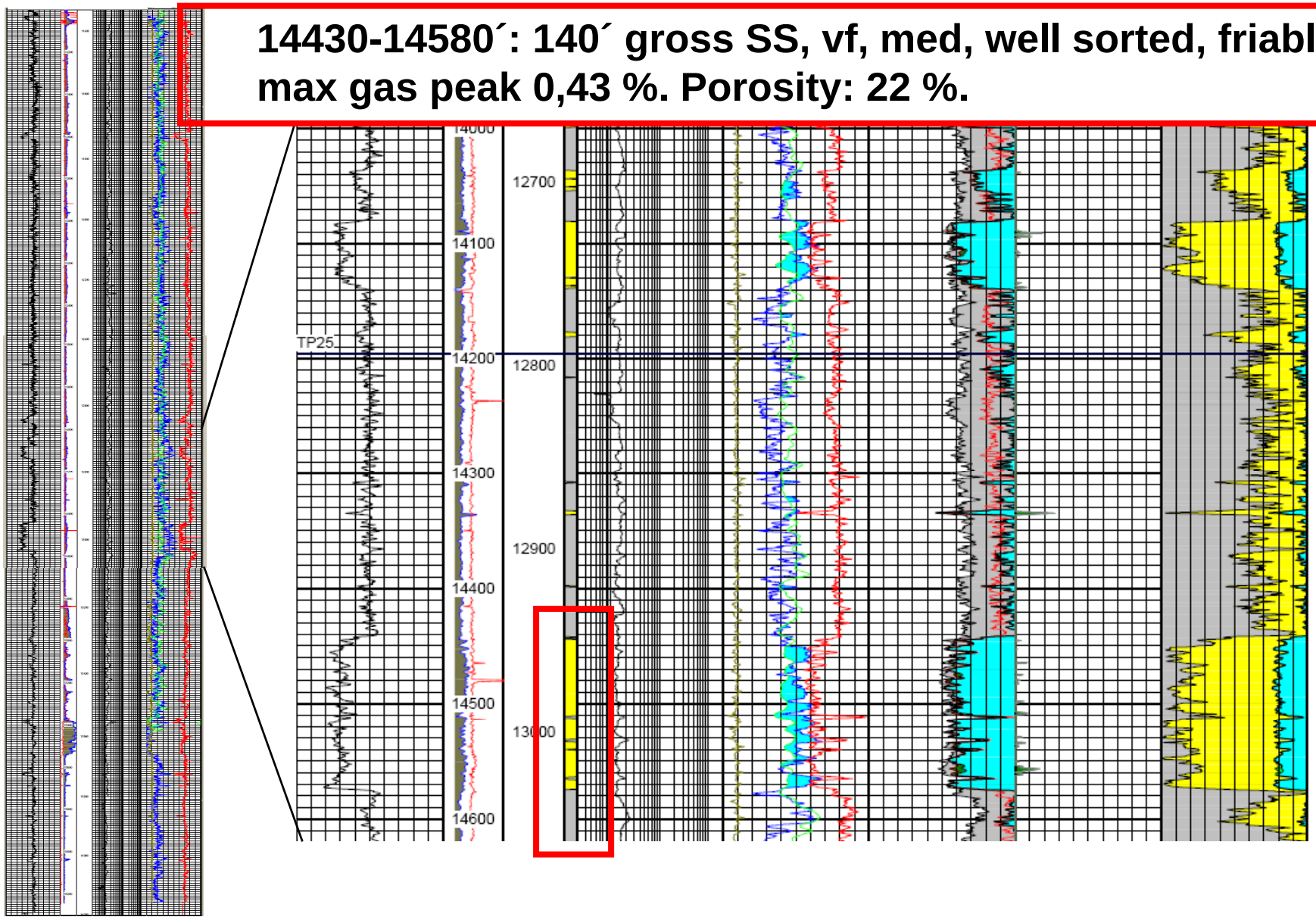
Horizon “55”: net sand: 14m, por: 21%-27%, Sw: 40%, 156 BCF



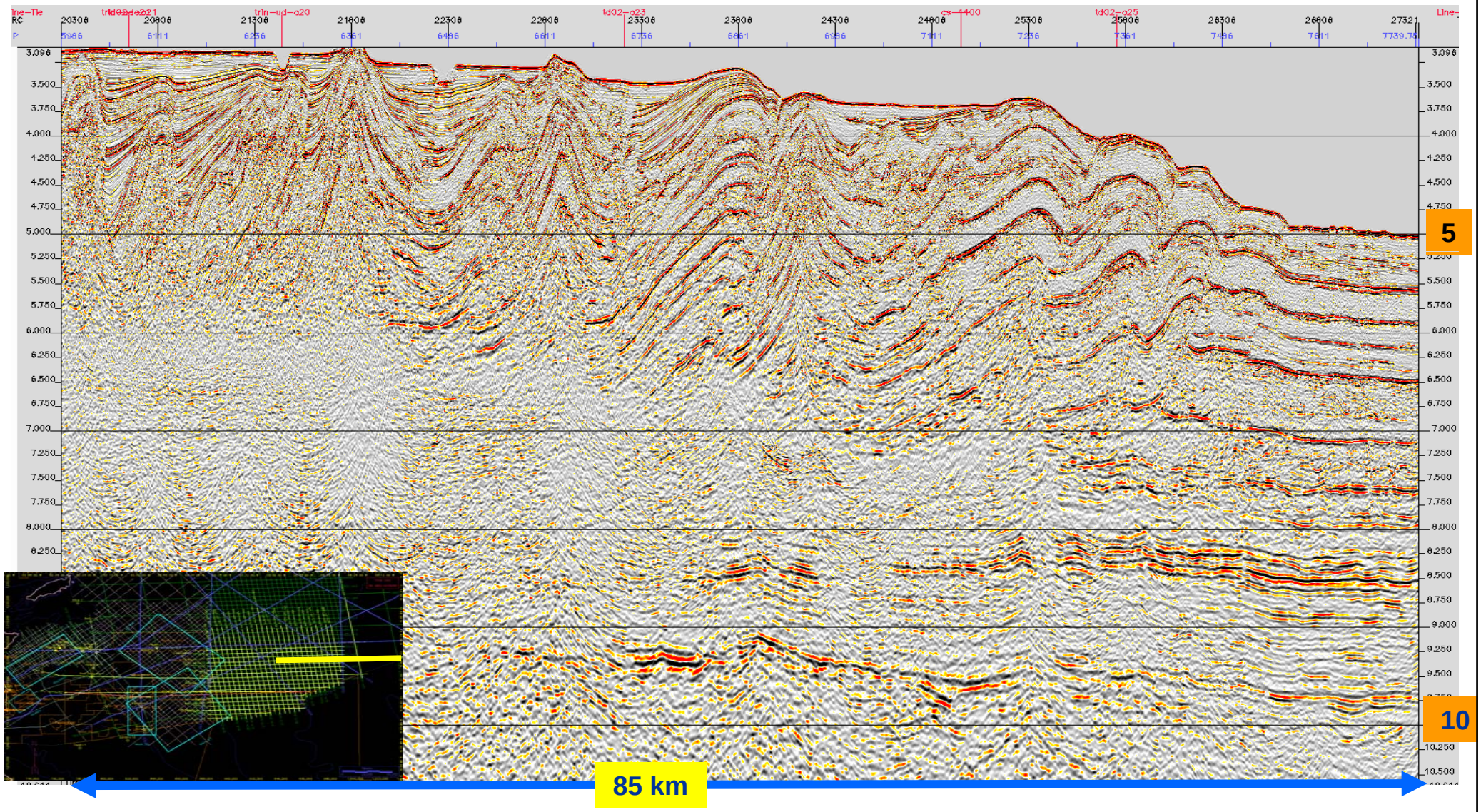
Horizon “60”: net sand: 9m, por: 23 – 30%, Sw: 40%, 59 BCF

Catfish - 1, Lower Pliocene

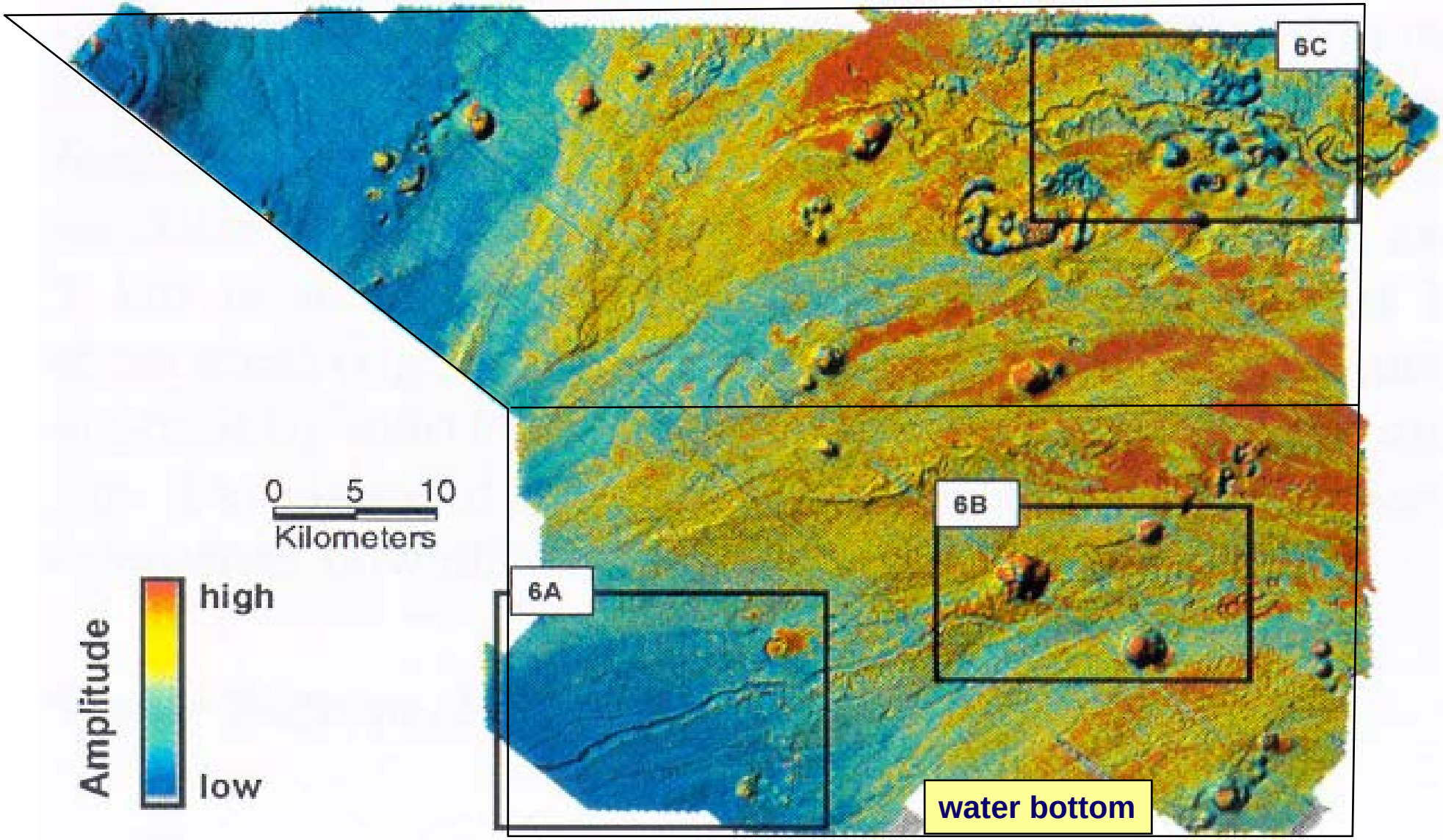
14430-14580´: 140´ gross SS, vf, med, well sorted, friable, max gas peak 0,43 %. Porosity: 22 %.



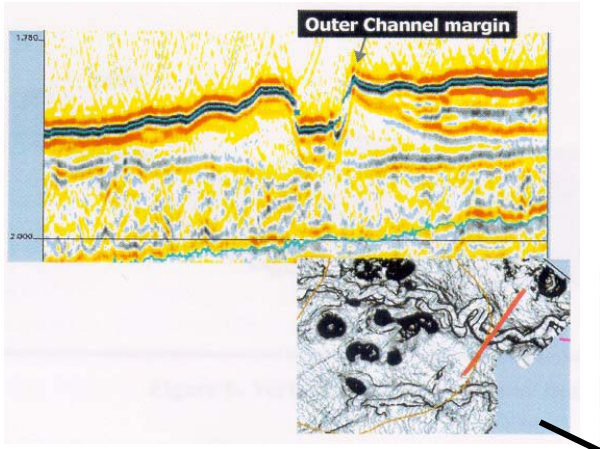
Active accretionary wedge

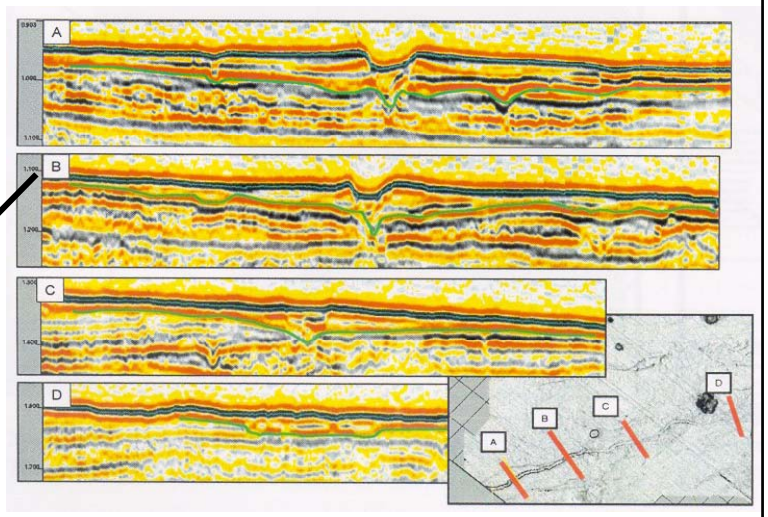


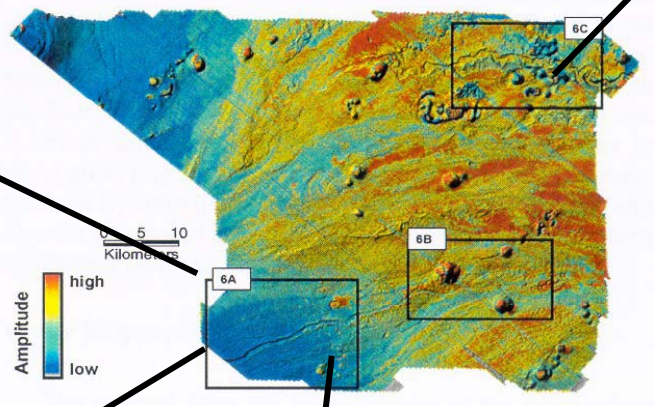
West of the UDW area, deepwater turbidites and shale diapirs

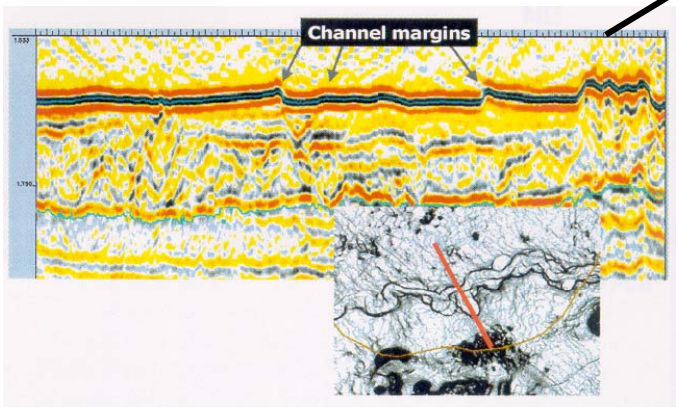


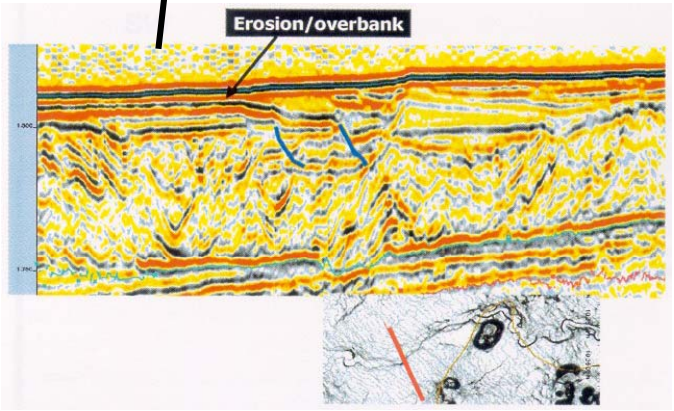
Modern analogs



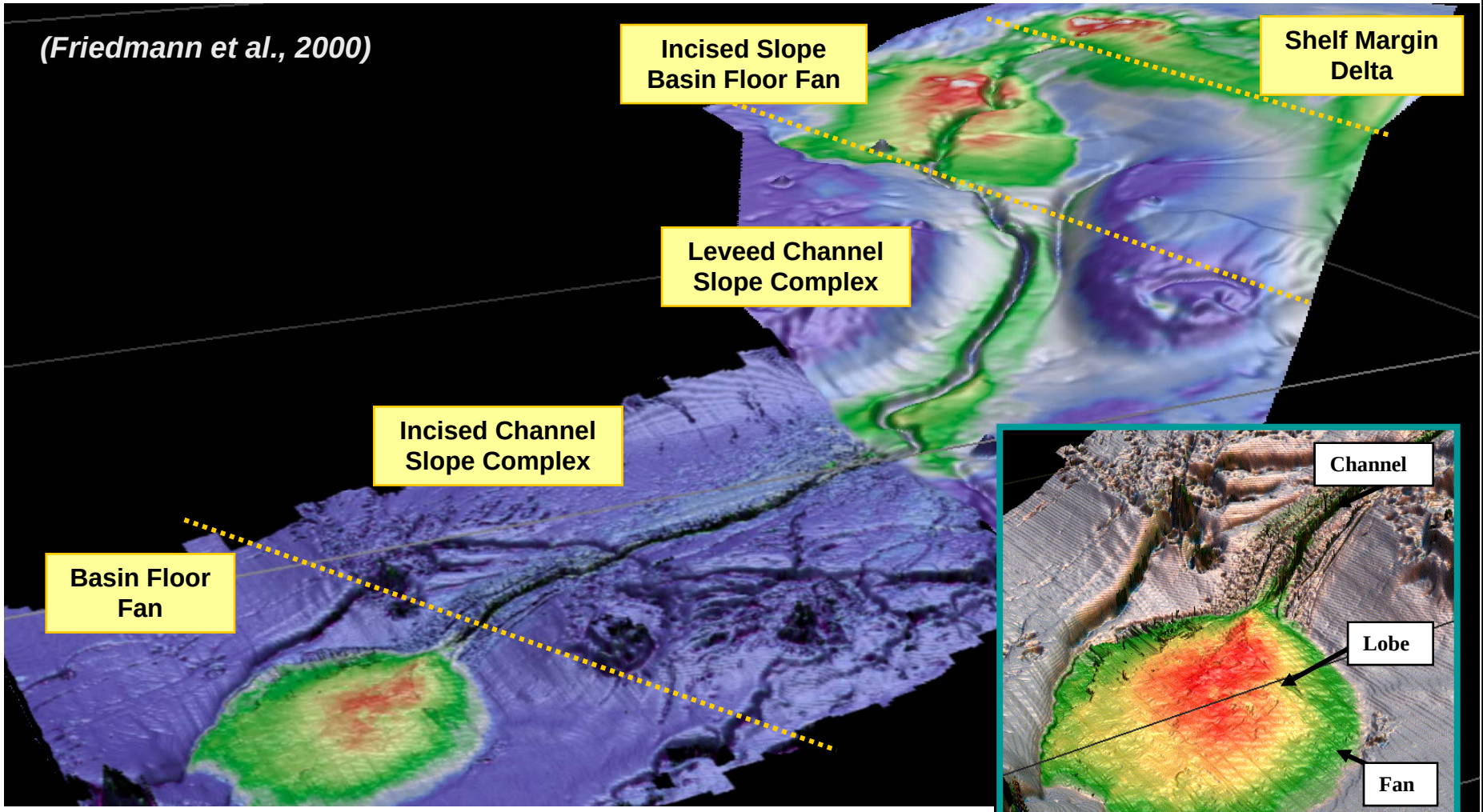






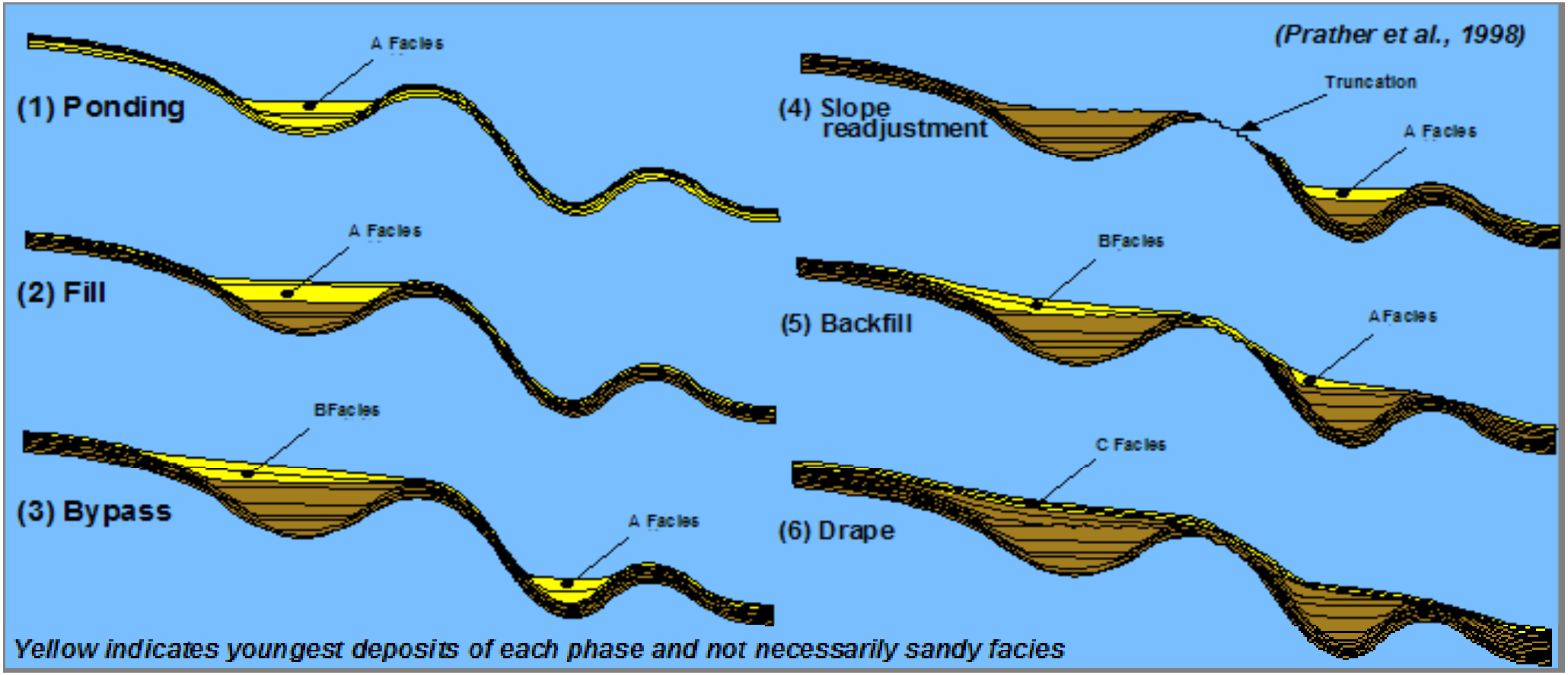


Turbidite System in Structurally Confined Basins **Channel and Lobe Facies Distribution**



Channels evolve to lobes when the down-slope gradient and/or flow-confinement change. As upslope ponds are filled, turbidite currents spill through channels producing down cutting. The new lobes (sheet-like sandstone bodies) accumulate down-slope. Whereas thick sand packages are deposited in the lows (reservoir), In the surrounding highs hemipelagic muds accumulate (lateral/top seal).

Evolution of Confined Basins
Facies Architecture



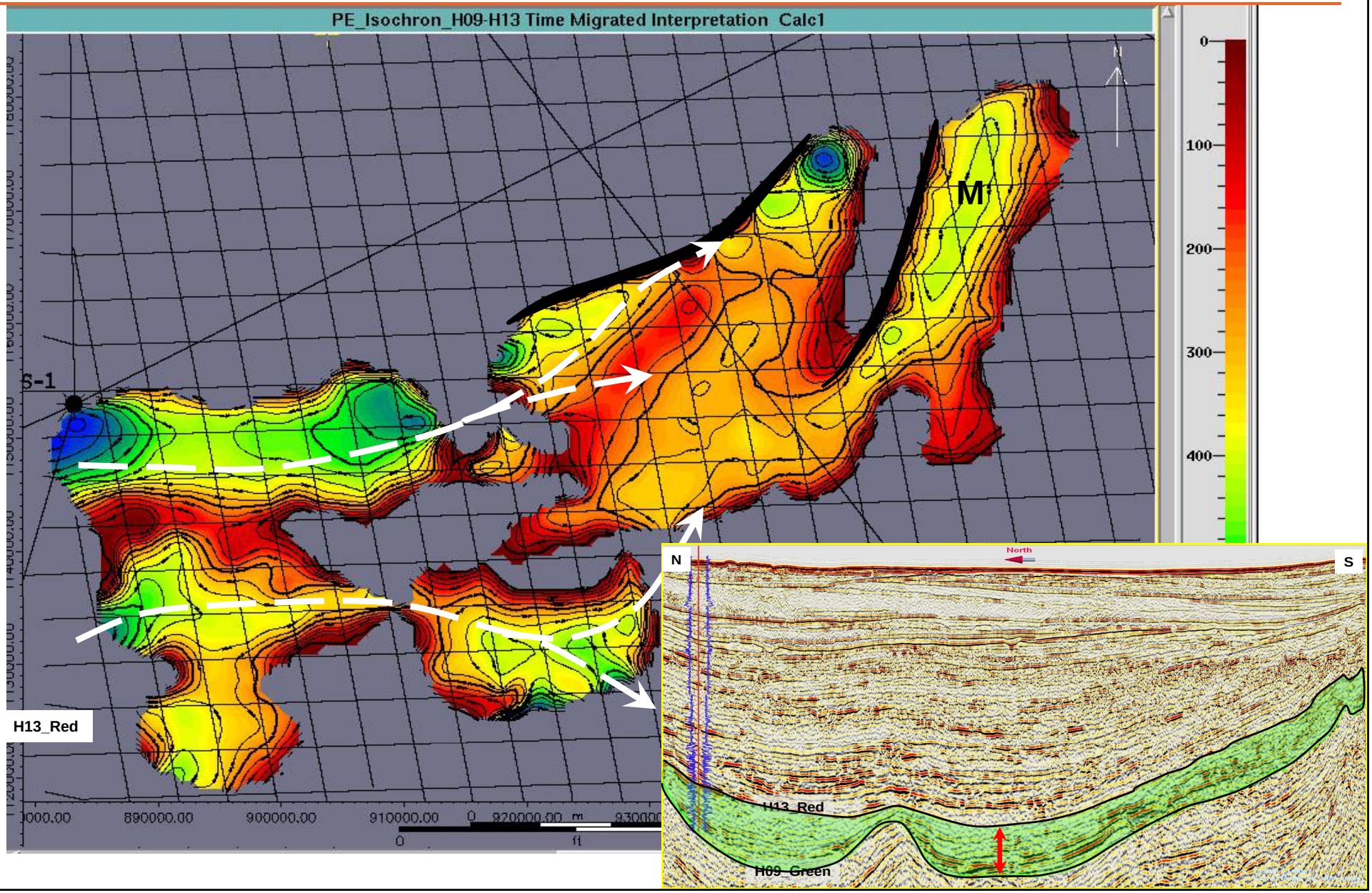
A. Early fluid gravity-flow events tend to 'sheet-outward' across the basin floor (sheet-like sandstones) and onlap the basin margin if the flow sediment volume is large enough. As the mud-content increases the channel/levee and background mudstone aggrades toward the equilibrium profile.

B. Once the slope basin is filled to the down-slope spill point the channel-levee system begins to erode and readjusts the slope toward a new equilibrium profile and transports significant volumes of sediment to the next down-slope minibasin.

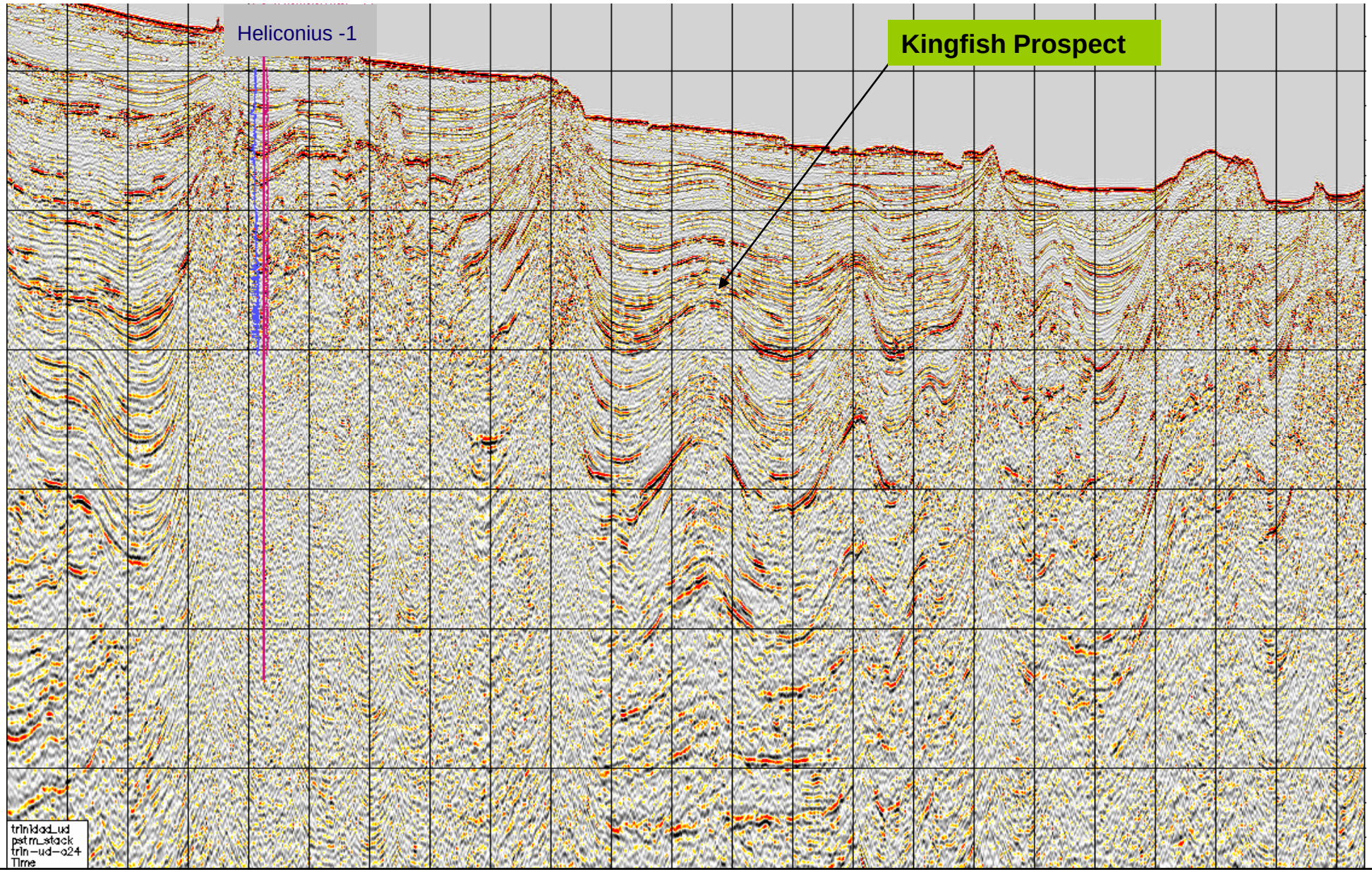
C. If the gravity-flow sediment supply is cut-off by avulsion of the supply system or relative rise of sea level, the entire area becomes draped with hemipelagic mudstones. These hemipelagic mudstones provide topseal and often separate pressure compartments.

Near Base Pleistocene isochron map

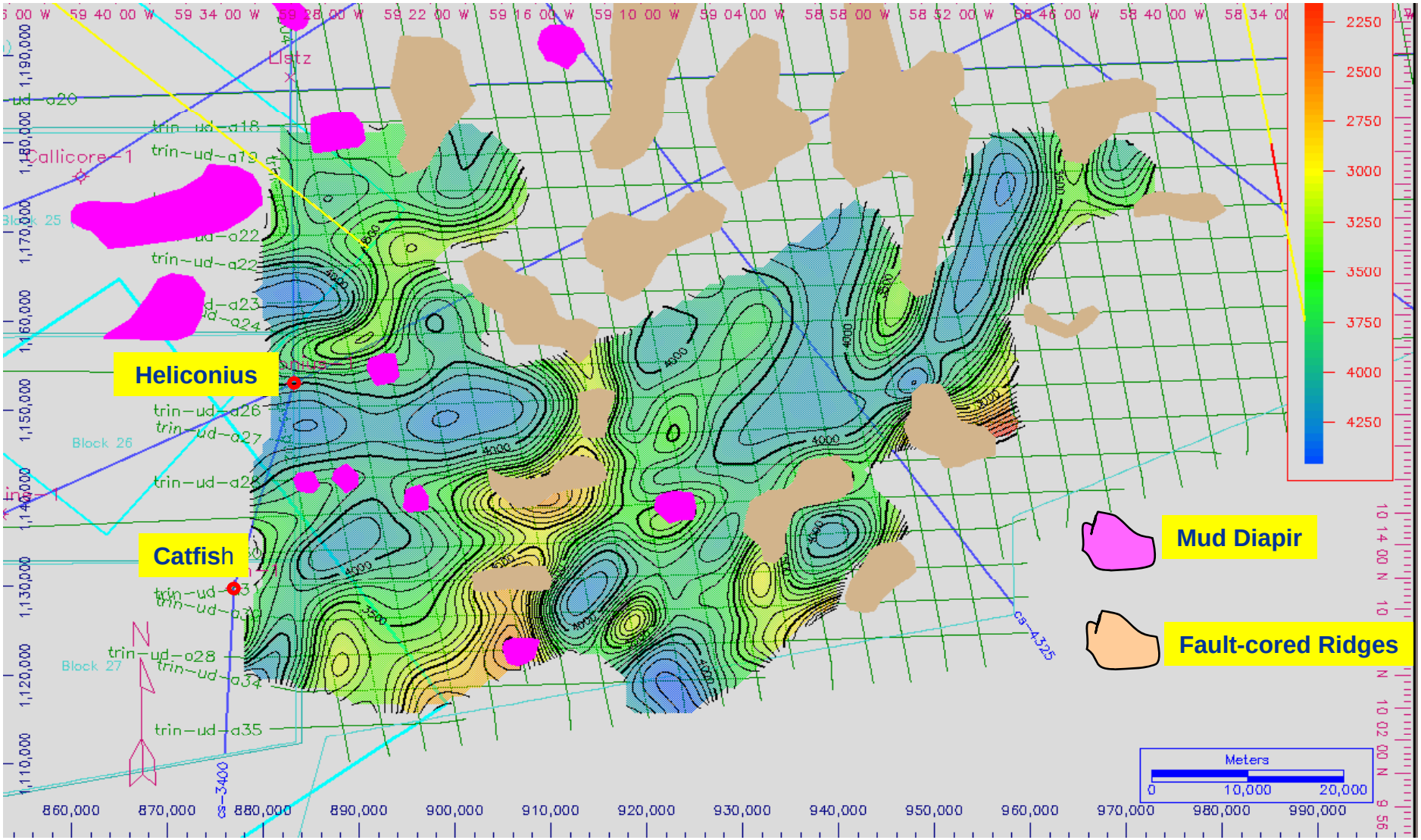
Minibasins and clastic transport pathways



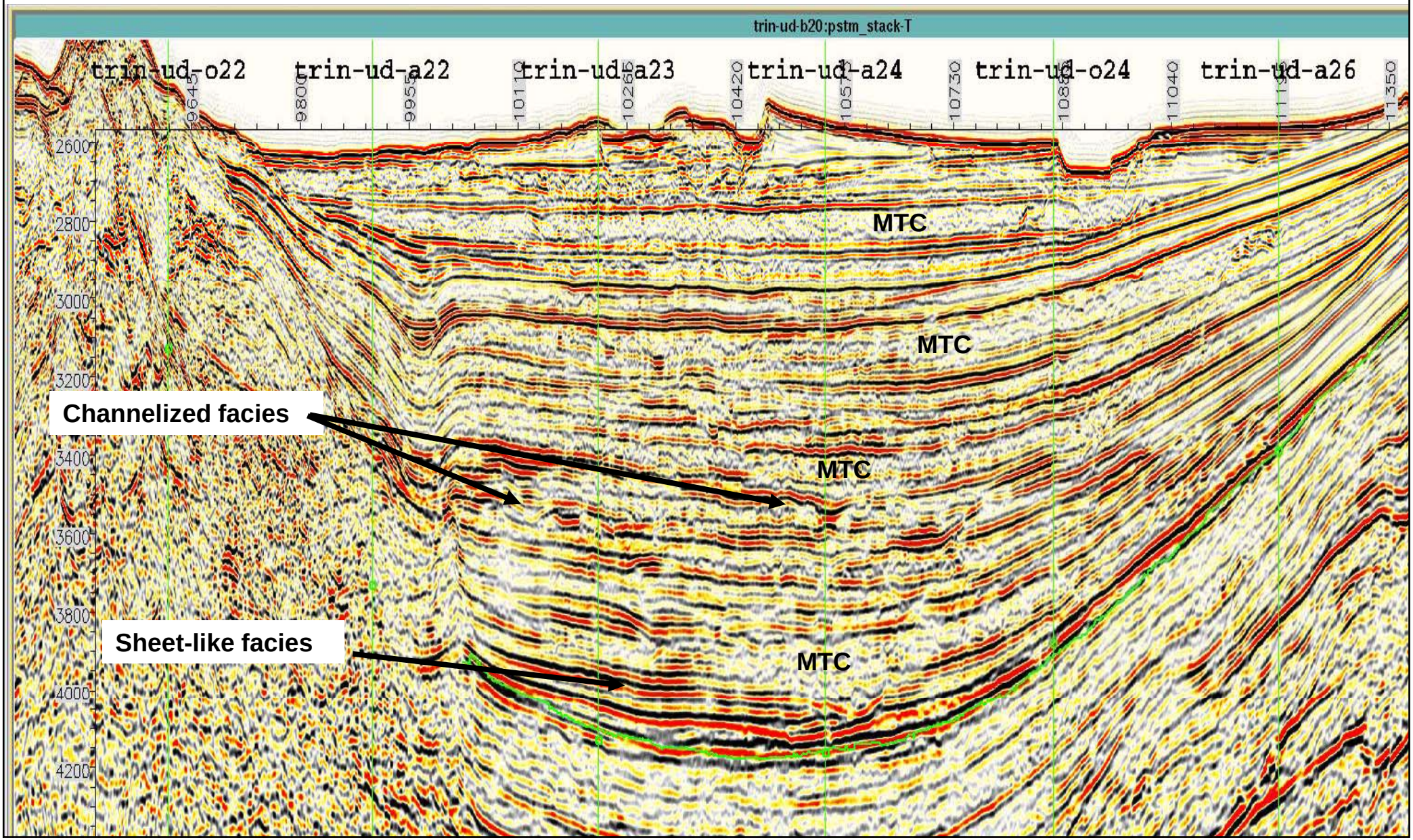
Regional W-E section



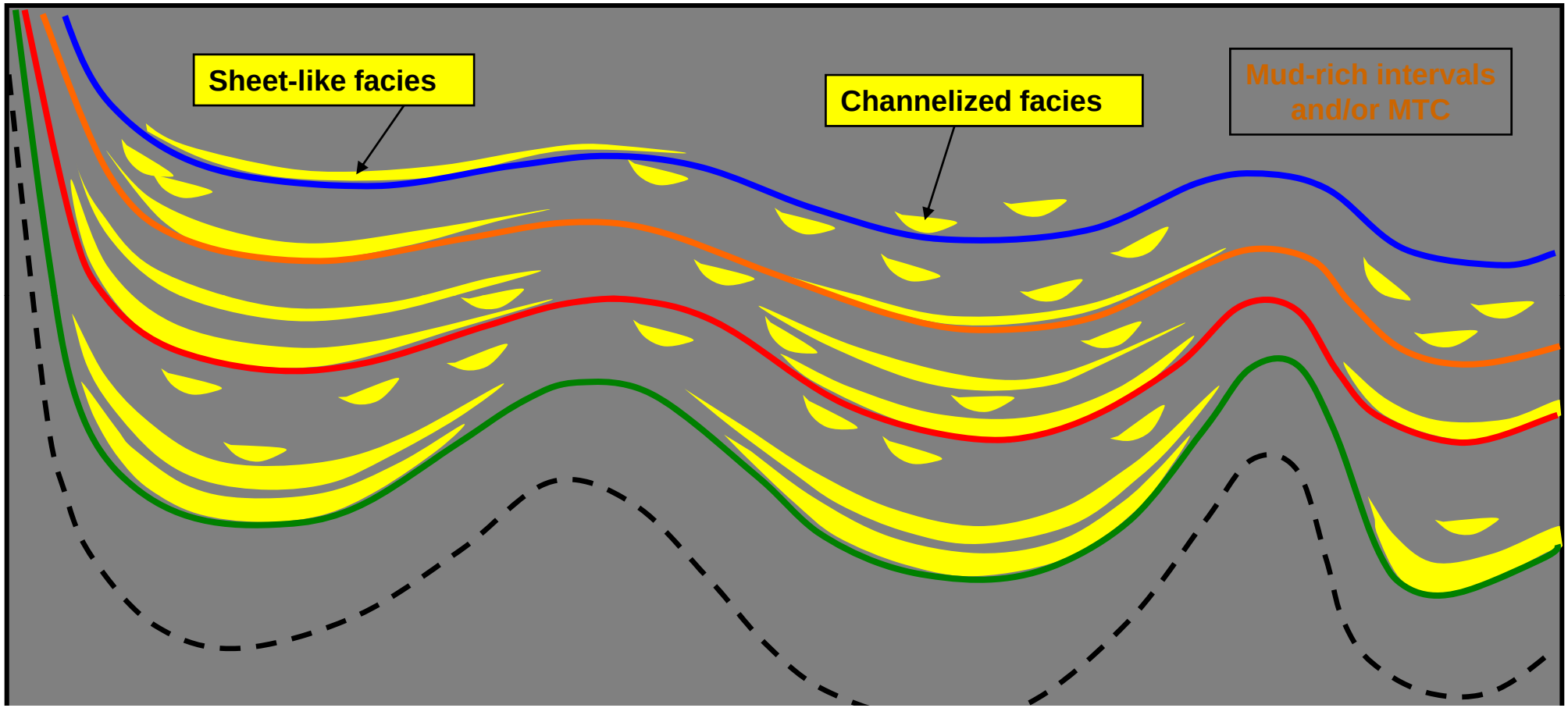
Upper Pliocene horizon (from Catfish) depicting minibasins, fault propagated folds and shale-cored ridges



Minibasins: Facies Seismic Signature MTC, Sheet-like and Channelized Bodies



Minibasin Fill in Trinidad UDW
Sequences and Facies Architecture

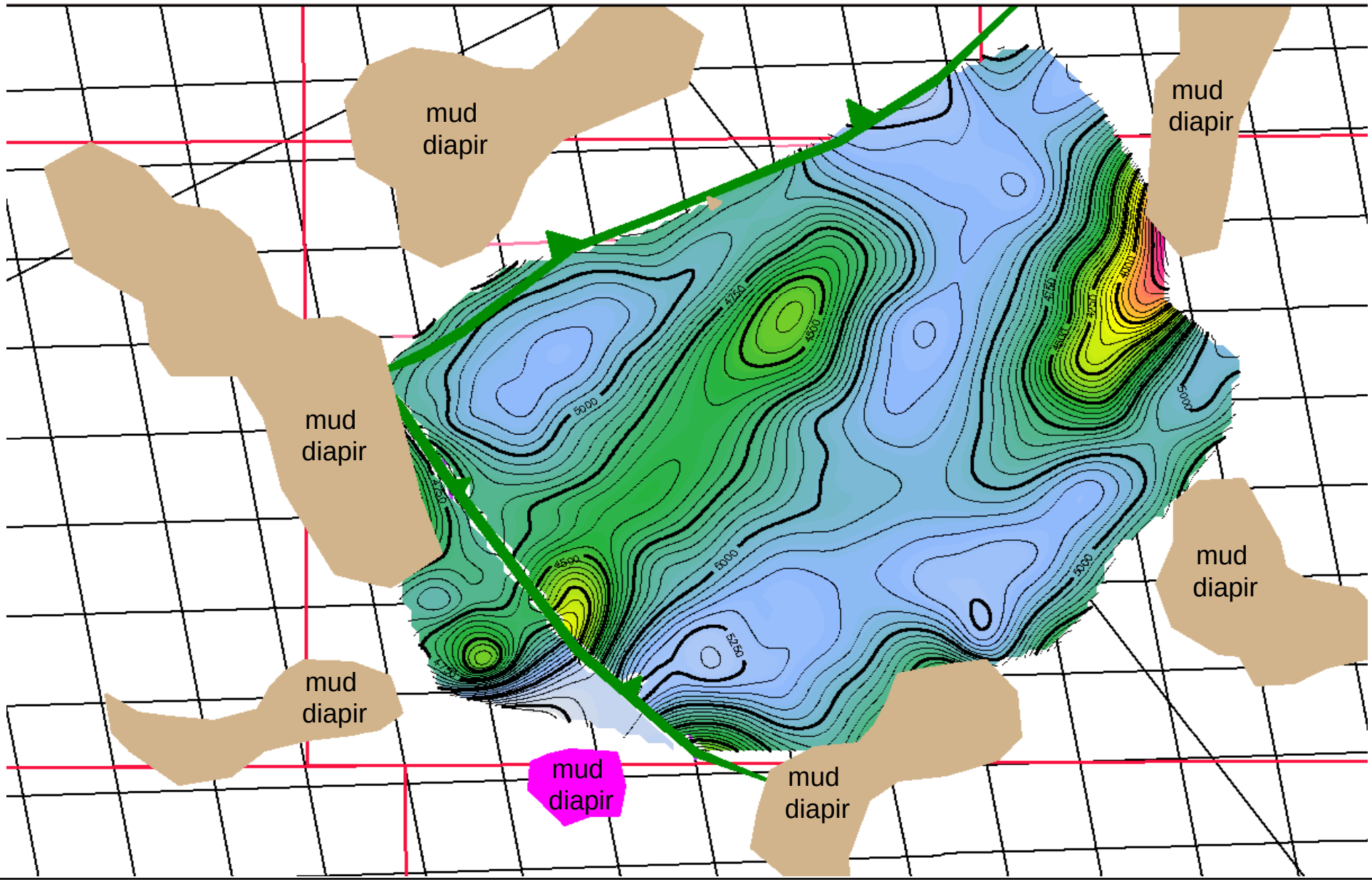


The lower interval of each sequence are prone to develop sheet-like sandstones, accumulated as lobes in a basin floor fan setting. In the upper portion of each sequence channelized bodies, with or without attached lobes, are more common.

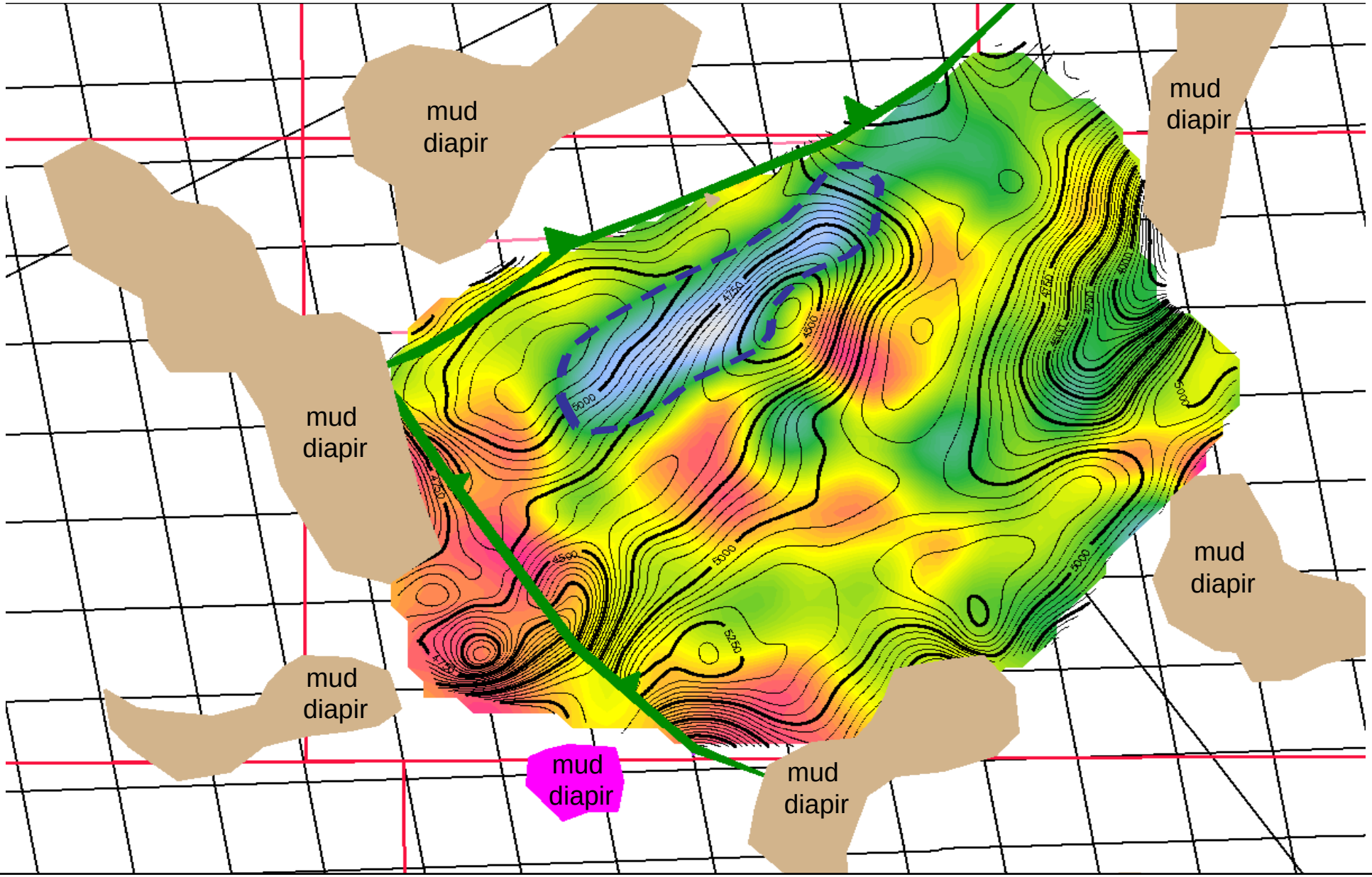
Younger units within the same minibasins are mainly made up of channelized bodies, accumulated within the distributary system of the deep water environment, and lobe accumulation should have been developed basinward. The youngest units have developed channel-levee complexes as observed in the area at the present day.

Sheet-like and channelized bodies are incased within mud-rich packages that clearly show features related to mass-transport complexes (MTC).

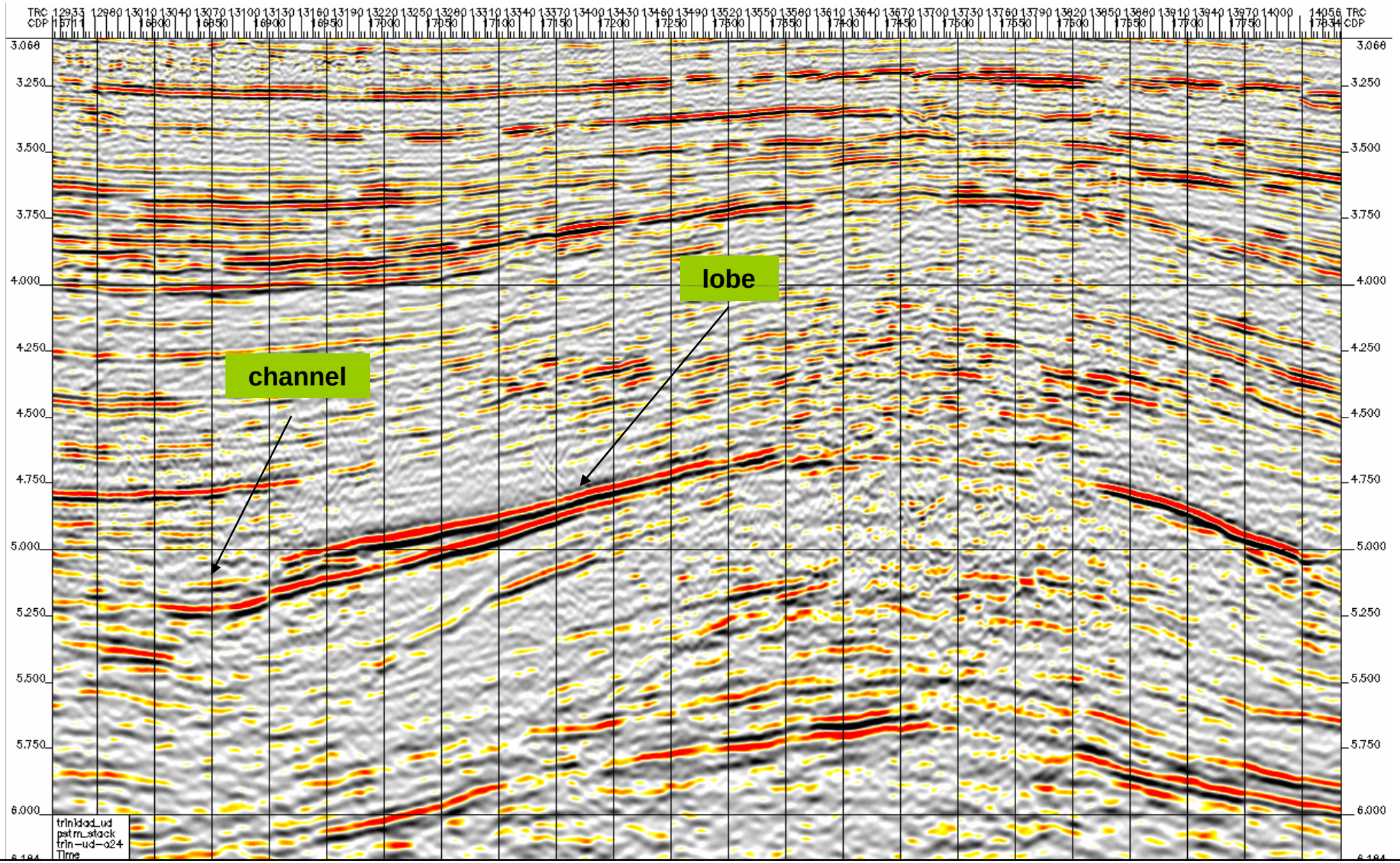
Kingfish structure



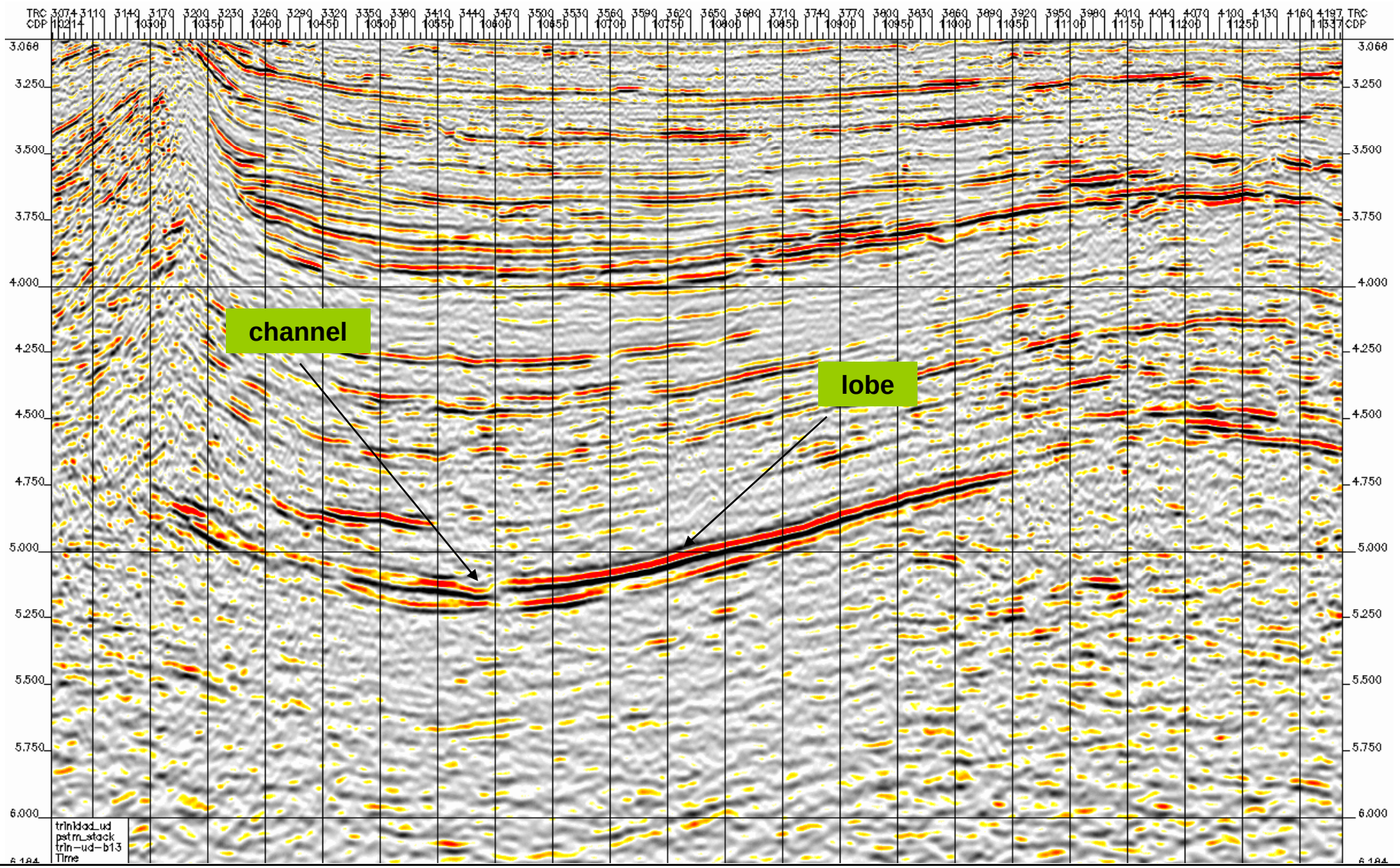
Kingfish structure and RMS amplitude



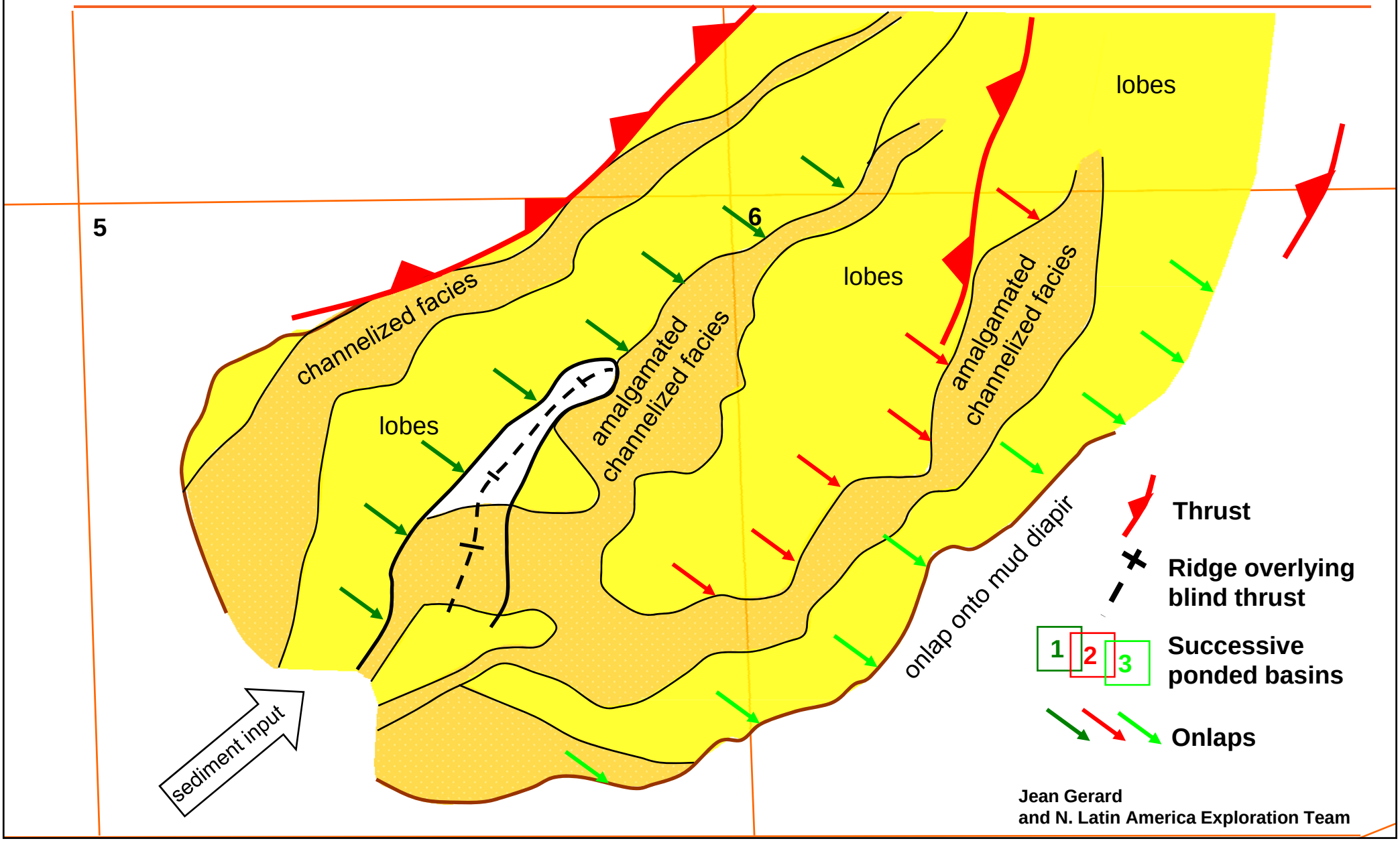
Kingfish Lower Pliocene facies



Kingfish Lower Pliocene facies

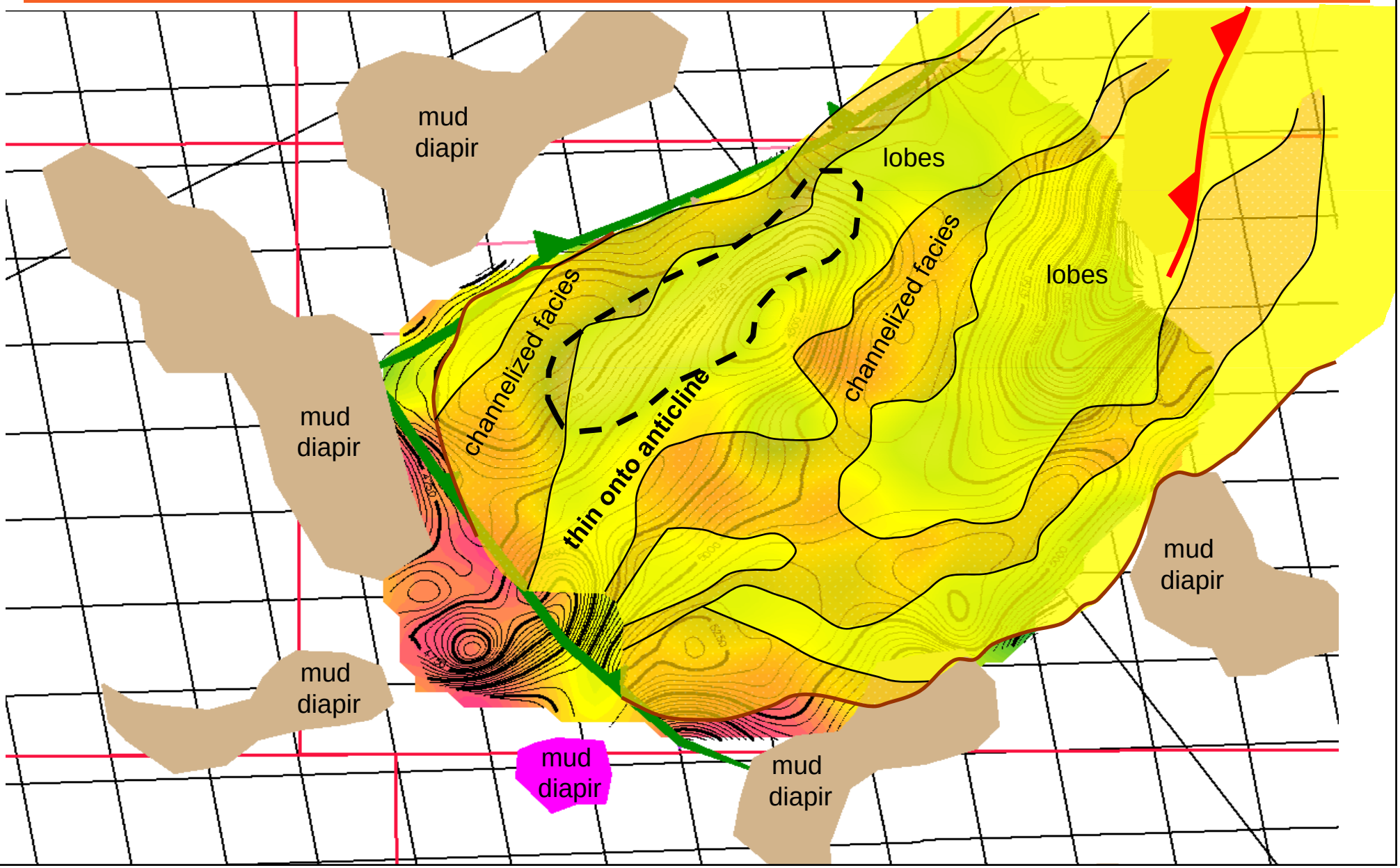


Trinidad UDW Blocks 5 and 6 Pliocene LST
Deepwater Channel and Lobe Facies Distribution



Jean Gerard
and N. Latin America Exploration Team

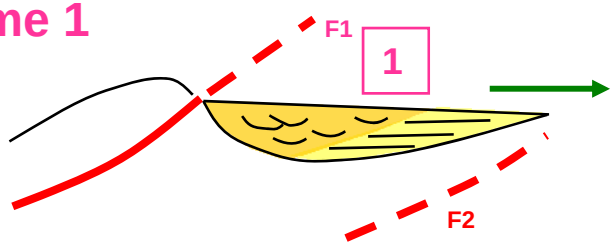
Kingfish structure, amplitude and facies



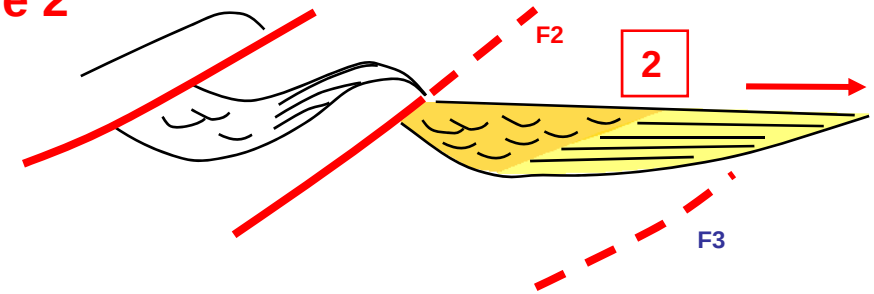
Trinidad UDW Schematic Evolution of Accretionary Wedge Minibasins

REPSOL YPF

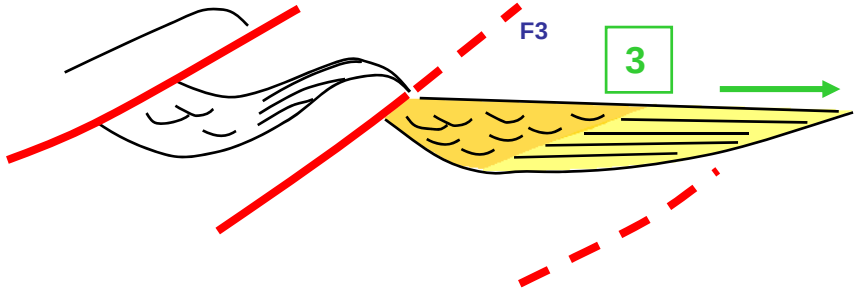
Time 1



Time 2



Time 3



LEGEND

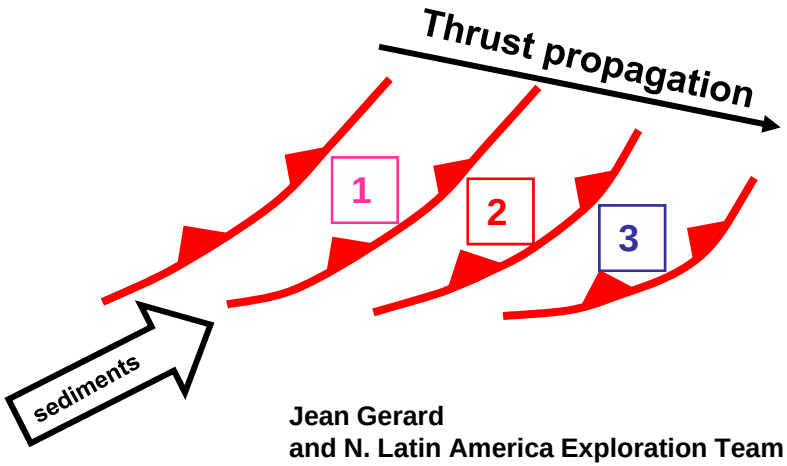
Deepwater Channelized Facies

Deepwater Lobe Facies

1 2 3 Successive Accretionary Wedge Minibasins

Onlaps

MAP VIEW



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and N. Latin America Exploration Team

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