

# **Mass-Transport Mechanisms and Resulting Deposits in a Deepwater Carbonate Debris Apron: Lower Cretaceous Tamabra Formation, Poza Rica Field Area, Mexico\***

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## **Abstract**

A large carbonate debris apron developed on the west side of the Early Cretaceous Tuxpan Platform in water depths up to 1000 m. The transition from the shallow-water, reef-rimmed shelf to the debris apron was abrupt, with slope angles up to 35°. The apron extended more than 20 km from the shelf edge. Near the platform, the apron is approximately 400 m thick, and at the basinward-most edge of data control, it is approximately 150 m thick. Density flows and suspension processes were the dominant mechanisms of sedimentation. Accumulations with cobble- to boulder-sized carbonate lithoclasts were deposited by debris and mud flows. Matrix strength was the dominant grain-support mechanism, but pore pressure and buoyancy also contributed. Deposits of this type include clast-bearing lime mudstone and carbonate breccia, with matrix texture ranging from carbonate mud dominated to carbonate grain dominated. Coarse-grained skeletal-grain accumulations were deposited by concentrated and hyperconcentrated density flows. Dispersive pressure was the dominant grain-support mechanism, but buoyancy also contributed. Deposits include coarse-grained packstone to grainstone and rudstone. Grains are of shallow-water origin. Some of the fine-grained carbonate grainstones are associated with deposition by turbidity currents and show components of Bouma sequences. Turbulence was the dominant grain-support mechanism for these flows. Lithofacies group into packages that appear to correspond to stages of relative sea-level changes. Debris-flow deposits dominated during the transgressive to early highstand stages, and concentrated to hyperconcentrated density-flow deposits dominated during stillstand or early, slowly relative falling of sea level.

## **References**

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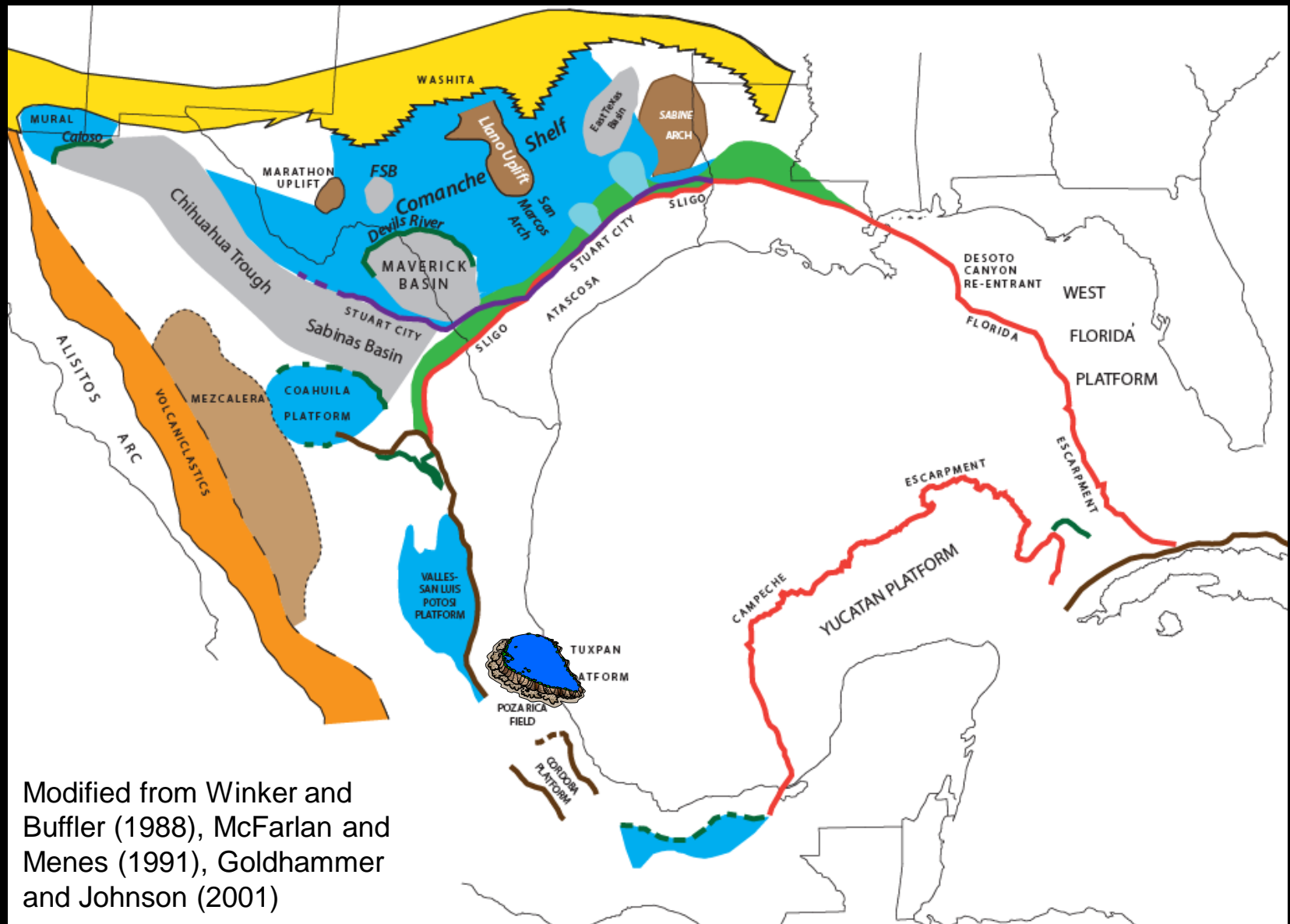
# Mass-Transport Mechanisms and Resulting Deposits in a Deepwater Carbonate Debris Apron: Lower Cretaceous Tamabra Formation, Poza Rica Field Area, Mexico

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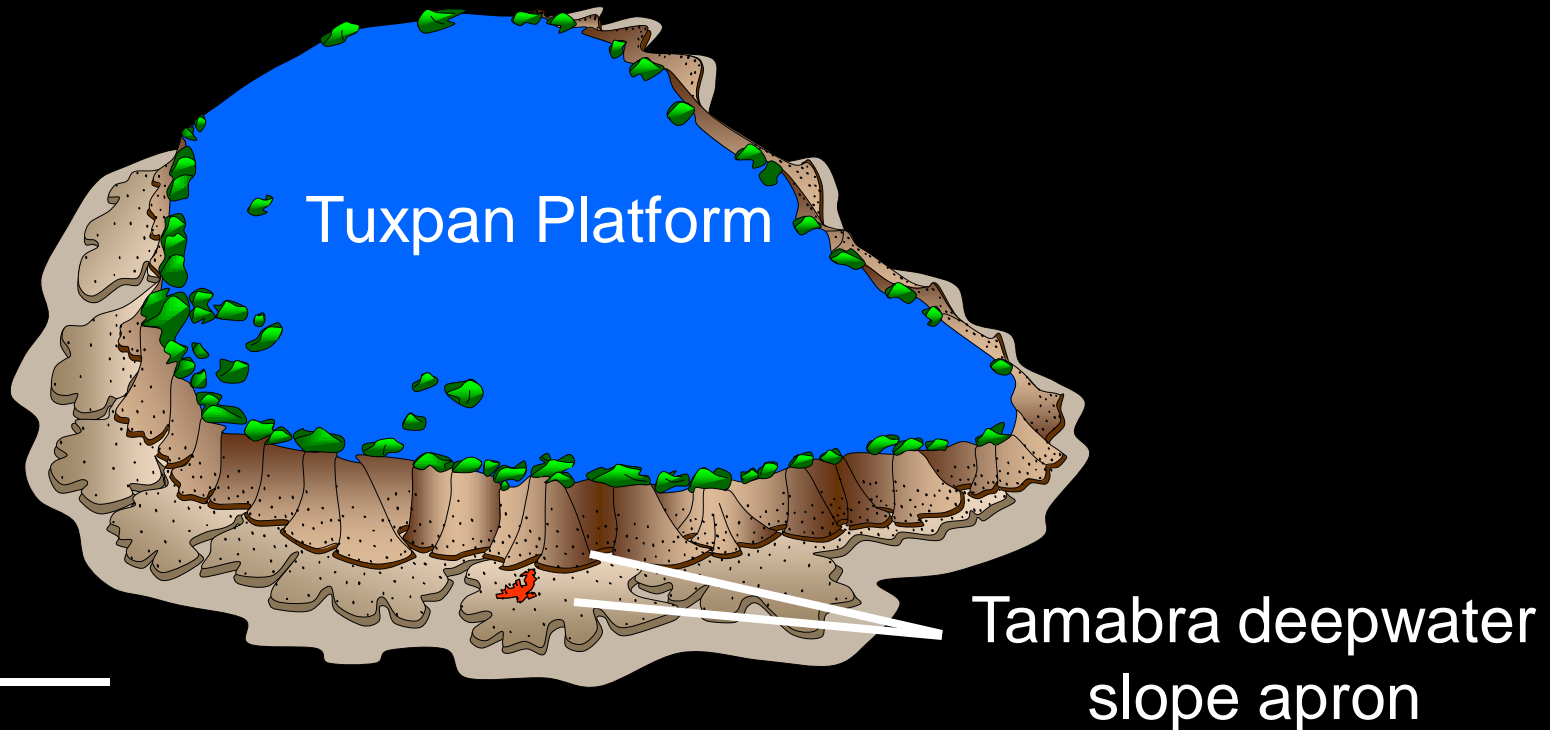


# Location



# Goal

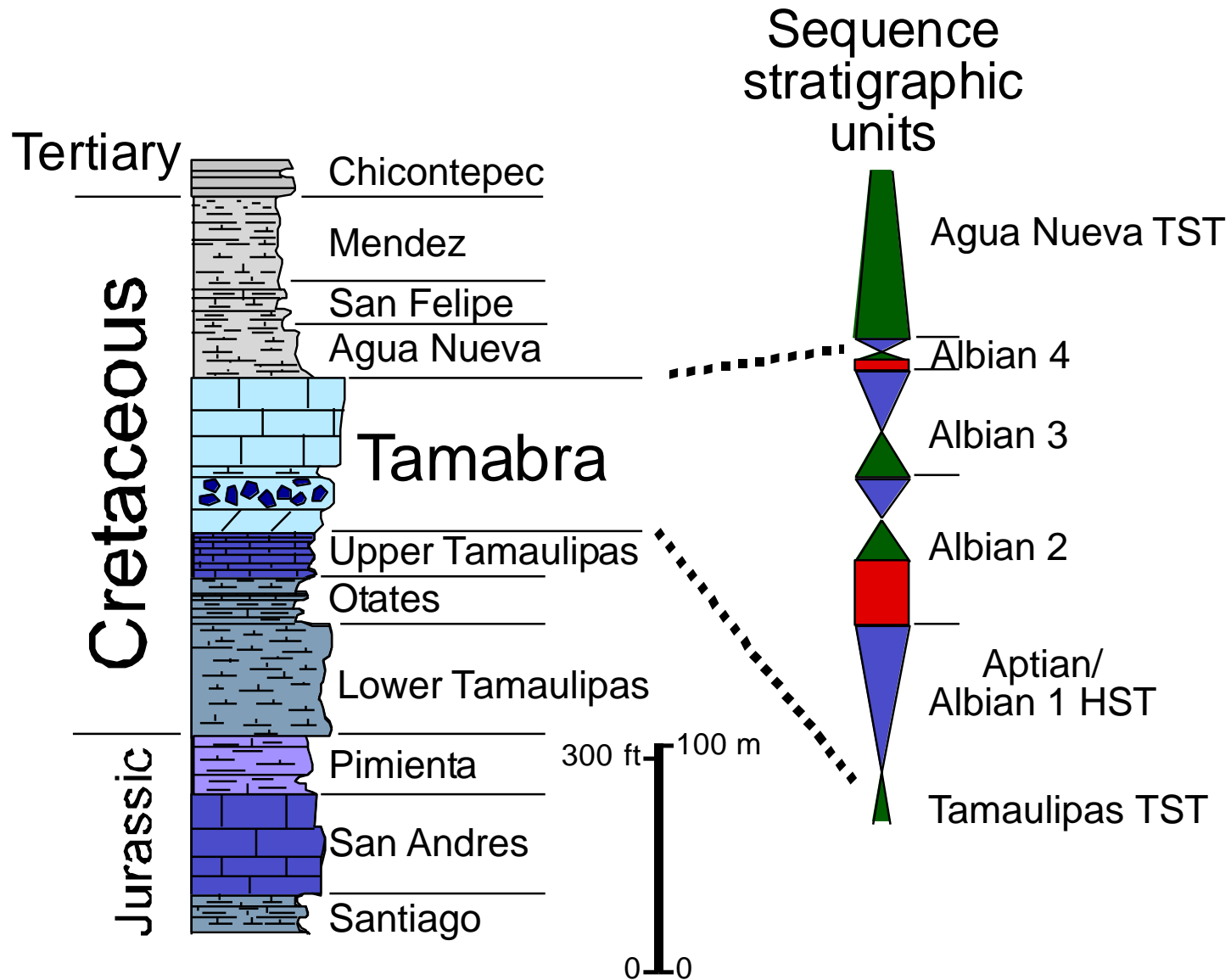
- Thick Tamabra deepwater slope apron surrounds the Tuxpan Platform



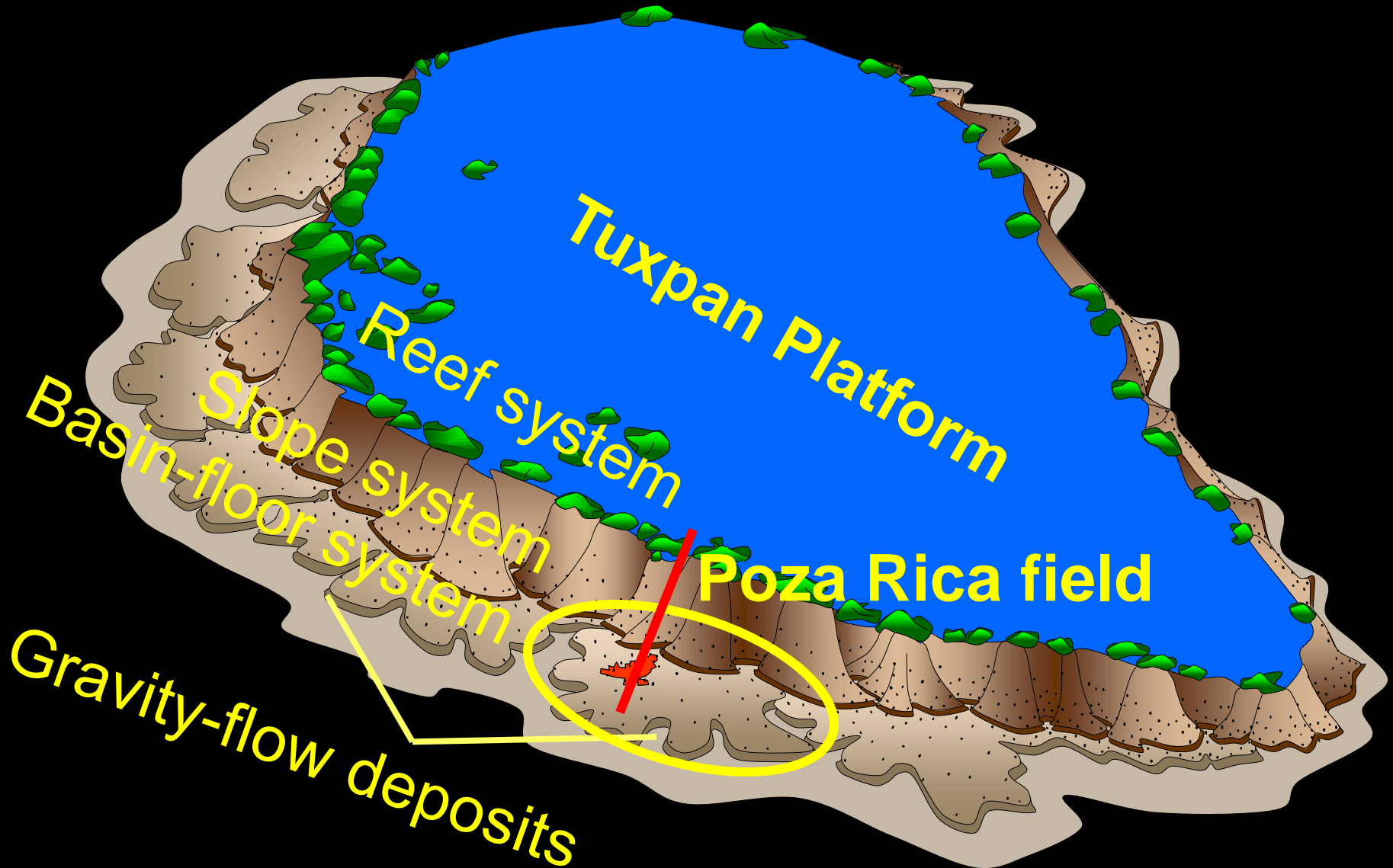
- Relate deepwater lithofacies to depositional processes

# Stratigraphy

# Stratigraphic Section



# General Depositional Setting





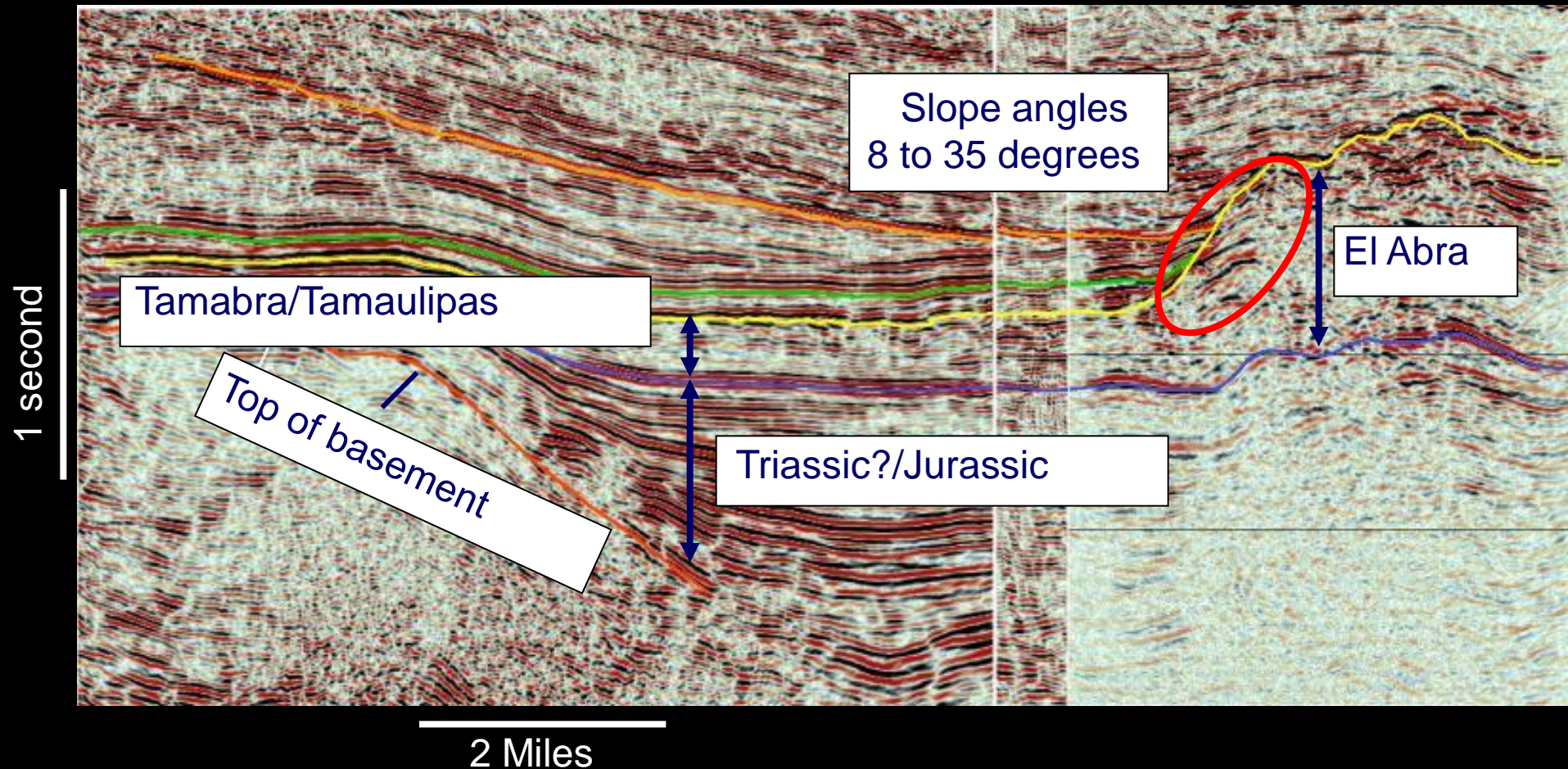
# Seismic Profile

SW

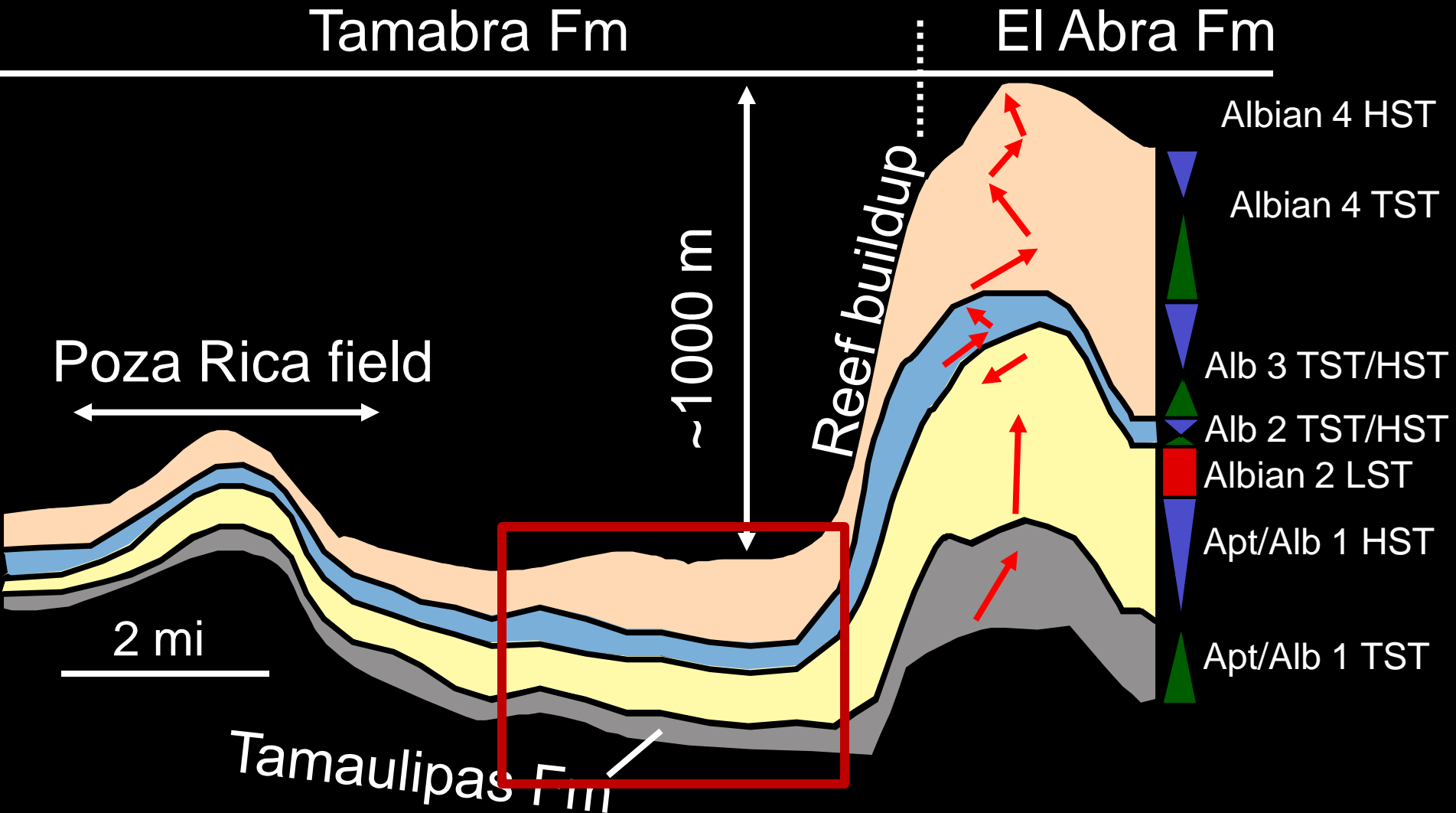
NE

Poza Rica field

Western leeward margin  
of Tuxpan Platform



# Conceptual Model Relating the Tuxpan Platform to Poza Rica Field



# Stratigraphic Dip Section

~10 Miles

Agua Nueva Fm

Albian 4  
LST - HST

Albian 3  
TST - HST

Albian 2 LST - HST

Apt. – Alb. 1 HST

300 ft

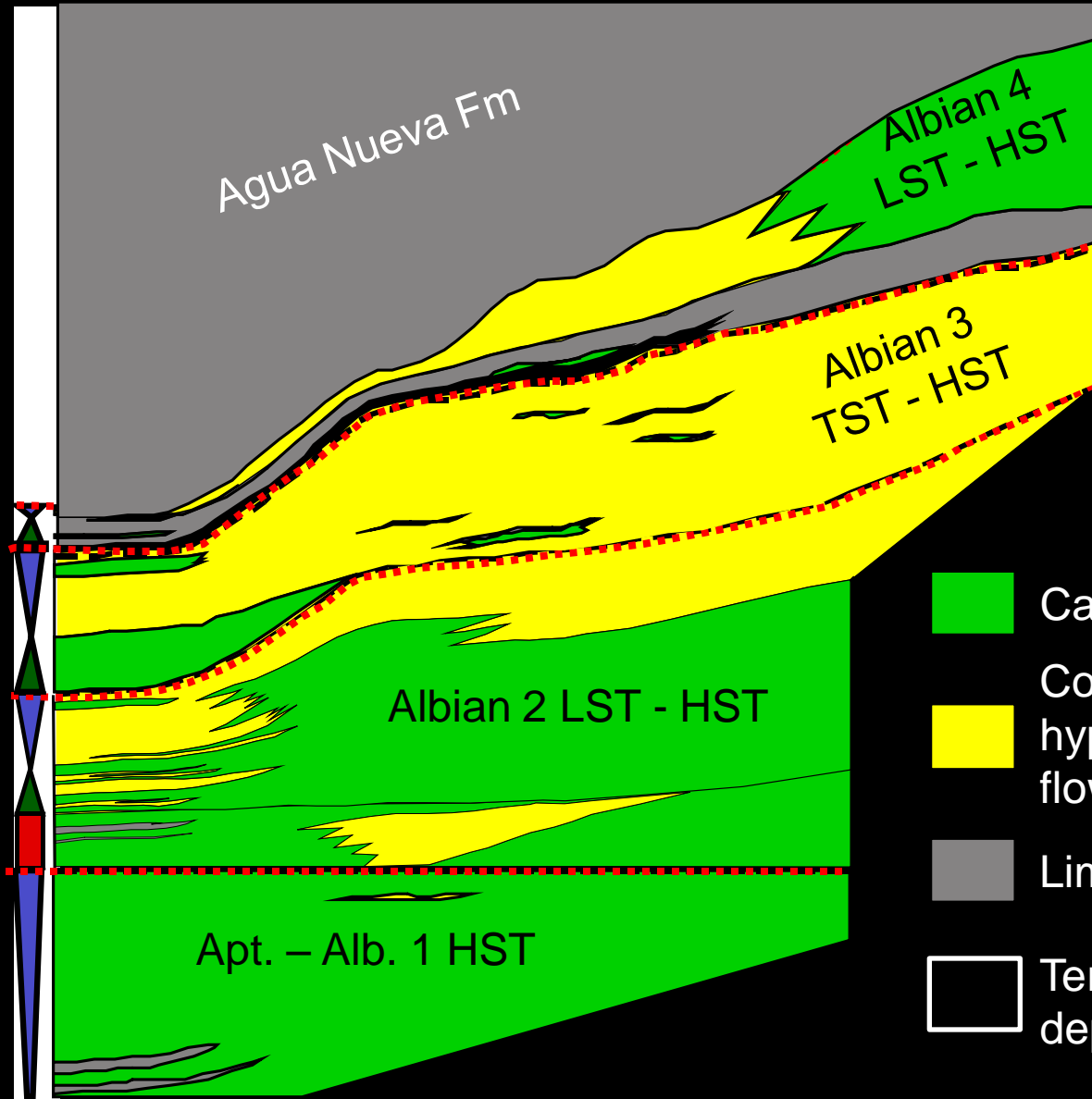
Tamabra Fm

Carbonate debris flows

Concentrated to  
hyperconcentrated density  
flows and turbidite deposits

Lime-mud suspension deposits

Terrigenous-mud suspension  
deposits



# **Depositional Lithofacies and Associated Depositional Processes**

# Density-Flow Classification

Mulder and Alexander (2001)

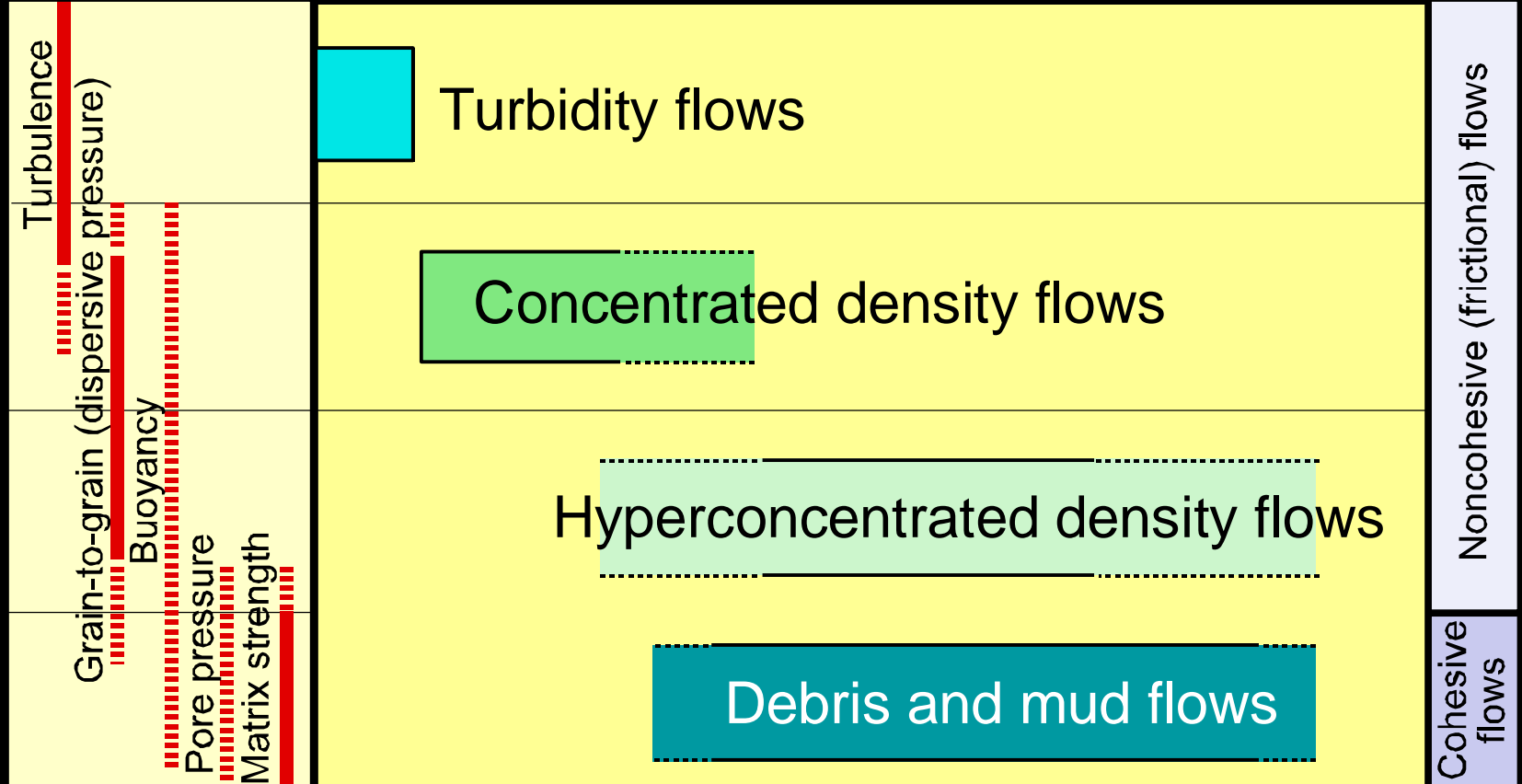
Dominant grain  
support  
mechanism

Sediment concentration (volume %)

0

50

100

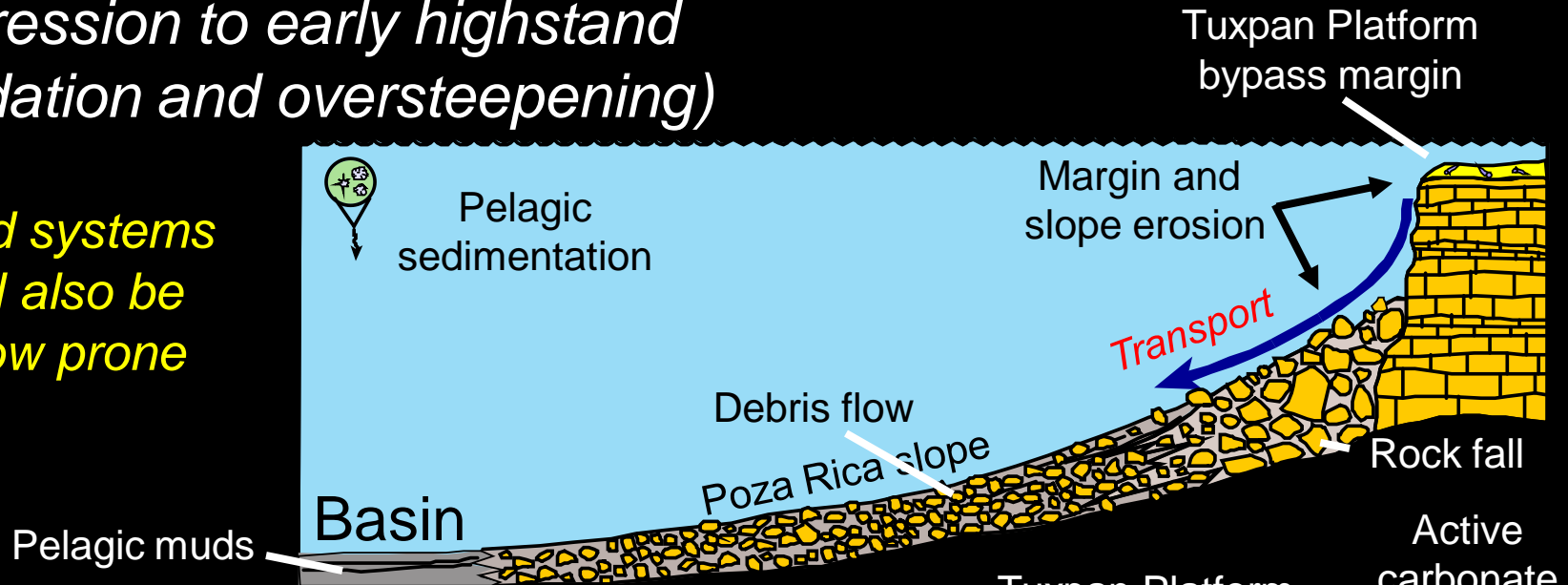




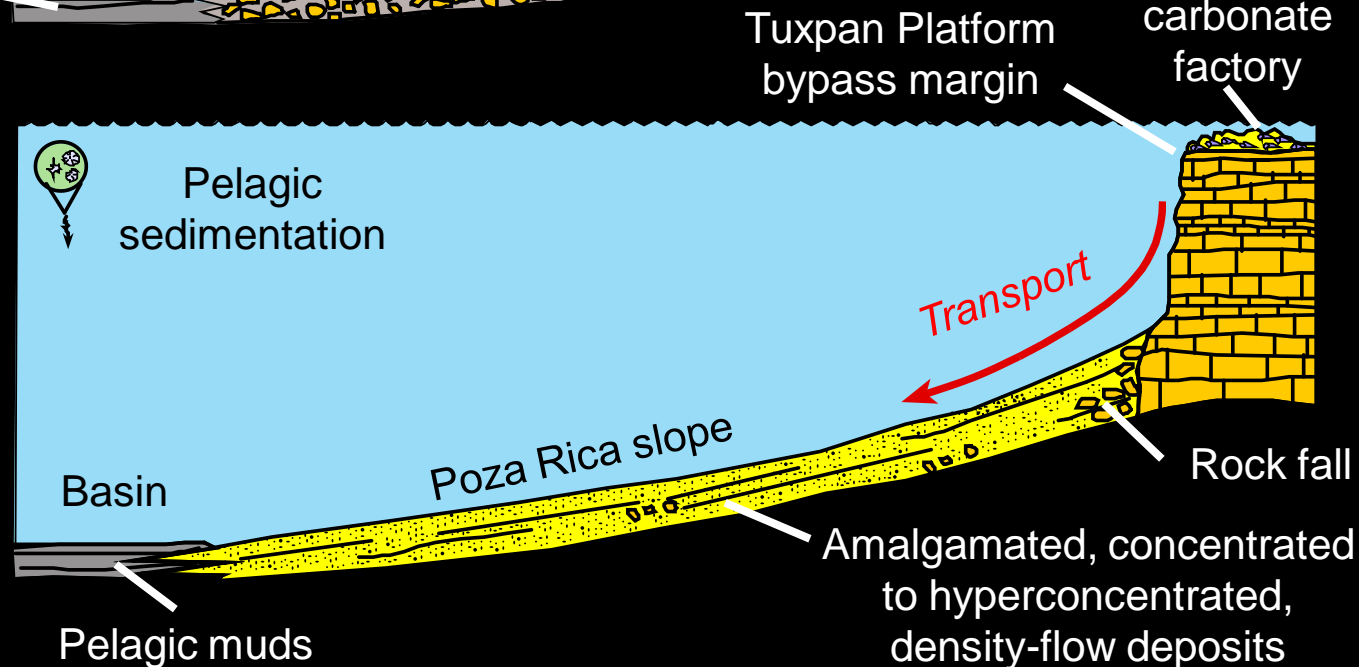
# Depositional Settings

*Transgression to early highstand  
(aggradation and oversteepening)*

*Lowstand systems  
tracts will also be  
debris-flow prone*



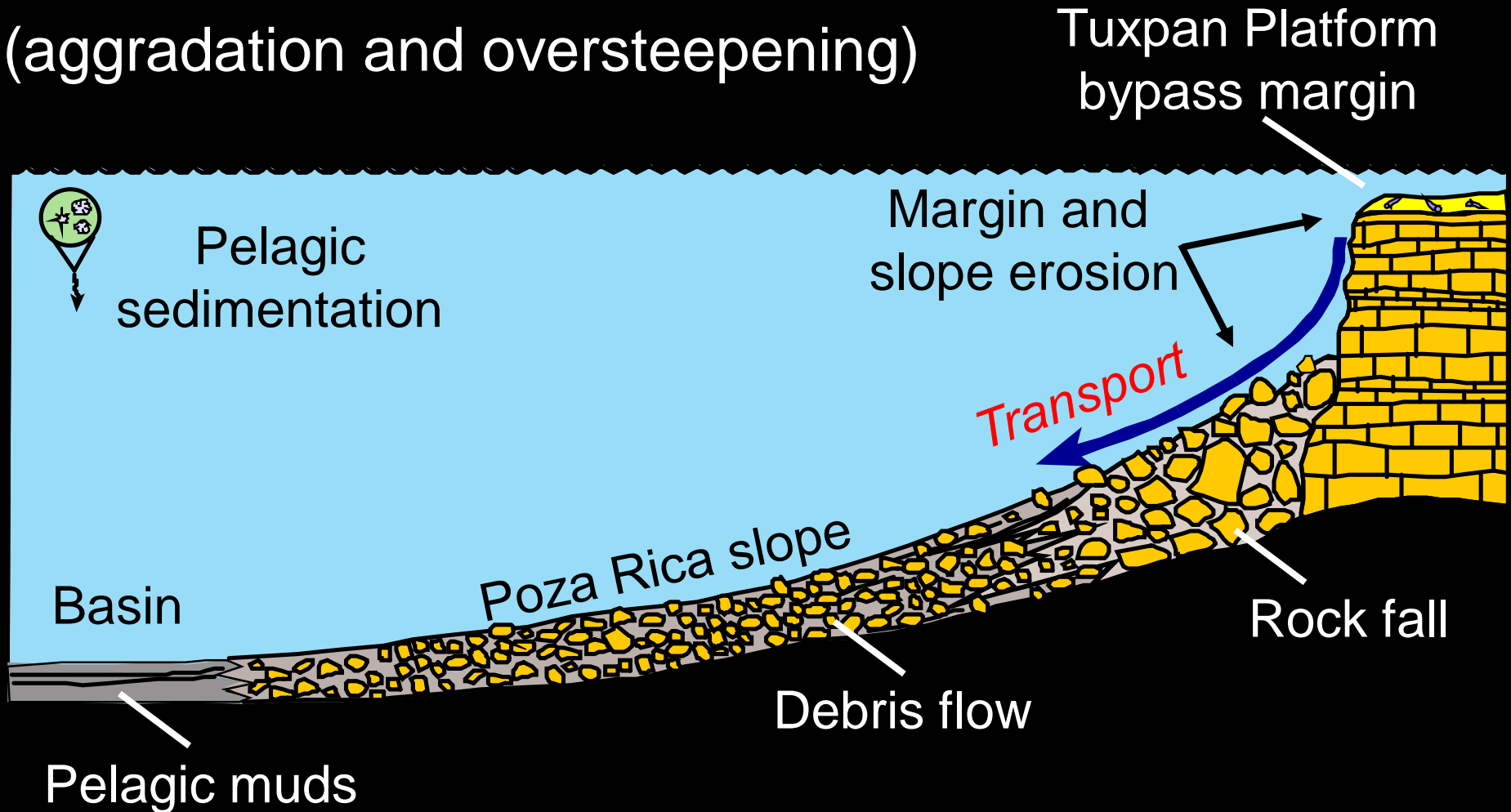
*Highstand shedding*



Model based on  
concept of McIlreath  
and James (1978)

# Depositional Setting

Lowstand to early highstand  
(aggradation and oversteepening)



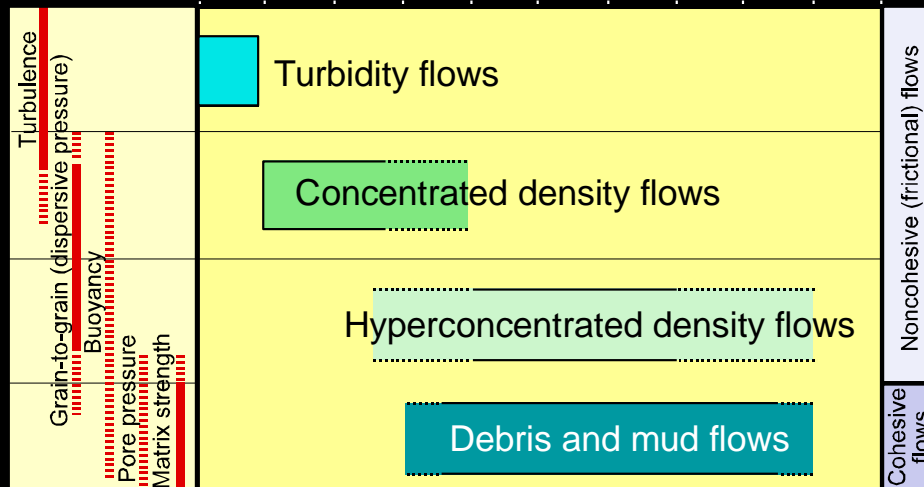
Model based on concept of McIlreath and James (1978)

# Mud Flows

- Cohesive flow of mud and few clasts supported by matrix strength and pore pressure
- Less than 10% clasts

Dominant grain support mechanism

Sediment concentration (volume %) 0 50 100



Mud flow w/clasts



Mud-supported debris flow

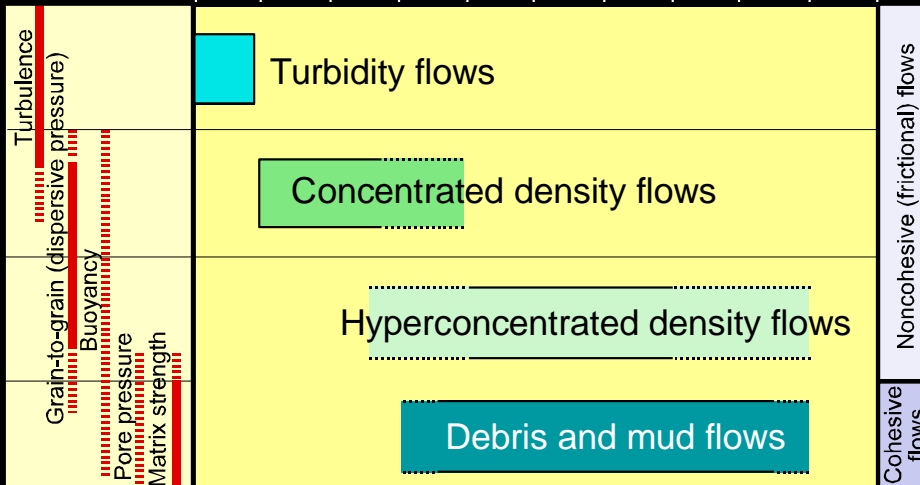


# Debris Flows

- Cohesive flow of mud and few clasts supported by matrix strength and pore pressure
- Greater than or equal to 15% clasts

Dominant grain support mechanism

Sediment concentration (volume %) 0 50 100



Clast-supported debris flow

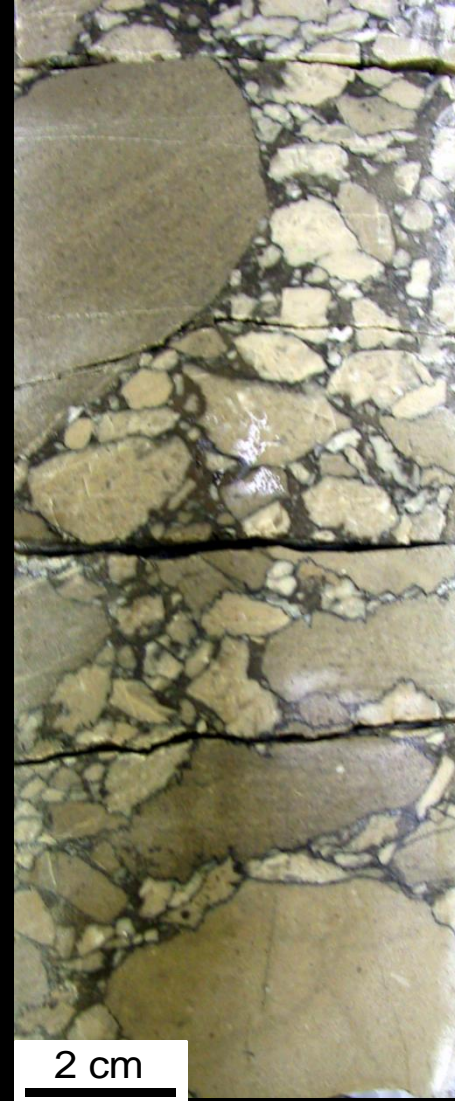
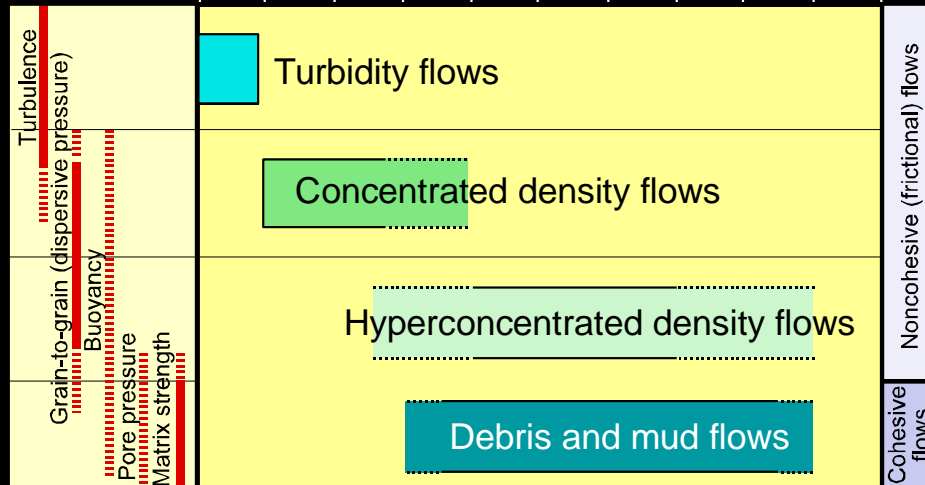


Matrix-free debris flow (stylobreccia)

# Debris-Flow Matrix Types

Dominant grain  
support  
mechanism

Sediment concentration (volume %) 0 50 100



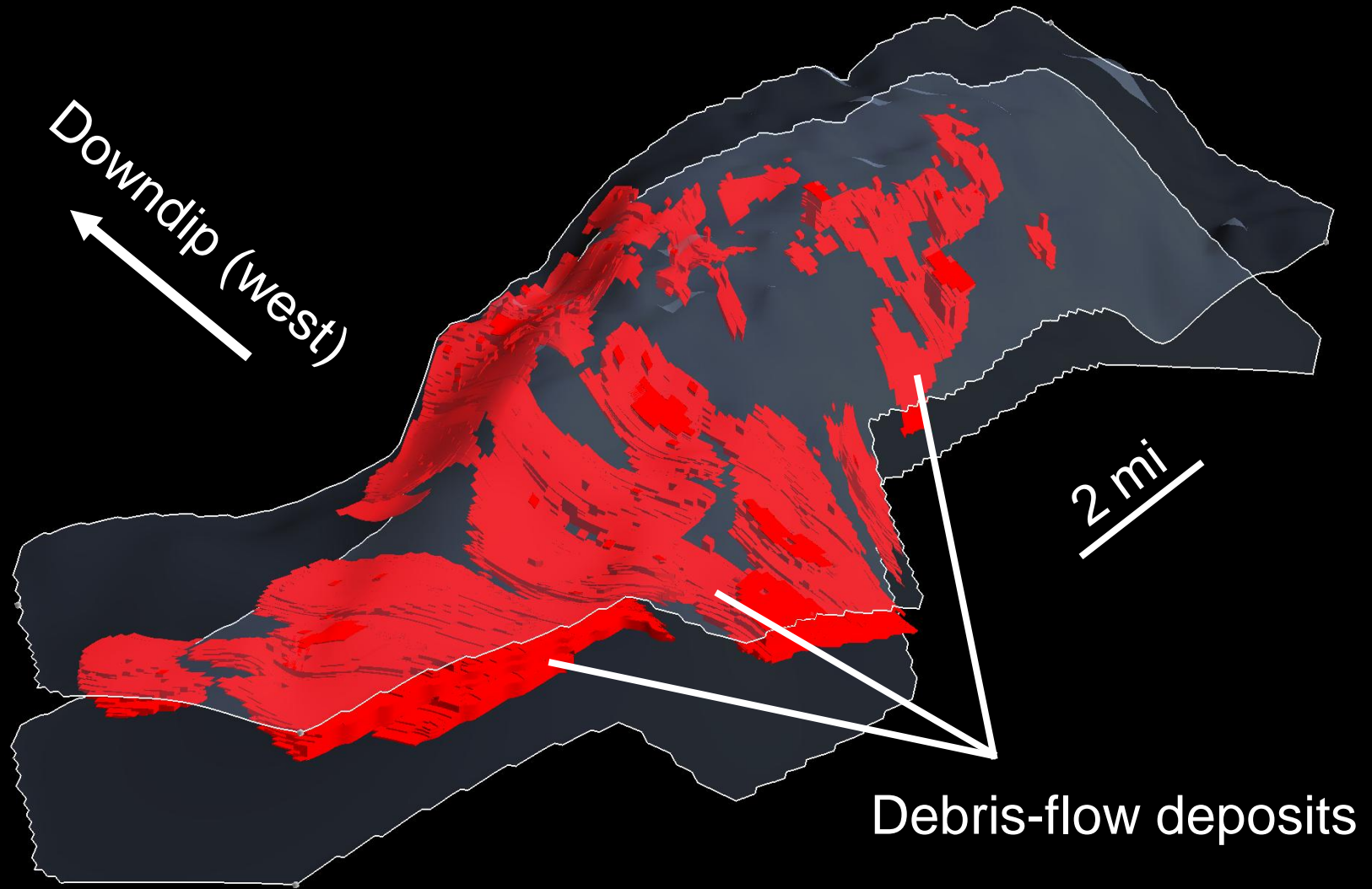
Debris flow  
w/mud matrix



Debris flow w/  
grain matrix (now  
dolomitized)

# Debris Flows

Geobodies constructed from wireline logs using GOCAD





# Depositional Setting

Highstand shedding

Tuxpan Platform  
bypass margin

Active  
carbonate  
factory

Pelagic  
sedimentation

Transport

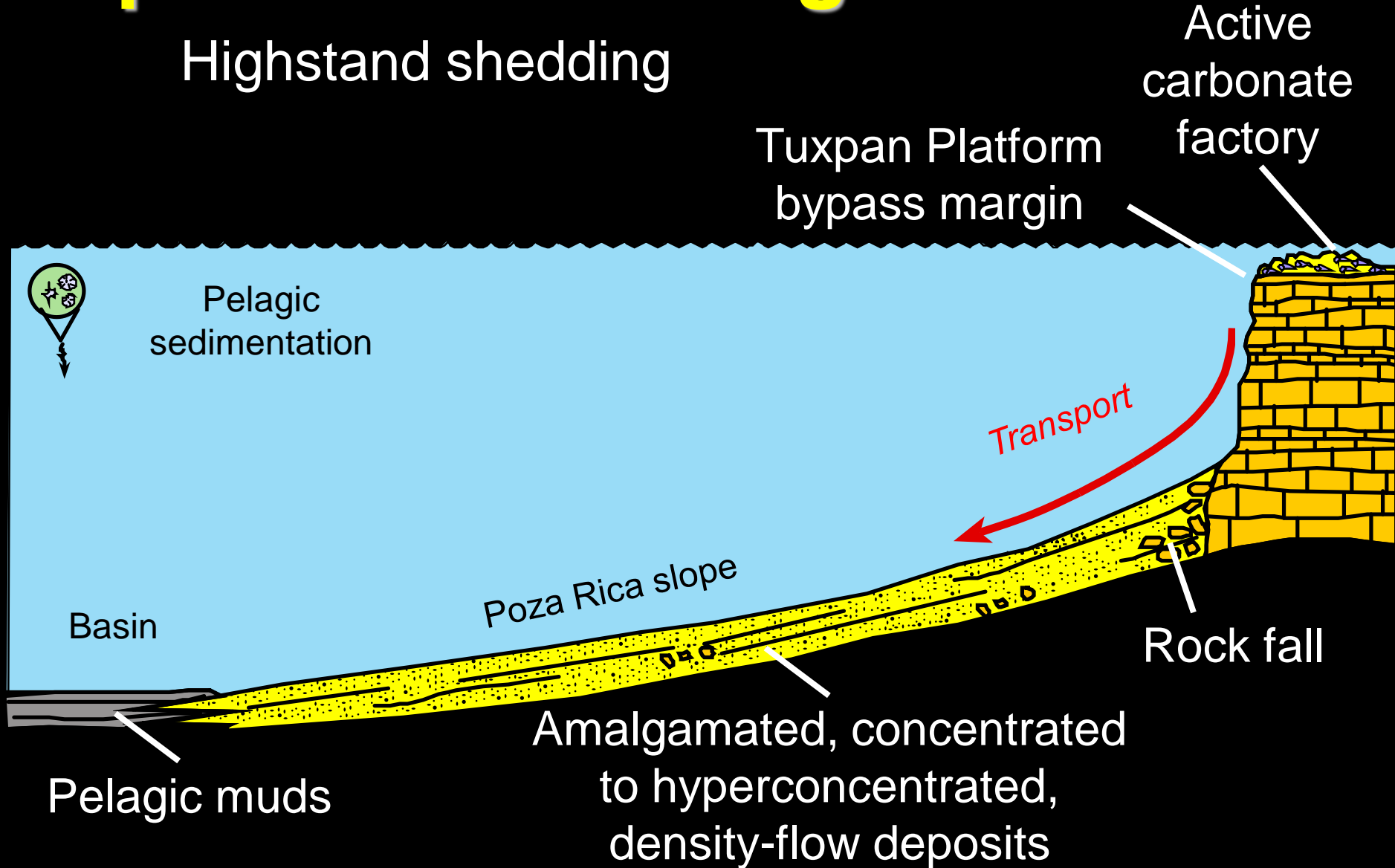
Poza Rica slope

Rock fall

Basin

Amalgamated, concentrated  
to hyperconcentrated,  
density-flow deposits

Pelagic muds

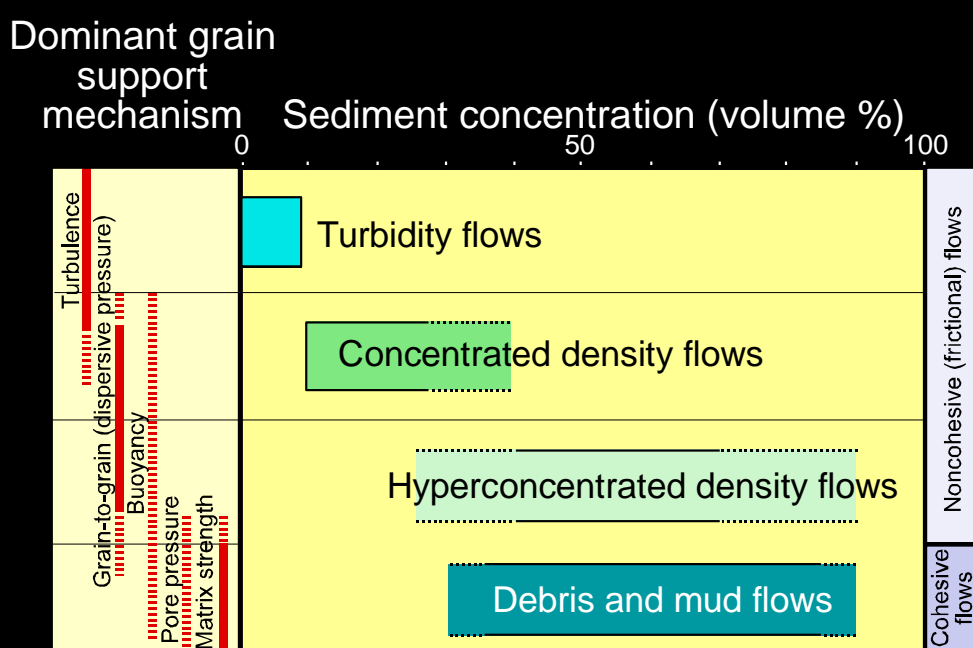


Model based on concept of McIlreath and James (1978)

# Hyperconcentrated Flow

## Homogenous hyperconcentrated flow

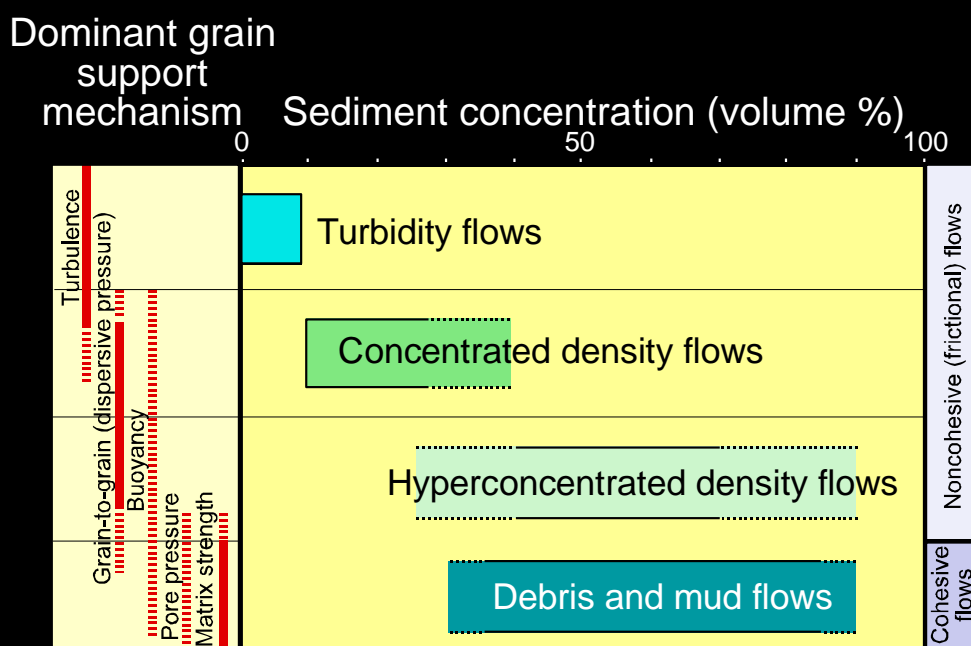
- Noncohesive flow of high sediment concentrations of 25% or more grains; promotes particle interaction
- Lacks sedimentary structures



# Concentrated Flow

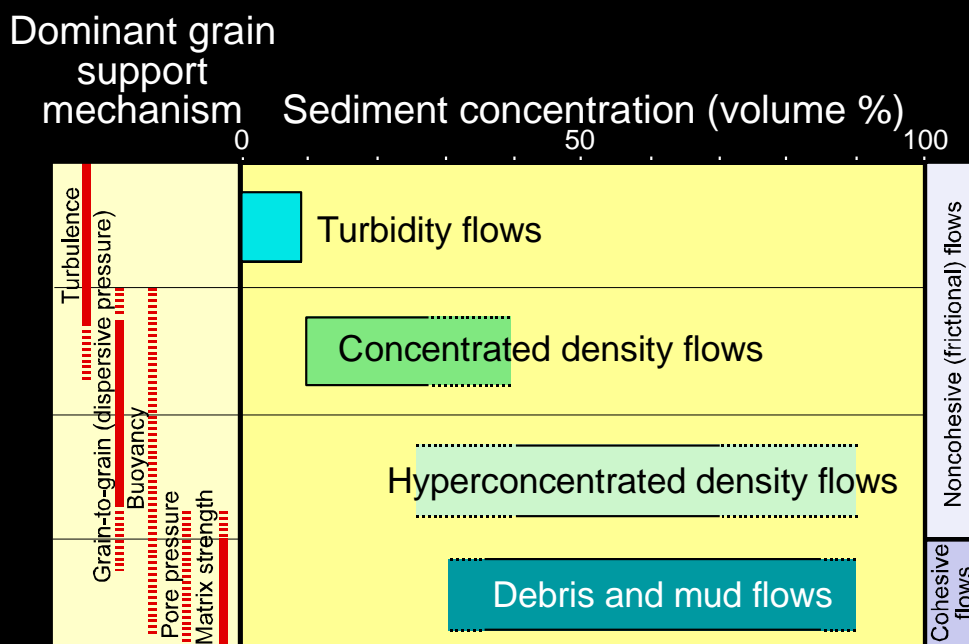
## Upward-fining concentrated flow

- Noncohesive flow with high sediment concentrations between 9 and 25% grains; promotes particle interaction
- Shows vertical sediment sorting



# Concentrated Flows

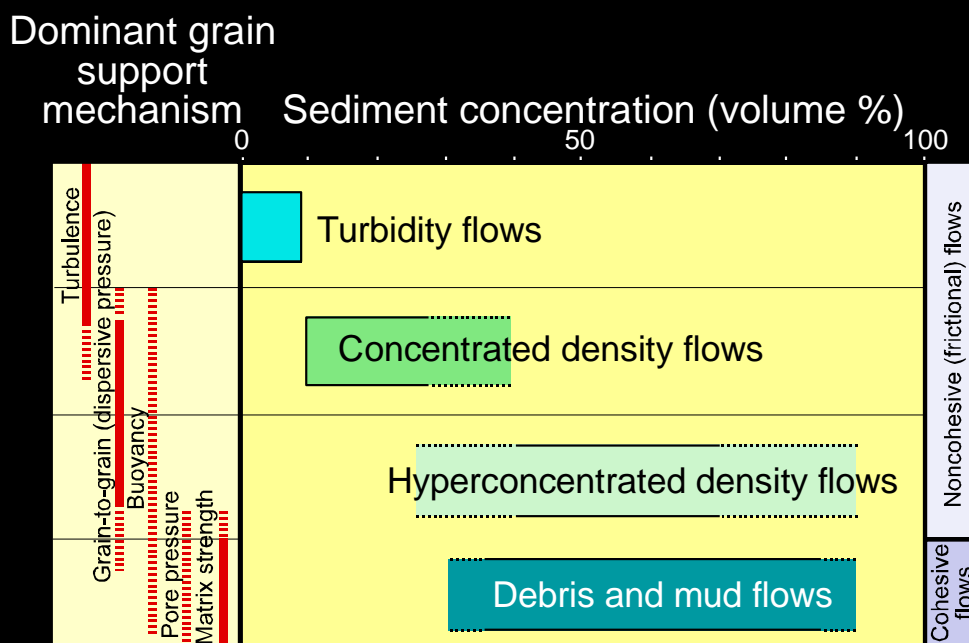
Several upward-fining,  
concentrated flows





# Concentrated Flows

Upward-fining concentrated flow  
with coarse lag at base



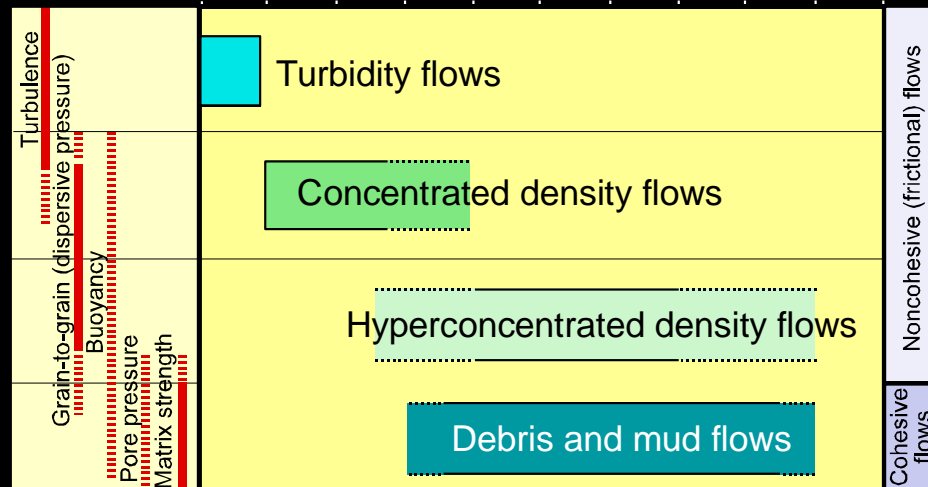


# Concentrated Flow

Basal coarse-grain lag of concentrated flow

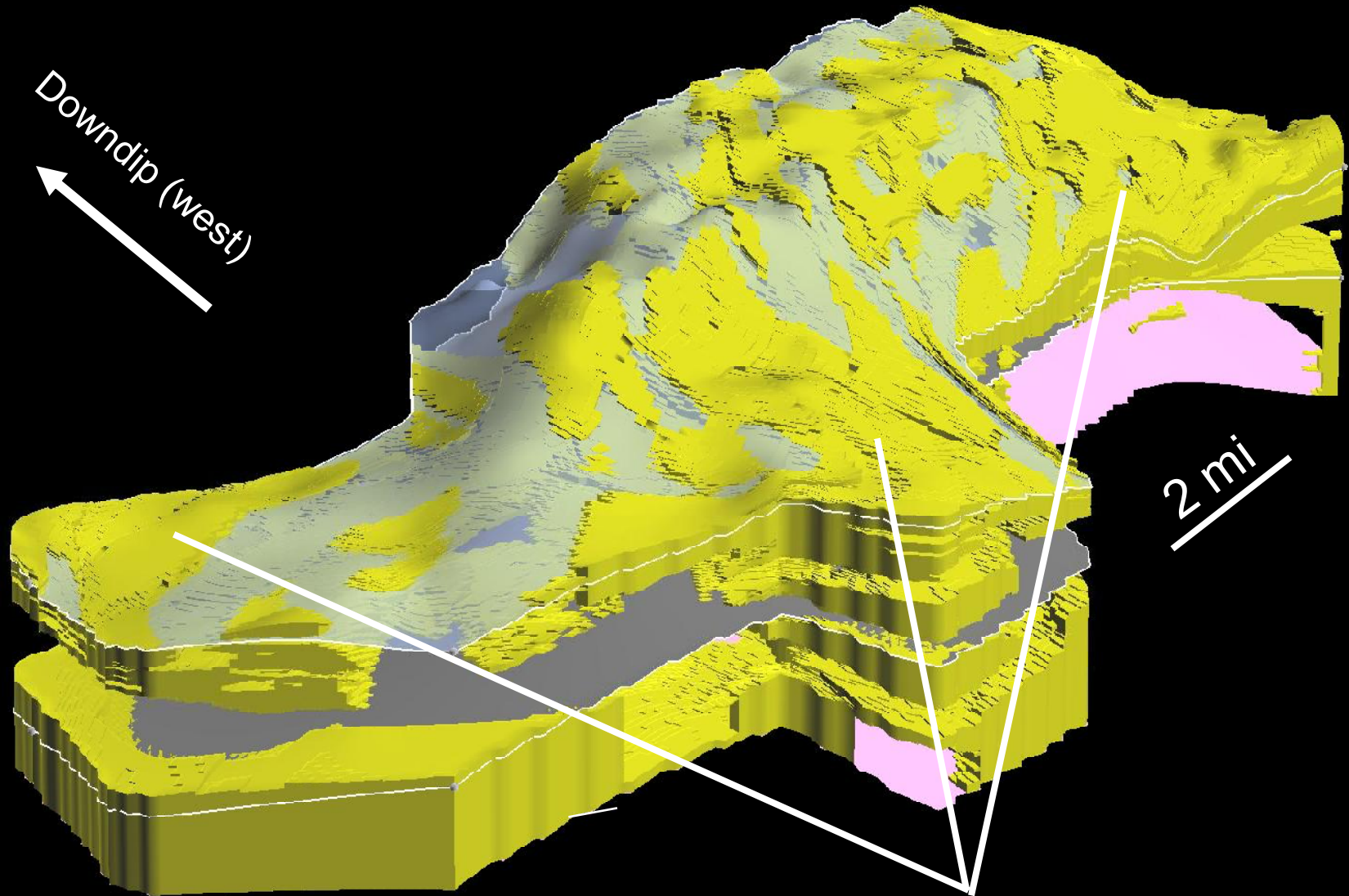
Dominant grain  
support  
mechanism

Sediment concentration (volume %) 0 50 100



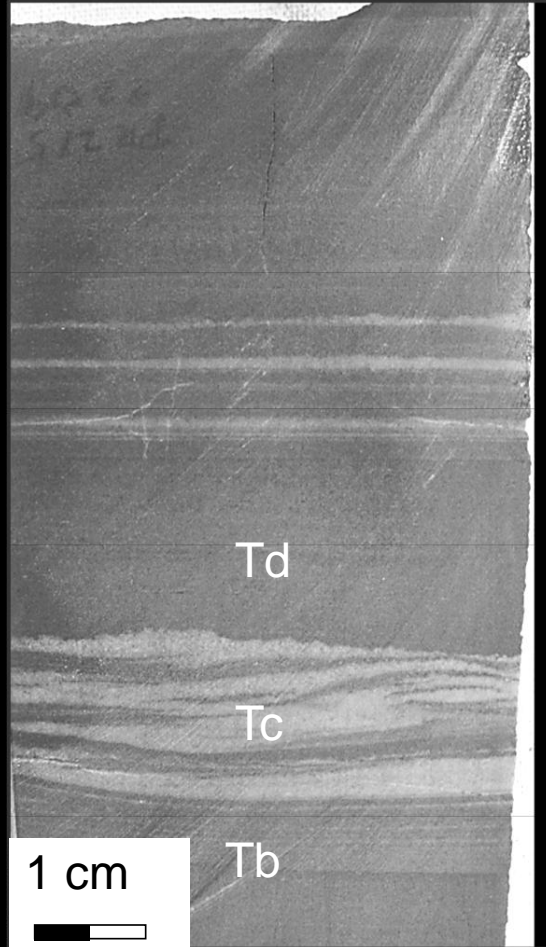
# Concentrated and Hyperconcentrated Flows

Geobodies constructed from wireline logs using GOCAD

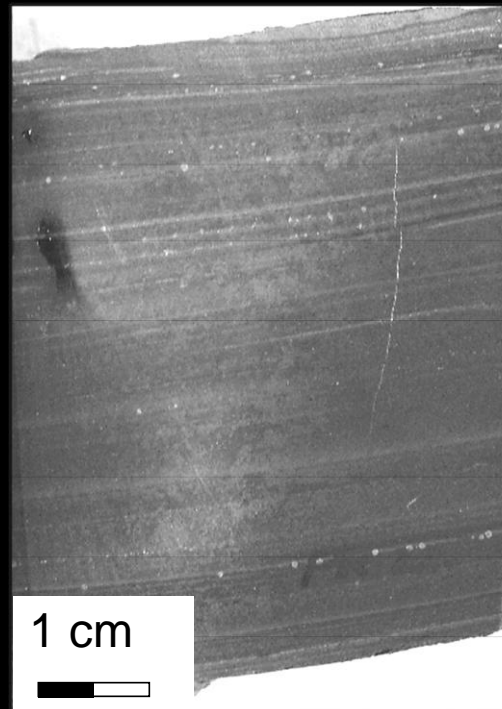


Concentrated and hyperconcentrated-flow deposits

# Turbidites



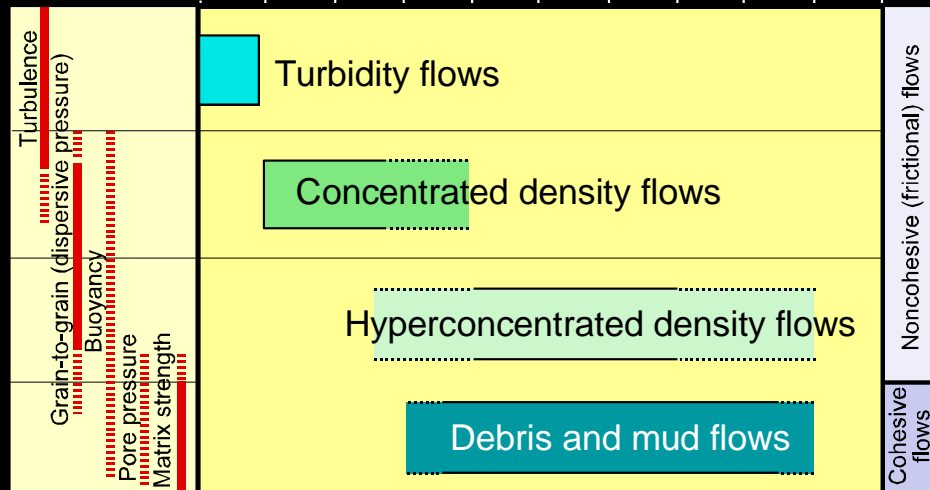
Dilute turbidites



- Noncohesive flow with sediment concentrations of 9% or less; turbulence main support mechanism
- Shows classic Bouma sequences

Dominant grain support mechanism

Sediment concentration (volume %) 0 50 100



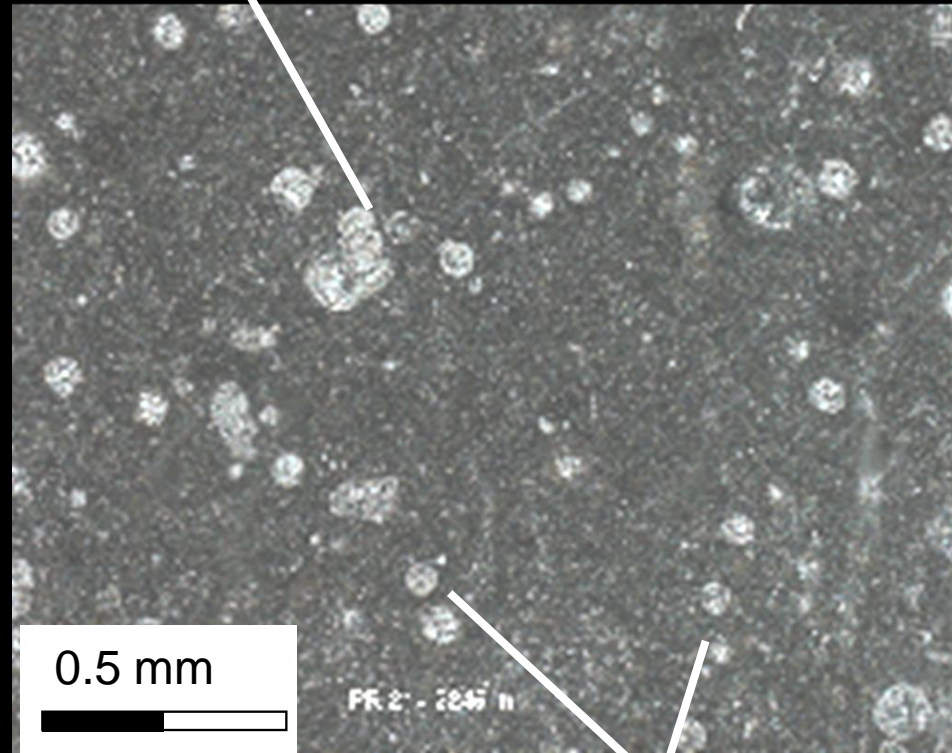


# Lime-Mud Suspension Deposits



Globigerinid-  
foraminifera

Thin section



Calcspheres

# Conclusions

- Tamabra carbonates of Poza Rica field were deposited in a deepwater debris apron
- Depositional processes were dominated by density flows and suspension sedimentation
- Breccias were deposited by debris flows
- Grainstones and grain-dominated packstones were deposited by concentrated and hyperconcentrated flows
- Deepwater deposits show an orderly response to relative sea-level changes