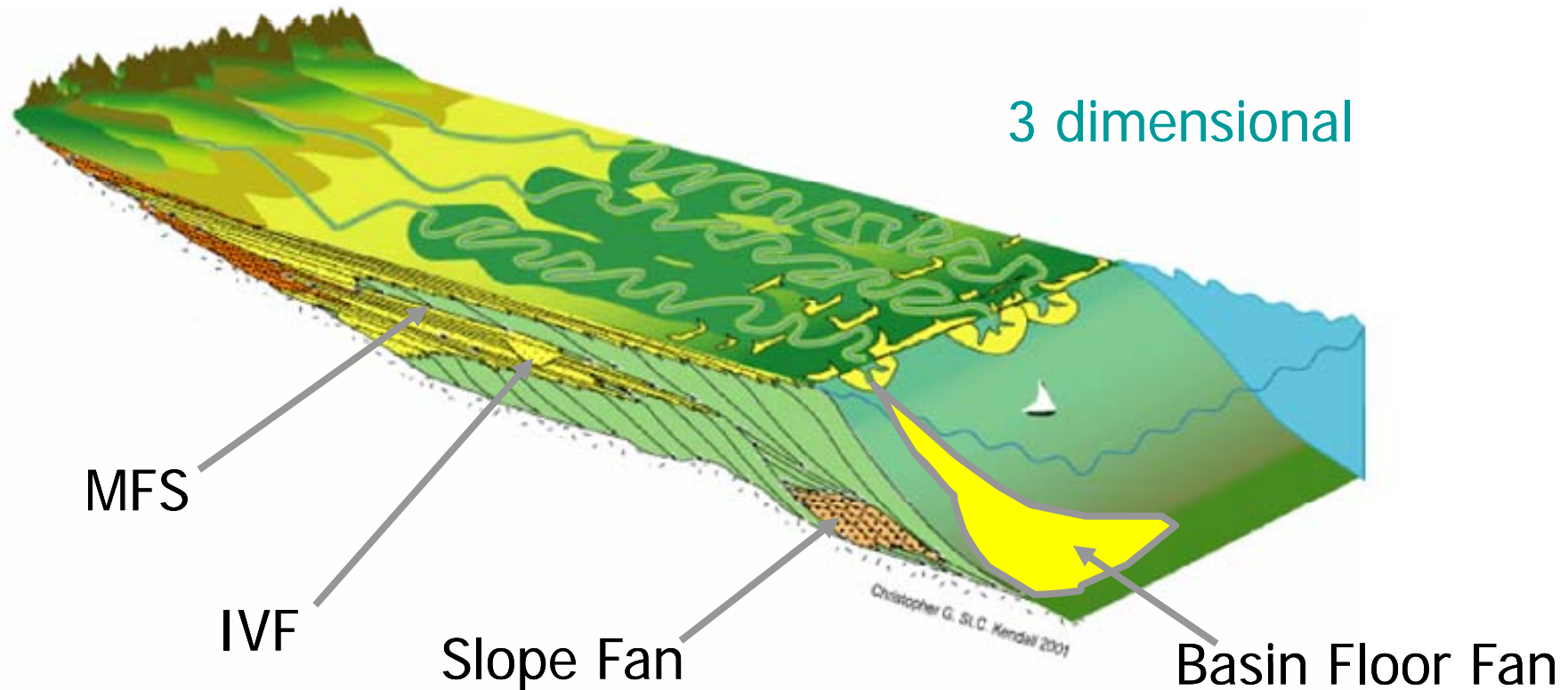


SEQUENCE STRATIGRAPHIC ANALYSIS

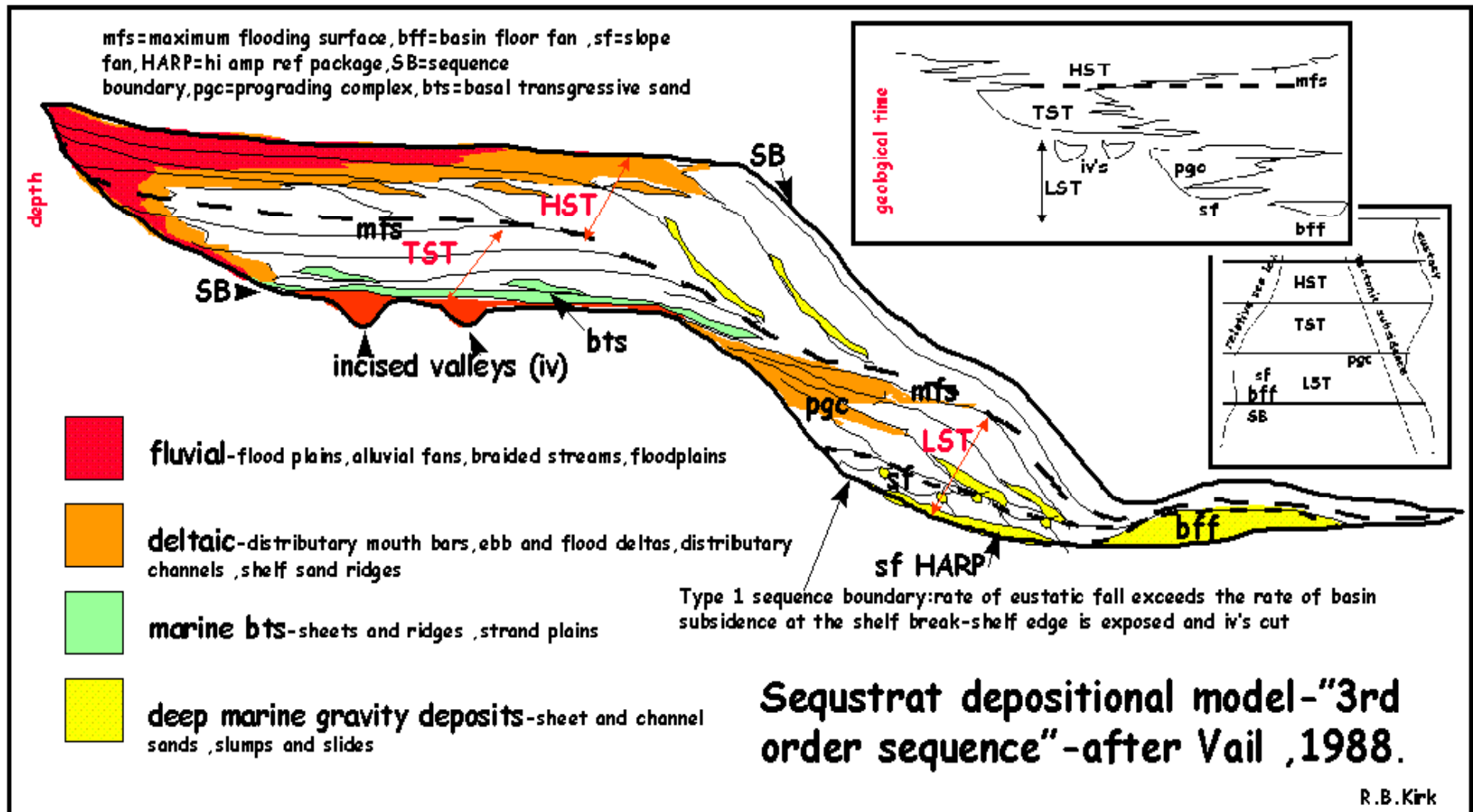
Robert Wong Hin Fatt, 2010
CCOP Workshop

A Simpler, More Useful Definition of Sequence Stratigraphy

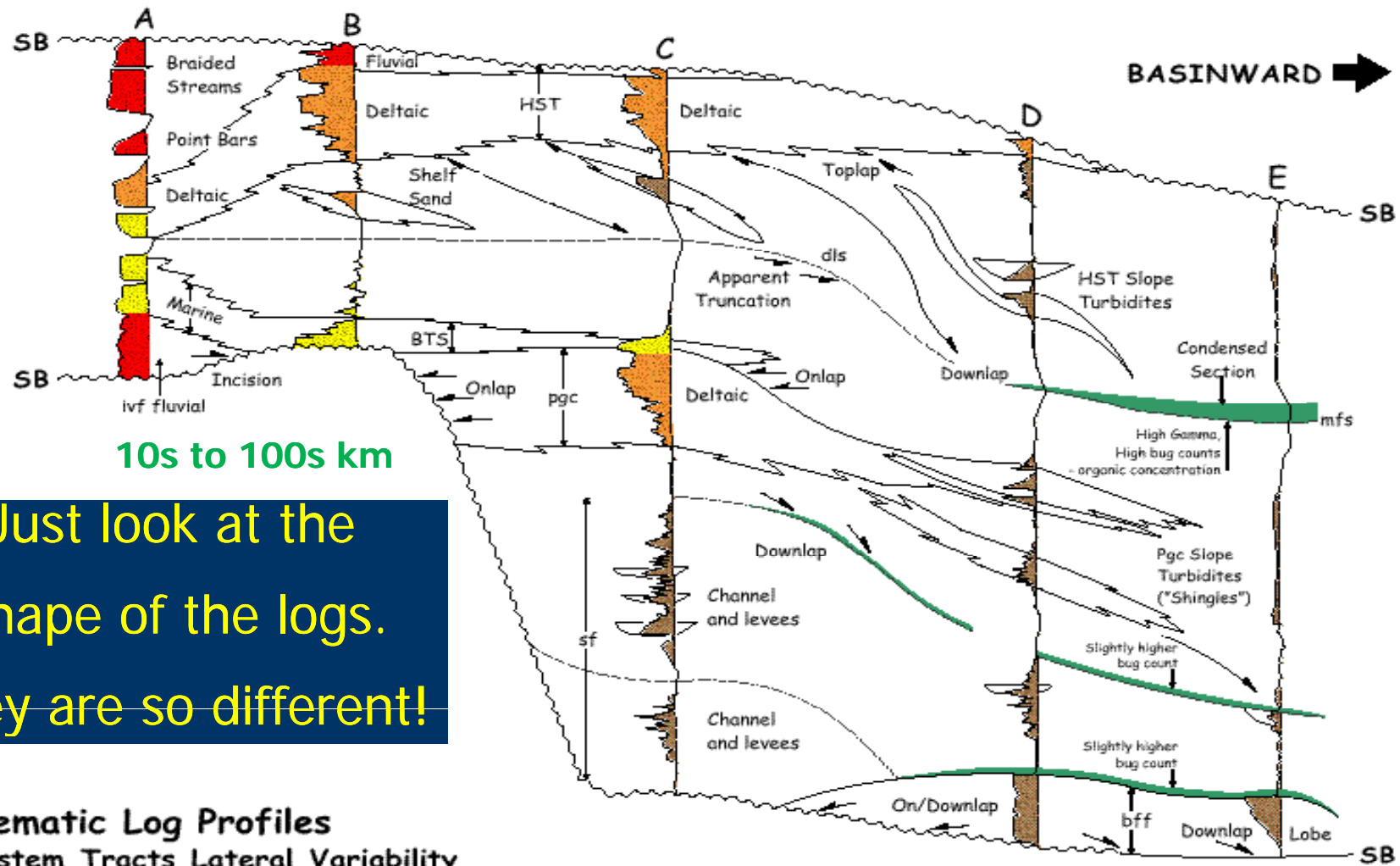
A method to impose the dimension of time on the relationships of rock units in space (area and depth)



Third order sequence described as Slug Model - 2 dimensional



Slug Model illustrated by logs



10s to 100s km

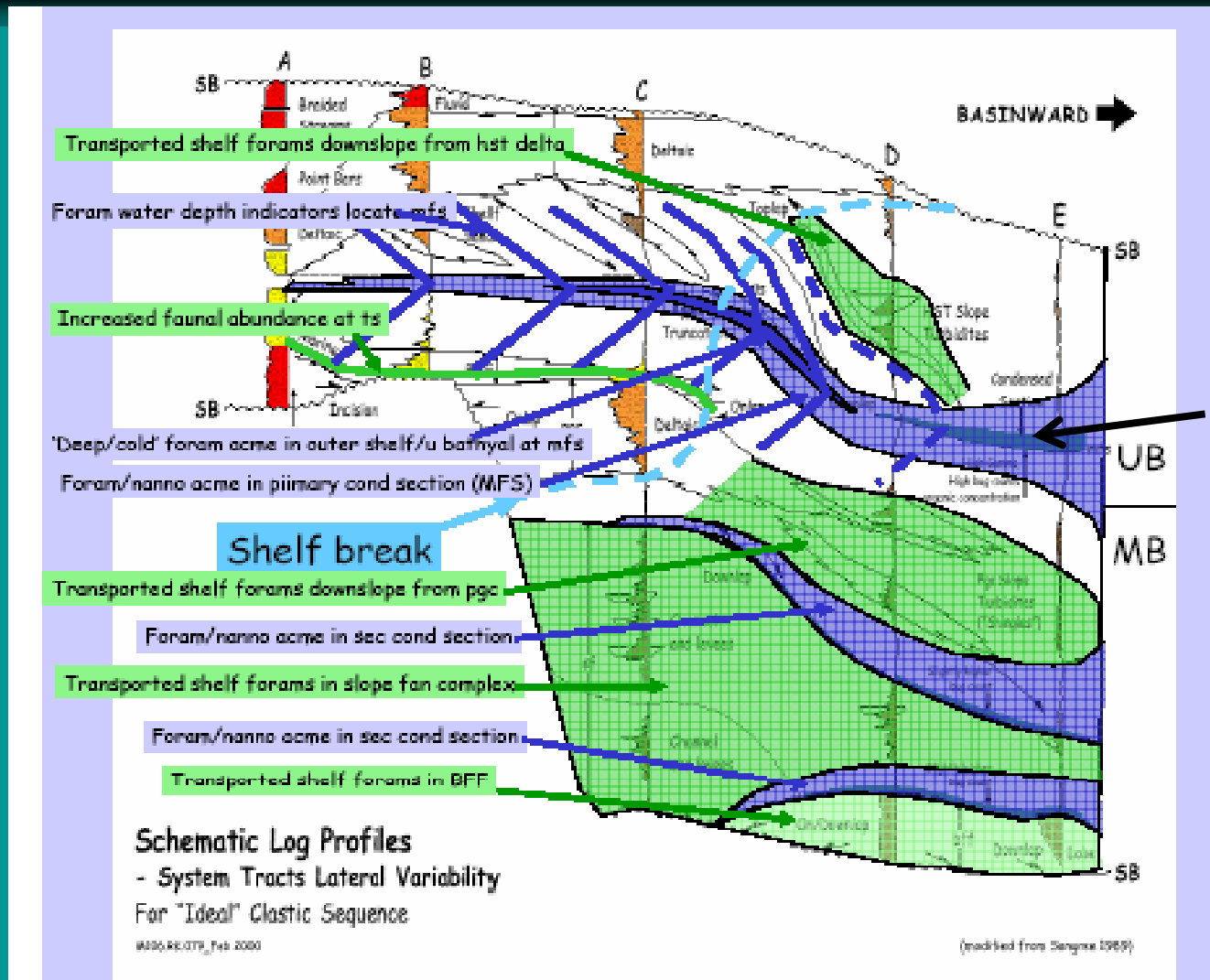
Just look at the
Shape of the logs.
They are so different!

Schematic Log Profiles
- System Tracts Lateral Variability
For "Ideal" Clastic Sequence

M106.RK.079_Feb 2000

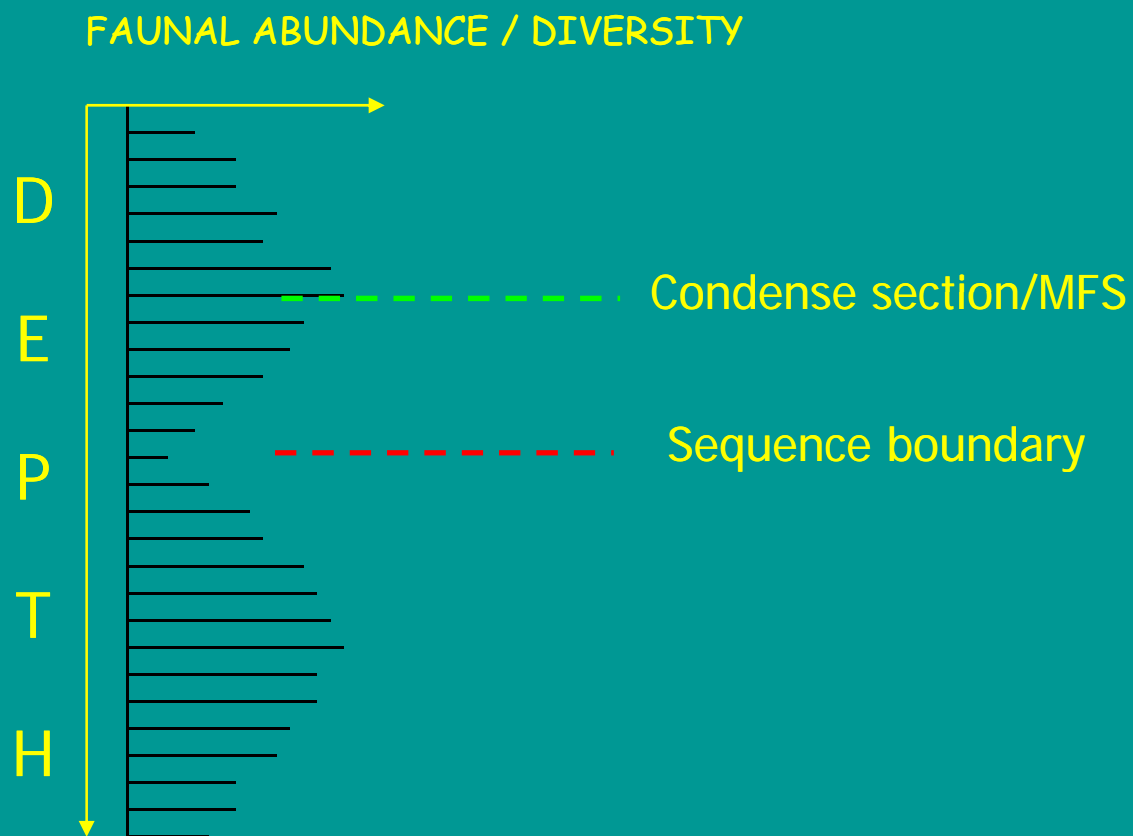
(modified from Sangree 1989)

Sequence biostratigraphy in a third-order sequence



Fossil abundance
And diversity
At condense
section

Use of biofacies in Sequence stratigraphy

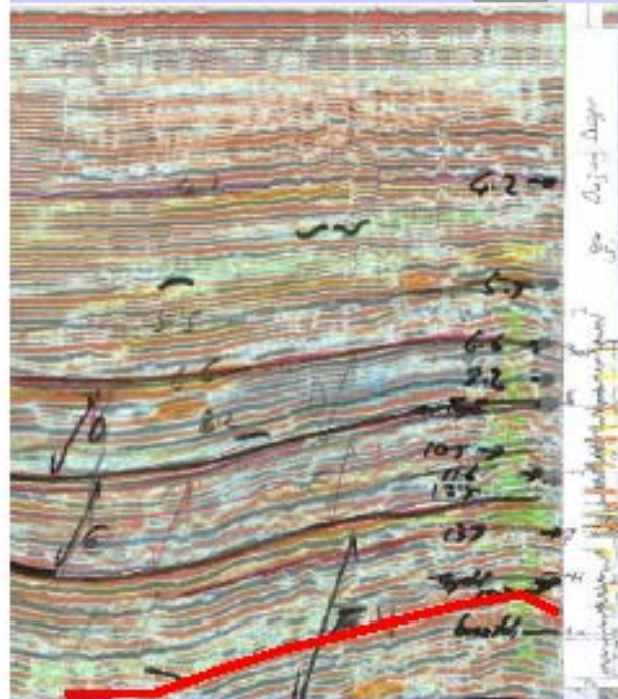


Correlation of Biostrat. , Well and Seismic Data

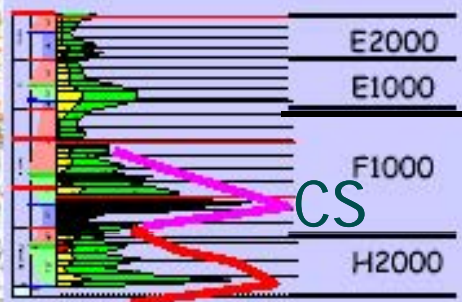
GROUP H



Group H proposed on basis of mangrove pollen acmes - makes sense in terms of seismic



Bujang Deep-1



Top F

SB

← Top H

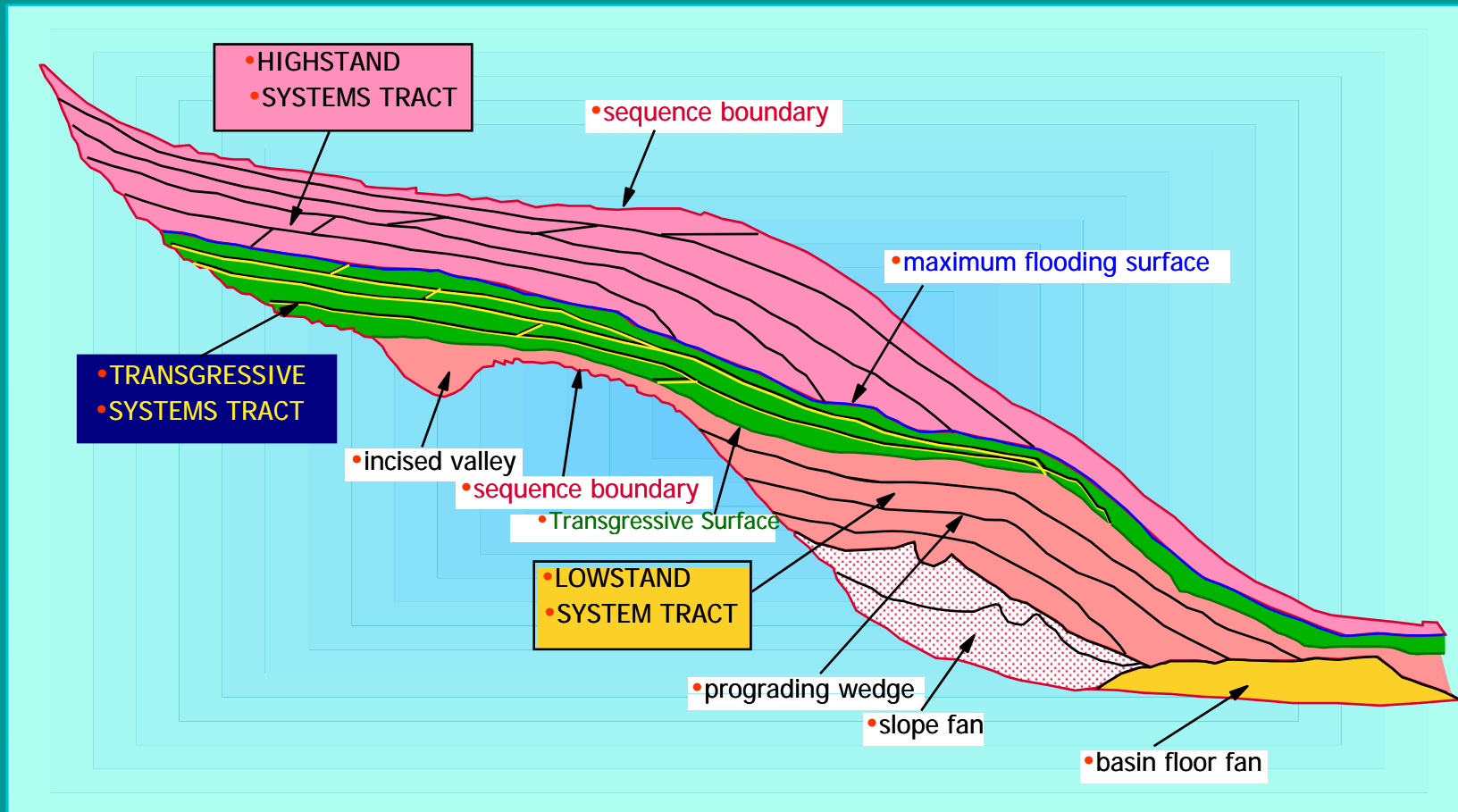
SB

Part 1

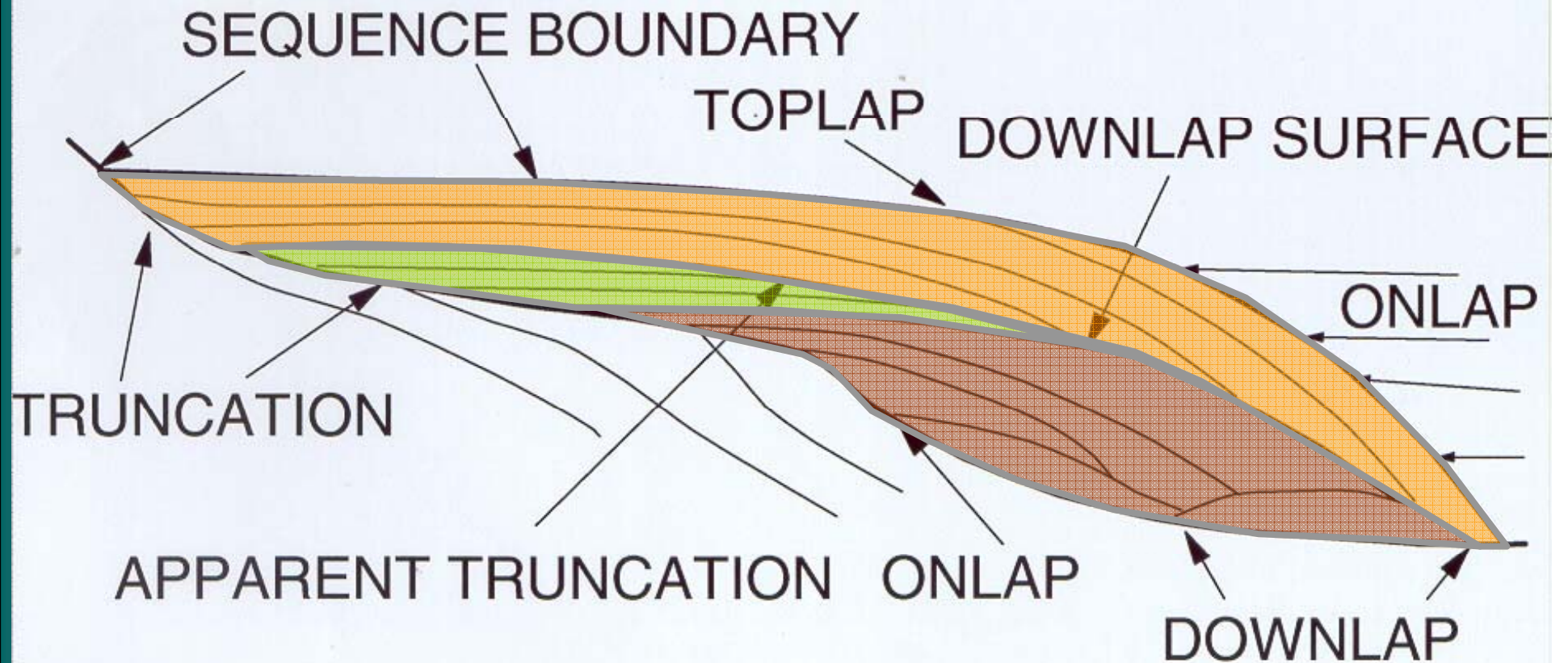
Seismic Facies Interpretation Within Sequence Stratigraphic Framework

Robert Wong Hin Fatt, 2010

A third-order sequence model showing systems tracts



Seismic facies relating to systems tracts



Remember! You must know where you are within the sequence stratigraphic framework.



SEISMIC FACIES ANALYSIS

Seismic facies definition

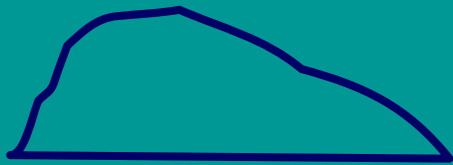
- Seismic reflections terminations
- Seismic reflections characteristics
- Seismic facies configurations

SEISMIC FACIES ANALYSIS

Definition: The description and geological interpretation of an association of seismic reflection parameters including:

- Amplitude
- Continuity
- Frequency
- Phase
- Geometric Configurations

English is compulsory



Rounded

Bounded

Mounded

Grounded

Hounded

Pounded

English is compulsory



Rounded

Bounded

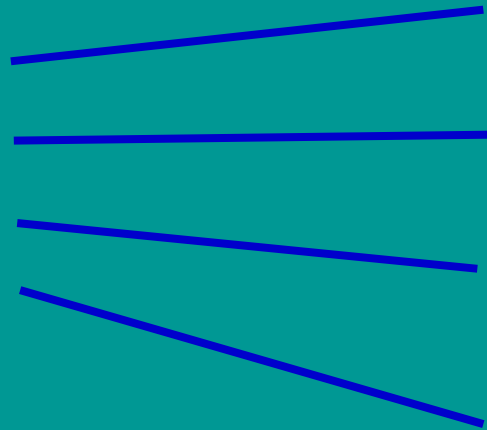
Mounded

Grounded

Hounded

Pounded

English is compulsory



Consistent

Divergent

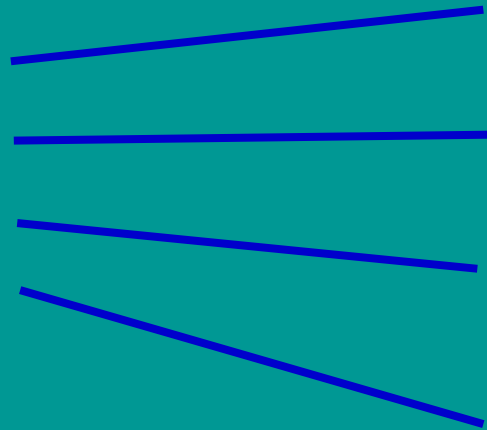
Convergent

Concurrent

Concordant

Redundent

English is compulsory



Consistent

Divergent

Convergent

Concurrent

Concordant

Redundant

English is compulsory



Sentimental

Cylindrical

Symbolical

Sigmoidal

Symmetrical

Sinister

English is compulsory



Sentimental

Cylindrical

Symbolical

Sigmoidal

Symmetrical

Sinister

English is compulsory



Oblong

Prolong

Along

Oblique

Obscure

Obese

Obvious

English is compulsory



Oblong

Prolong

Along

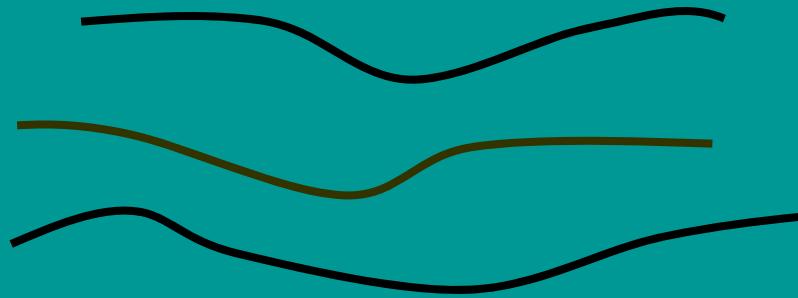
Oblique

Obscure

Obese

Obvious

English is compulsory



Curvy

Hummocky

Wavy

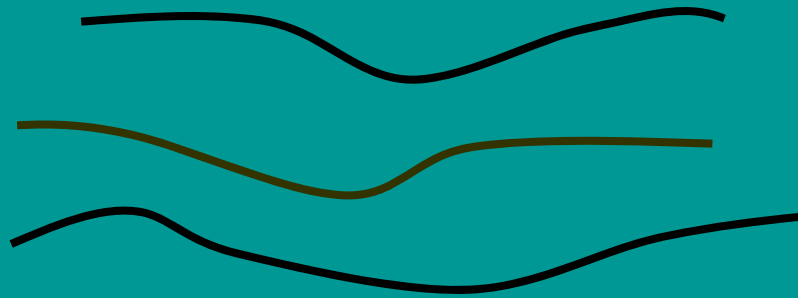
Shaky

Funny

Tiny

wormy

English is compulsory



Curvy

Hummocky

Wavy

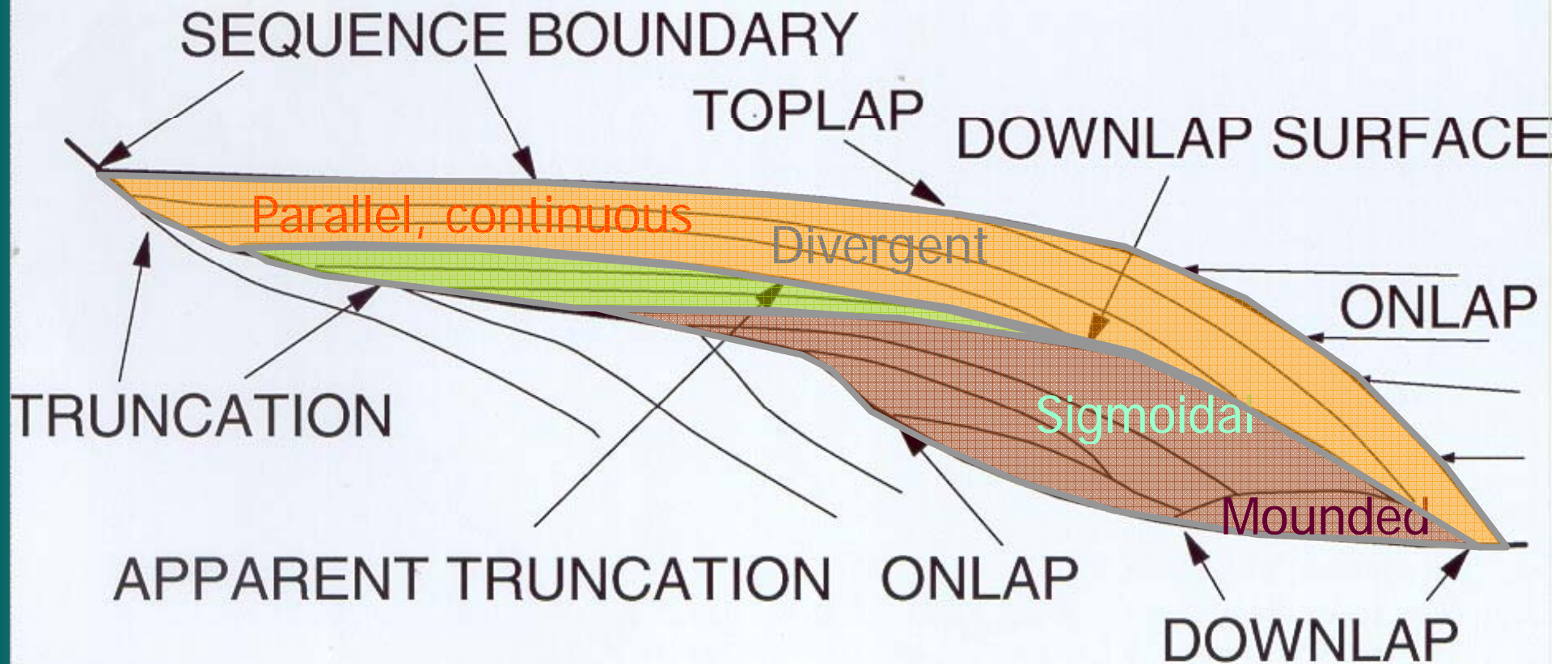
Shaky

Funny

Tiny

wormy

Seismic facies relating to systems tracts



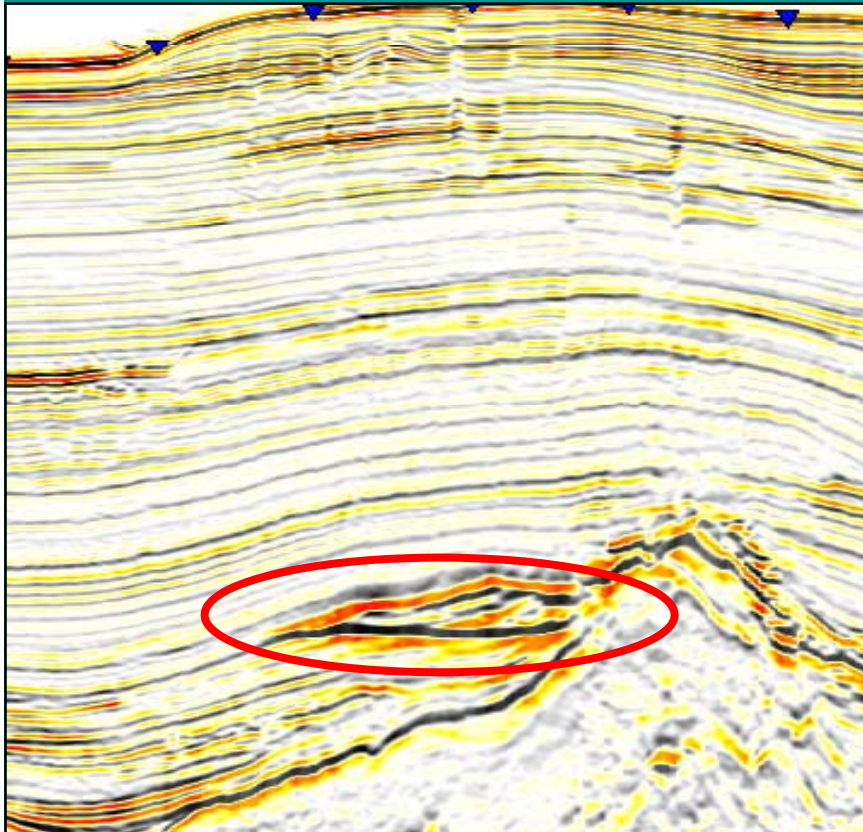
SEISMIC FACIES ANALYSIS

SEISMIC REFLECTION CHARACTERISTICS

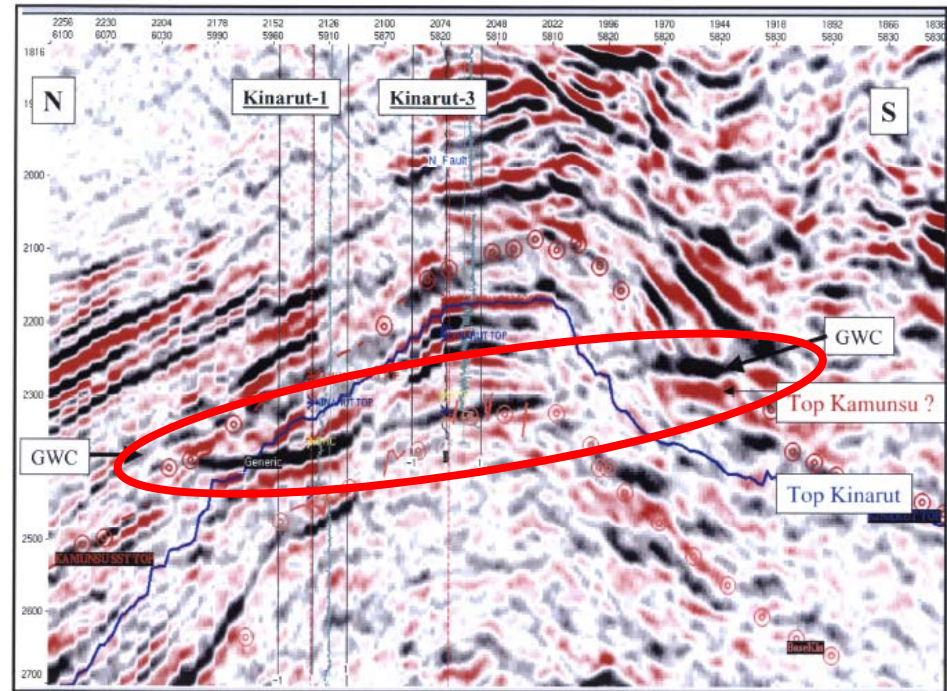
<i>Feature</i>	<i>Geologic Interpretation</i>
Amplitude	Vertical stratal discontinuity, bed spacing, fluid content
Continuity	Lateral stratal continuity, Depositional processes, geologic time line
Frequency	Bed thickness, fluid content
Phase Change	Fluid content, facies change
Geometry	Depositional environment
Flat Spot, Tilted Surface	Fluid Contact (GOC, GWC, OWC)

Obvious flat spot and tilted surface

Flat spot



Tilted surface



Kinarut-3, 1 horizons and markers

Figure 1.2.1.5

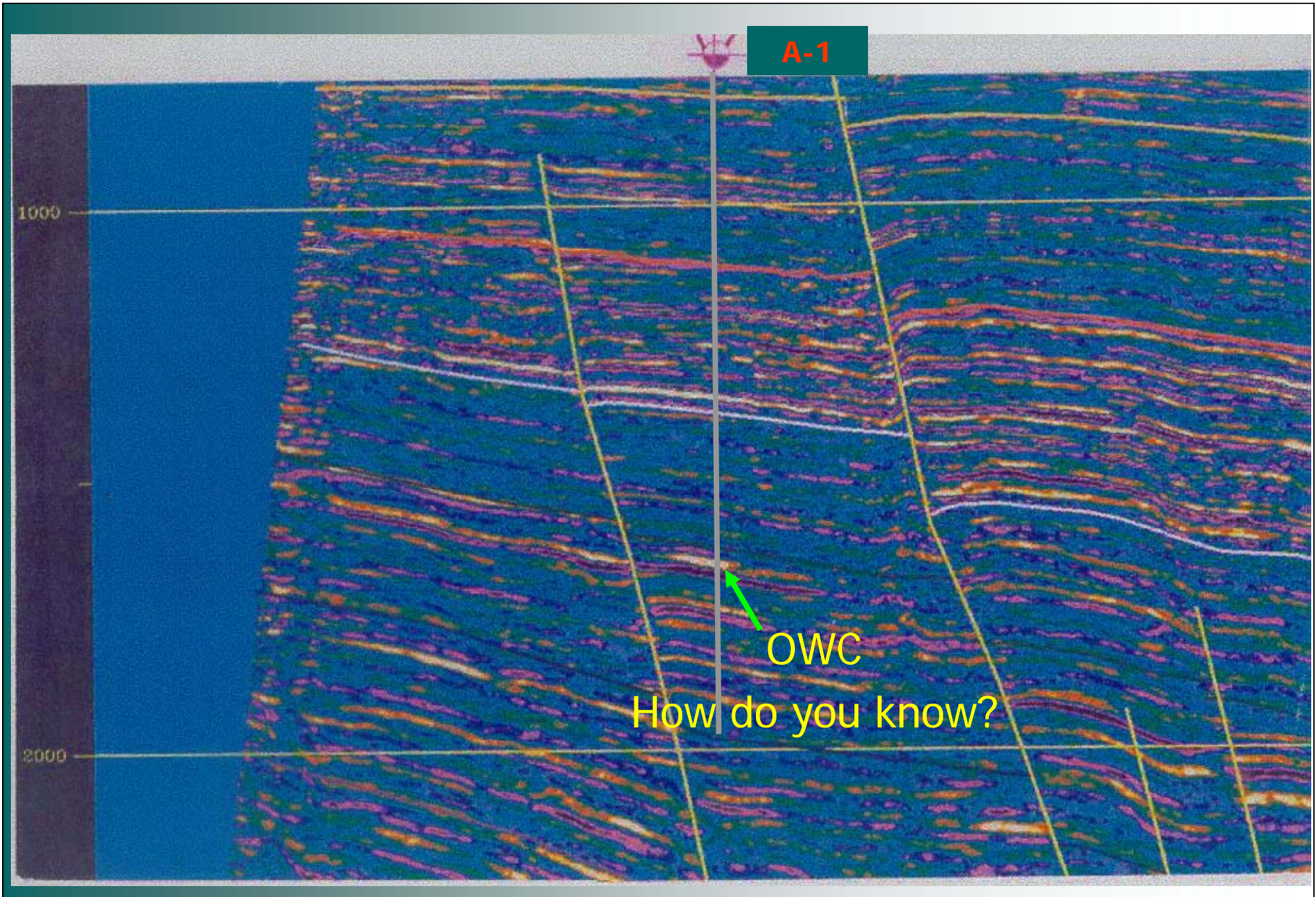
A-1

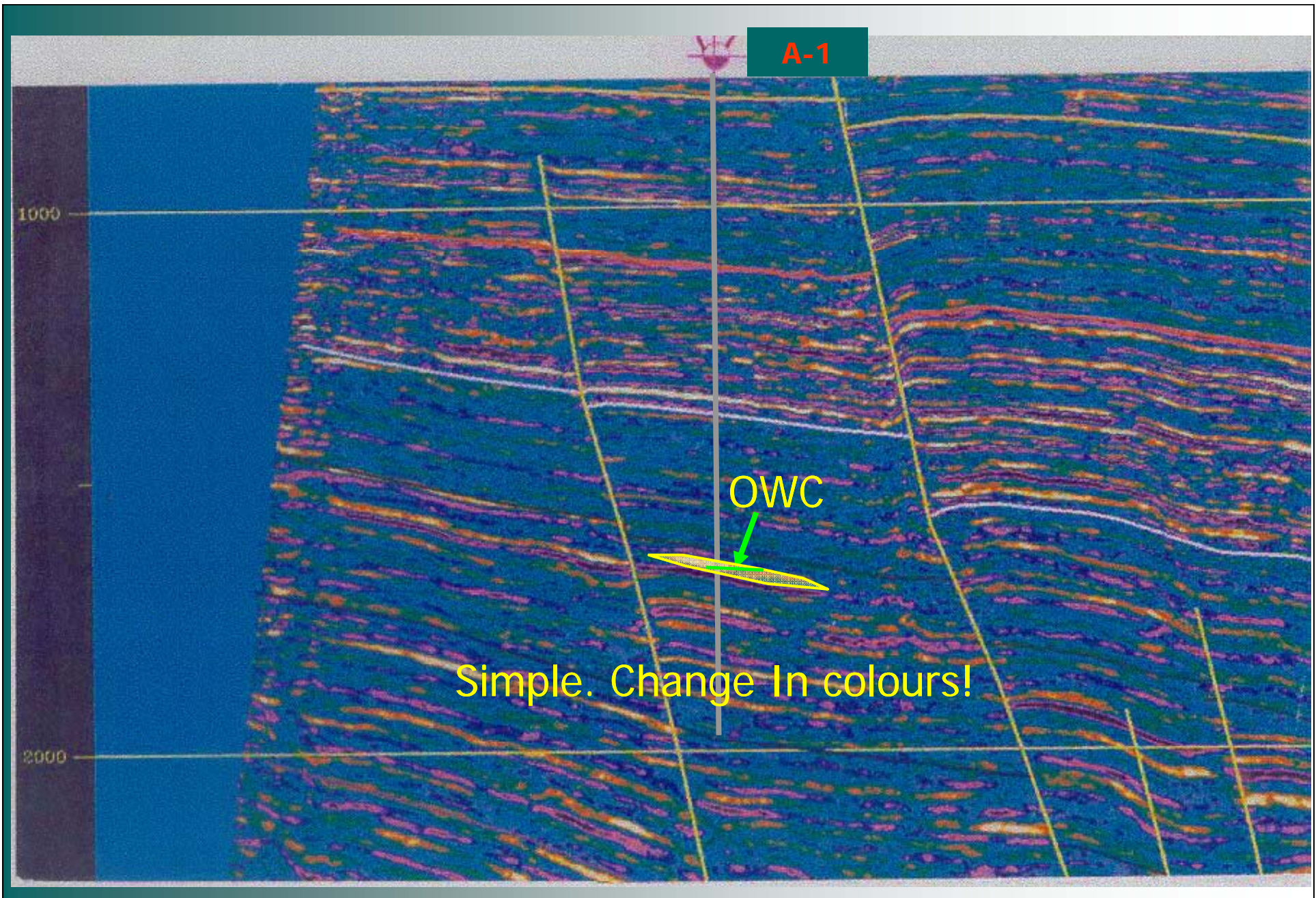
Can you point to the oil bearing channel sand which was encountered by the well?

100

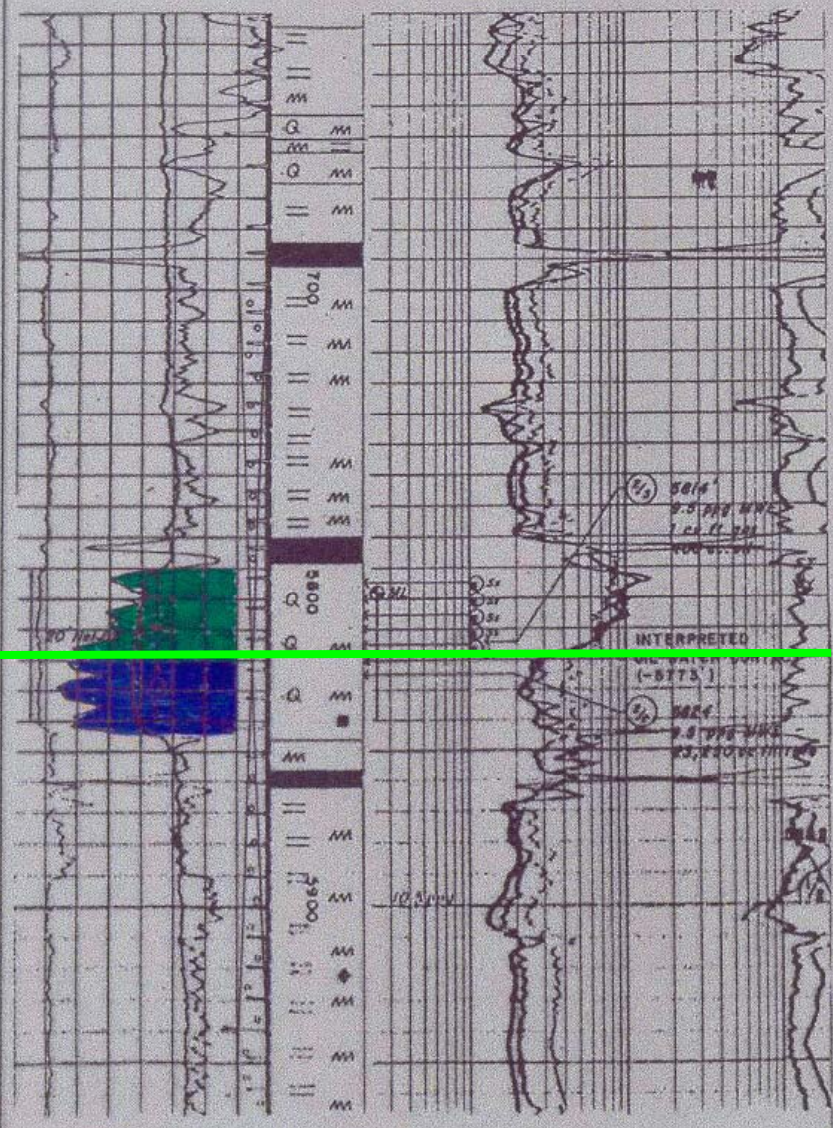
2000







WIRELINE LOG OF A-1 THROUGH THE H CHANNEL SAND

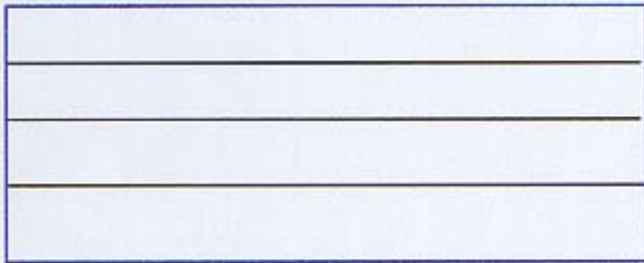


**OWC seen
on seismic**

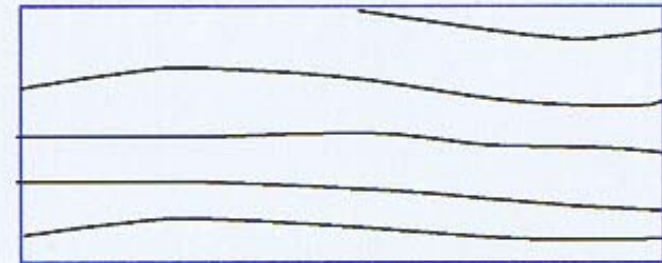
SEISMIC FACIES ANALYSIS

INTERNAL CONFIGURATIONS

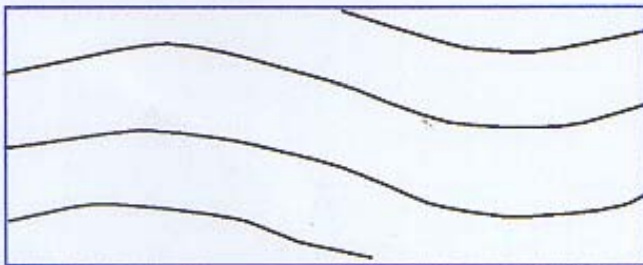
PARALLEL-EVEN



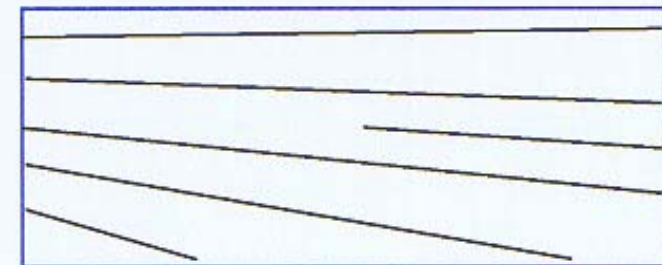
SUBPARALLEL



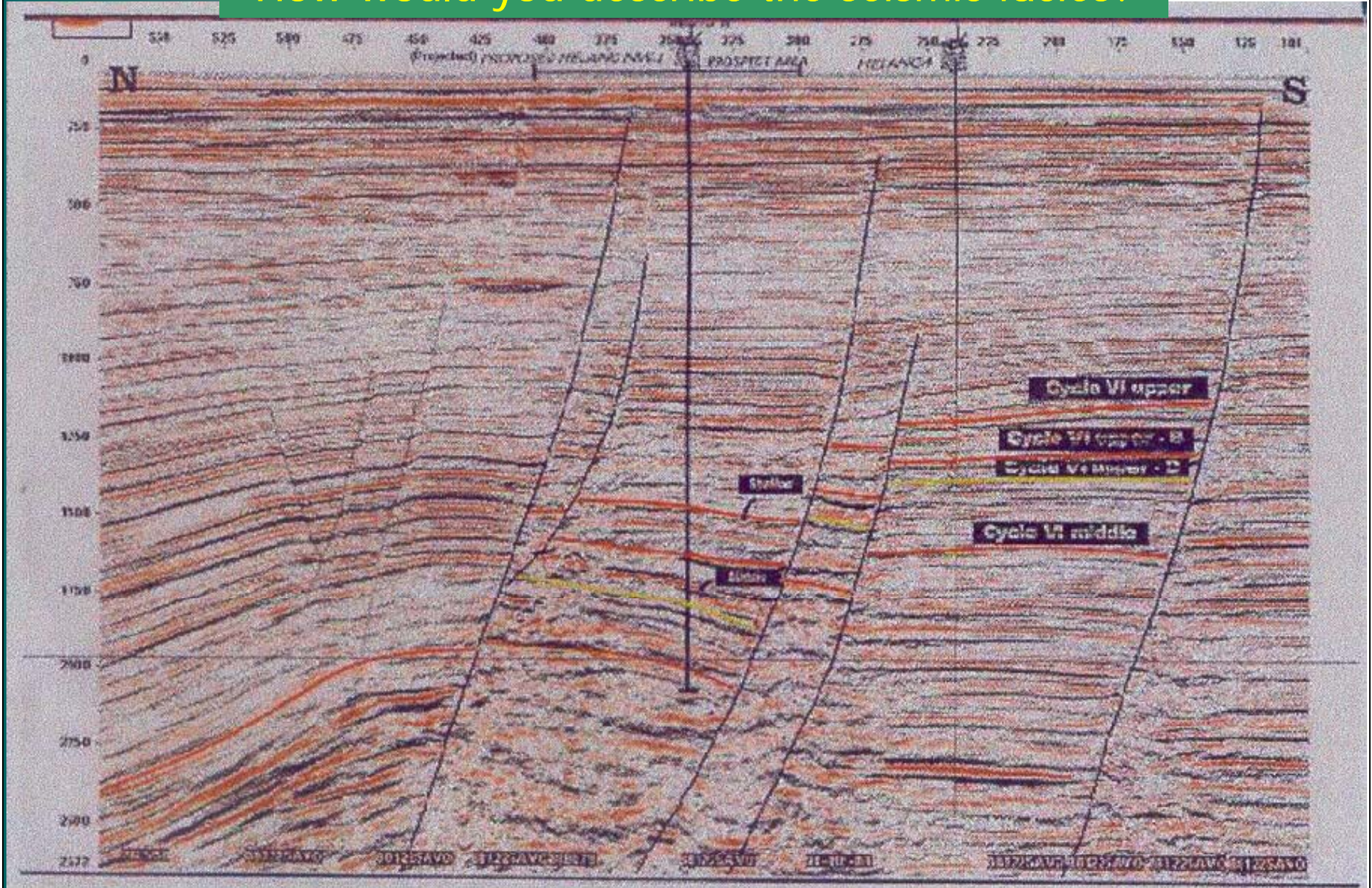
PARALLEL-WAVY



DIVERGENT



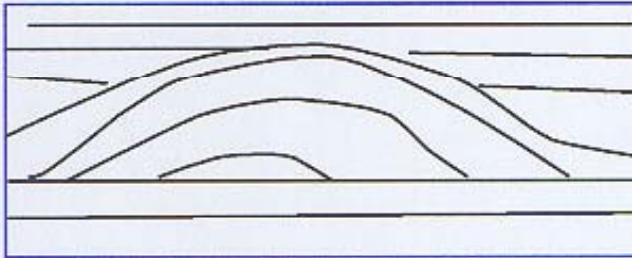
How would you describe the seismic facies?



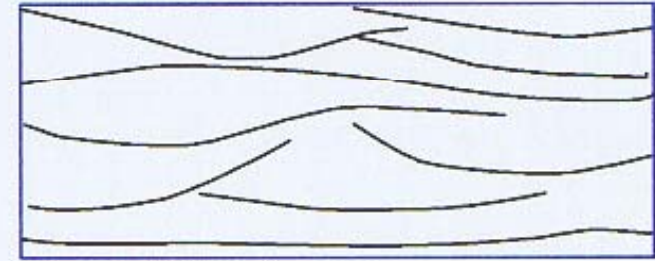
SEISMIC FACIES ANALYSIS

INTERNAL CONFIGURATIONS

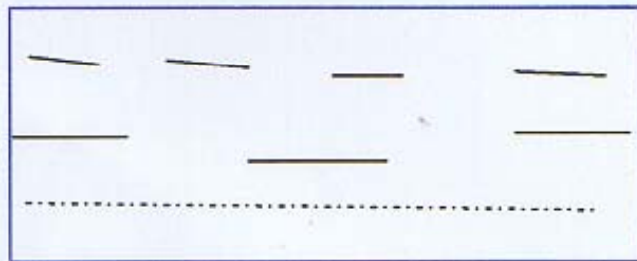
MOUNDED



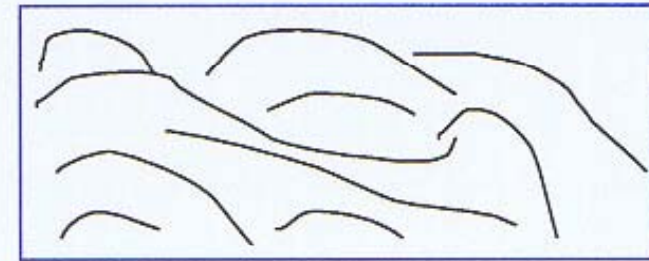
HUMMOCKY



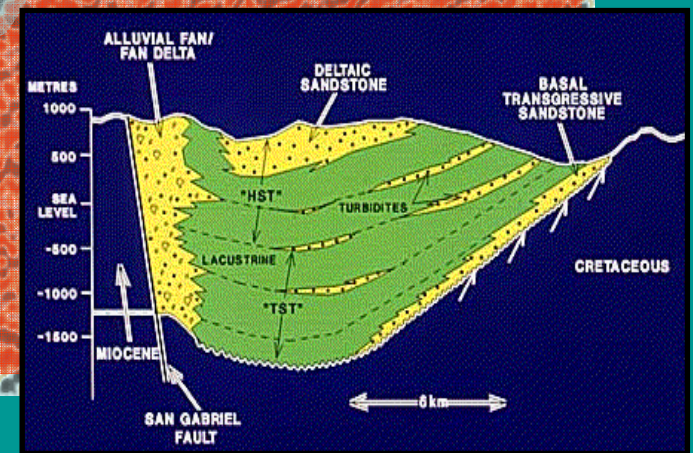
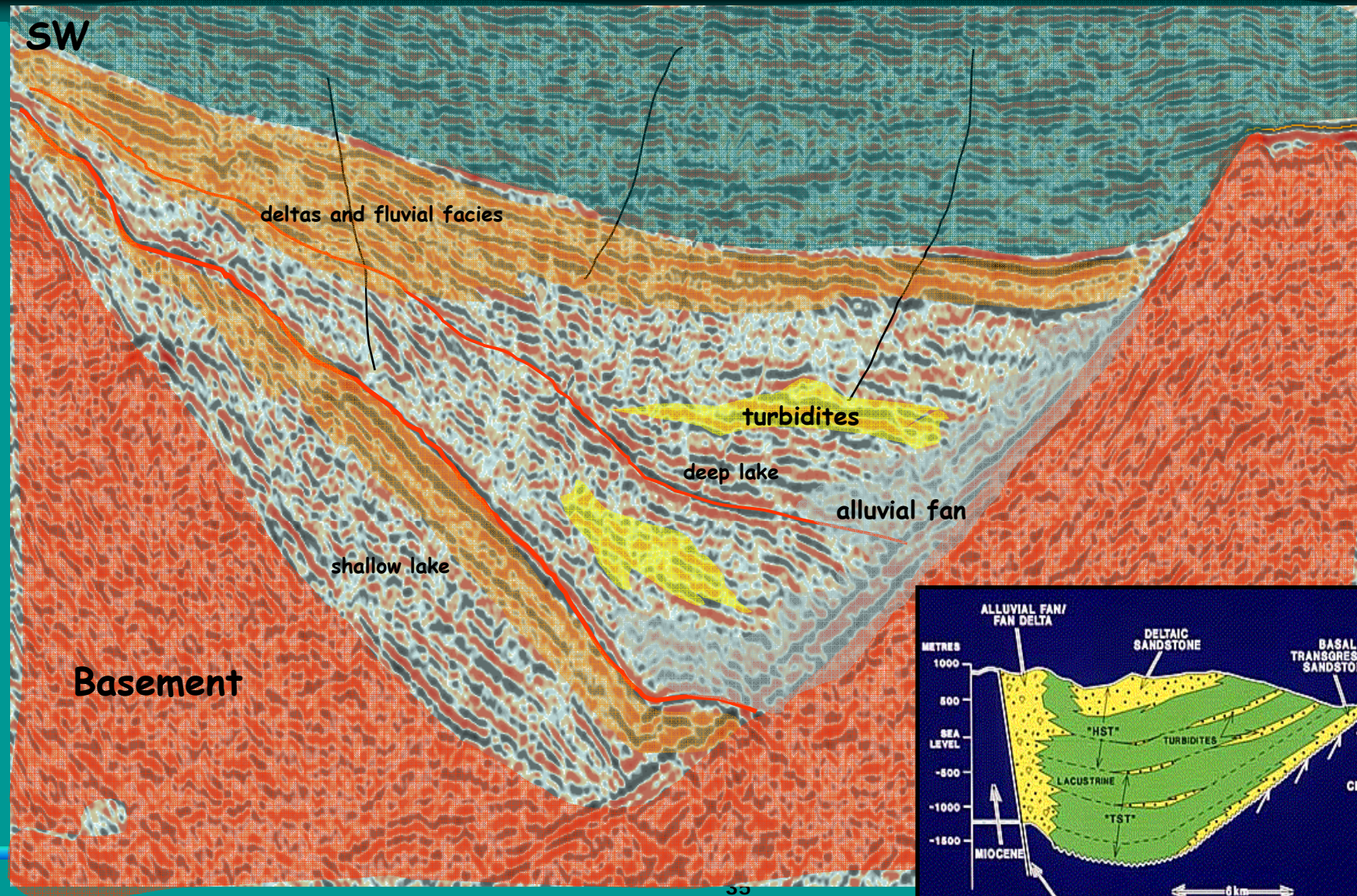
WEAK TO
REFLECTION FREE



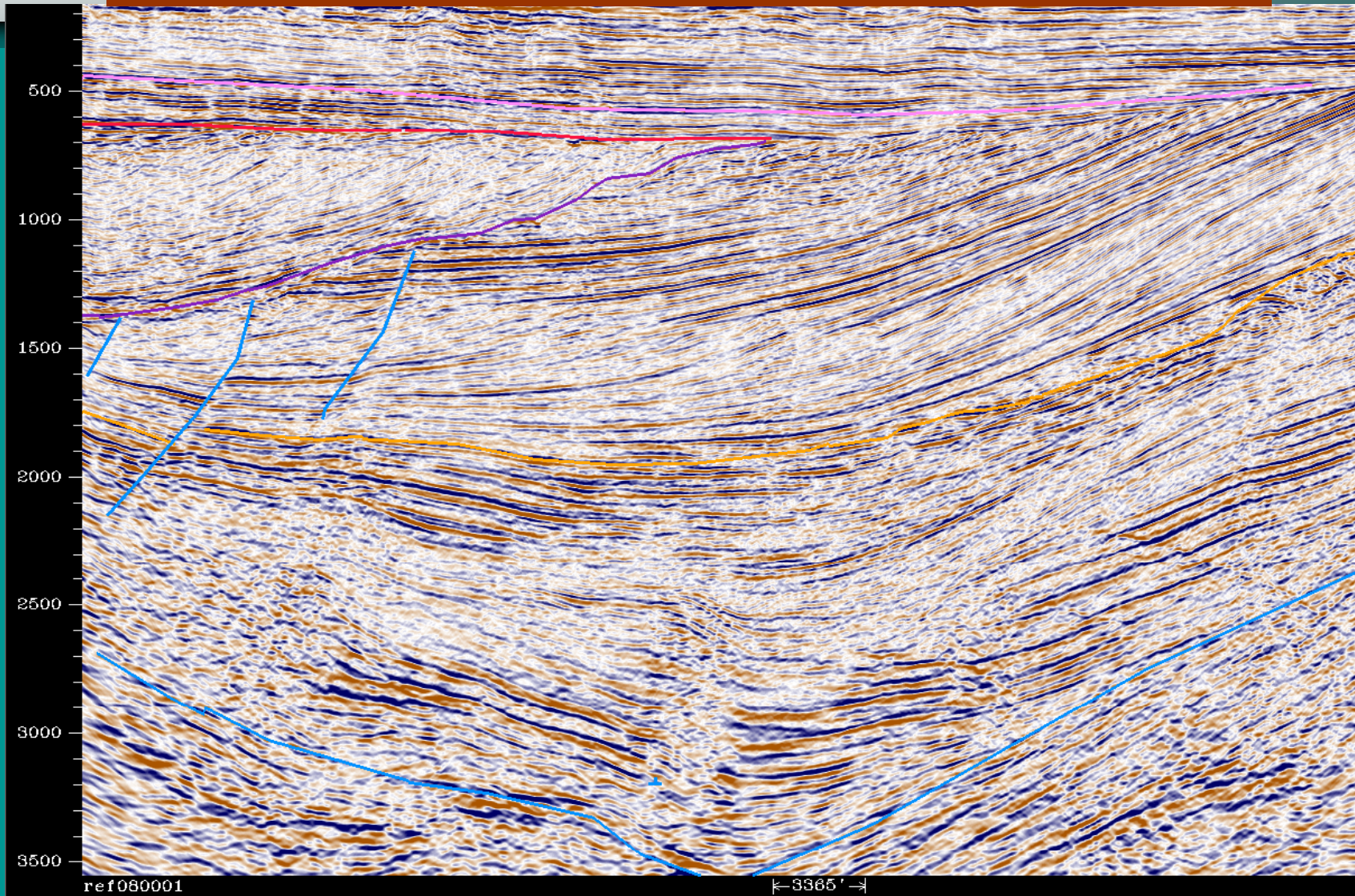
CHAOTIC



Can you describe the seismic facies?



Seismic facies interpretation- Can you continue the interpretation?

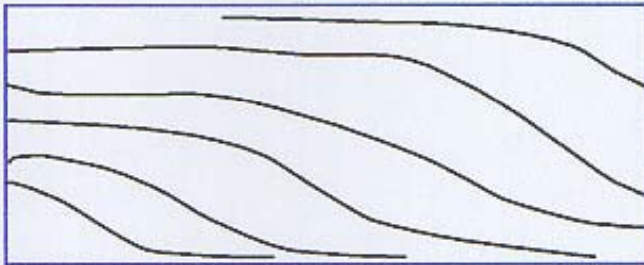


Line 76R504

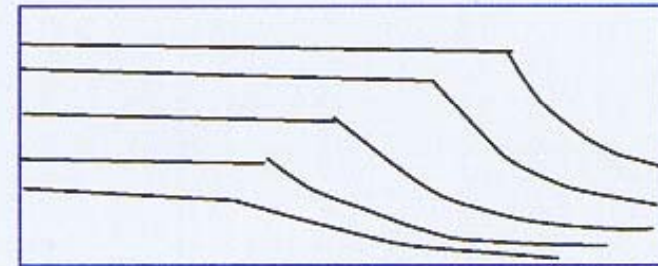
SEISMIC FACIES ANALYSIS

PROGRADING CLINOFORMS

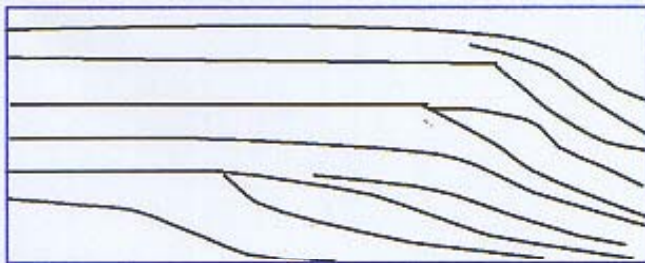
SIGMOID



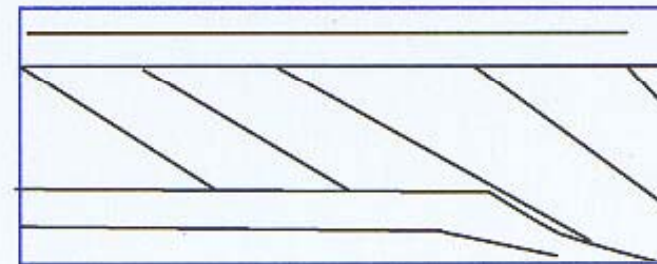
OBLIQUE



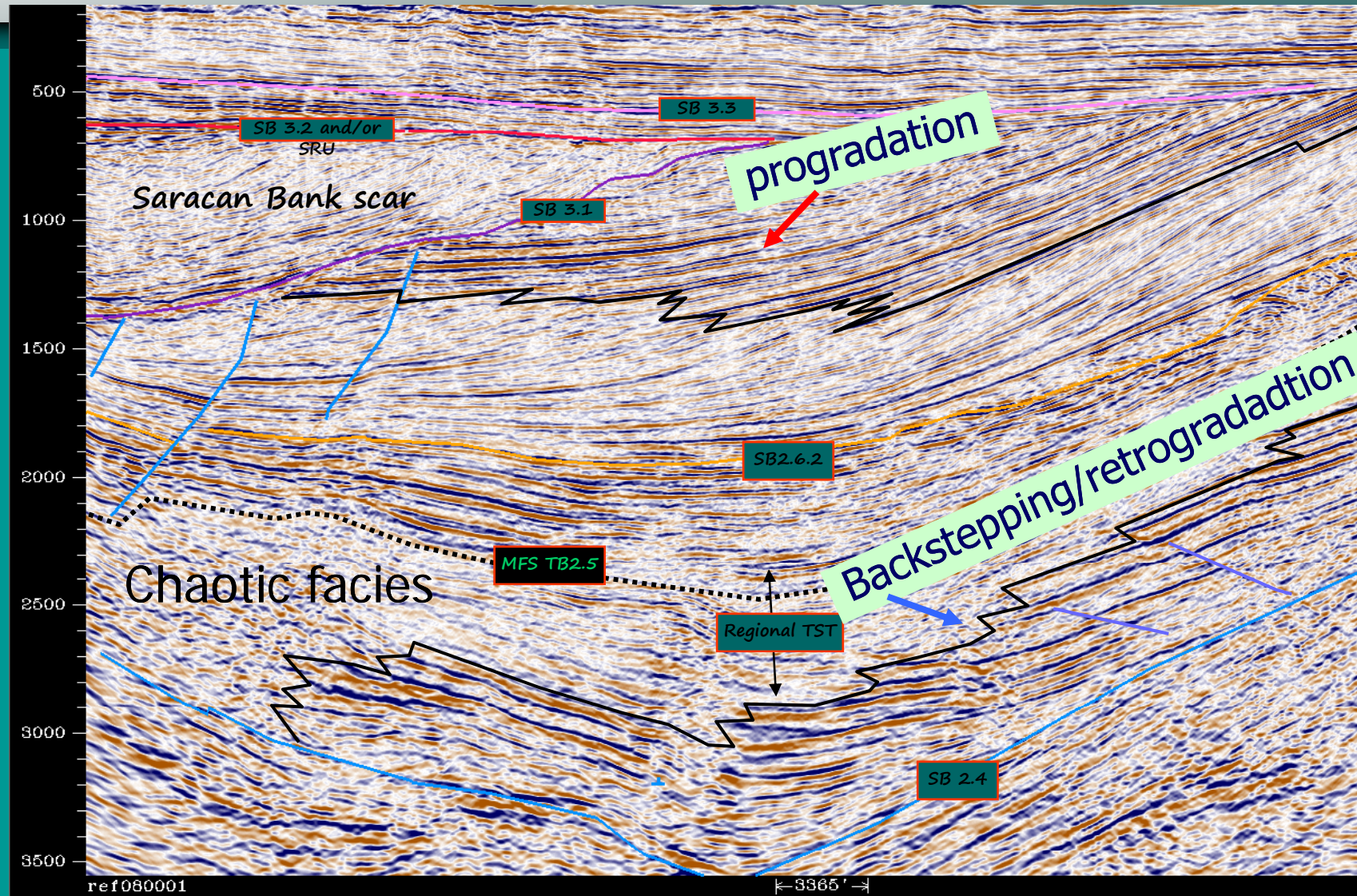
COMPLEX SIGMOID-
OBLIQUE



SHINGLED

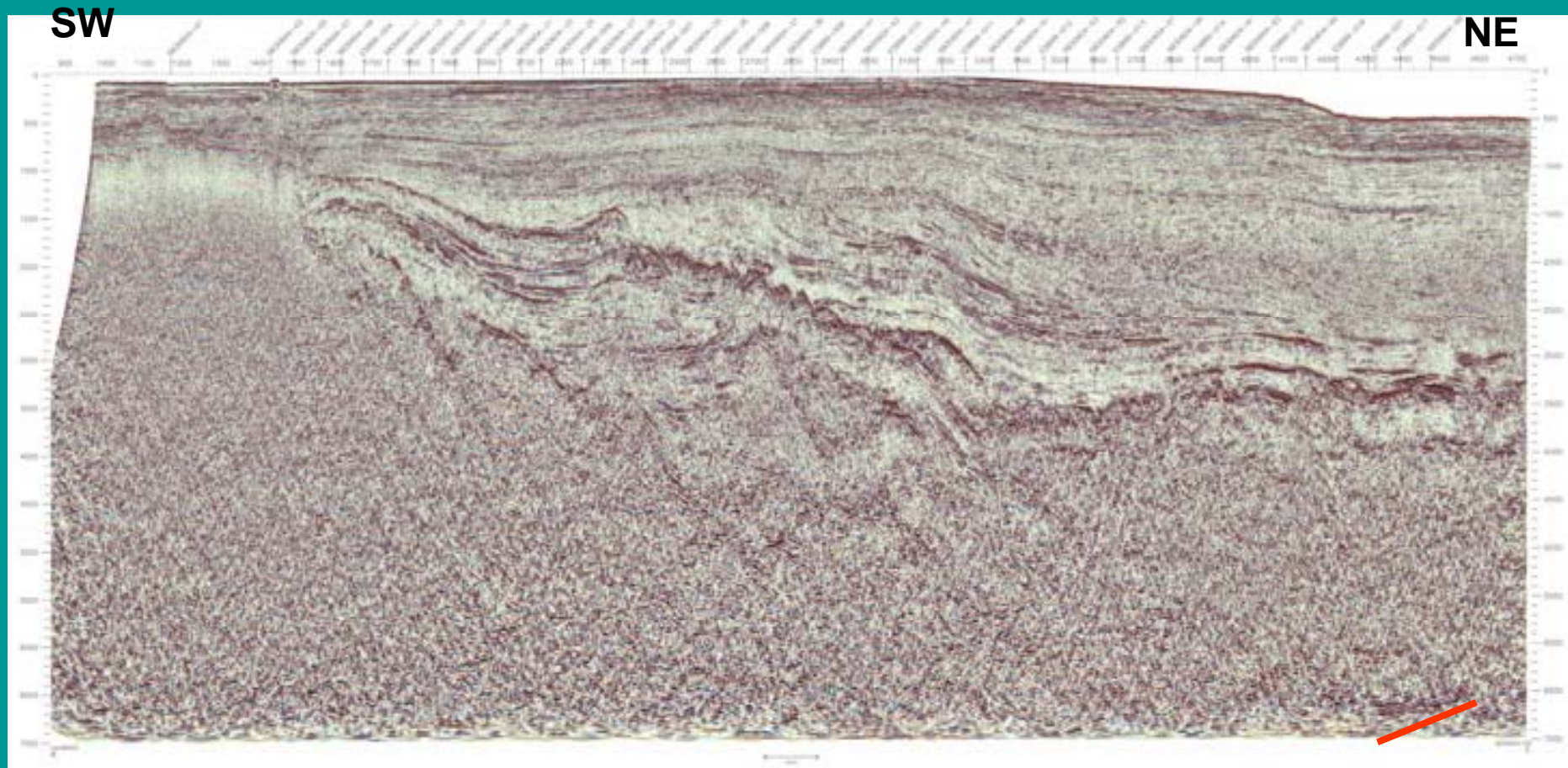


Seismic facies interpretation



Line 76R504

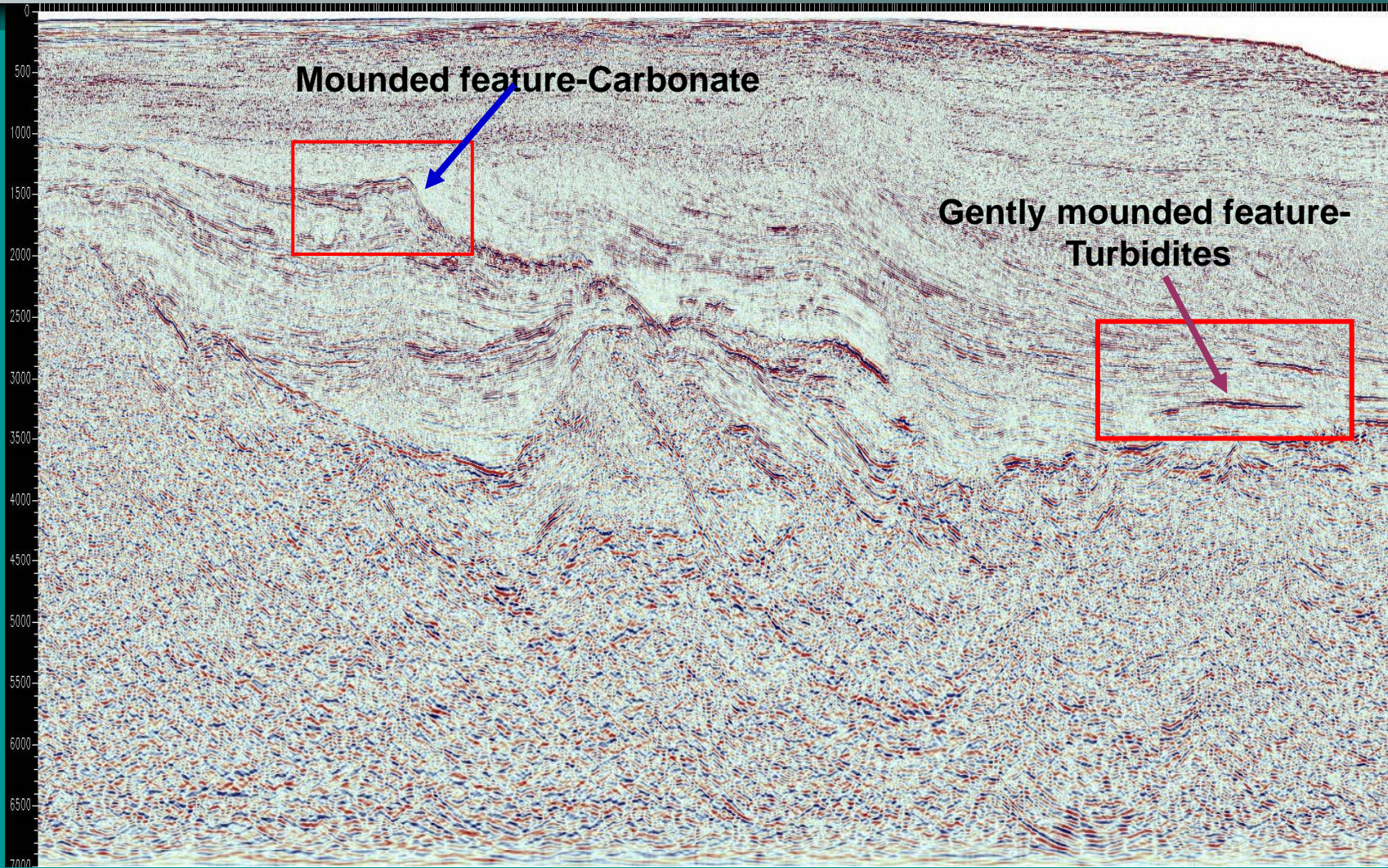
Uninterpreted seismic cross-section: East Sabah



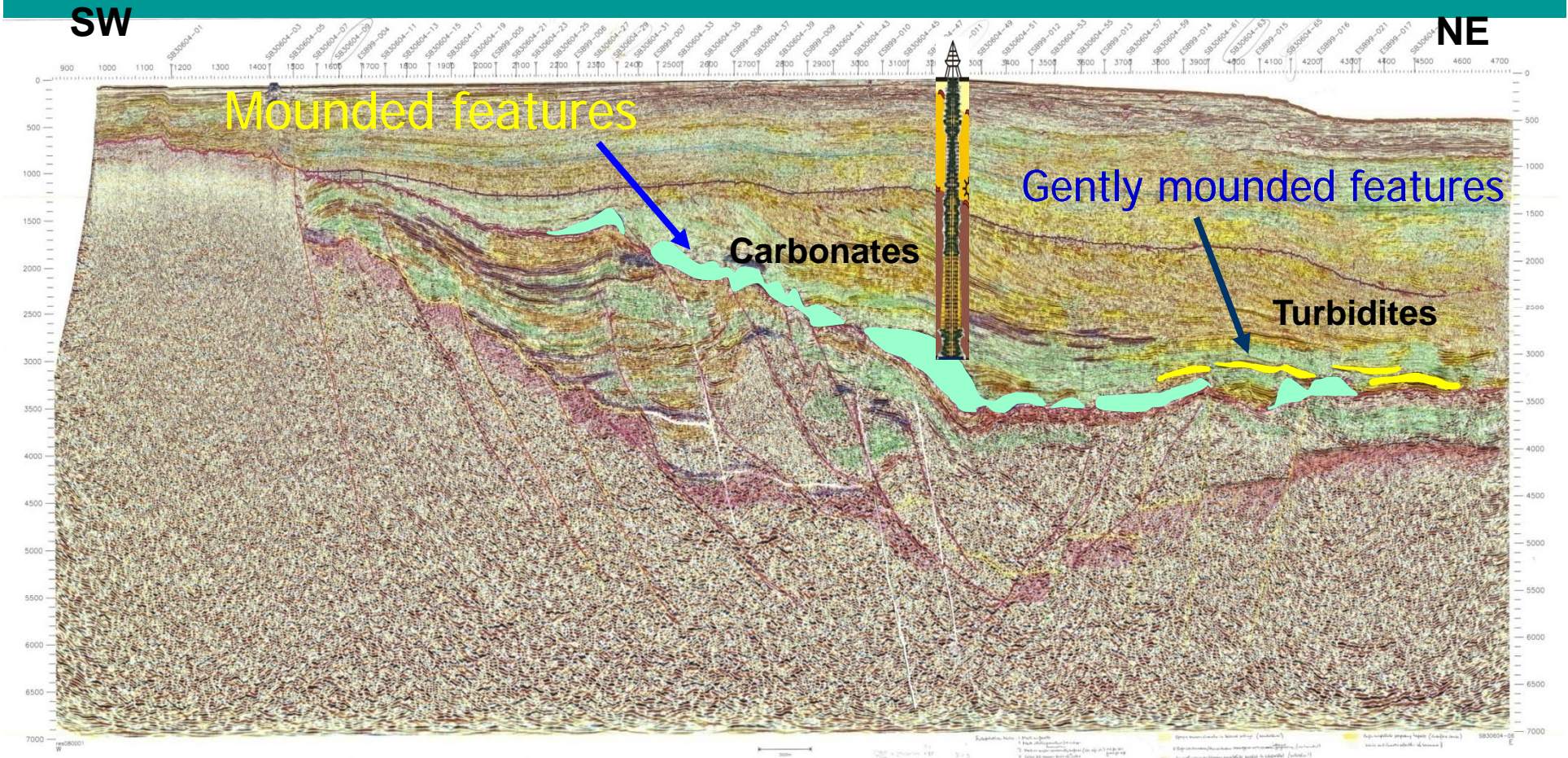
East Sabah Regional Line: Dip Line

SW

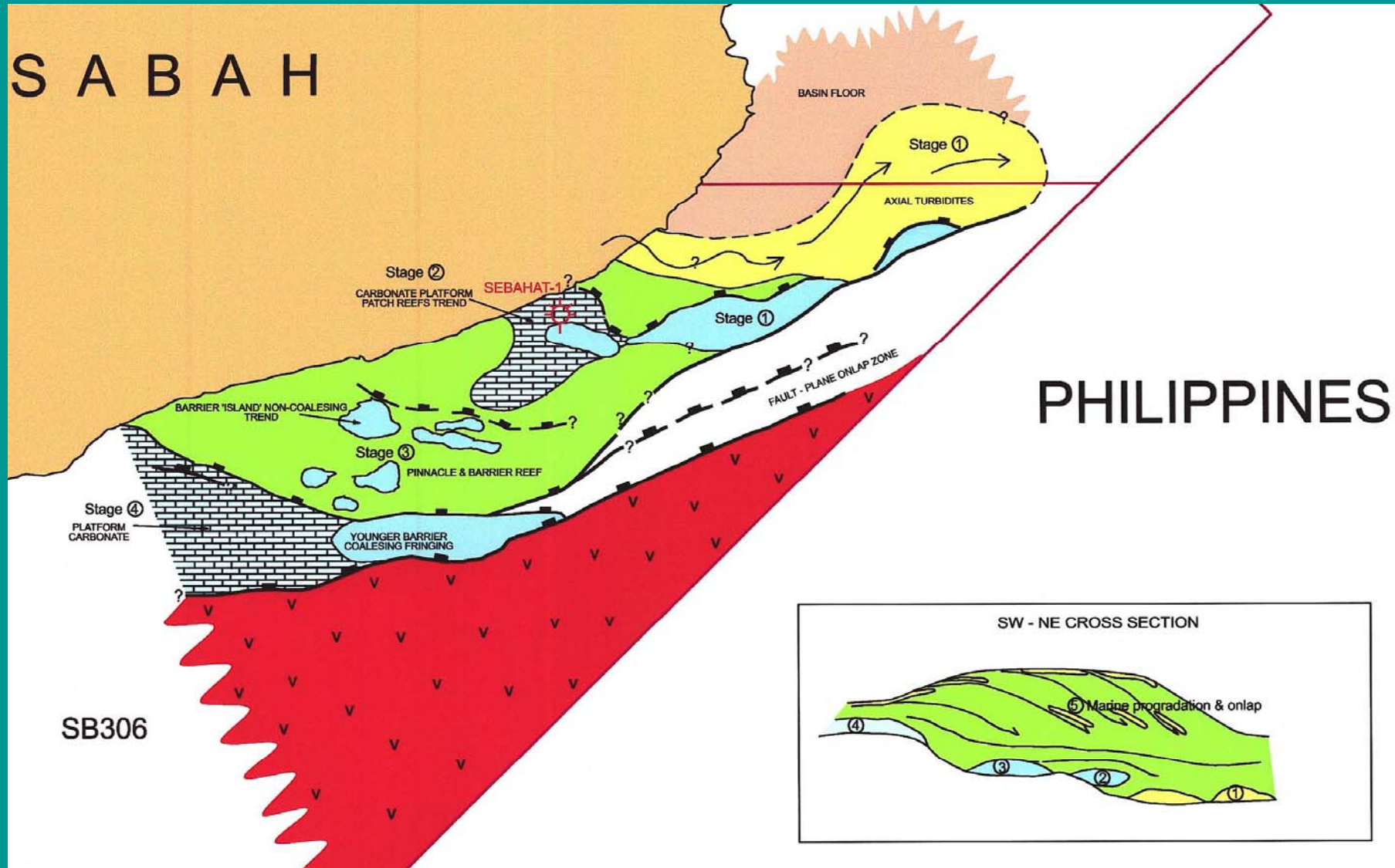
NE



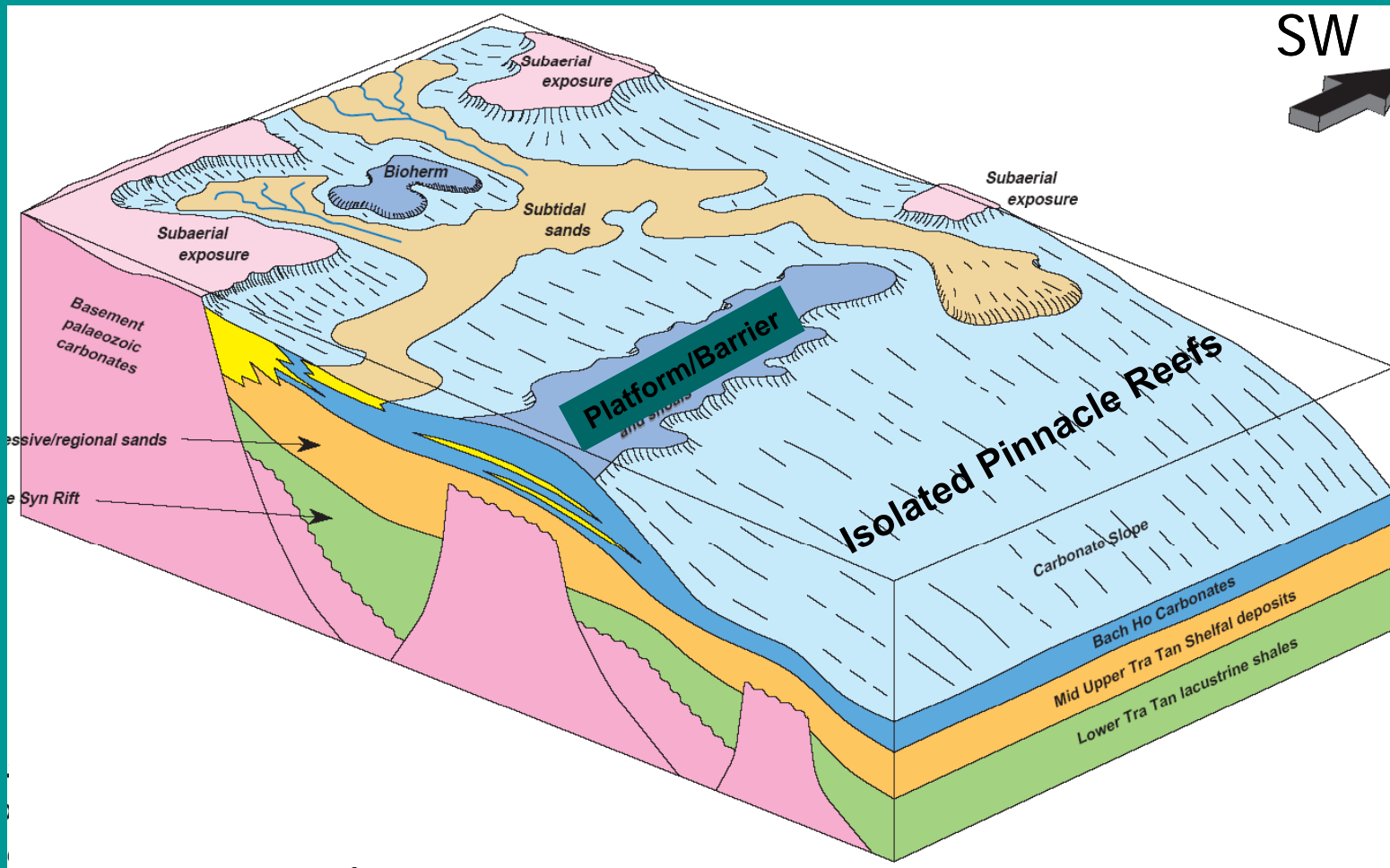
Seismic Sequence Stratigraphy



Seismic facies/paleofacies mapping

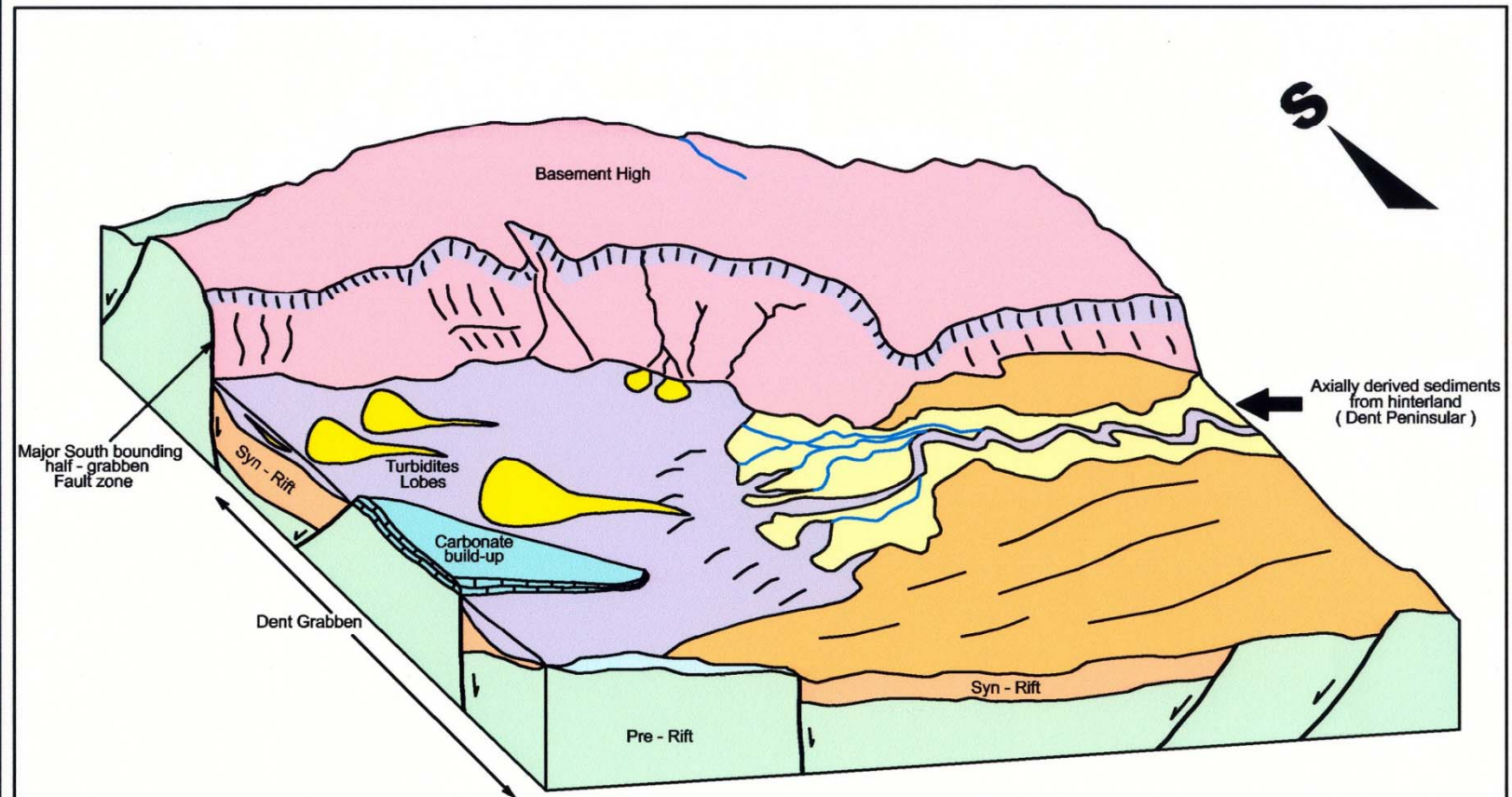


Reservoir Characterization - Carbonate Model



Reservoir Characterization - Turbidite Model

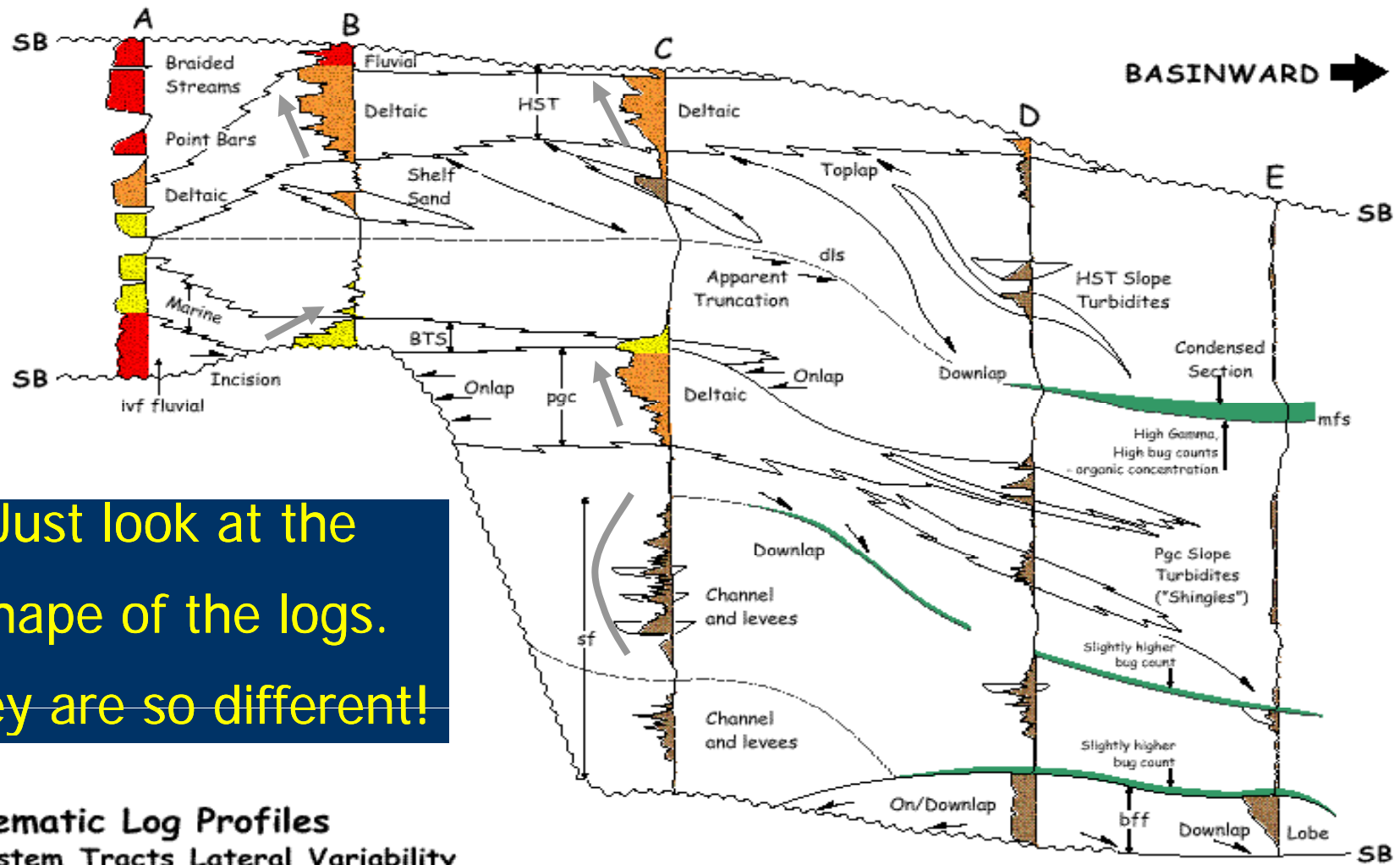
Axial Sedimentation Model in Dent Grabben (Lowstand System Tract)



Part 2

Sequence Analysis based on Log Character

Slug Model illustrated by logs- Indicating Vertical and Horizontal Variability



Just look at the
Shape of the logs.
They are so different!

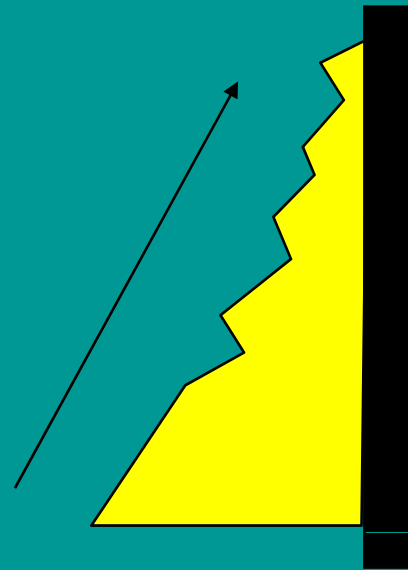
Schematic Log Profiles
- System Tracts Lateral Variability
For "Ideal" Clastic Sequence

M106.RK.079_Feb 2000

(modified from Sangree 1989)

An English Lesson On Log Description

What do we call this log shape?



Bull?

Ball?

Bell?

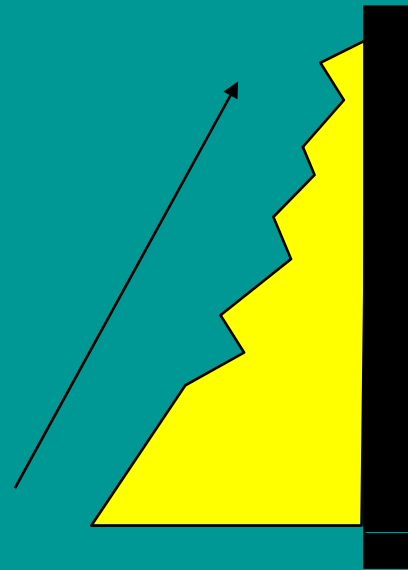
Bear?

Bird?

Blog?

An English Lesson On Log Description

What do we call this log shape?



Bull?

Ball?

Bell?

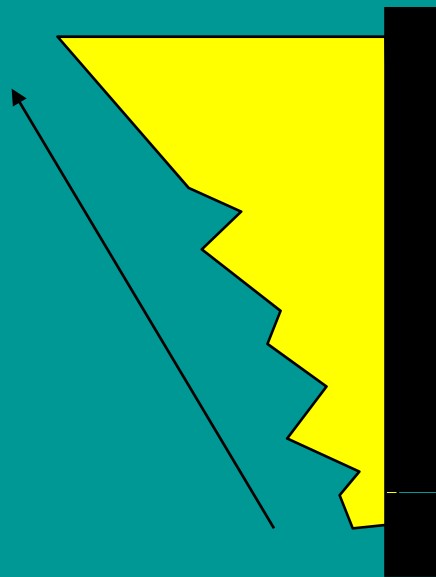
Bear?

Bird?

Blog?

An English Lesson On Log Description

What do we call this log shape?



Flurry?

Funny?

Funnel?

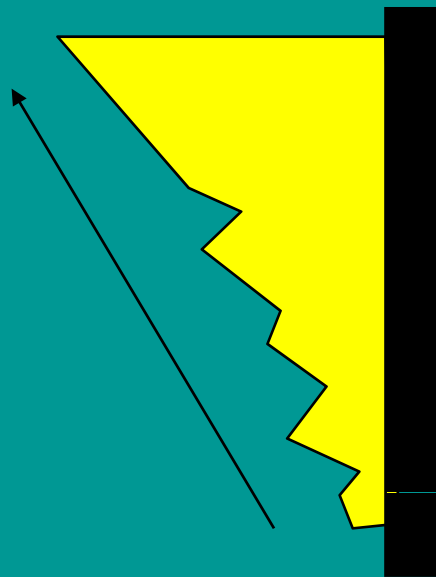
Funky?

Fuzzy?

Furry?

An English Lesson On Log Description

What do we call this log shape?



Flurry?

Funny?

Funnel?

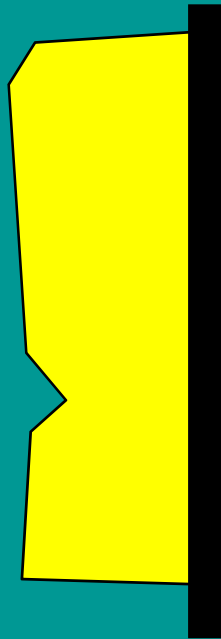
Funky?

Fuzzy?

Furry?

An English Lesson On Log Description

What do we call this log shape?



Bulky?

Blocky?

Belly?

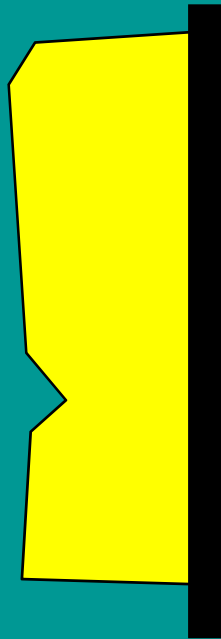
Baloney?

Baby?

Body?

An English Lesson On Log Description

What do we call this log shape?



Bulky?

Blocky?

Belly?

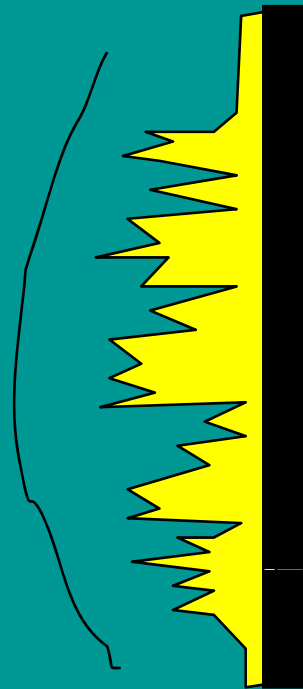
Baloney?

Baby?

Body?

An English Lesson On Log Description

What do we call this log shape?



Ecstatic?

Eccentric?

Eclectic?

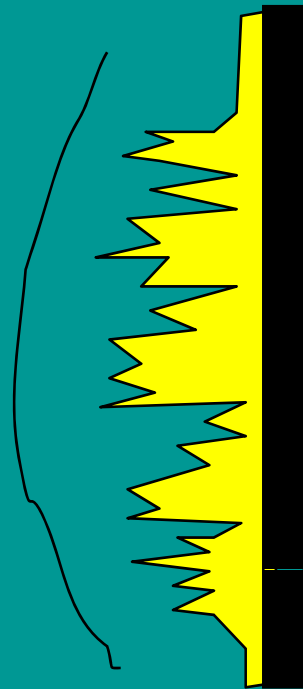
Erratic?

Eustatic?

Electric?

An English Lesson On Log Description

What do we call this log shape?



Ecstatic?

Eccentric?

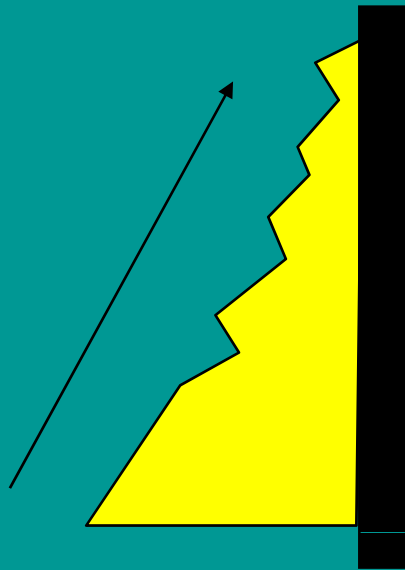
Eclectic?

Erratic?

Eustatic?

Electric?

Inferred Depositional Environment From Logs



Fluvial/Braided Stream?

Meandering Channel Sands/Barrier Bars?

Overbank/Levee/Crevasse Splay?

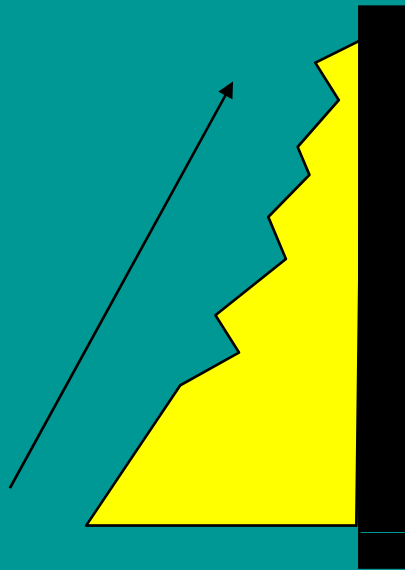
River Mouth Bar/Beach Sands?

Shallow Marine Sands/Deltaic Sands?

Deep Marine Sands/Basin Floor Sands?

Levee Channel Complex/Slope Fans?

Inferred Depositional Environment From Logs



Fluvial/Braided Stream?

Meandering Channel Sands/Barrier Bars?

Overbank/Levee/Crevasse Splay?

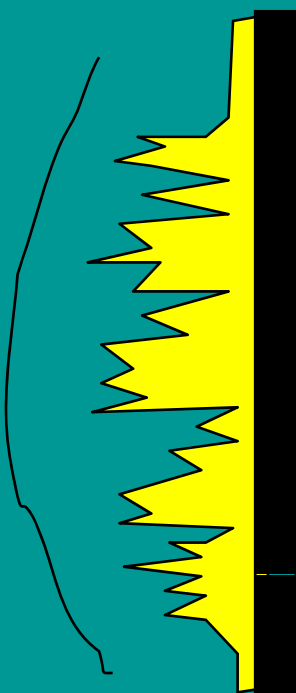
River Mouth Bar/Beach Sands?

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Depositional Environment From Logs



Fluvial/Braided Stream?

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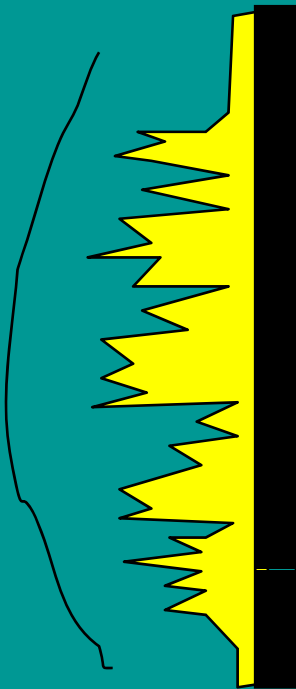
River Mouth Bar/Beach Sands?

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Deep Marine Sands/Basin Floor Sands?

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Depositional Environment From Logs



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Depositional Environment From Logs

Fluvial/Braided Stream?

Meandering Channel Sands/Barrier Bars?

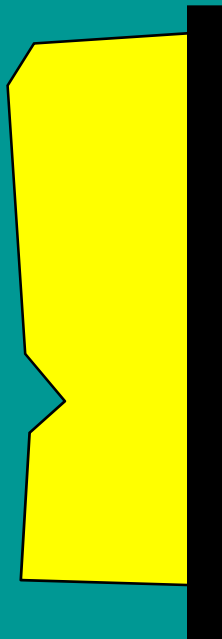
Overbank/Levee/Crevasse Splay?

River Mouth Bar/Beach Sands?

Shallow Marine Sands/Deltaic Sands?

Deep Marine Sands/Basin Floor Sands?

Levee Channel Complex/Slope Fans?



Depositional Environment From Logs

Fluvial/Braided Stream?

Meandering Channel Sands/Barrier Bars?

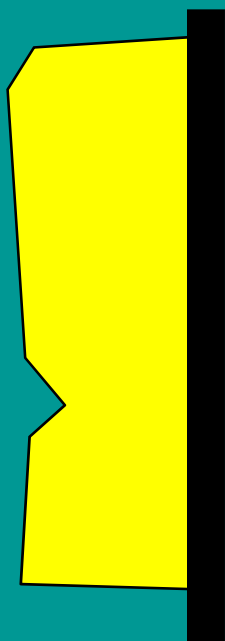
Overbank/Levee/Crevasse Splay?

River Mouth Bar/Beach Sands?

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Depositional Environment From Logs

Fluvial/Braided Stream?

Meandering Channel Sands/Barrier Bars?

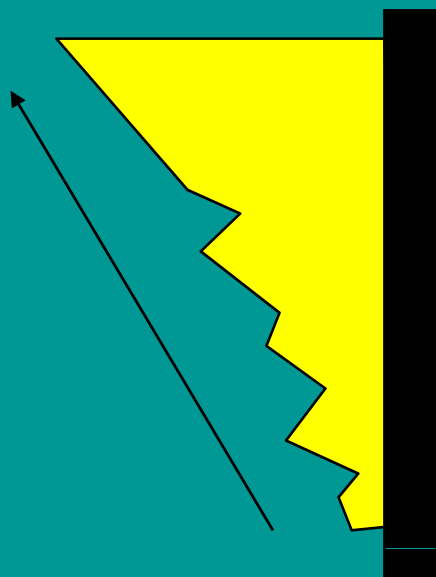
Overbank/Levee/Crevasse Splay?

River Mouth Bar/Beach Sands?

Shallow Marine Sands/Deltaic Sands?

Deep Marine Sands/Basin Floor Sands?

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Depositional Environment From Logs

Fluvial/Braided Stream?

Meandering Channel Sands/Barrier Bars?

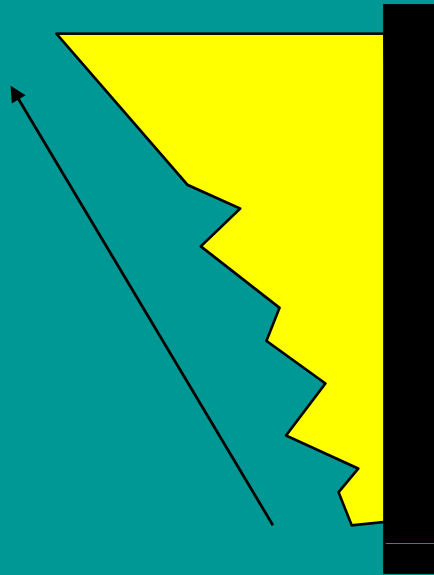
Overbank/Levee/Crevasse Splay?

River Mouth Bar/Beach Sands?

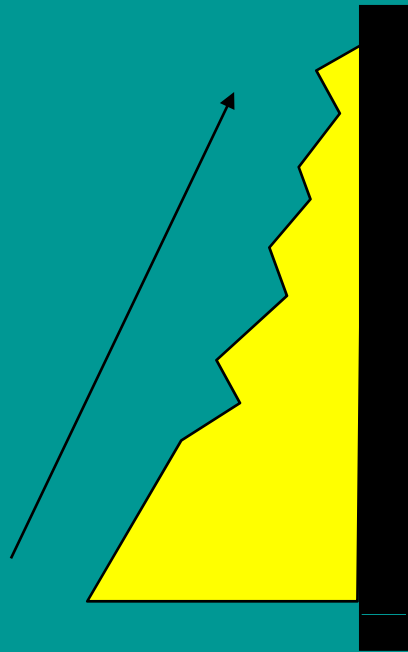
Shallow Marine Sands/Deltaic Sands?

Deep Marine Sands/Basin Floor Sands?

Levee Channel Complex/Slope Fans?



The Log Can Tell You A Story From Bottom to Top



Coarsening upward?

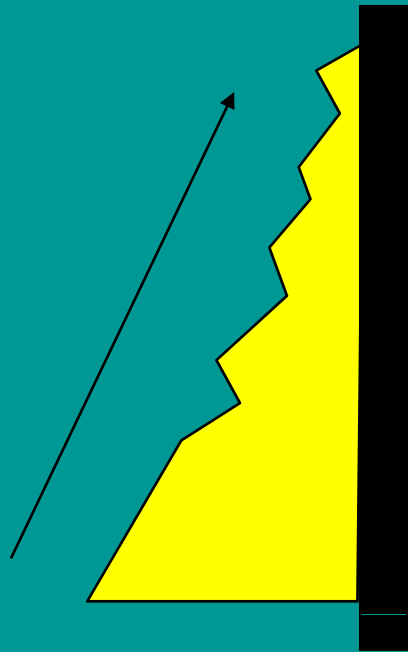
Fining upward?

Shallowing Upward?

Deepening Upward?

No Or Little Change?

The Log Can Tell You A Story From Bottom to Top



Coarsening upward?

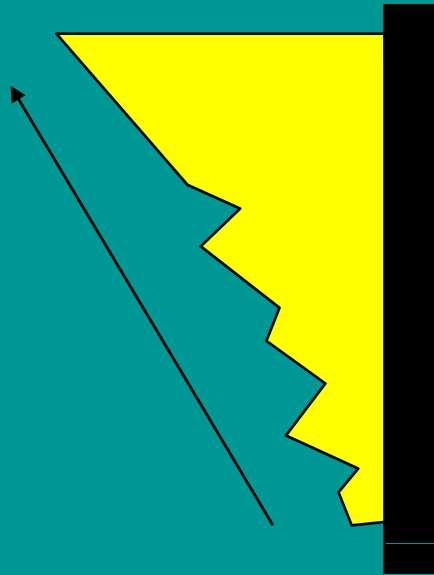
Fining upward?

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Deepening Upward?

No Or Little Change?

The Log Can Tell You A Story From Bottom to Top



Coarsening upward?

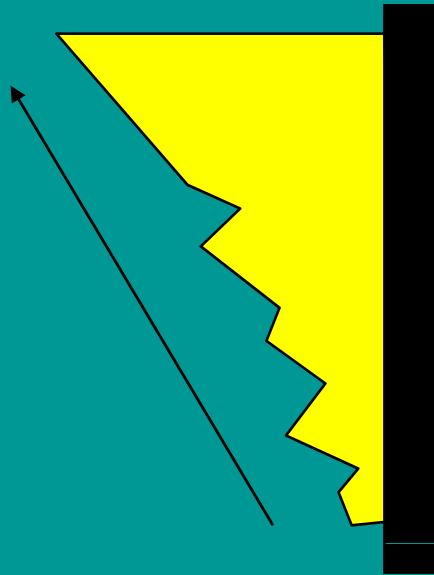
Fining upward?

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The Log Can Tell You A Story From Bottom to Top



Coarsening upward?

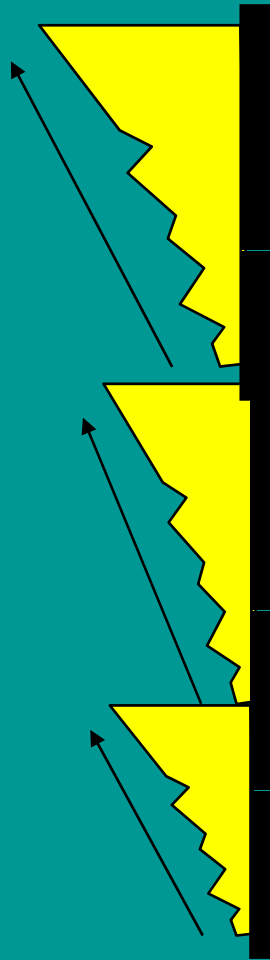
Fining upward?

Shallowing Upward?

Deepening Upward?

No Or Little Change?

The Log Can Tell You A Story From Bottom to Top



Overall coarsening upward?

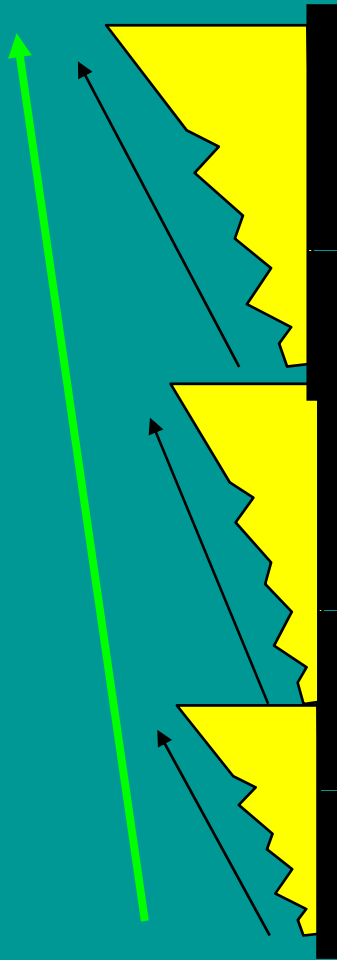
Overall fining upward?

Overall shallowing upward?

Overall deepening upward?

Overall little or no change?

The Log Can Tell You A Story From Bottom to Top



Overall coarsening upward?

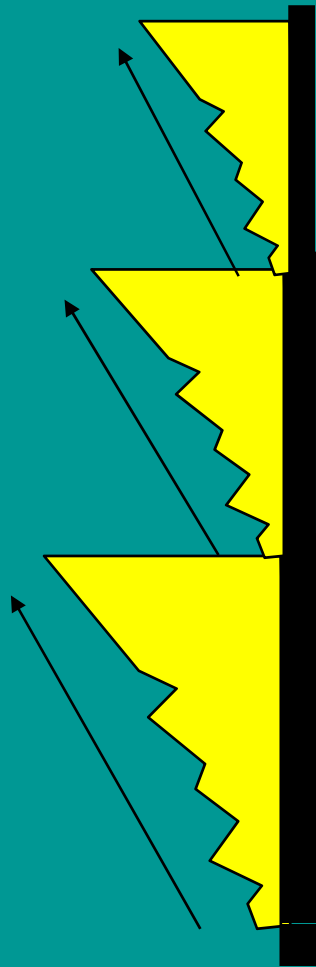
Overall fining upward?

Overall shallowing upward?

Overall deepening upward?

Overall little or no change?

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Overall coarsening upward?

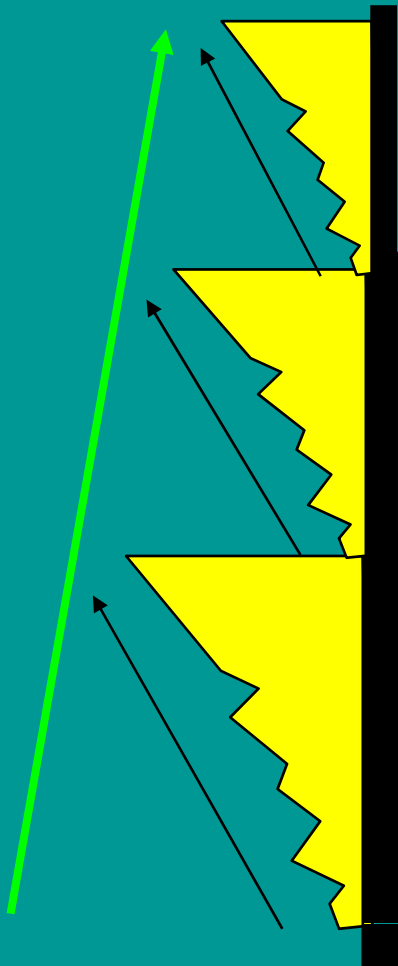
Overall fining upward?

Overall shallowing upward?

Overall deepening upward?

Overall little or no change?

The Log Can Tell You A Story From Bottom to Top



Overall coarsening upward?

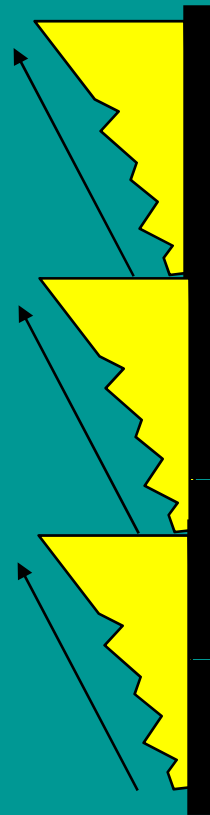
Overall fining upward?

Overall shallowing upward?

Overall deepening upward?

Overall little or no change?

The Log Can Tell You A Story From Bottom to Top



Overall coarsening upward?

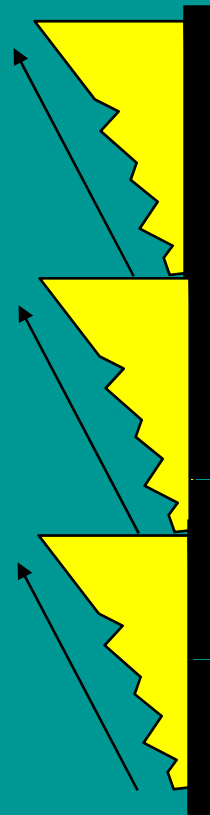
Overall fining upward?

Overall shallowing upward?

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The Log Can Tell You A Story From Bottom to Top



Overall coarsening upward?

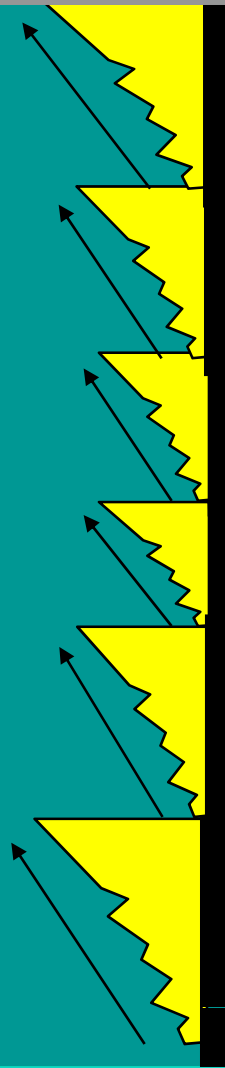
Overall fining upward?

Overall shallowing upward?

Overall deepening upward?

Overall little or no change?

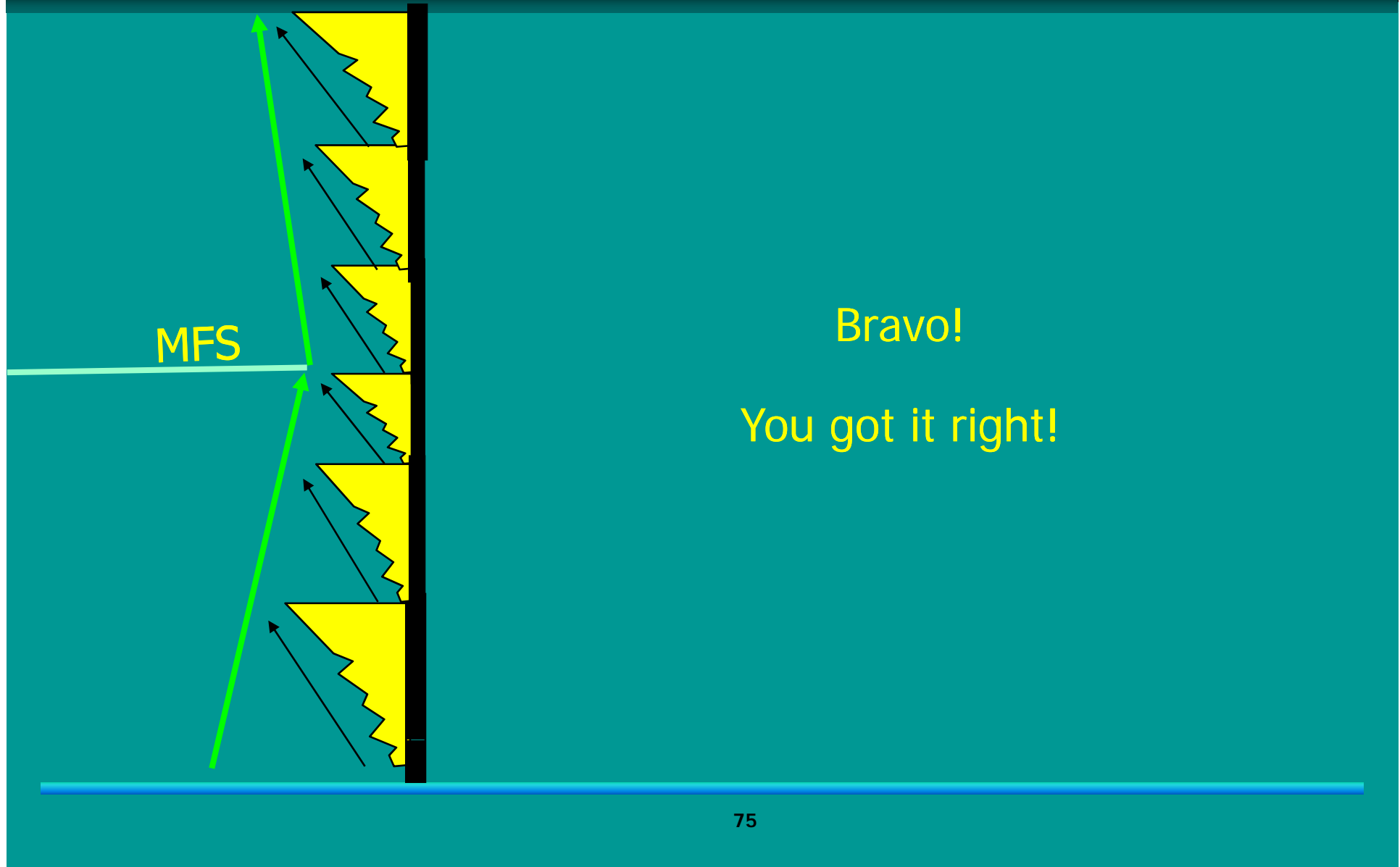
The Log Can Tell You A Story From Bottom to Top



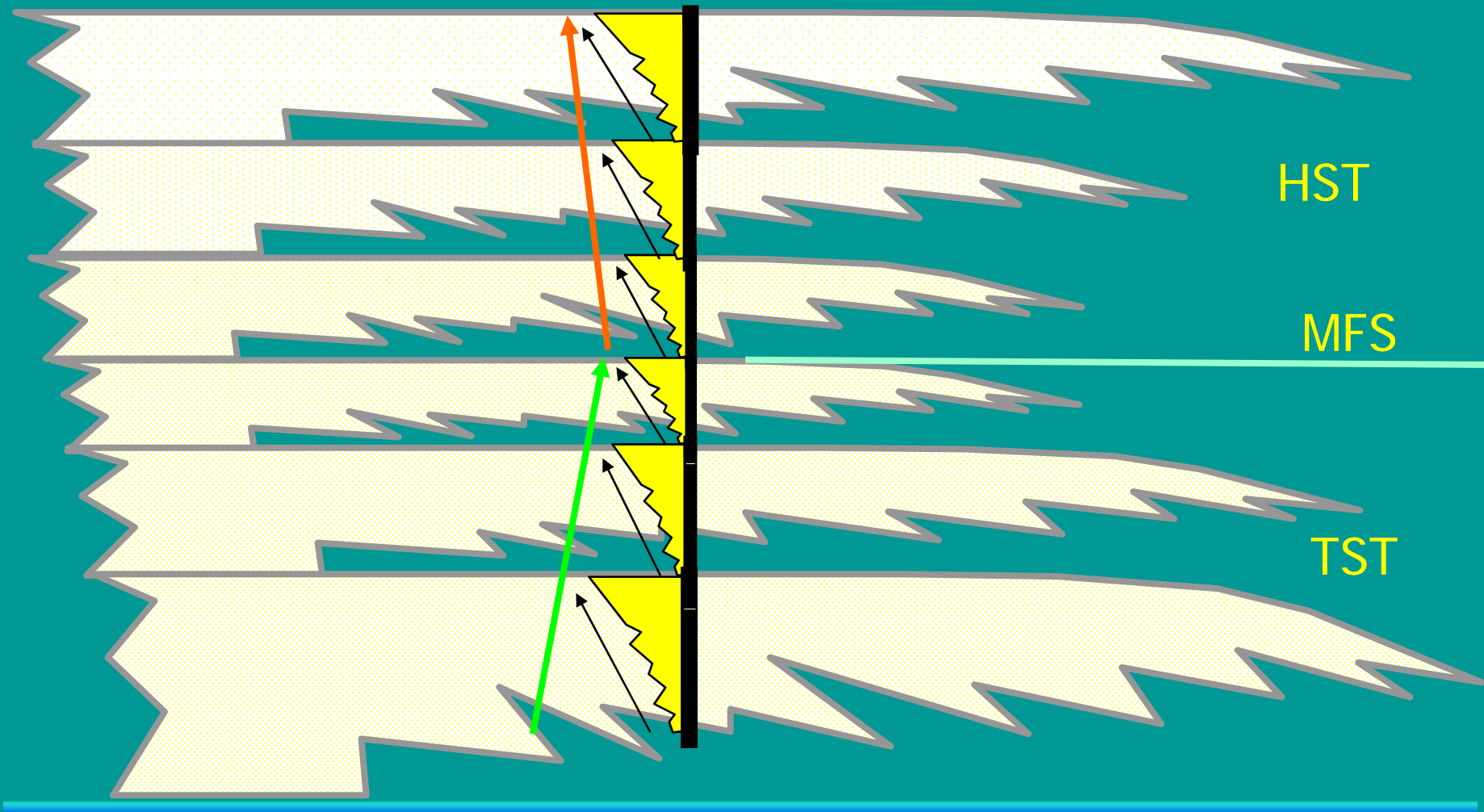
How is Max. Flooding Surface defined?

Can you mark the MFS?

The Log Can Tell You A Story From Bottom to Top

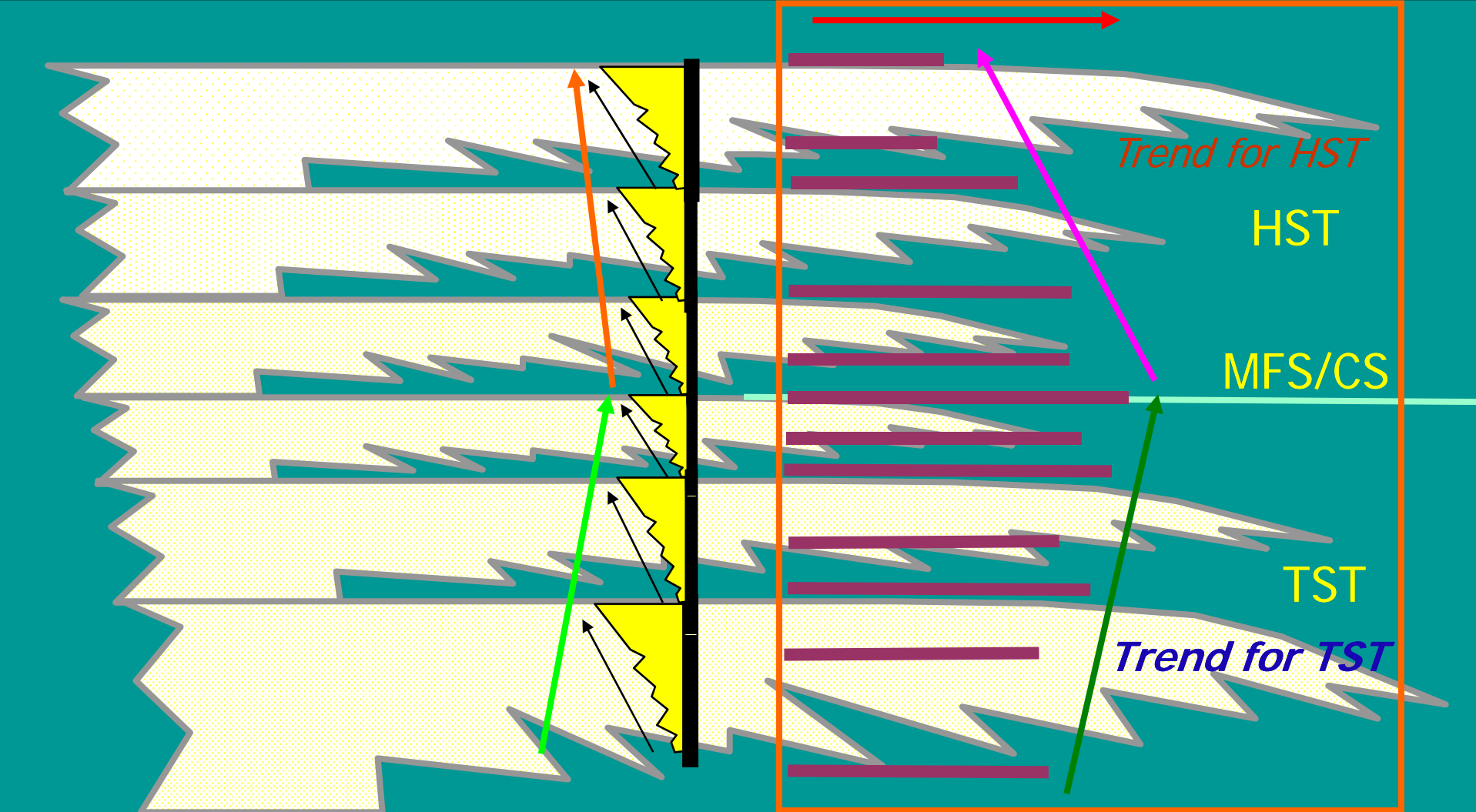


Now You Can Interpret The Systems Tracts



Now You Can Interpret The Systems Tracts Properly

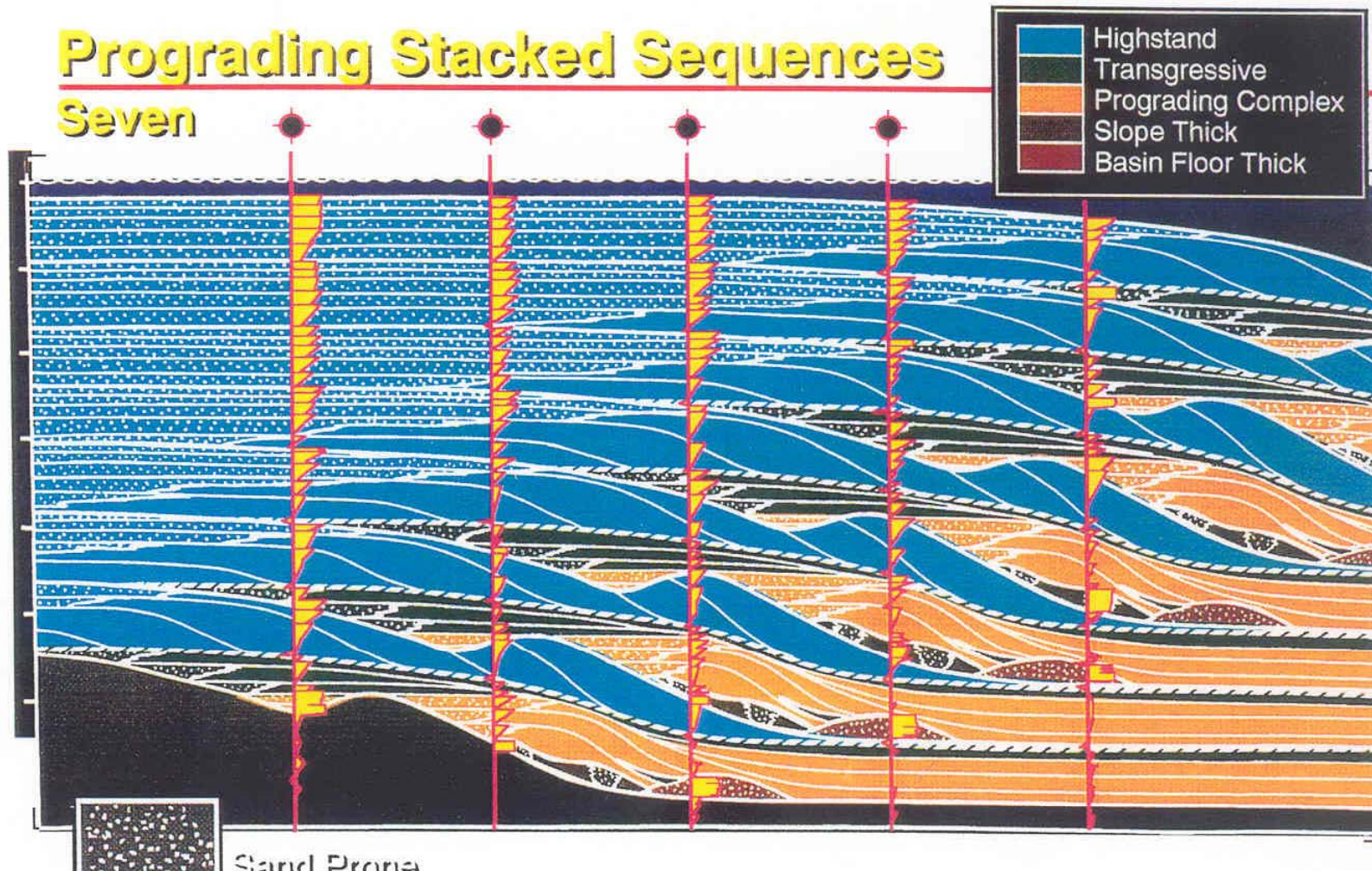
Increasing abundance and diversity to the right



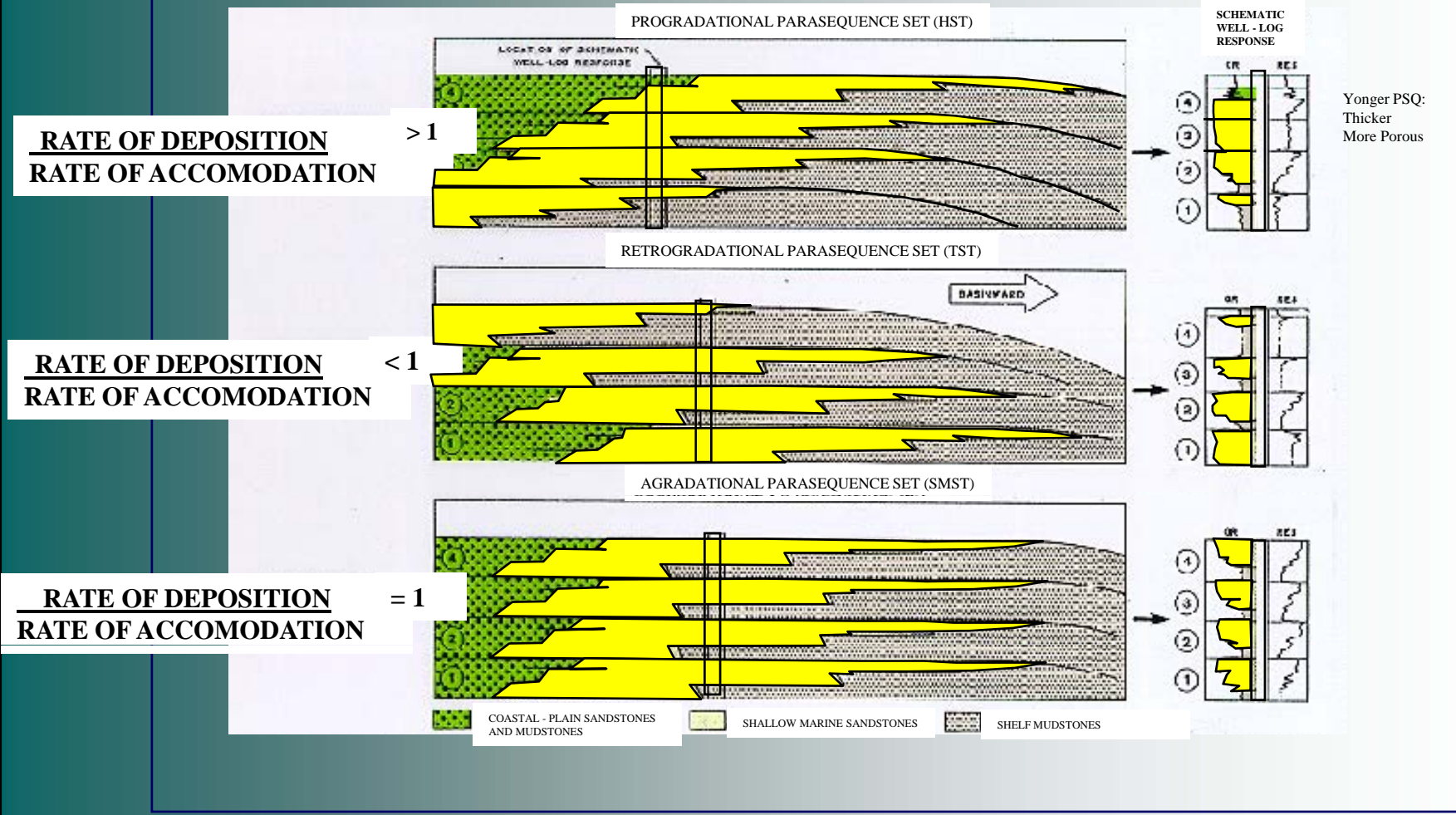
Log Pattern For Overall Prograding Sequences

Can You show the TSTs and the LSTs with their boundaries?

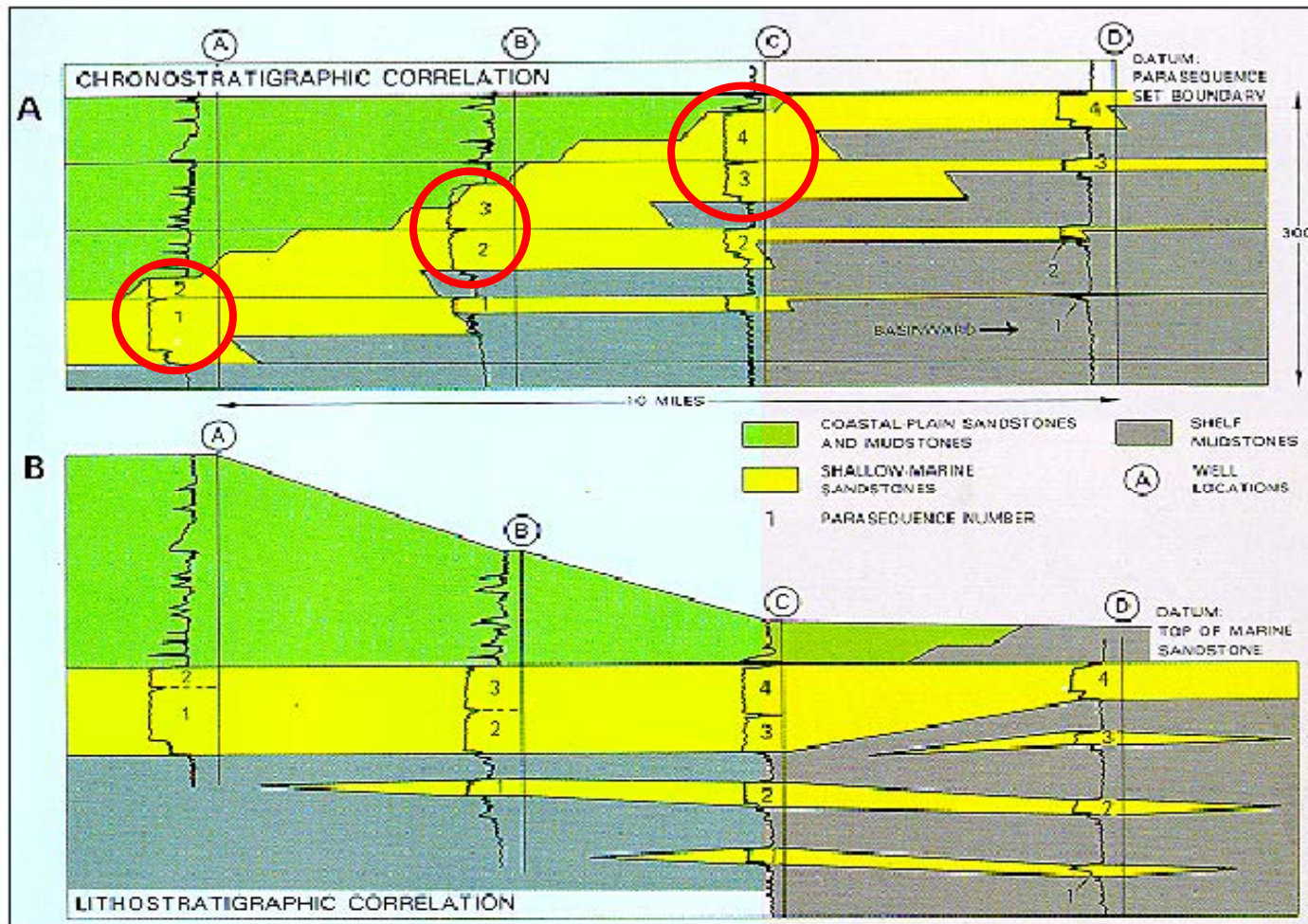
Prograding Stacked Sequences Seven



The Overall Log Character is Related to the Rate of Deposition Vs Rate of Accommodation Especially in a Marine Environment

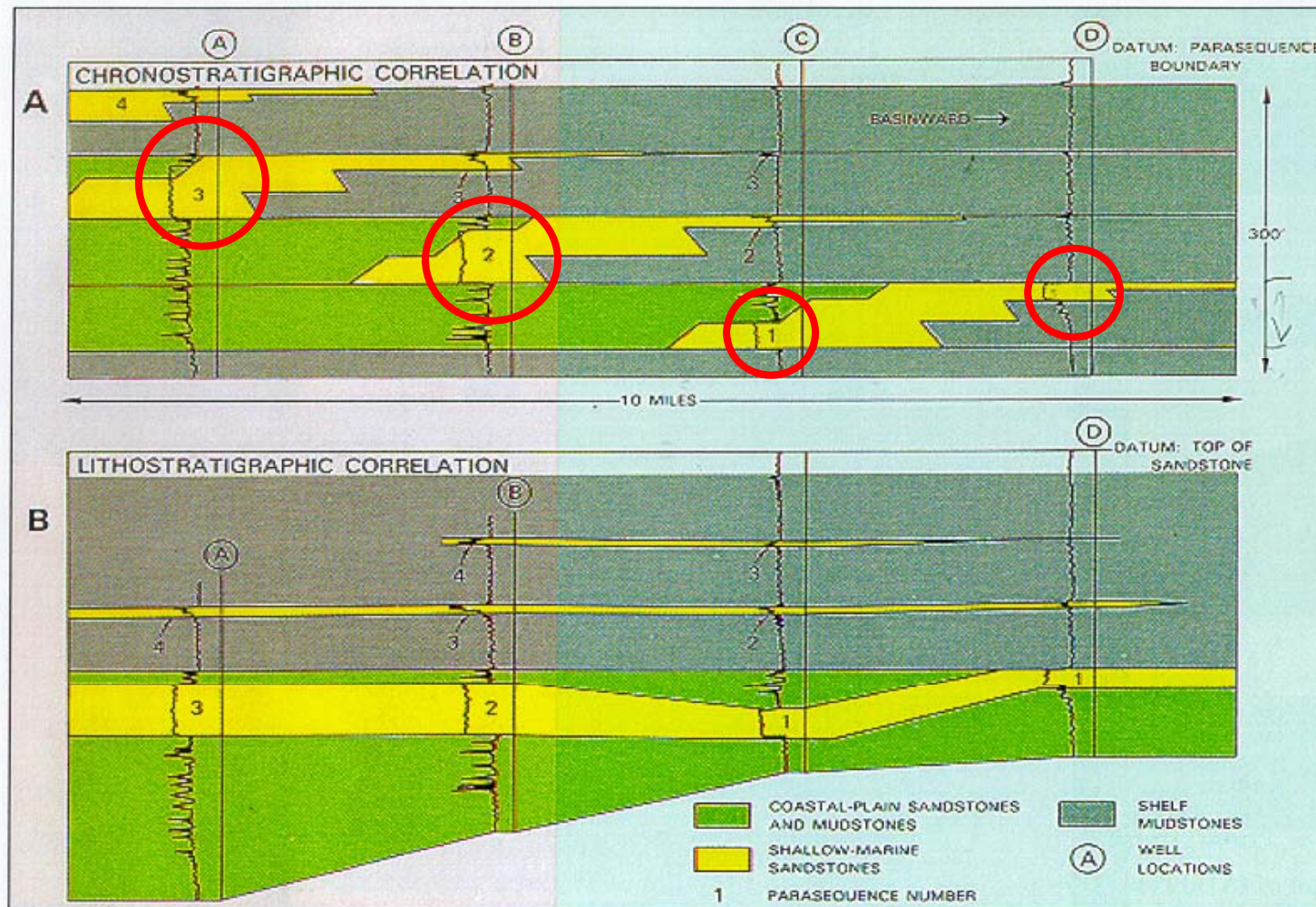


If you mis-correlate the sands in HST, it might still be OK



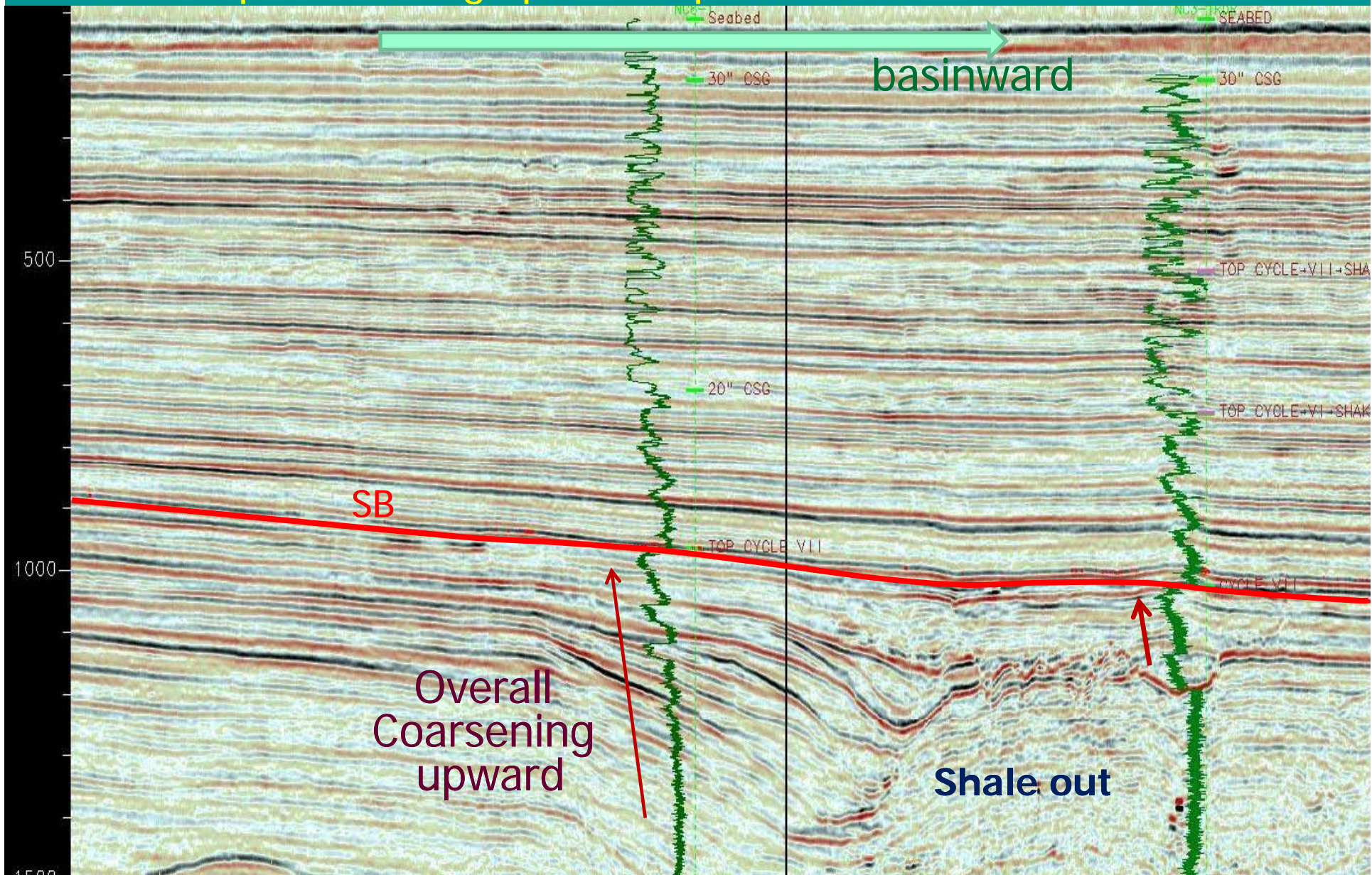
Comparison of (A) chronostratigraphic correlation and (B) lithostratigraphic correlation styles: progradational parasequence set.

But if you mis-correlate the sands in TST, it is not OK!



Comparison of (A) chronostratigraphic correlation and (B) lithostratigraphic correlation styles: retrogradational parasequence set

Sequence stratigraphic interpretation with seismic and well



SE

NW

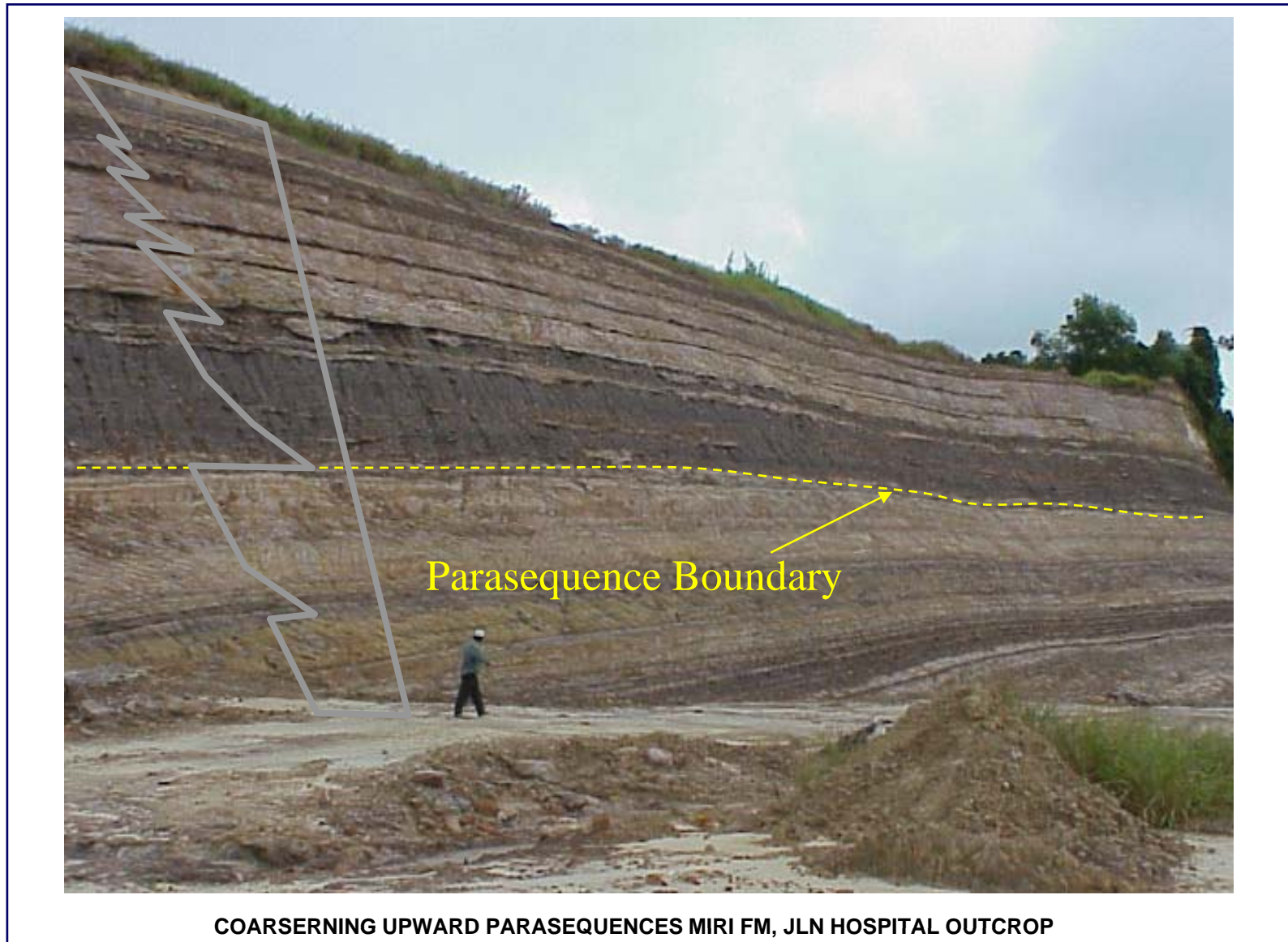
A Field Geologist Looking at Outcrop Scale

How does a geologist
Interpret the outcrop?

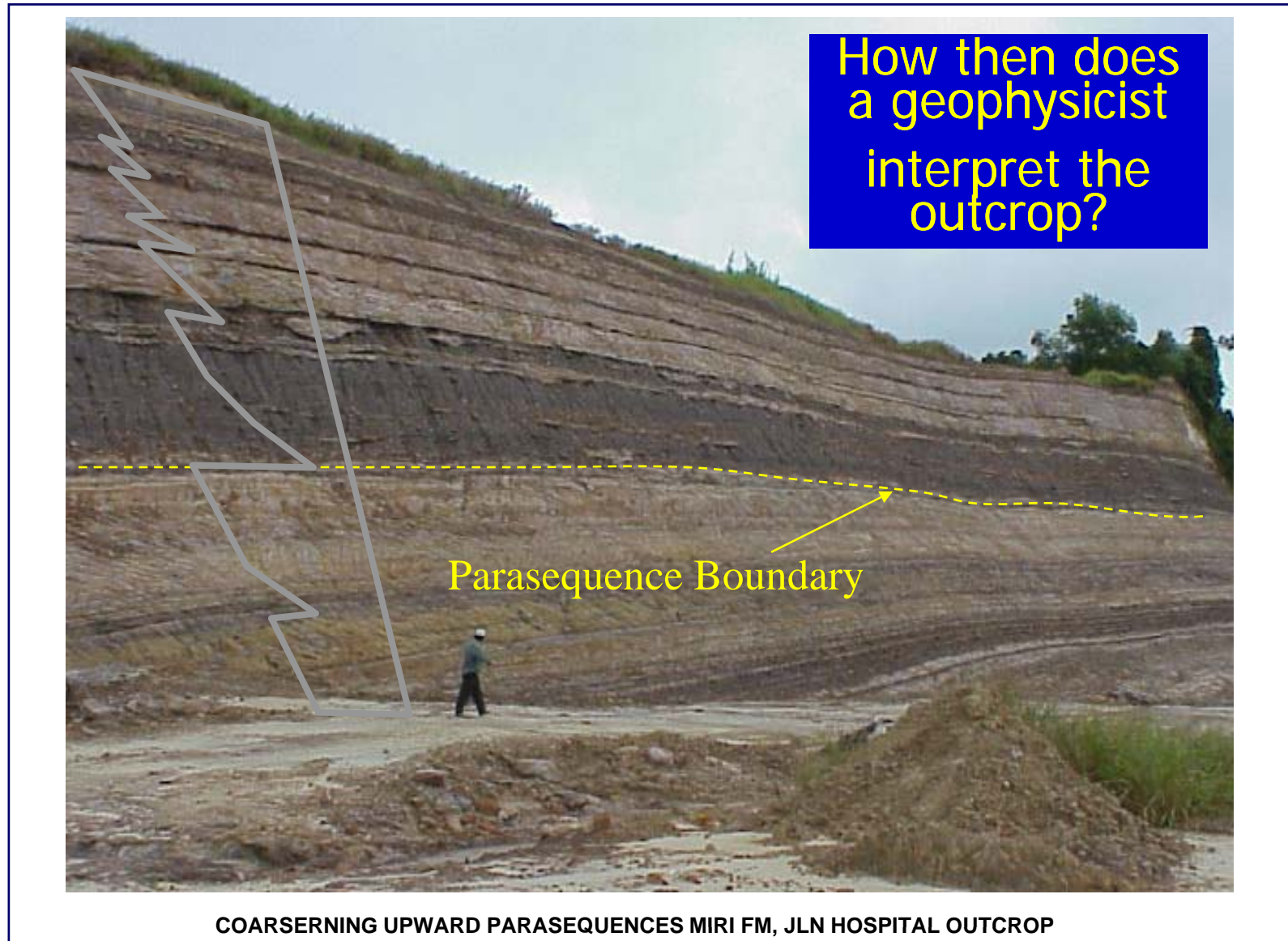


COARSERNING UPWARD PARASEQUENCES MIRI FM, JLN HOSPITAL OUTCROP

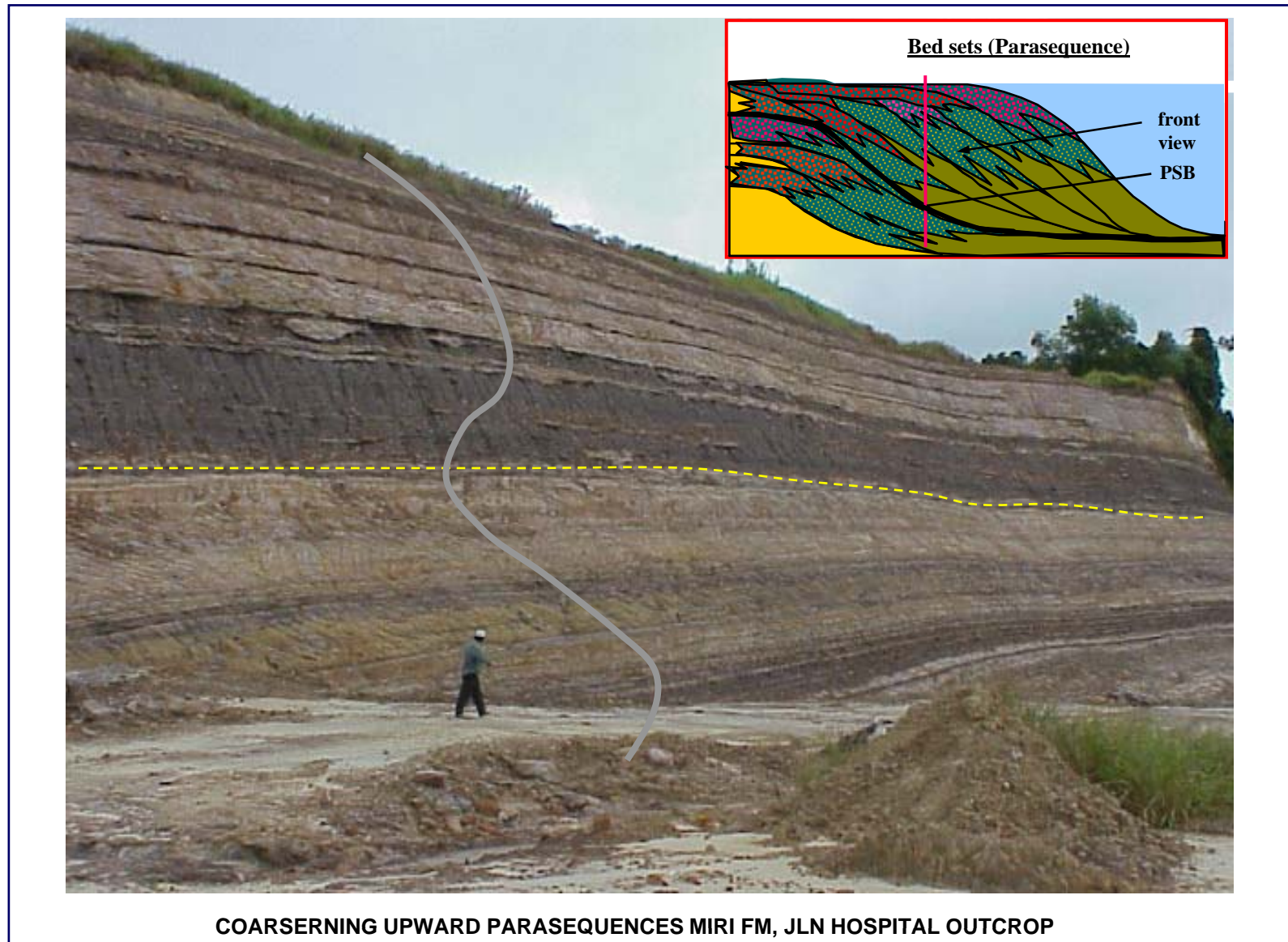
A Geologist integrates outcrop with log



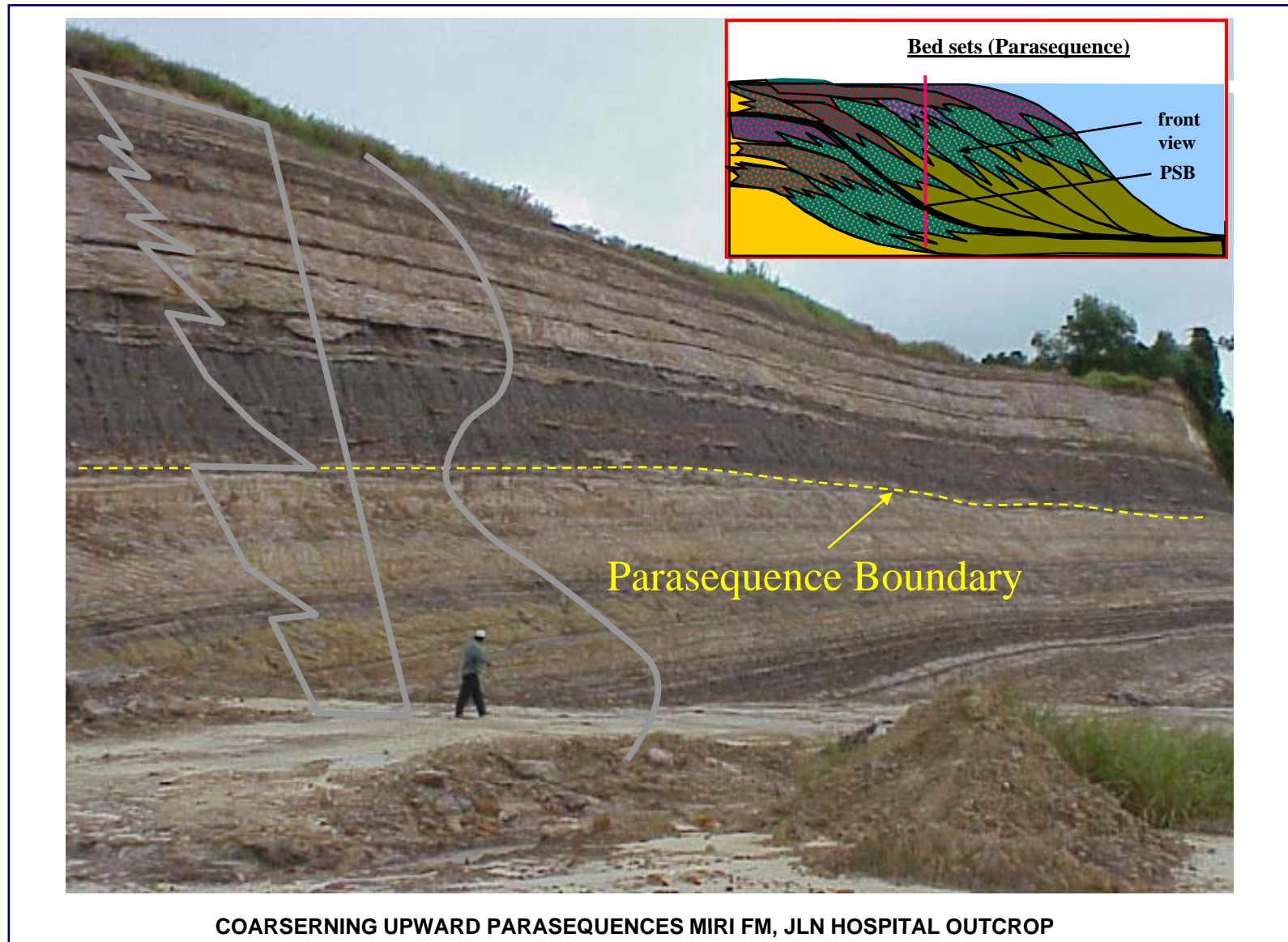
A Geologist integrates outcrop with log



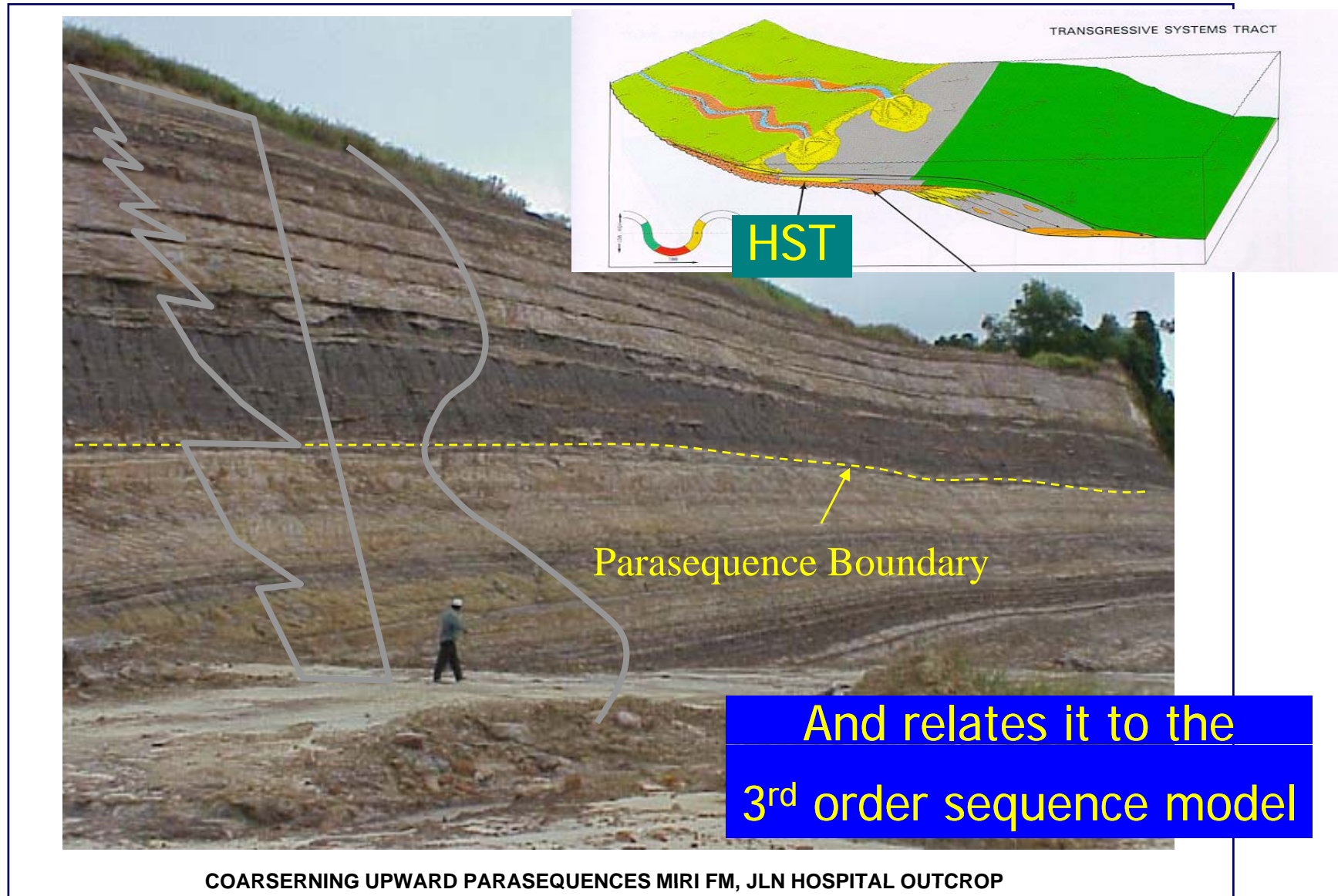
A Geophysicist Integrates Outcrop with Seismic



A Sequence Stratigrapher integrates outcrops, well and seismic



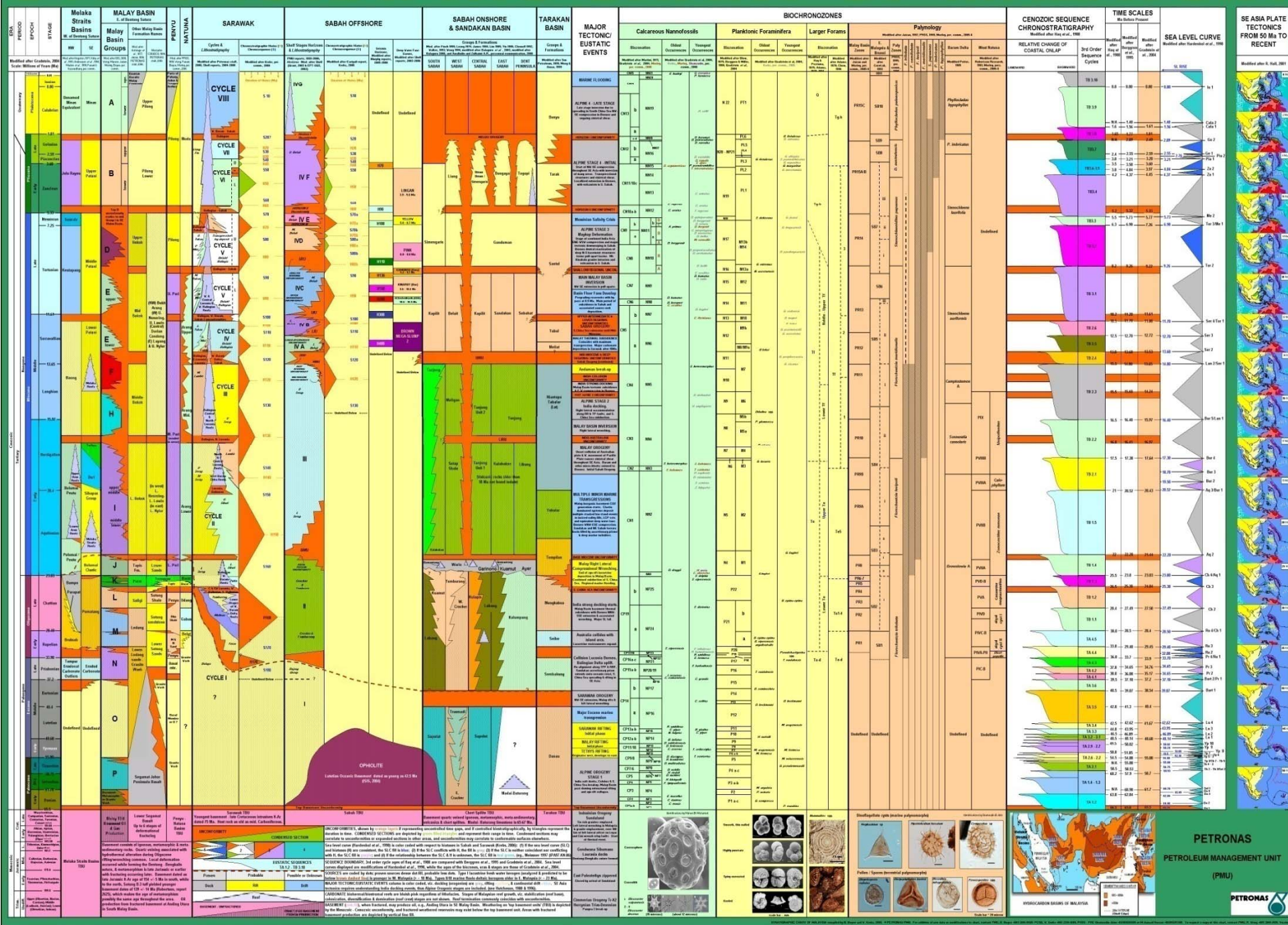
A Sequence Stratigrapher integrates outcrops, well and seismic





After you have done the sequence stratigraphic interpretation, you can just relax

STRATIGRAPHIC CHART OF MALAYSIA



BALINGIAN STRATIGRAPHIC SCHEME

