

^{AV}Parasequences in Third Generation (3G) Sequence Stratigraphy

By
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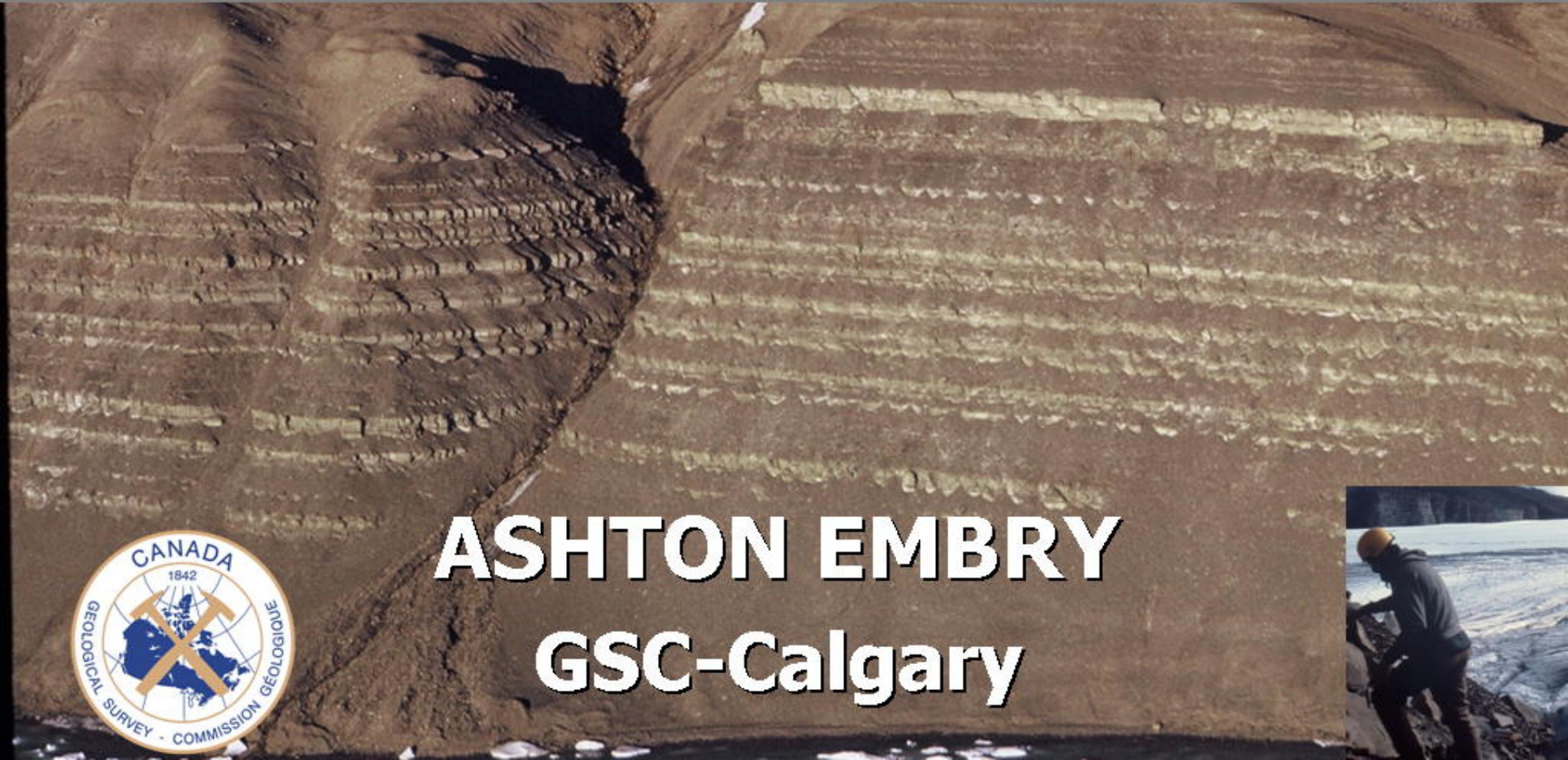
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Abstract

Third generation (3G) sequence stratigraphy maintains the main components of earlier sequence methodologies developed by Sloss/Wheeler (1G) and Exxon geoscientists (2G) and avoids the pitfalls that have limited their usefulness. One of the units added to sequence stratigraphy in the second generation phase was the parasequence, defined as “A relatively conformable succession of genetically related beds or bedsets bounded by marine flooding surfaces”. A marine flooding surface was defined as a surface across which there is evidence of an abrupt increase in water depth. For clastic strata this boundary coincides with the contact of sandstone and overlying shale and is thus a lithostratigraphic boundary rather than a sequence stratigraphic one. In 3G sequence stratigraphy maximum regressive surfaces are used as the boundaries of a parasequence. A maximum regressive surface is the stratigraphic horizon that marks the change from shallowing-upward, regressive strata below to deepening-upward, transgressive strata above. This change of boundary definition brings the parasequence into sequence stratigraphy and allows a parasequence to be directly related to a sequence that is in part bounded by maximum regressive surfaces. The critical difference between the two is the occurrence of subaerial unconformities and/or unconformable shoreface ravinements on the boundaries of a sequence and their absence on the boundaries of a parasequence. Furthermore, a maximum regressive surface has a lower diachroniety than a lithologic/facies contact has and thus parasequence boundaries of 3G sequence stratigraphy allow a much better quasi-chronostratigraphic framework to be established than do the parasequence boundaries of the 2G methodology.

Parasequences in Third Generation (3G) Sequence Stratigraphy



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OUTLINE

- **Quick Review of First, Second and Third Generation (1G, 2G, 3G) Sequence Stratigraphy**
- **Parasequences in Second Generation Sequence Stratigraphy.**
- **New, improved, Third Generation Parasequences**

FIRST GENERATION SEQUENCE STRATIGRAPHY

1917 – 1964

Formulation of basic concepts and
introduction of the sequence as a
distinct stratigraphic unit.



Larry

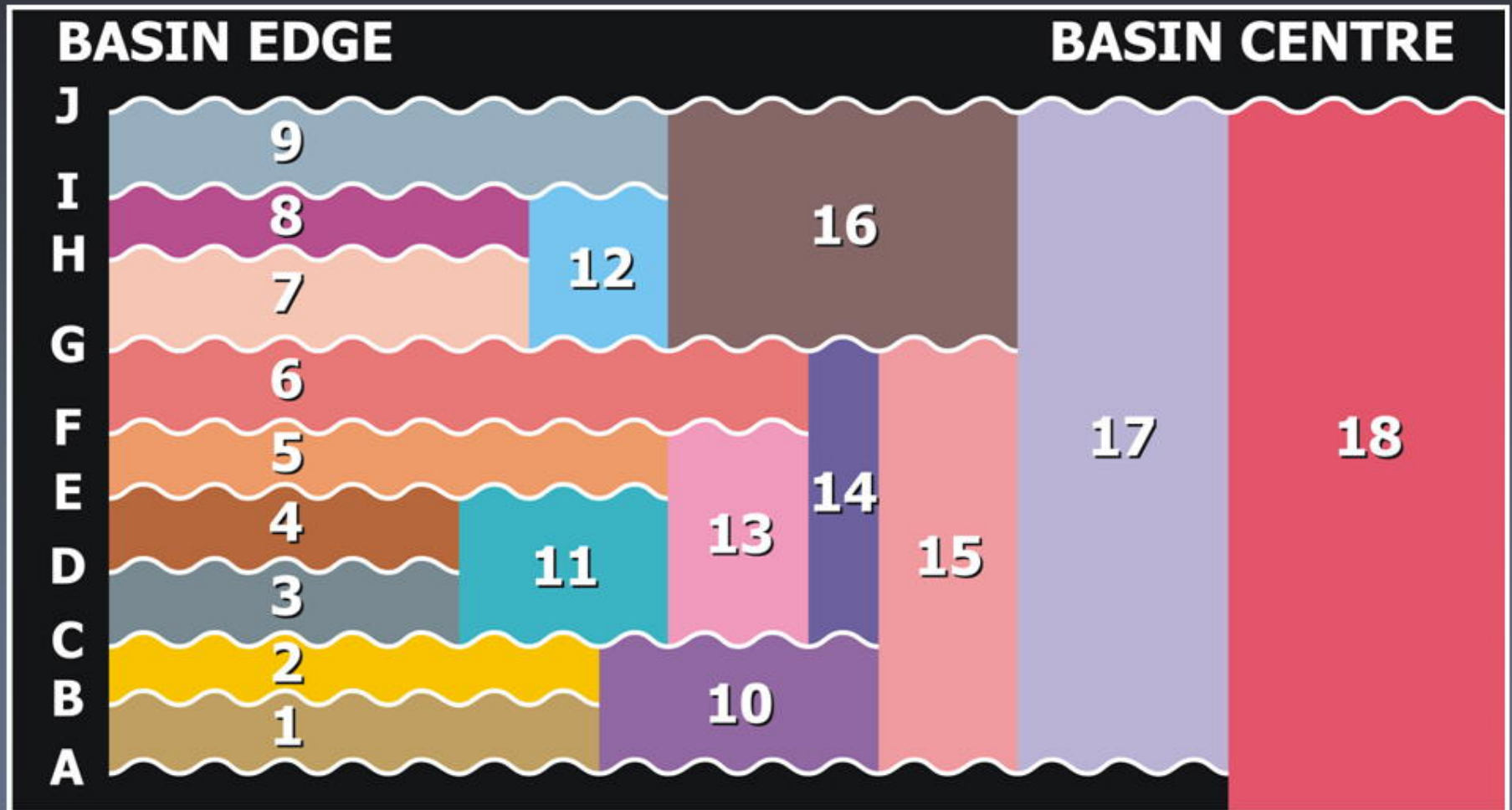


Harry



JOE

NOMENCLATURAL NIGHTMARE OF 1G SEQUENCES



SECOND GENERATION SEQUENCE STRATIGRAPHY



1974 – Present



Reintroduction of the basic principles of sequence stratigraphy to a generation of sedimentologists combined with some significant improvements in methodology.

2G

SEQUENCE DEFINITION

**A Sequence ... is
bounded at its
top and base by
unconformities
or their
correlative
conformities**

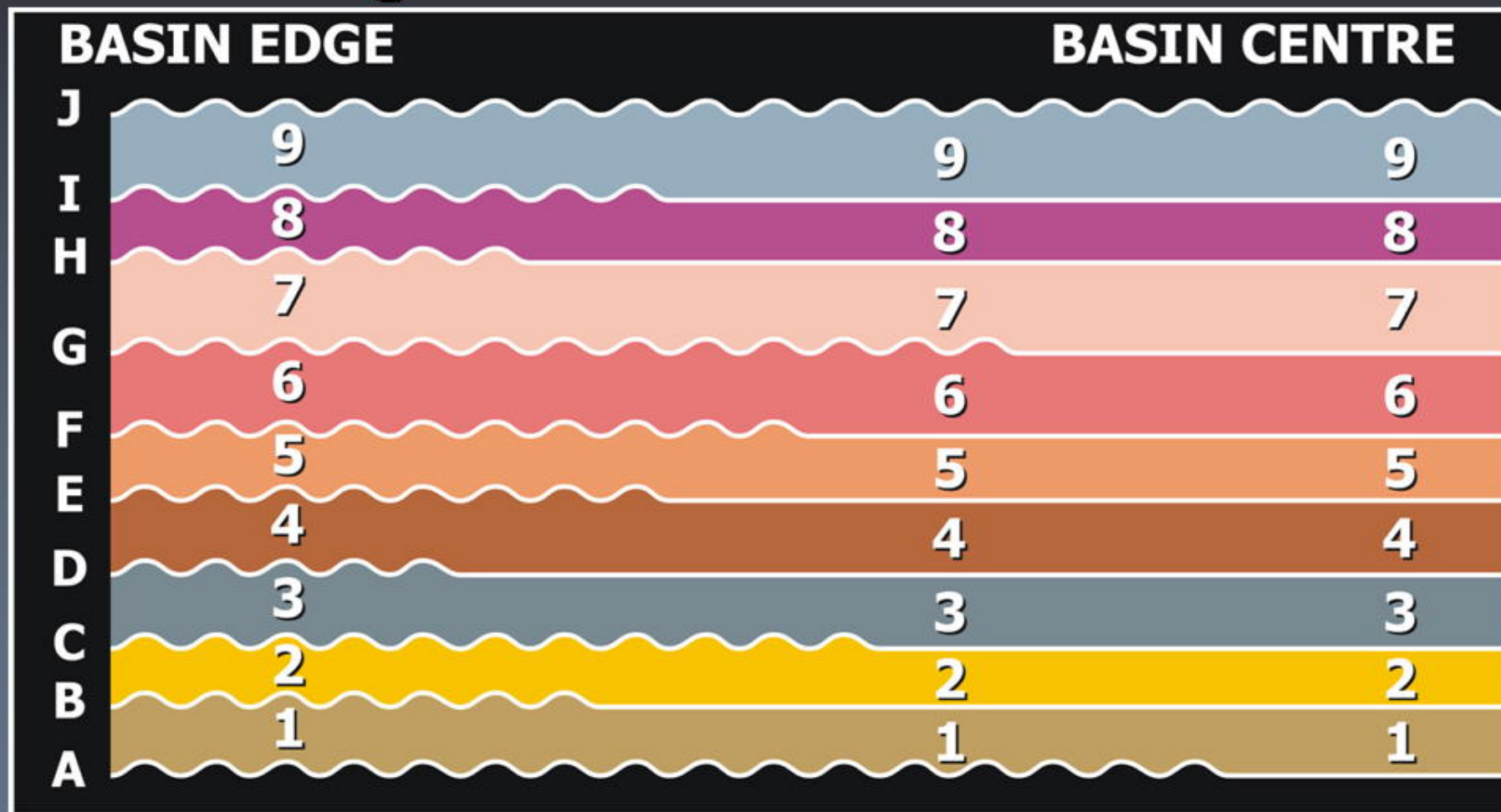


PETE



BOB

NOMENCLATURAL SIMPLICITY OF 2G SEQUENCE STRATIGRAPHY

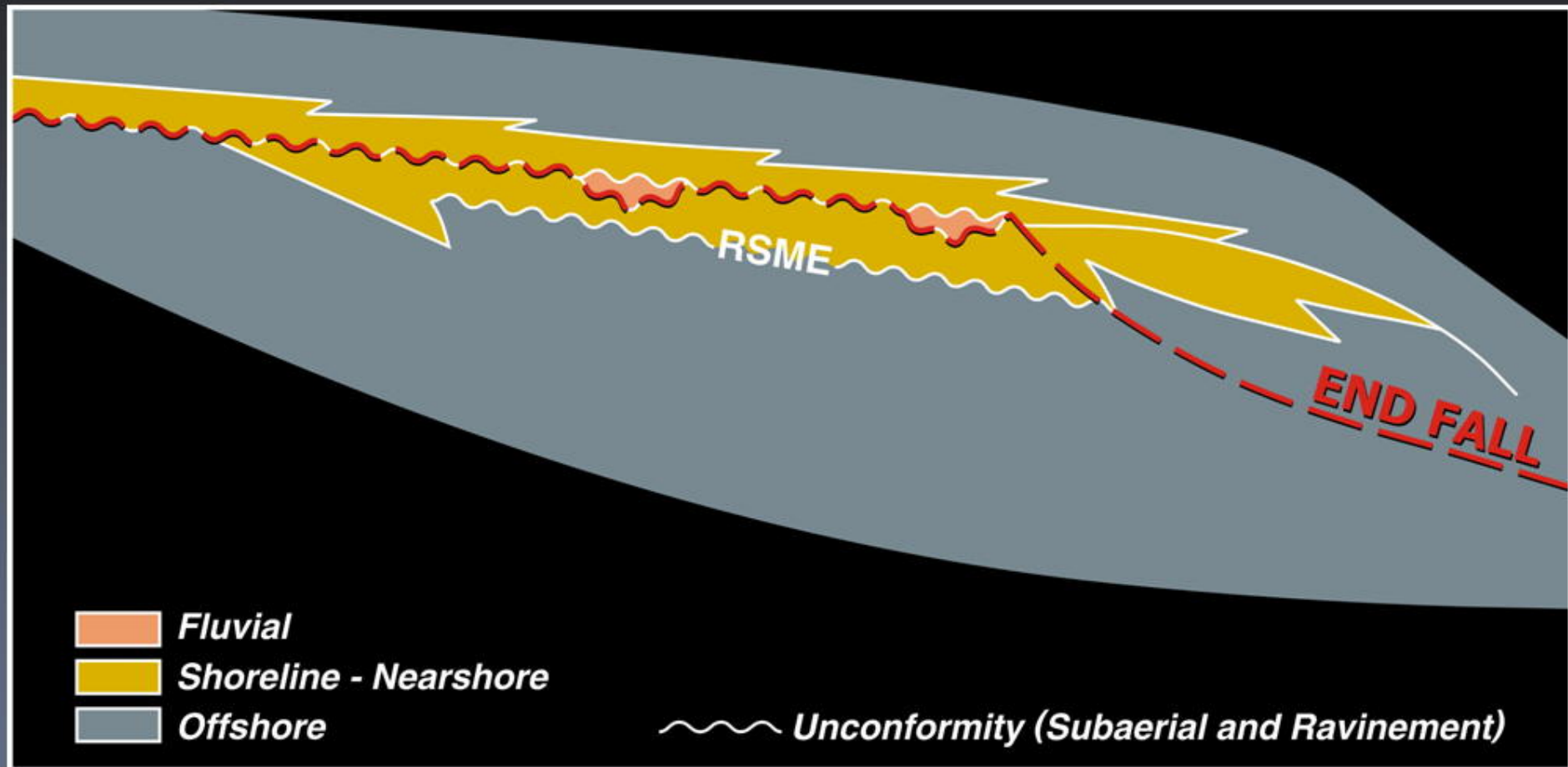


The Biggest Problem with 2G Sequence Stratigraphy

**The use of an invisible
time surface for the
correlative portion of the
sequence boundary.**

2G SEQUENCE BOUNDARIES

Time Surface at the Start or End of Base Level Fall



THIRD GENERATION SEQUENCE STRATIGRAPHY

1992 – Present

Retention of the important contributions and abandonment of the flawed concepts, methods and jargon of 1G and 2G sequence stratigraphy.

THIRD GENERATION SEQUENCE STRATIGRAPHY

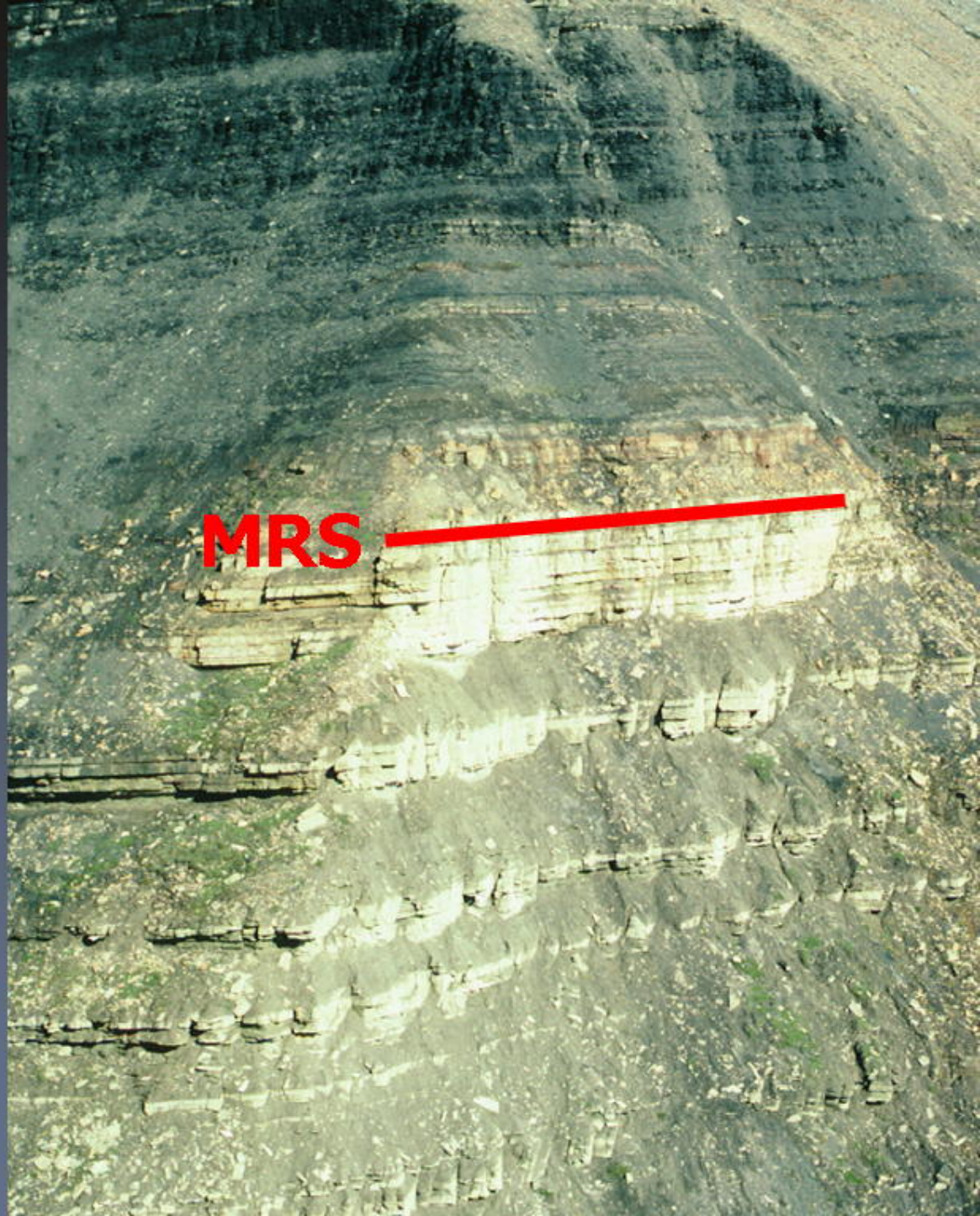
1992 – Present

**Introduction of pragmatic
and scientifically
defendable definitions and
methods with a minimum
of jargon.**

3G Correlative Conformity of a Sequence Boundary

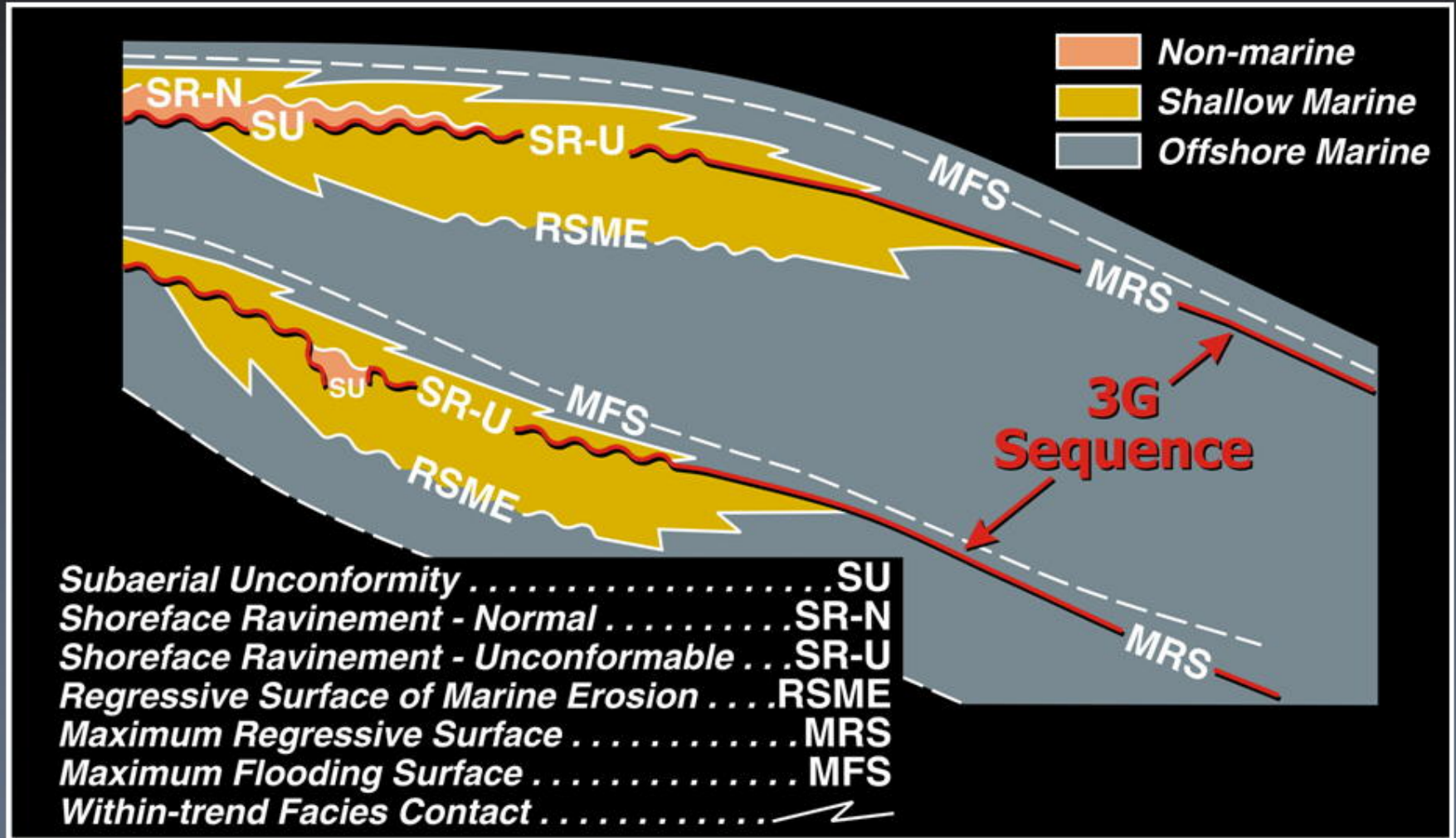
**Maximum regressive
surface (MRS) which
extends basinward from
the termination of the
unconformity**

**A maximum
regressive
surface
marks a
change from
a regressive
trend to a
transgressive
one**



RAMP SETTING

3G vs. 2G Correlative Conformity





3G Sequence Boundary (SU)



3G Sequence Boundary (MRS)

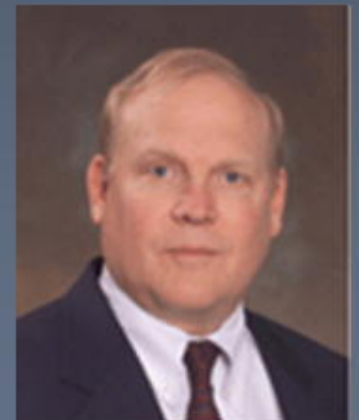
2G Sequence Stratigraphy

Another important contribution was the introduction of another specific type of unit – the parasequence.

2G Parasequence:

A relatively conformable succession of genetically related beds or bedsets bounded by marine-flooding surfaces.

Van Wagoner et al, 1990



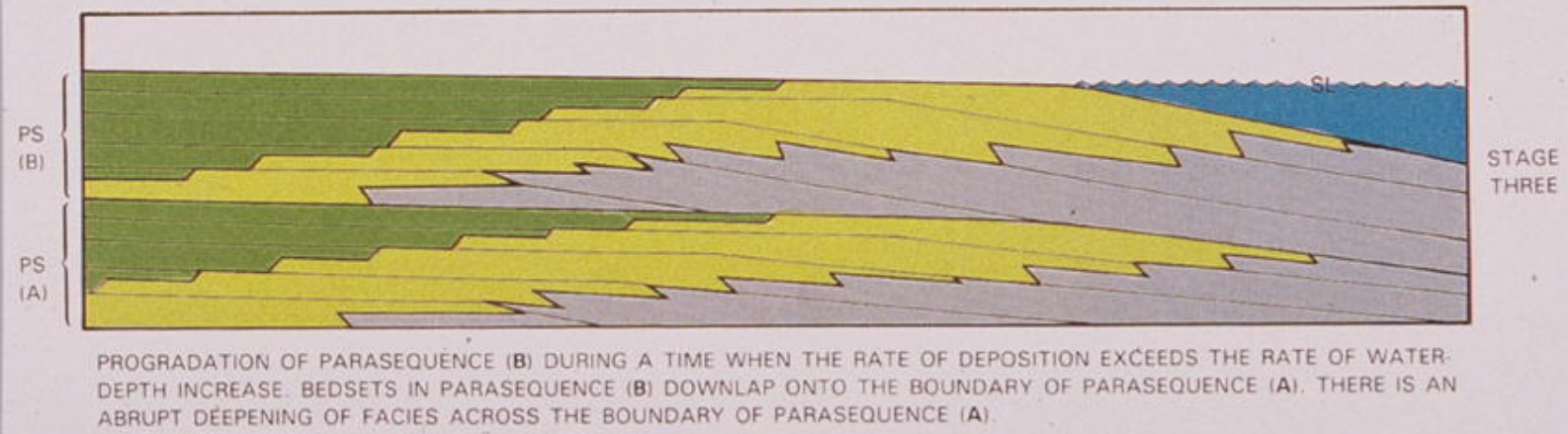
Marine-Flooding Surface:

**A surface separating
younger from older strata
across which there is
evidence of an abrupt
increase in water depth.**

Van Wagoner et al, 1990



Instantaneous transgressions with no transgressive deposits are not actualistic



Development of a Parasequence Boundary

Van Wagoner et al, 1990

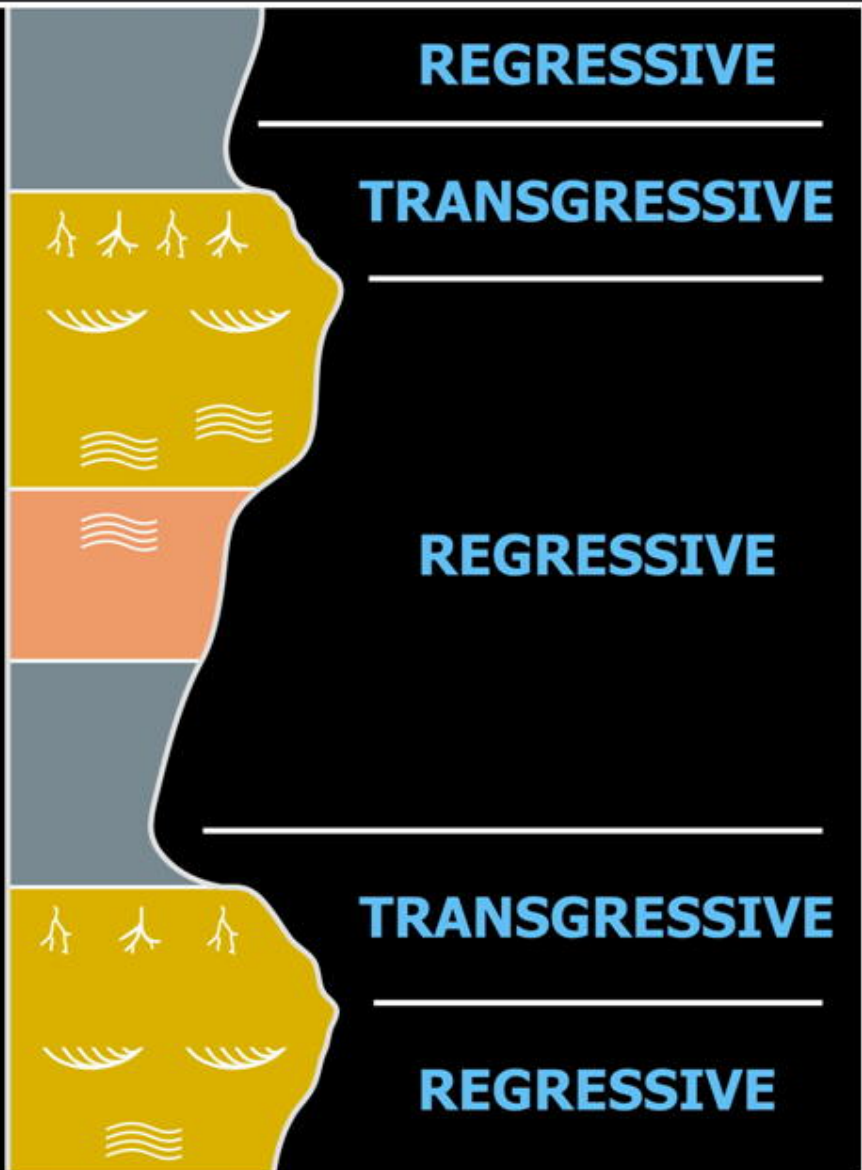
Parasequence Generation

It is accepted that parasequences form when the ratio between the rate of sedimentation and the rate of base level rise (S/BLR) fluctuates between >1 (regression) and <1 (transgression).

Parasequence Generation

Such fluctuations between regressive intervals and transgressive ones are driven by changes in sedimentation rates and/or base level rise rates related to either intrinsic controls (e.g. delta lobe migration) or by extrinsic controls (eustasy or tectonics).

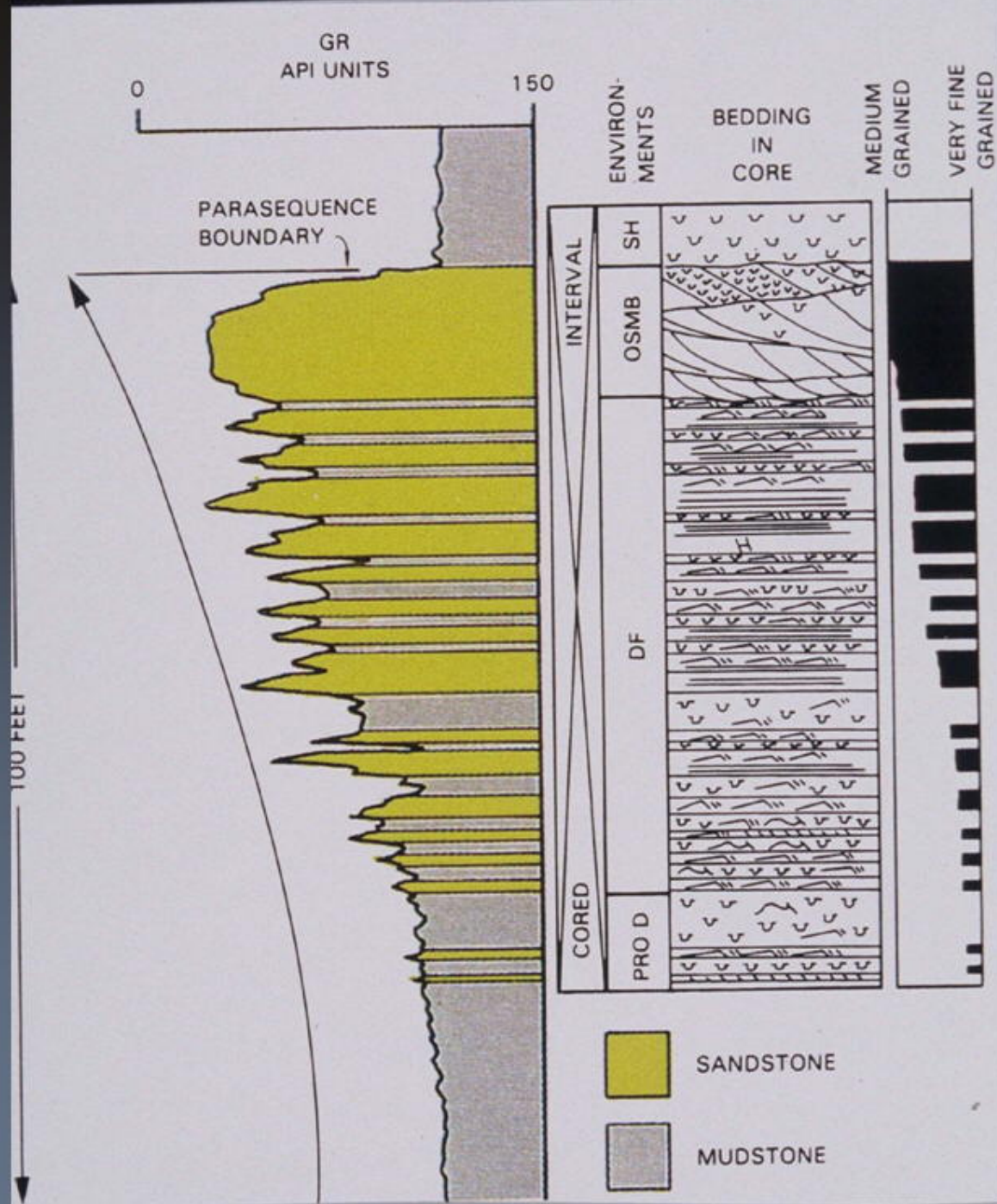
Parasequence Boundary



What is the best contact to use for drawing the boundaries of a parasequence?

**The 2G
Parasequence
Boundary is
drawn at the
contact
between
sandstone
below and
shale above
("flooding
surface").**

Van Wagoner et al, 1990

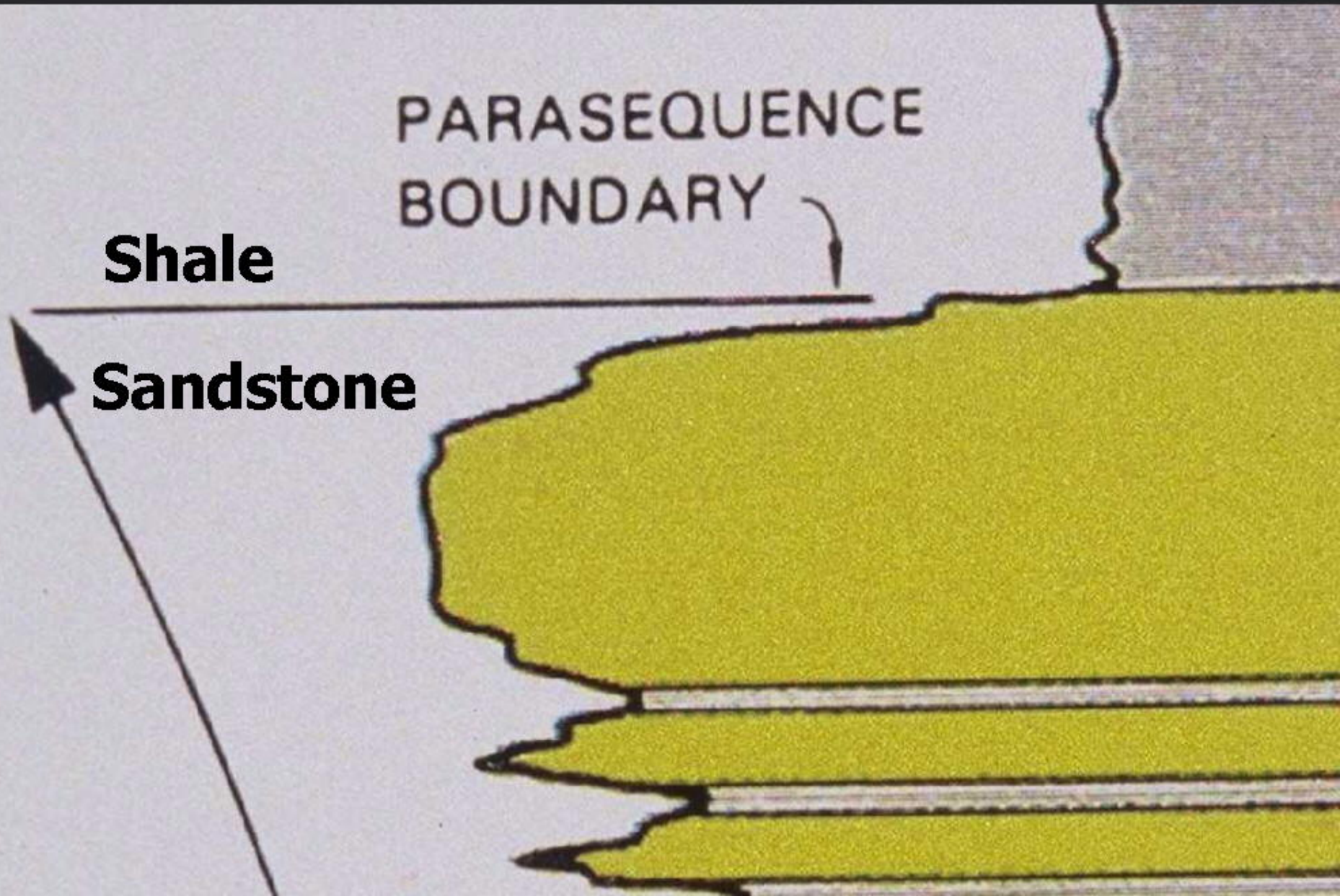


2G PARASEQUENCE BOUNDARY

PARASEQUENCE
BOUNDARY

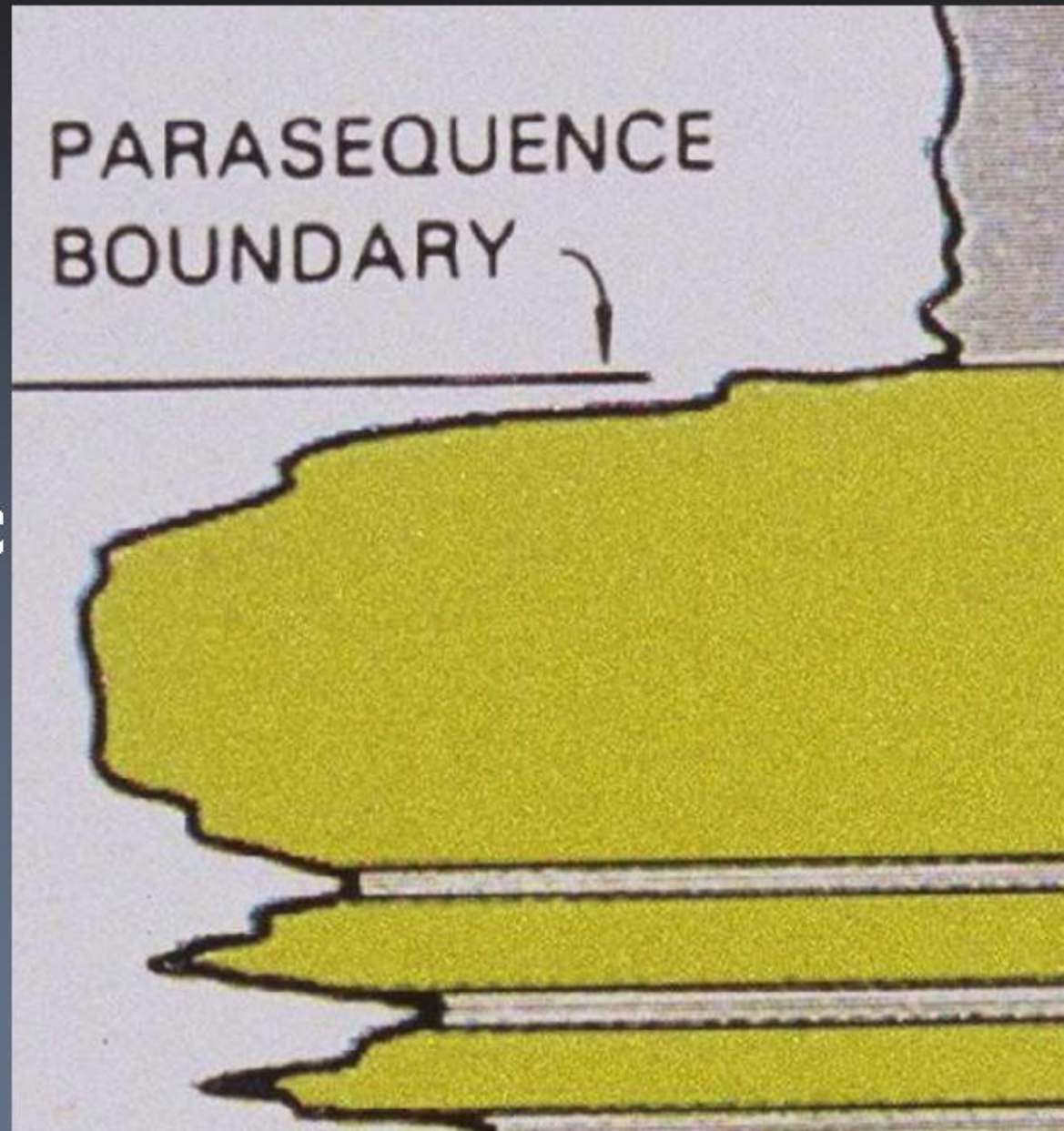
Shale

Sandstone



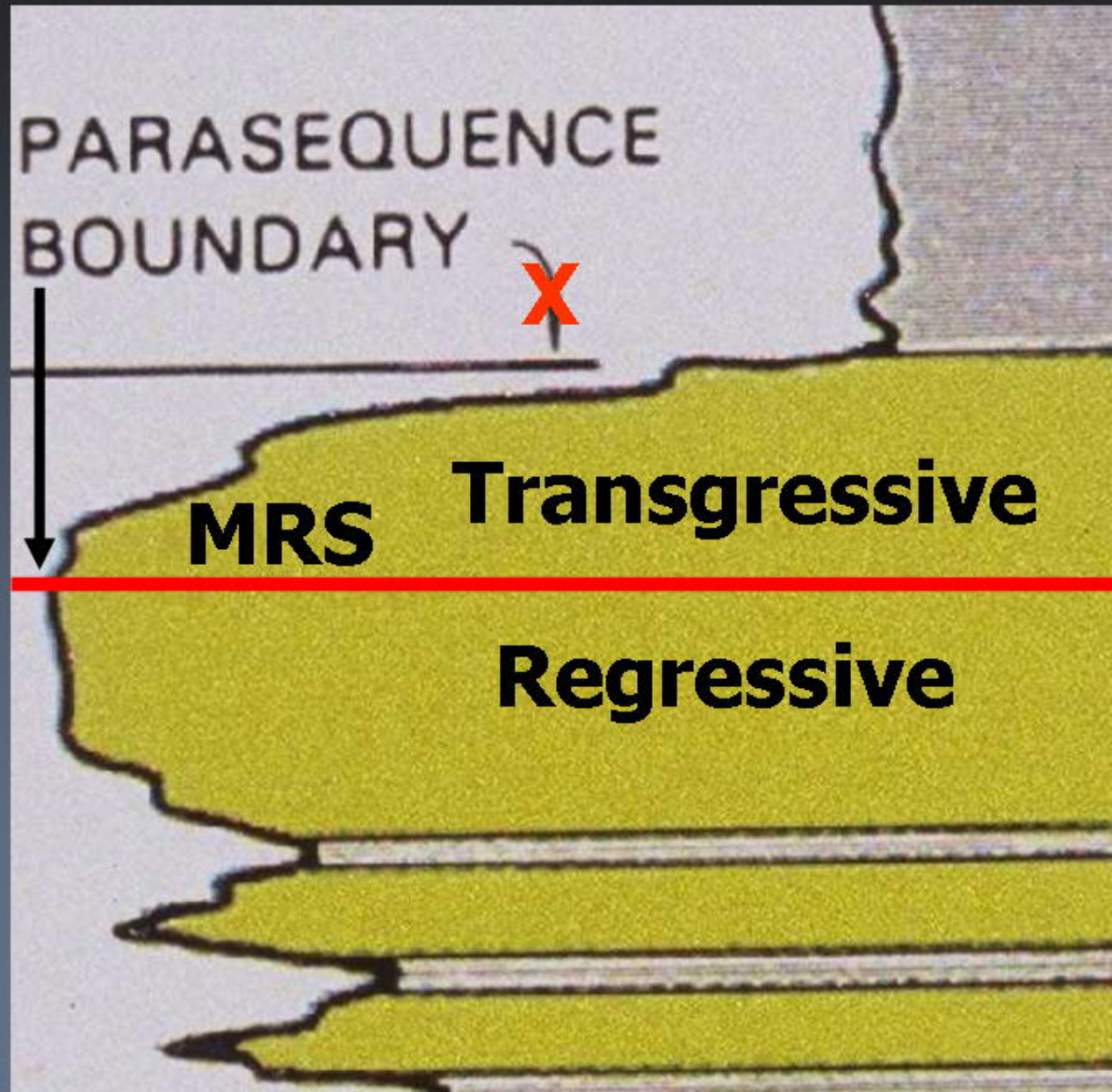
2G PARASEQUENCE BOUNDARY

This sand/shale contact is an in-trend facies contact or lithostratigraphic contact, not a sequence stratigraphic one.



3G PARASEQUENCE BOUNDARY

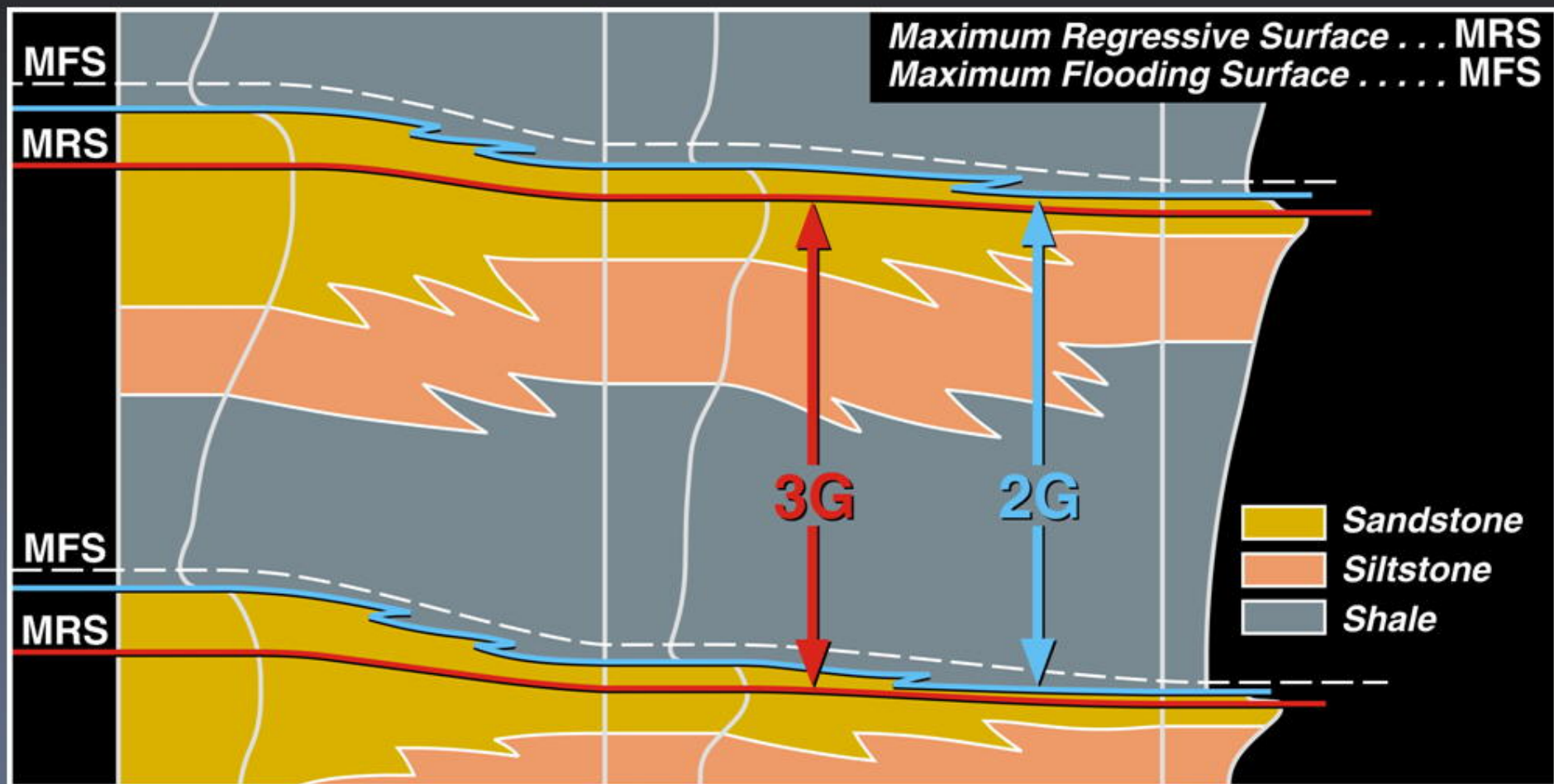
The maximum regressive surface is a much more logical and practical boundary for a parasequence



The MRS as a Parasequence Boundary

An MRS has a lower diachroniety than a flooding surface (a retrogradational facies contact) and thus 3G parasequences better approximate chronostratigraphic units than do 2G parasequences.

3G vs. 2G PARASEQUENCE

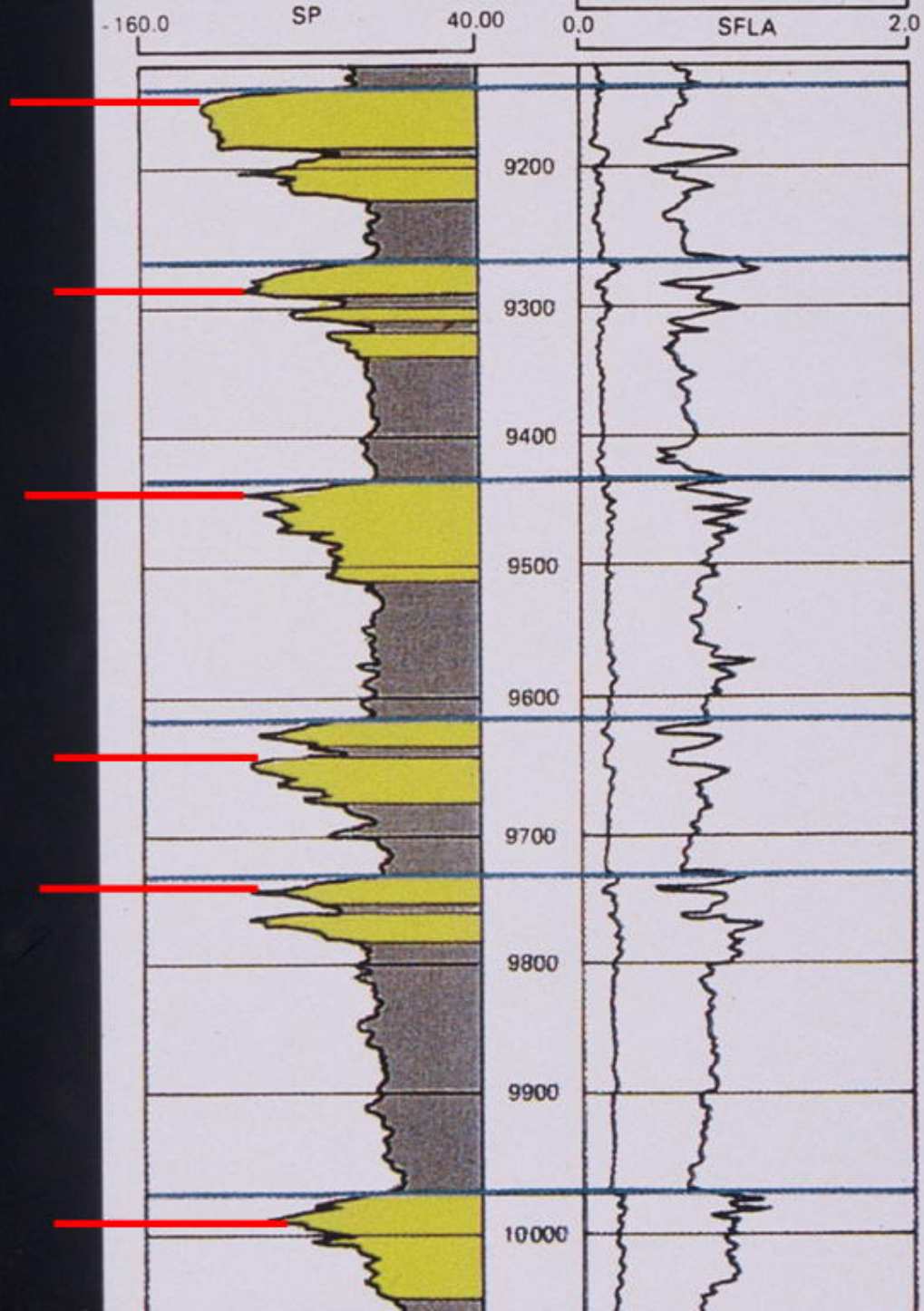


The MRS as a Parasequence Boundary

This low diachroniety aspect of 3G parasequence boundaries is important for more accurate correlations and facies predictions than is presently possible with 2G parasequences.

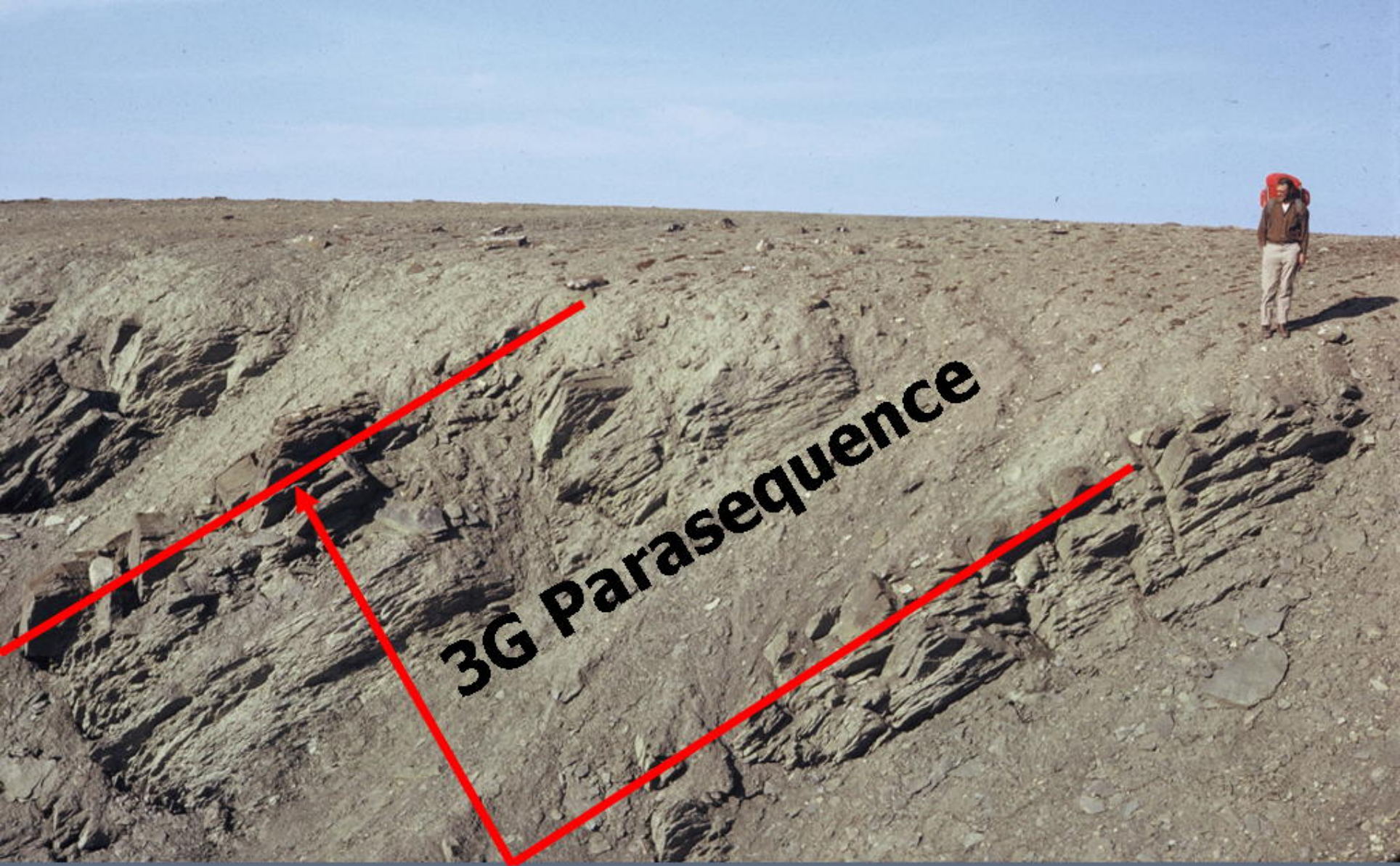
**The MRS
contact can
be readily
determined in
most cases
and brings the
parasequence
into sequence
stratigraphy.**

Log from
Van Wagoner et al, 1990



3G Parasequence

Is defined as a sequence stratigraphic unit bounded by maximum regressive surfaces at least one of which does not correlate with an unconformity.



3G Parasequence

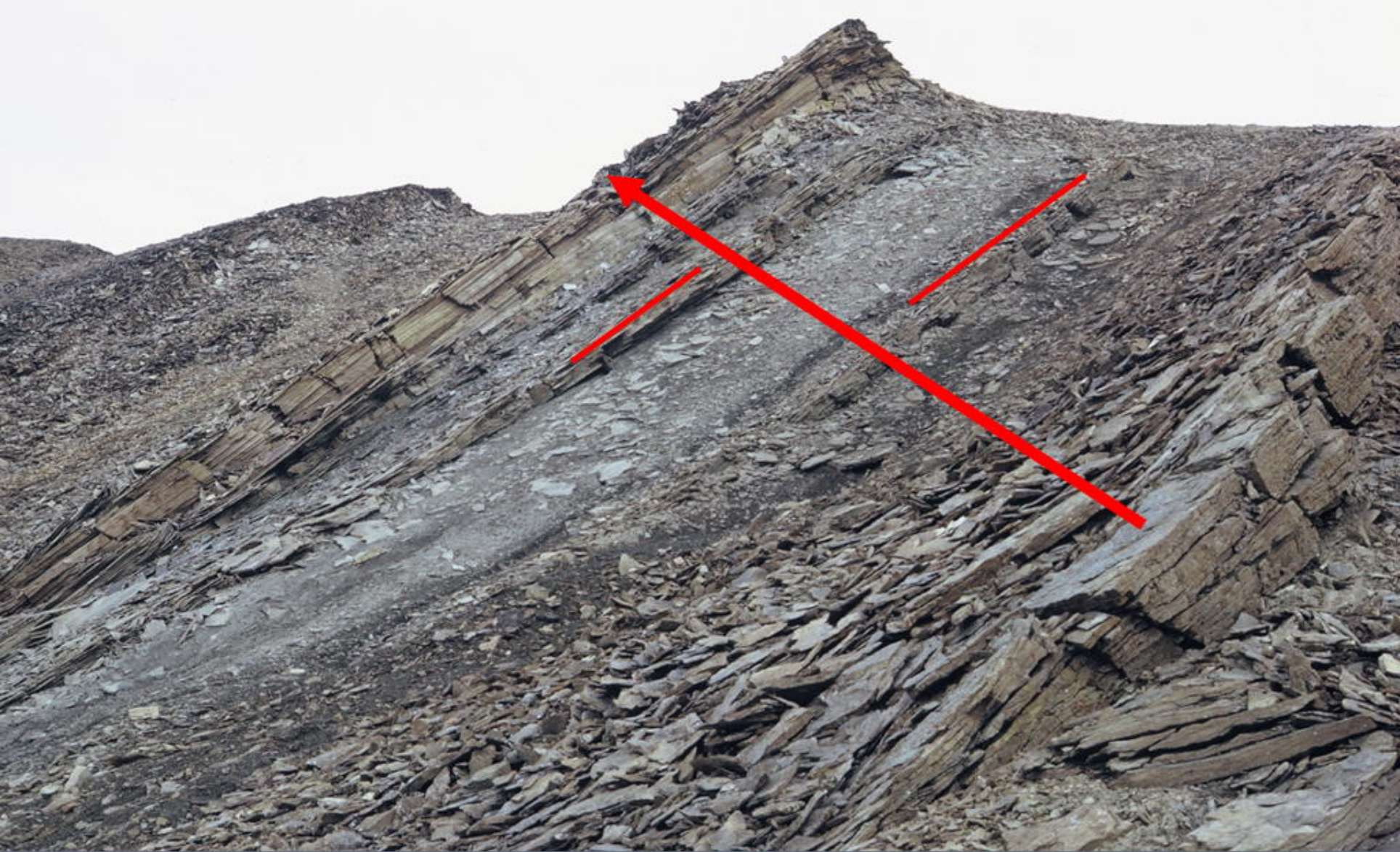
Parasequence Boundary



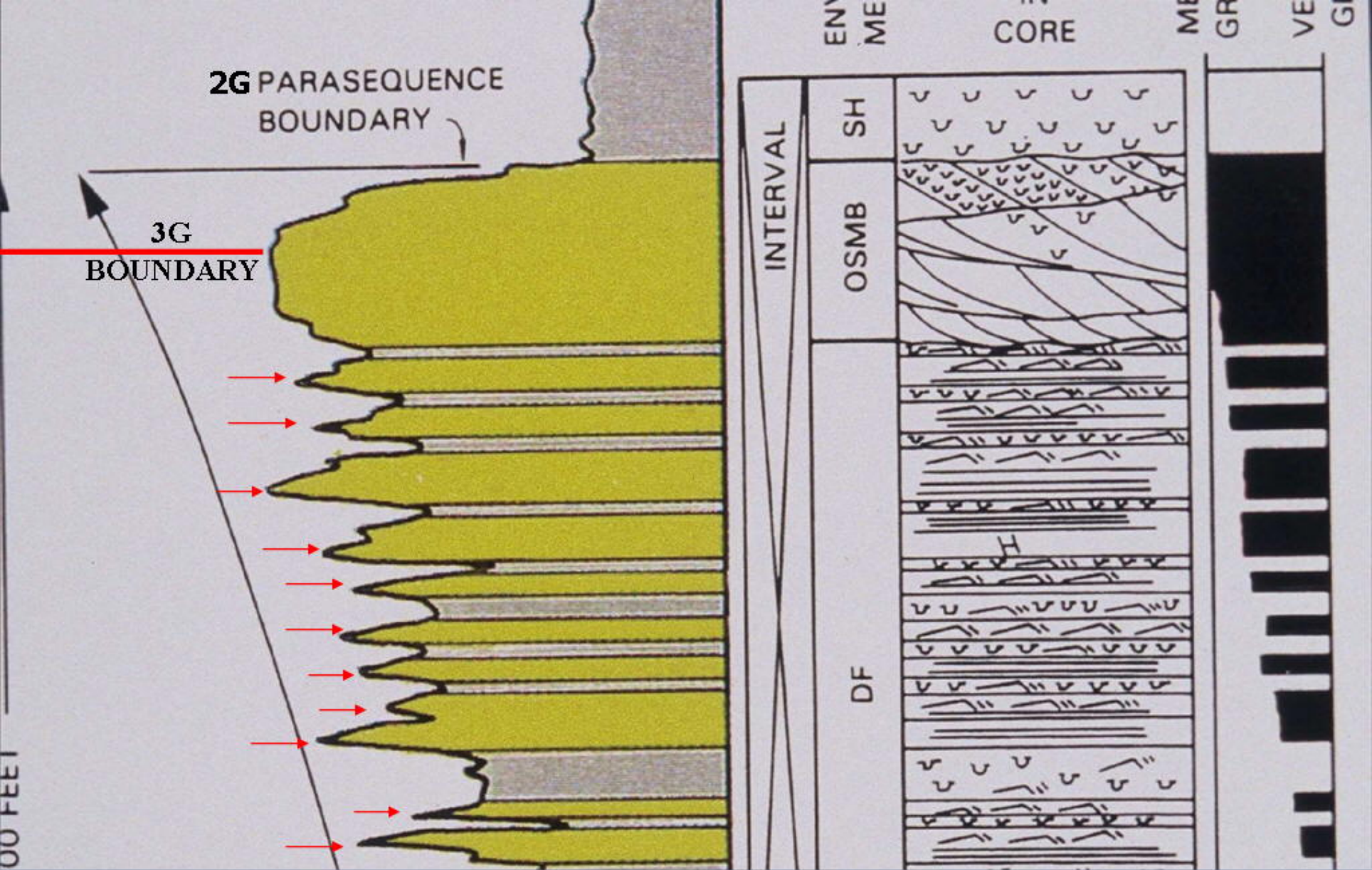
Parasequence Contact at MRS

Parasequence Hierarchy

**A 3G parasequence is
NOT scale dependent and
its definition depends
solely on the
determination of its
bounding surfaces.**



Parasequence Hierarchy



Parasequence Hierarchy

**CISCO
B-66**

MRS

MRS

Sequence

GAMMA

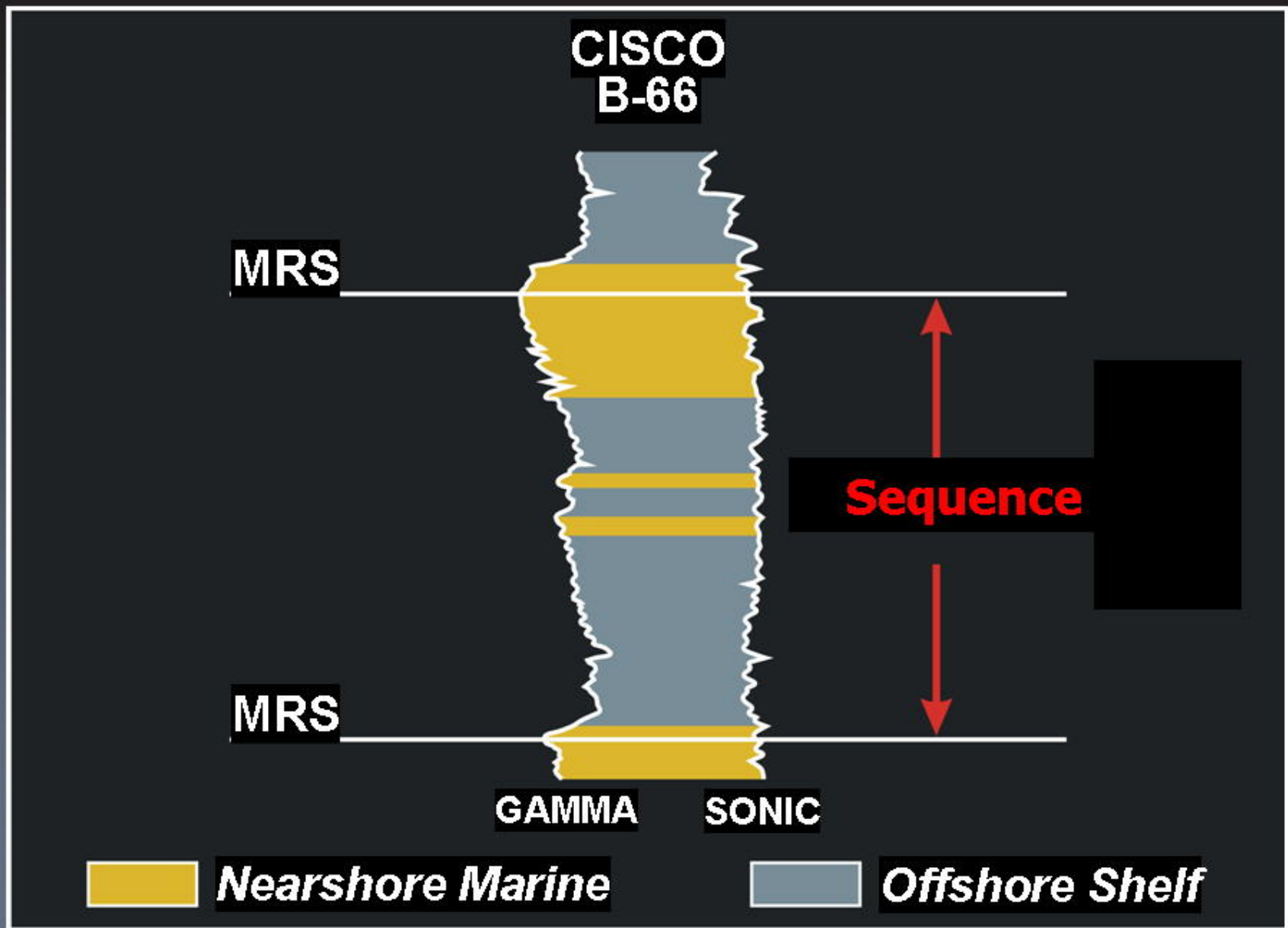
SONIC



Nearshore Marine



Offshore Shelf



Parasequences and Sequences

A parasequence becomes elevated to a sequence when it can be demonstrated that BOTH bounding MRSs correlate with subaerial unconformities.

Sequence

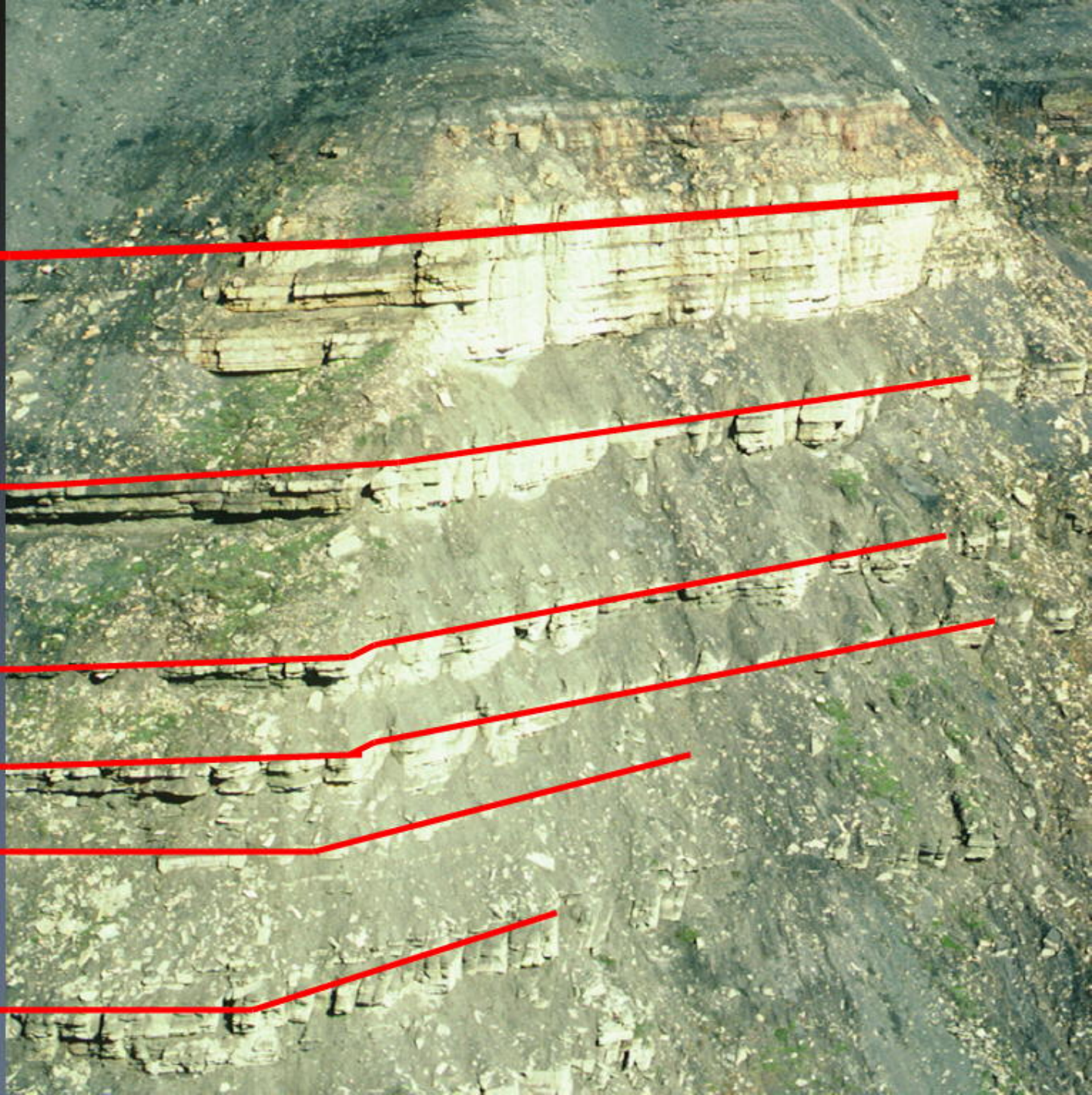
PS 5

PS 4

PS 3

PS 2

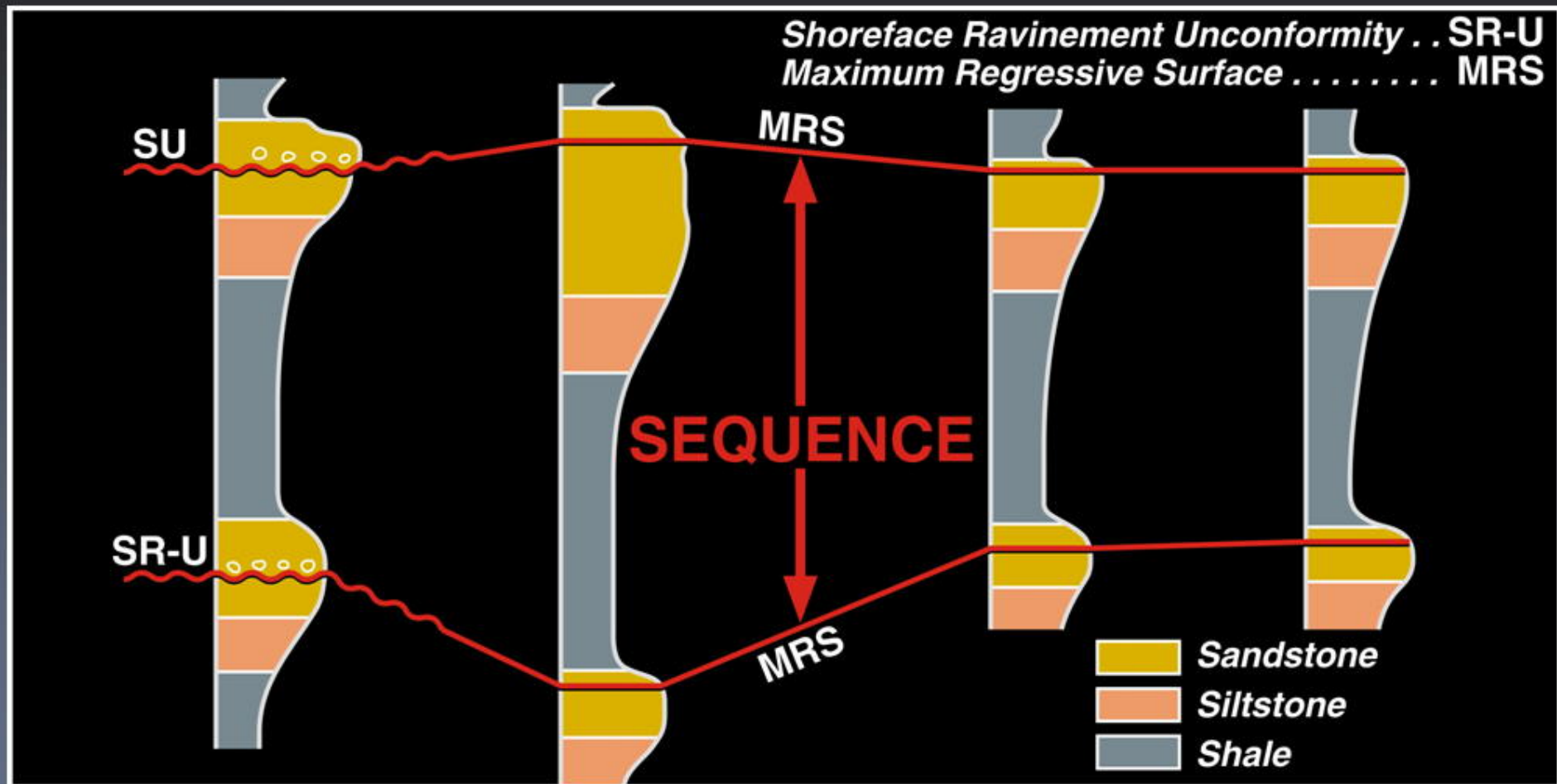
PS 1



Parasequences and Sequences

Parasequences can be considered as “sequences in waiting”. New data and/or interpretations can transform a parasequence into a sequence.

SEQUENCE vs. PARASEQUENCE



Conclusions

A 2G parasequence with its diachronous, facies contacts is a lithostratigraphic unit rather than a sequence stratigraphic one. This significantly reduces its value in stratigraphic analysis.

Conclusions

A 3G parasequence is a sequence stratigraphic unit and is defined as a unit bounded by maximum regressive surfaces at least one of which does not correlate with a subaerial unconformity.

Conclusions

A 3G parasequence is not scale dependent and a nested hierarchy of parasequences can occur.

Conclusions

A 3G parasequence becomes a 3G sequence when both boundaries are found to correlate with subaerial unconformities.

Conclusions

3G parasequences are excellent units for high resolution correlation and subdivision of a stratigraphic succession and for consequent paleogeographic interpretations and facies predictions.

**Thank You
Very Much
for Your
Attention**



**I Haven't Got Time
for Questions**

