层序地层学基础
Basis of Sequence Stratigraphy

——2009年本科生

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层序地层学基础

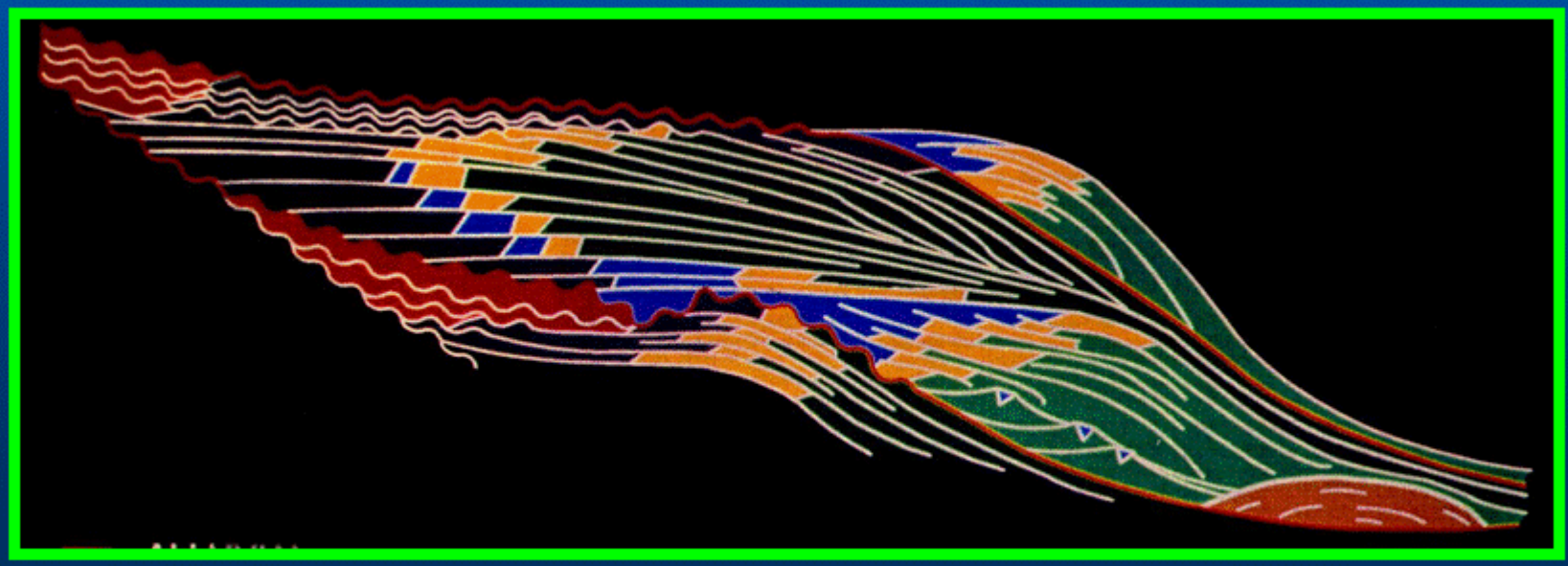
第二部分　层序地层学基础

- ♣ 层序地层学的基本理论和关键性定义
- ♣ 钻井、地震资料的层序地层学解释方法

➢第六章　高分辨率层序地层学概述

基本概念——层序

- **一套相对整一的、成因上有联系的、其顶和底面以不整合面或者与这些不整合面可以对比的整合面为界的地层**(据Vail等，1977)。层序是在海平面升降周期曲线上相邻的两个下降速度转折点之间沉积的，它由一套体系域所组成。



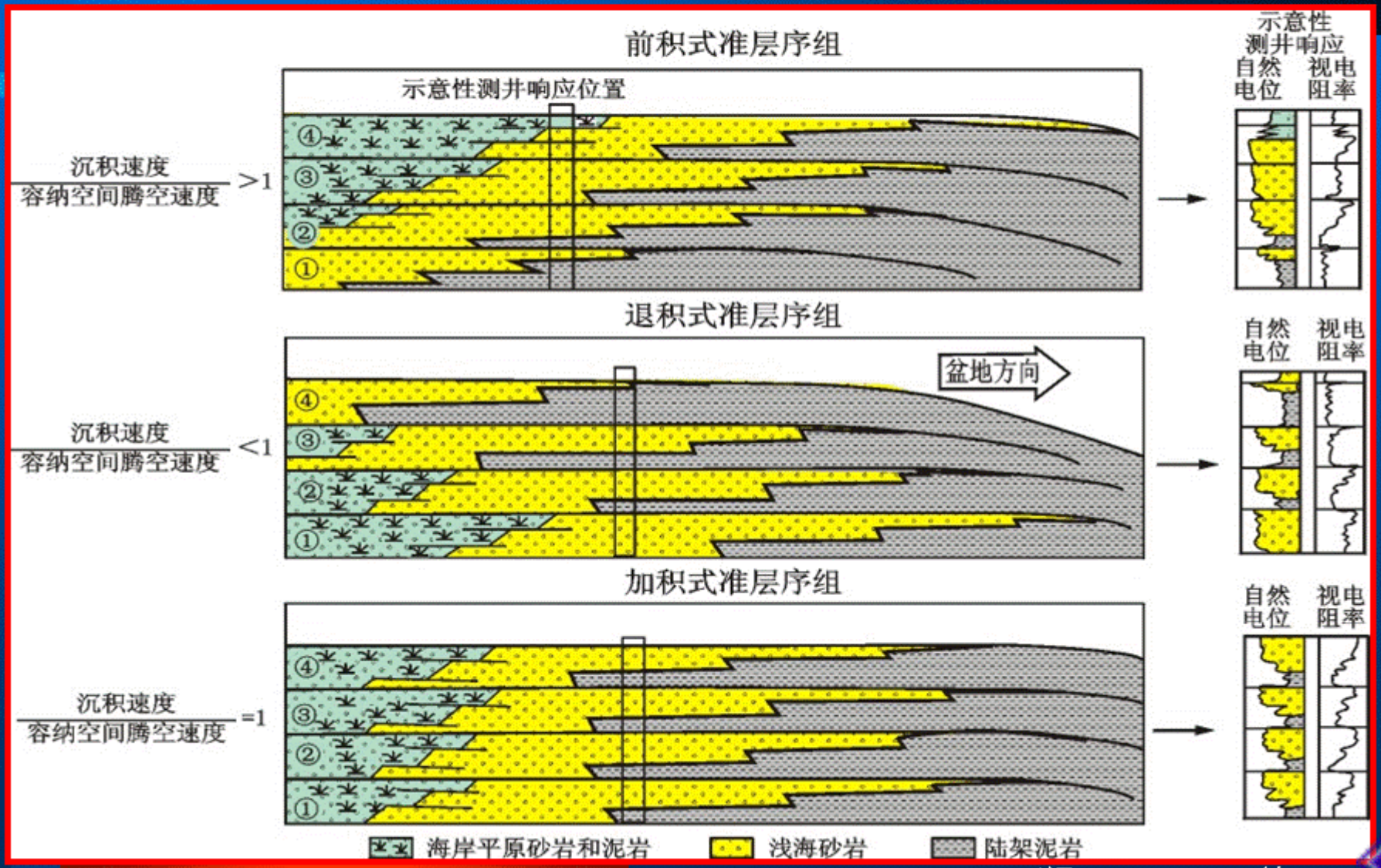
Definition of Key Terms

准层序组 *Parasequence Set*

- 一系列成因相关的、并具特定叠加模式的准层序，大多数情况下，它以主要洪泛面和与之相对应的界面为界。
- A succession of genetically related parasequences which form a distinctive stacking pattern that is bounded, in many cases, by major marine-flooding surface and their correlative surface (J.C.Van Wagoner, 1988) .

准层序组 *Parasequence Set*

内部地层叠覆方式及其测井响应特征



（据Van Wagoner等，1988）

Definition of Key Terms

准层序组的类型

- 当沉积物供应速率大于可容纳空间的增长速率时，形成progradational(进积或前积)准层序组
- 当沉积物供应速率小于可容纳空间的增长速率时，形成 retrogradational(退积)准层序组
- 当沉积物供应速率约等于可容纳空间的增长速率时，形成 aggradational(加积)准层序组

Definition of Key Terms

准层序组 *Parasequence Set*

- Its boundary form in response to an increase in water depth.

1. Parasequence set boundaries

(1) separate distinctive parasequcnce-stacking patterns,

(2) may coincide with sequence boundaries,

(3) may be downlap surface and boundaries of systems tracts.

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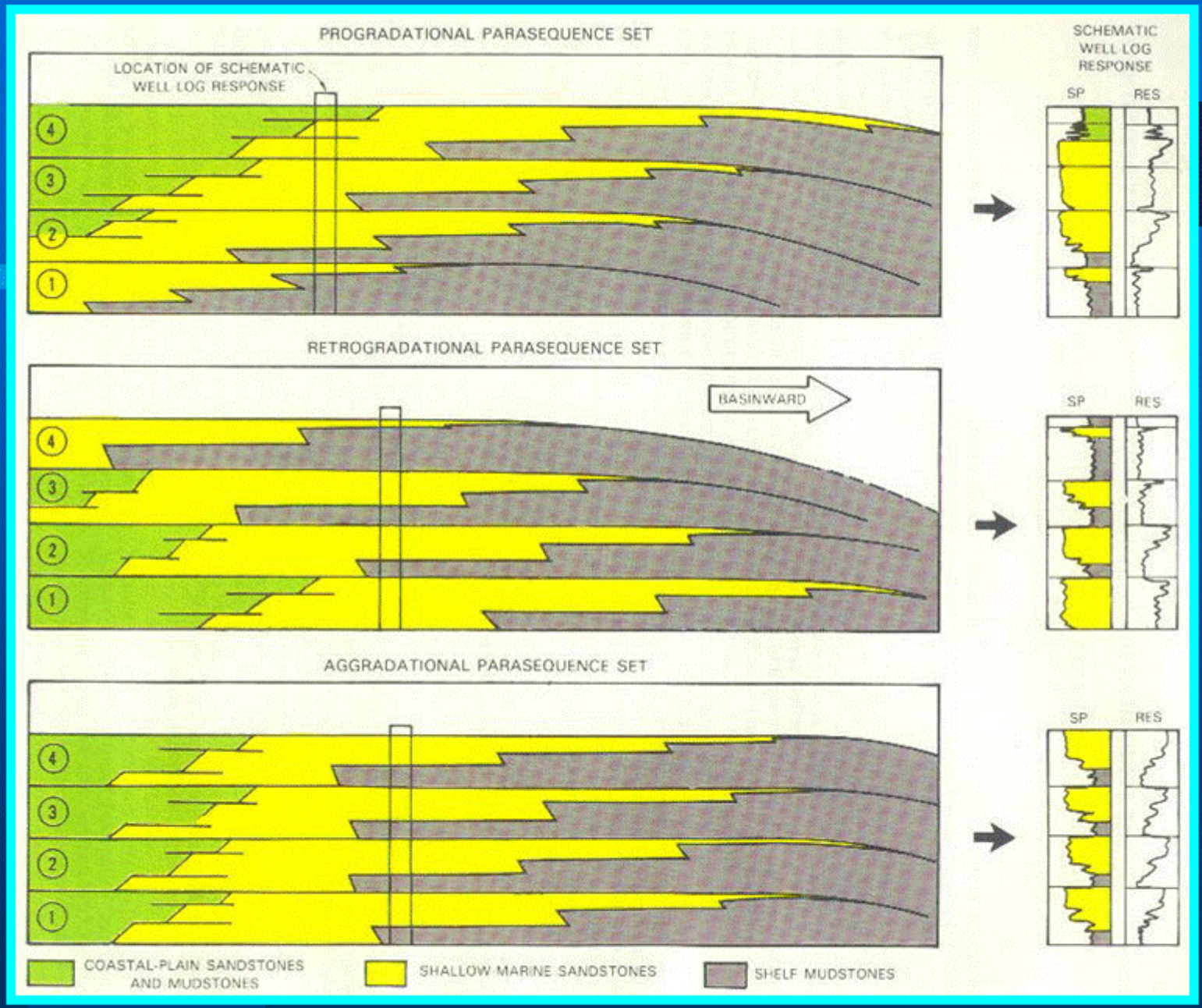
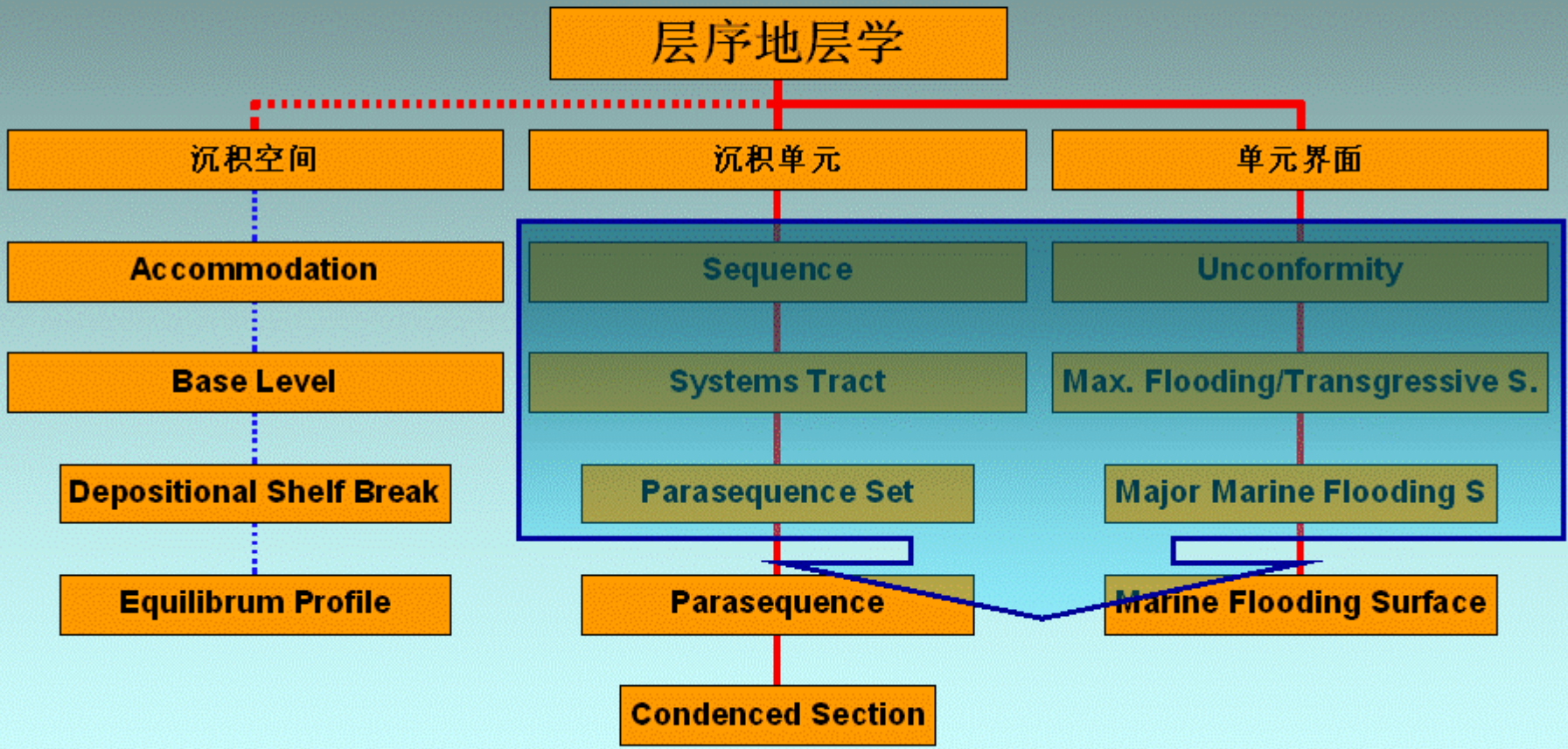


三种类型：进积式（或前积式），退积式和加积式

The Relationship of the Terms



Definition of Key Terms

准层序 *Parasequence*

- 一个相对整一的地层序列，它由成因相关的岩层或岩层组组成，并以洪泛面和与之相对应的界面为界。
- **A relatively conformable succession of genetically related beds or bedsets bounded by marine-flooding surface and their correlative surface(J.C.Van Wagoner, 1985).**

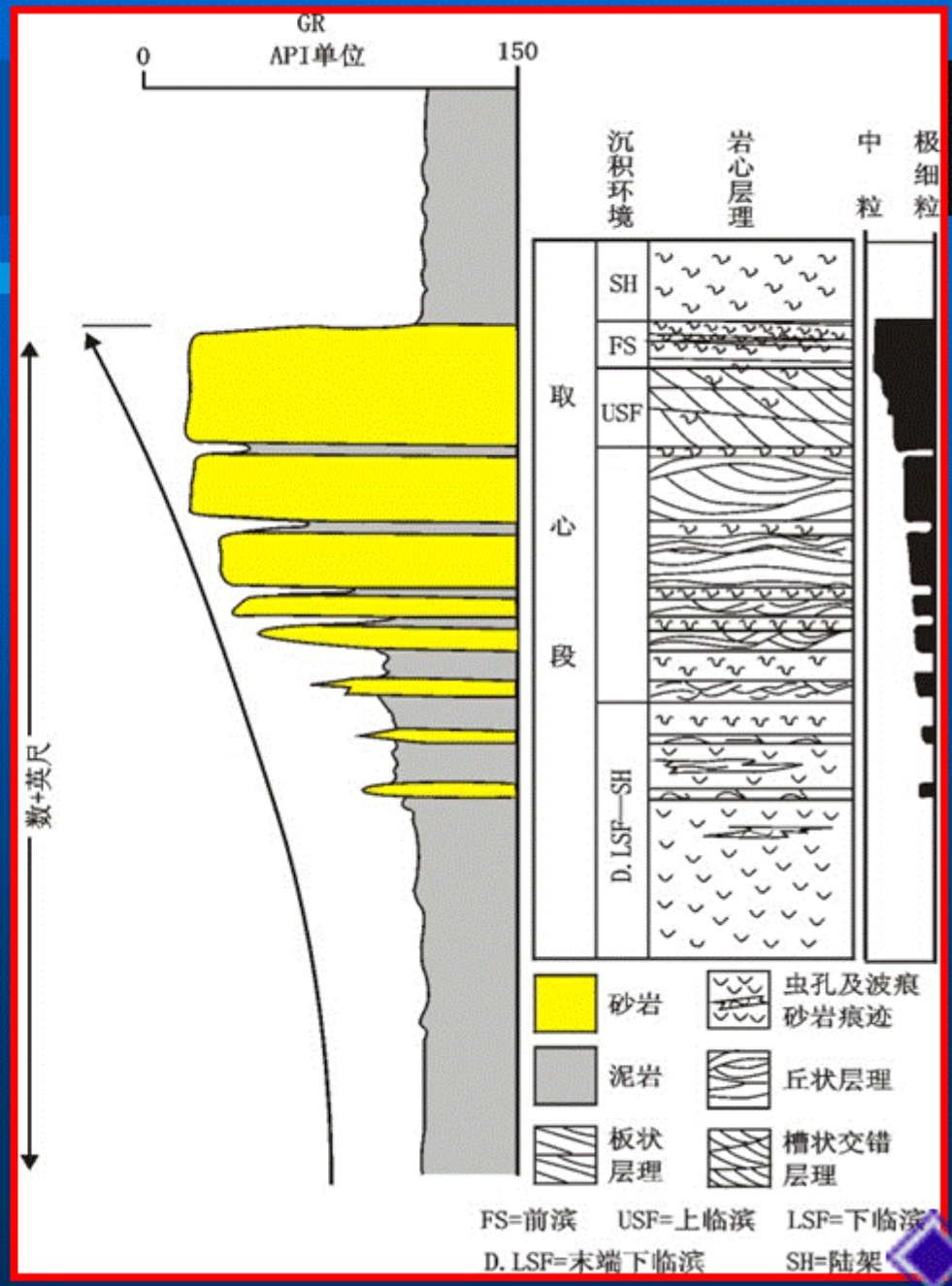
Definition of Key Terms

准层序

Parasequence

碎屑滨岸环境的向上变粗准层序特征

- 它形成在浪控或河控的滨岸浅滩上。

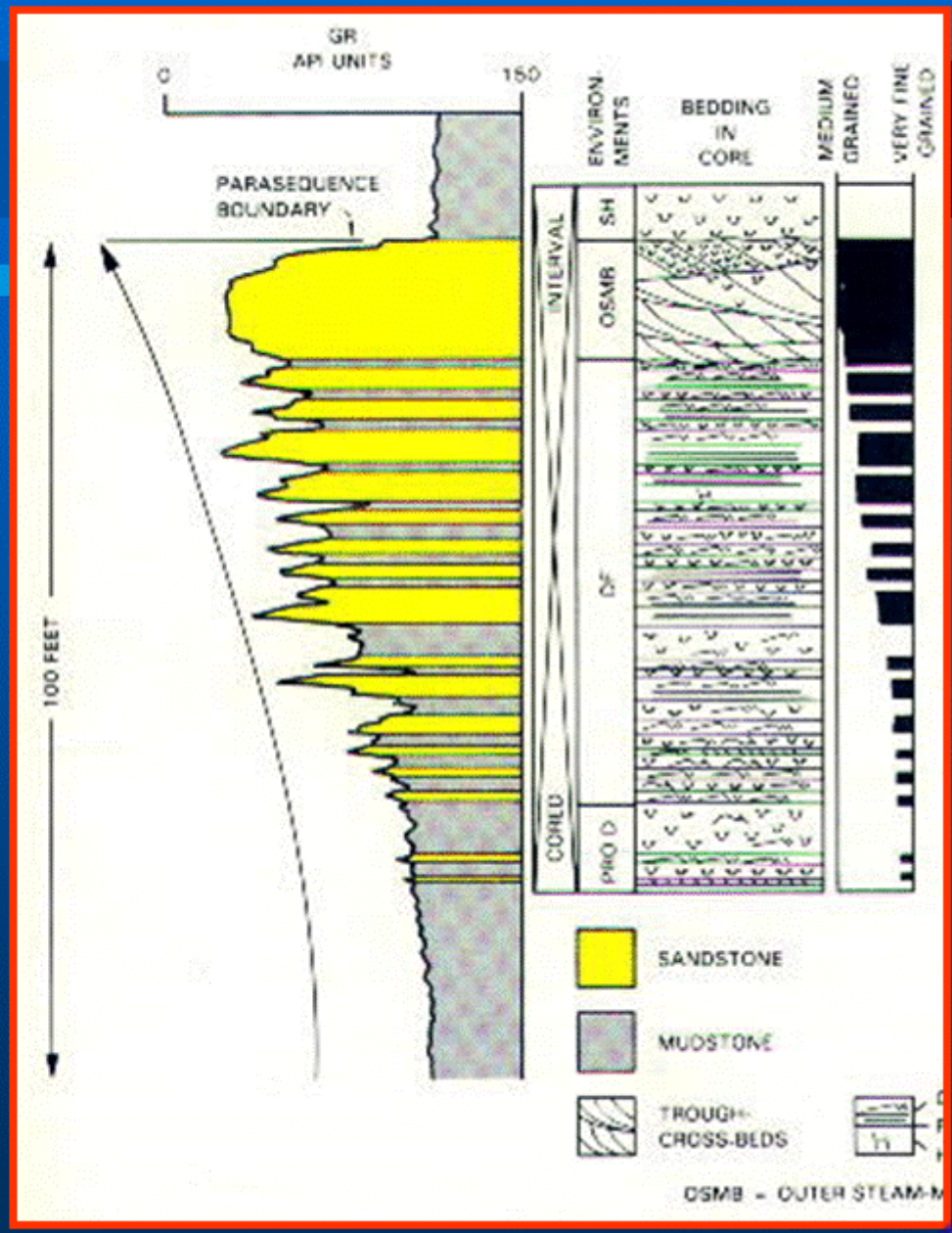


Definition of Key Terms

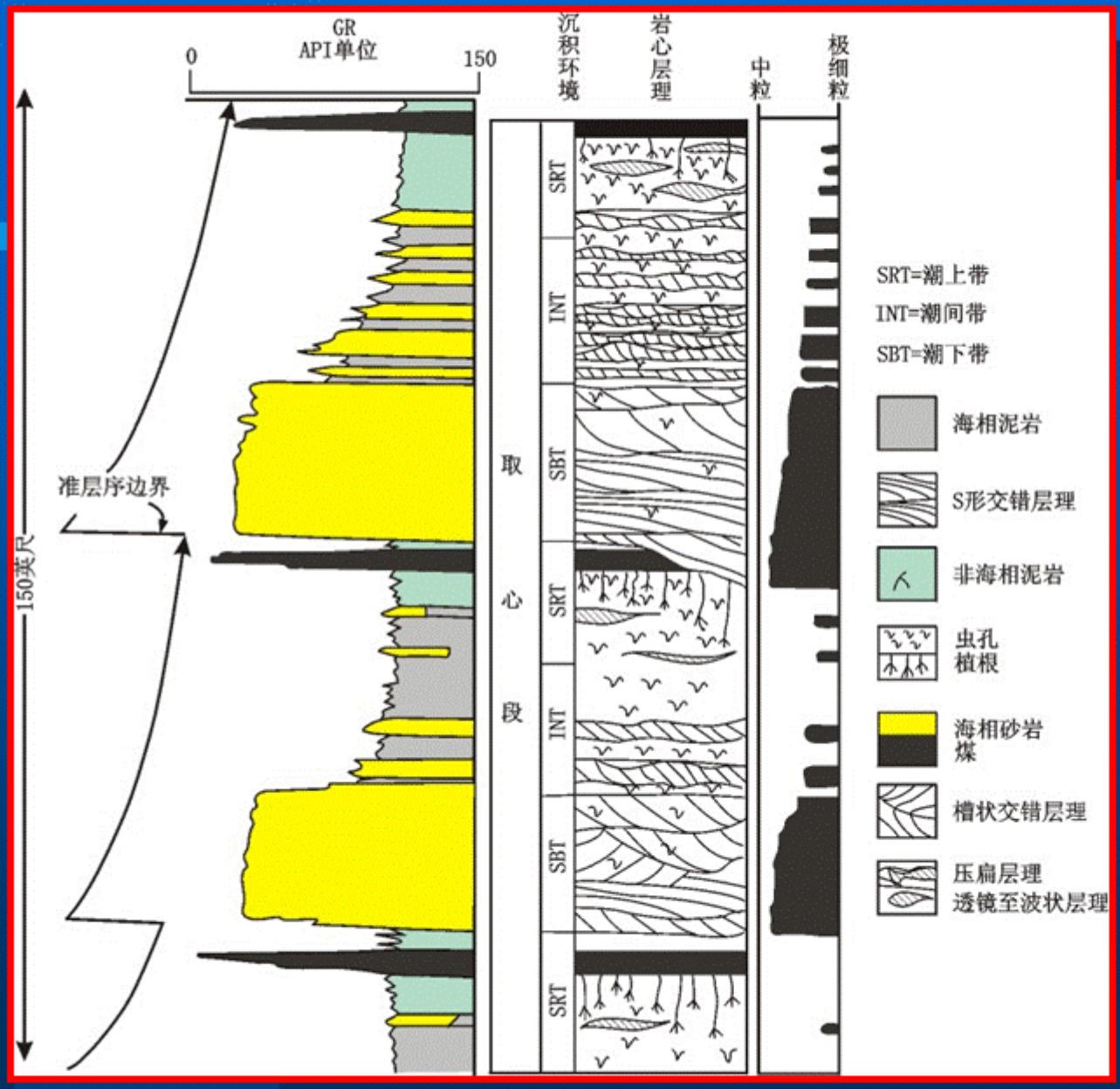
准层序

Parasequence

- 向上变粗的、三角洲砂沉积准层序的地层特征。
- 它形成在河控或者是浪控的滨岸浅滩上。



潮坪环境的向上变细准层序特征



（据Van Wagoner等，1988）

准层序*Parasequence*

- Parasequences have been identified in coastal-plain, deltaic, beach, tidal, and shelf environments (Van Wagoner, 1985).
- It is difficult to identify parasequences in fluvial sections where marine or marginal-marine rocks are absent, and in slope or basinal sections, which are deposited too far below sea level to be influenced by an increase in water depth.

准层序*Parasequence*

- The general concepts presented here apply to all of the depositional environments mentioned above in which parasequences have been recognized; the following discussion illustrates deltaic and beach parasequcnces because these are common in most basins.

Parasequence Characteristics

- Most silliciclastic parasequences are progradational, i.e. the distal toes of successively younger sandstone bedsets were deposited progressively farther basinward.
- This depositional pattern results in an upward-shoaling association of facies in which younger bedsets were deposited in progressively shallower water.

Parasequence Characteristics

- Some siliciclastic, and most carbonate, parasequences are aggradational and also shoal upward.
- The vertical-facies associations within both the upward-coarsening and upward-fining parasequenc are interpreted to record a gradual decrease in water depth.

Parasequence Characteristics

- In some environments, where siliciclastic deposition is condensed or the water depth is too great, lithologic variation may not be sufficient to recognize prarsequences easily.
- In these sections, strata appear to deepen upward gradually, although careful observation may reveal subtle evidence of flooding surfaces marking parasequence boundaries.

Parasequence Boundary

- Parasequence boundary —— marine-flooding surface
- It is a planar surface of local to basinal extent and exhibits only minor topographic relief over large areas.
- A marine-flooding surface sharply separates deeper-water rocks, from shallower-water rocks, such as lower-shoreface sandstone, below.

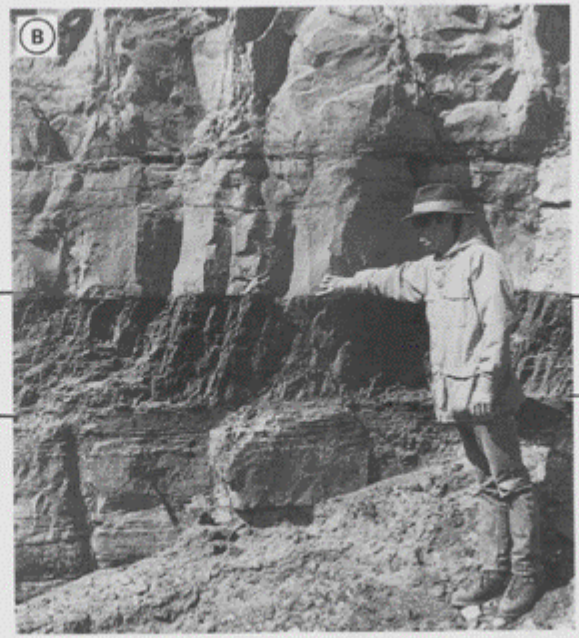
Parasequence Boundary

- The flooding surface is characterized by minor submarine erosion and nondeposition, with a minor hiatus indicated.
- The amount of submarine erosion associated with a marine-flooding surface varies, but probably ranges from a few inches to tens of feet, with several feet being most common.

露头资料中的准层序



A. ROADCUT ALONG HIGHWAY 6, 3.3 MILES NORTH OF HELPER, UTAH. THE YOUNGEST COAL CAPS THE SPRING CANYON MEMBER AND IS OVERLAIN BY THE ABERDEEN MEMBER, BOTH OF THE BLACKHAWK FORMATION. THESE ROCKS ARE UPPER CRETACEOUS (CAMPANIAN) IN AGE. THE PARASEQUENCE SET BOUNDARY OCCURS ON TOP OF THE COAL (SEE PHOTO B FOR DETAILS).



HUMMOCKY BEDDED AND BURROWED LOWER-SHOREFACE SANDSTONE

PARASEQUENCE AND PARASEQUENCE SET BOUNDARY

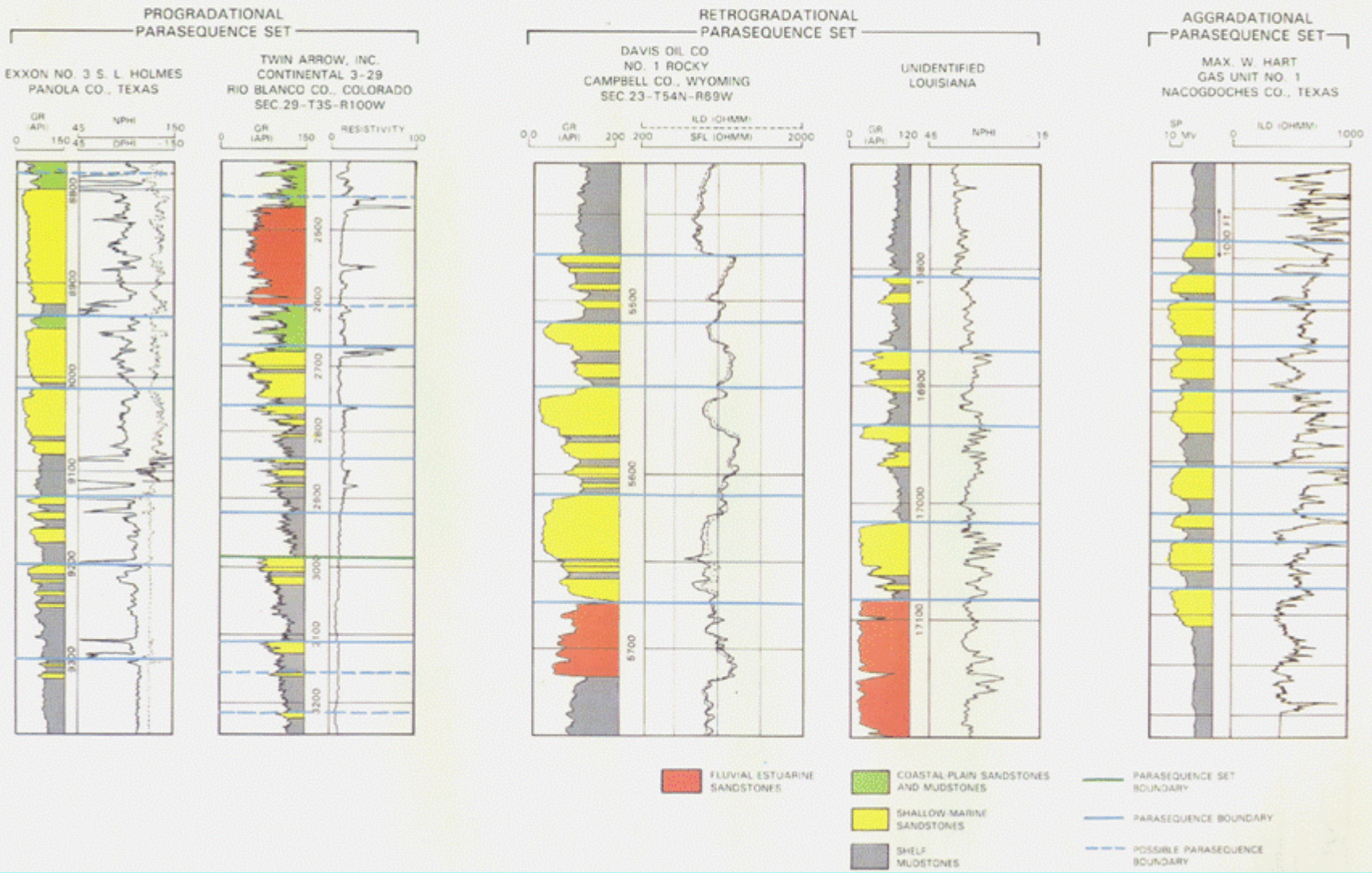
COAL

LANDWARD EDGE OF A SANDSTONE DEPOSITED IN A TIDAL-INLET ENVIRONMENT

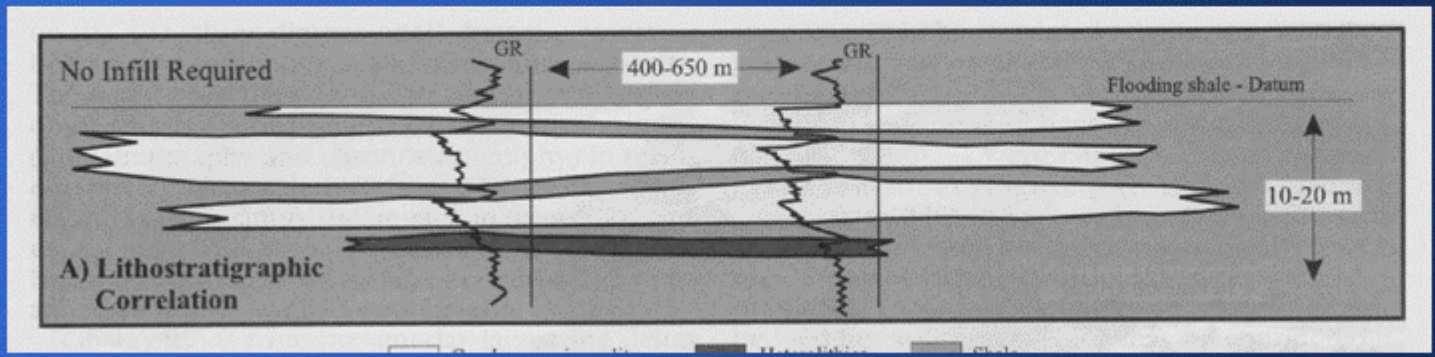
THESE ROCKS WERE DEPOSITED IN A BAY OR LAGOONAL ENVIRONMENT

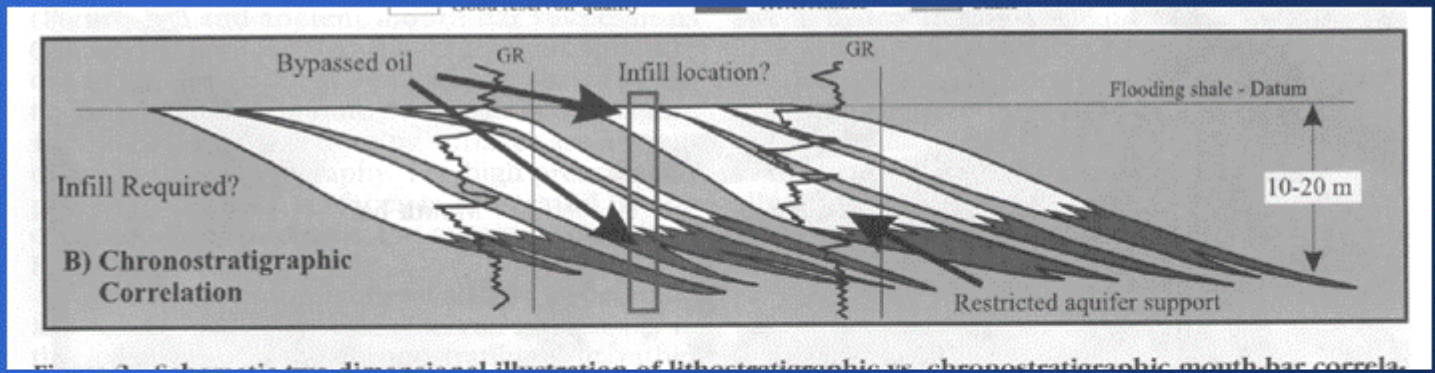
B. THE FINGER OF THE GEOLOGIST IS ON A SURFACE THAT IS BOTH A PARASEQUENCE AND A PARASEQUENCE SET BOUNDARY. THE BOUNDARY IS SHARPLY DEFINED BY COALS BELOW AND BIOTURBATED, VERY FINE-GRAINED, HUMMOCKY-BEDDED SANDSTONES ABOVE. THE BOUNDARY IS REMARKABLY FLAT WITH NO EVIDENCE OF TRUNCATION, EROSIONAL RELIEF, OR TRANSGRESSIVE LAG. THIS SURFACE IS TYPICAL OF PARASEQUENCE AND PARASEQUENCE SET BOUNDARIES. THE BOUNDARY IS INTERPRETED TO BE A FLOODING SURFACE. THE INTERPRETATIONS OF THE DEPOSITIONAL ENVIRONMENTS ARE SHOWN TO THE RIGHT OF PHOTO B.

测井资料中的准层序

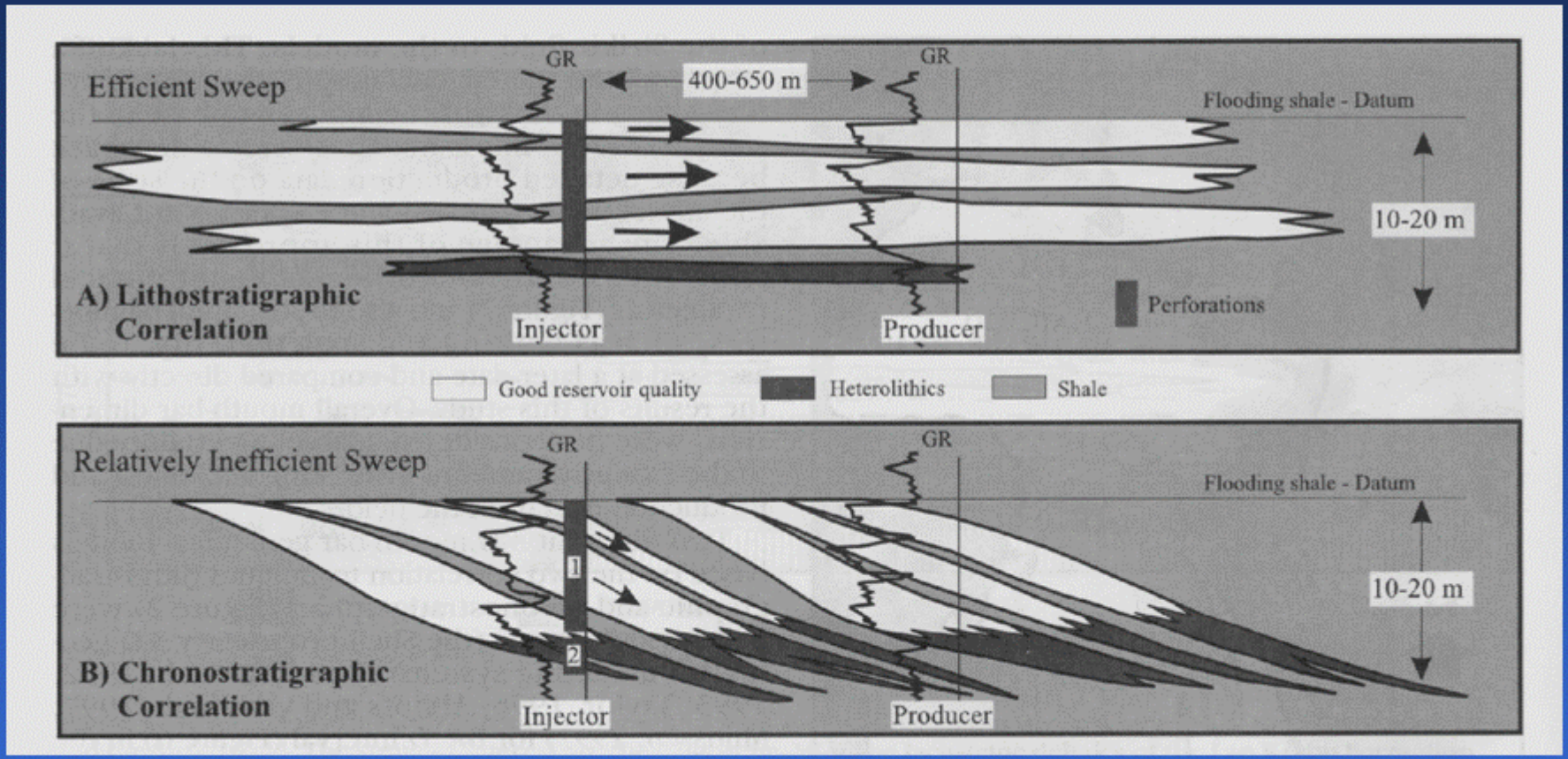

PROGRADATIONAL PARASEQUENCE SET
EXXON NO. 3 S. L. HOLMES
PANOLA CO., TEXAS
TWIN ARROW, INC.
CONTINENTAL 3-29
RIO BLANCO CO., COLORADO
SEC.29-T3S-R100W
RETROGRADATIONAL PARASEQUENCE SET
DAVIS OIL CO
NO. 1 ROCKY
CAMPBELL CO., WYOMING
SEC.23-T54N-R69W
UNIDENTIFIED
LOUISIANA
AGGRADATIONAL PARASEQUENCE SET
MAX. W. HART
GAS UNIT NO. 1
NACOGDOCHES CO., TEXAS
FLUVIAL ESTUARINE SANDSTONES
COASTAL PLAIN SANDSTONES AND MUDSTONES
SHALLOW-MARINE SANDSTONES
SHELF MUDSTONES
PARASEQUENCE SET BOUNDARY
PARASEQUENCE BOUNDARY
POSSIBLE PARASEQUENCE BOUNDARY

测井资料中准层序的划分与对比

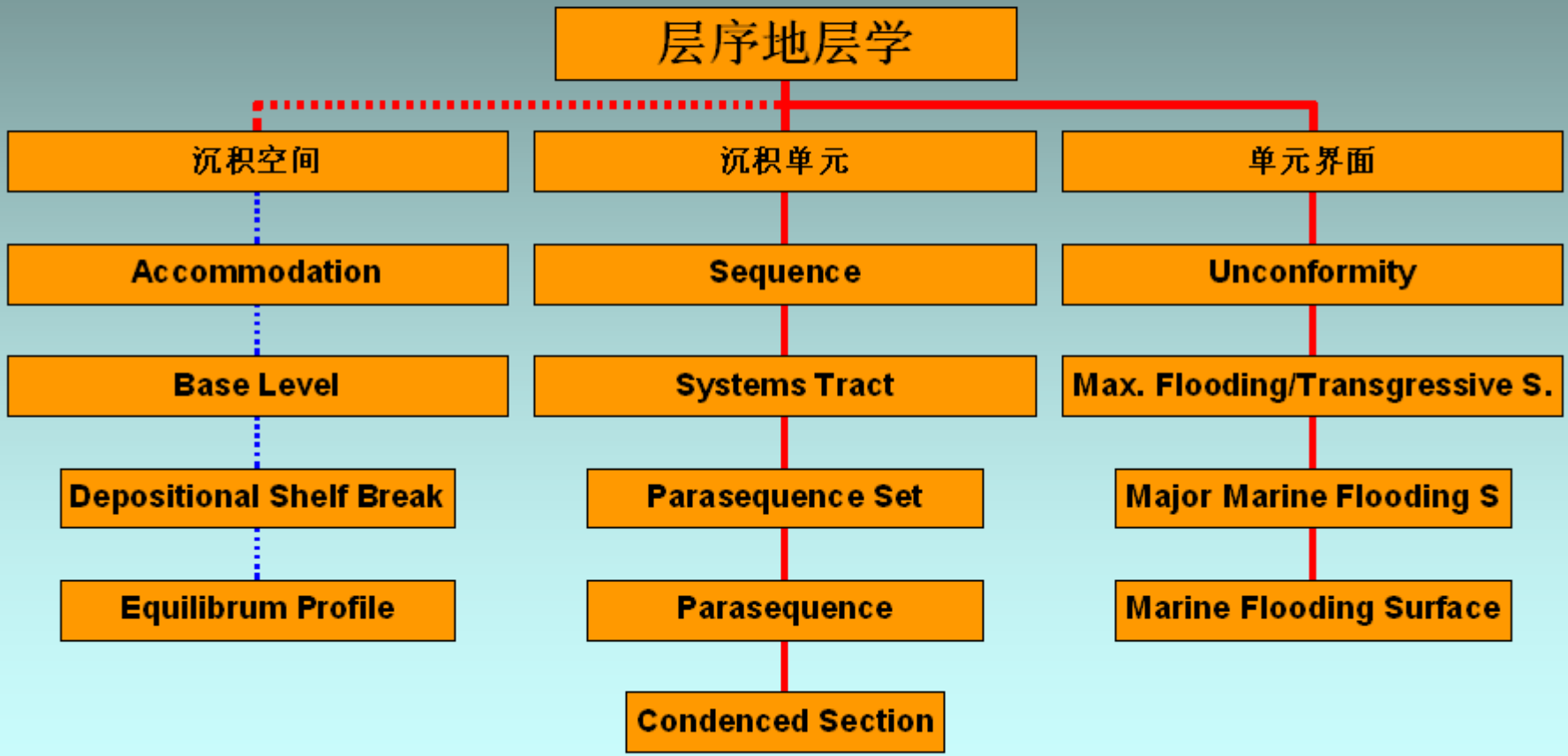




测井资料中准层序的划分



The Relationship of the Terms



The Relationship of the Terms

- MAIN

  Accommodation——Base Level——Depositional Shelf Break（Equilibrium Profile——Equilibrium Point）

- SEDIMENTS

  Sequence> Systems Tract> Depositional System> Parasequence Set> Parasequence> Condenced Section

- SURFACE

  Unconformity> Transgressive S. = Maximum Flooding S.> Marine Flooding S.

层序基本结构特征

层序界面——不整合 SB/ UN

密集段（cs）

高位体系域 HST

最大洪泛面 mfs

水进体系域 TST

海进面 ts

准层序组及准层序

下切谷（ivf）

低位体系域 LST

低位进积楔 LSW

低位扇

斜坡扇 SF

盆底扇 BF

陆棚边缘体系域 SMST

I 型层序界面——I 型不整合 SB I

II 型层序界面 SB II

第六章学习结束，请继续！

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