Stratigraphy & Correlation

Stratigraphy – Correlation - Mapping

Objectives of Session
Introduce Stratigraphy & Correlation

At the end of this session the participant should be able to:

- List traditional types of stratigraphy and a typical application
  - Lithostratigraphy – rock types
  - Biostratigraphy – marker fossils
- Describe how to correlate
- Be aware of non unique correlations
- list uses of correlations

Stratigraphy & Correlation - Purpose

Why distinguish rock layers?

- Petroleum habitat framework
- Distinguish reservoir and its extent in non reservoir rocks, identify and model flow units

Correlation model Impacts …e.g.

- Volumetrics (channels instead of sheets)
- FDP costs – required well spacing for reservoir
- Geosteering (litho/bio)
- Well planning - depth prognosis
- Near Field Potential

Operations Data

- Well Location
- Prognosed depths, off set well data
- Map, cross section, seismic panels, arbitrary line
- Over burden hazards

Implications?

Where do you first meet Stratigraphy?

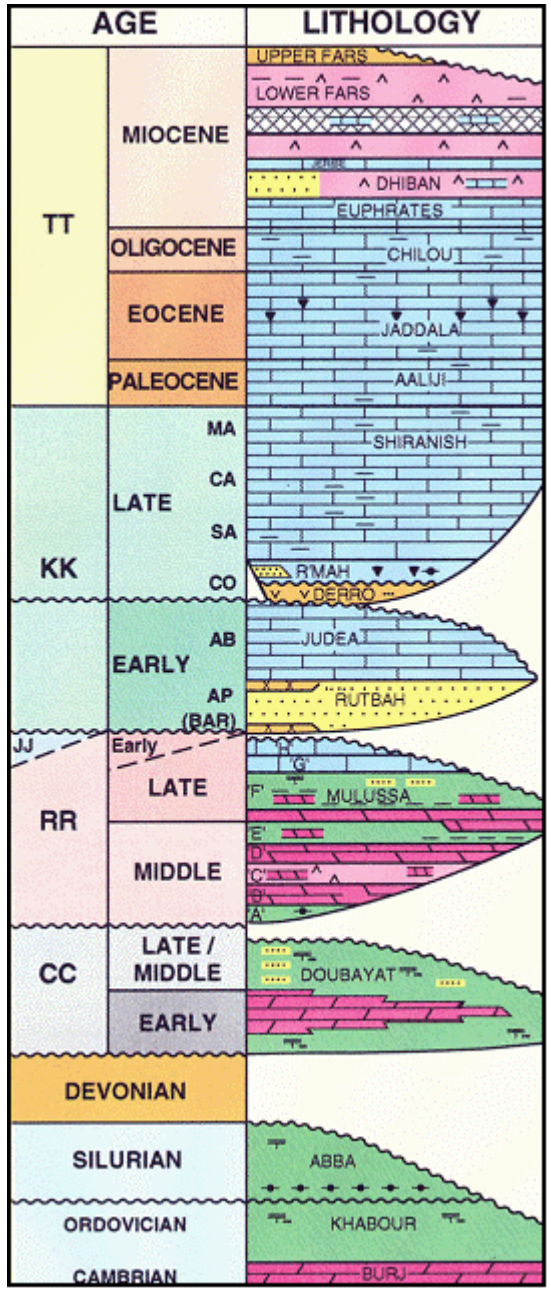
In a Well Proposal - Stratigraphic Column

- Schematic Lithostratigraphy example

Al Waleed Syria

Portrays:

- *Vertical rock type sequence,*
- *Time,*
- *Missing time,*
- *Lateral extents.*



Stratigraphic Column

Million years	EON	ERA	PERIOD	RESERVOIR example	
0	Phanerozoic	Cenozoic			
1.8			Quaternary		
5.3			Pliocene	turbidite	Egypt
23.8			Miocene	Lake mouthbars	Lan Krabu, Sirikit, Thailand
33.7			Oligocene	Platform carbonate	Asmari, Iran
54.8			Eocene		
65			Paleocene	turbidite	Schiehallion, North Sea
142		Mesozoic	Cretaceous	Braid stream	Dentale Fm, Rabi, Gabon
206			Jurassic	Coastal, deltaic	Brent Group, North Sea
248			Triassic	Braid stream	Sadlerorokit, Alaska
290		Paleozoic	Permian	aeolian	Rotliegend, North Sea
354			Carboniferous	Platform carbonate	Kashgan Caspian
417			Devonian	Reef	Golden Spike, Canada
443			Silurian		
495			Ordovician		
545			Cambrian	Shallow marine	Barik, Oman

EP00 slide on rocks

Nomenclature…

- Tops Prognosis, offset wells
- Lithology, Facies
- formation, Formation, Unit
- Overburden, Seal, Reservoir, Source (underburden)

The earth is ca. 4.55 billion years old

(the best estimate for the Universe is 13 billion years old)

Represent the age of the earth in 24 hours,then….

•1 hour is approx 200 million years:

- **Paleozoic starts at 21:09**
- **Devonian starts at 21:49**
- **Carboniferous starts at 22:07**
- **Jurassic starts at 22:53**
- **Cretaceous starts at 23:15**

  most of the world's oil is less than 1 hour old
- **Tertiary starts at 23:39**

Absolute versus Relative Ages

Unstable isotope analysis

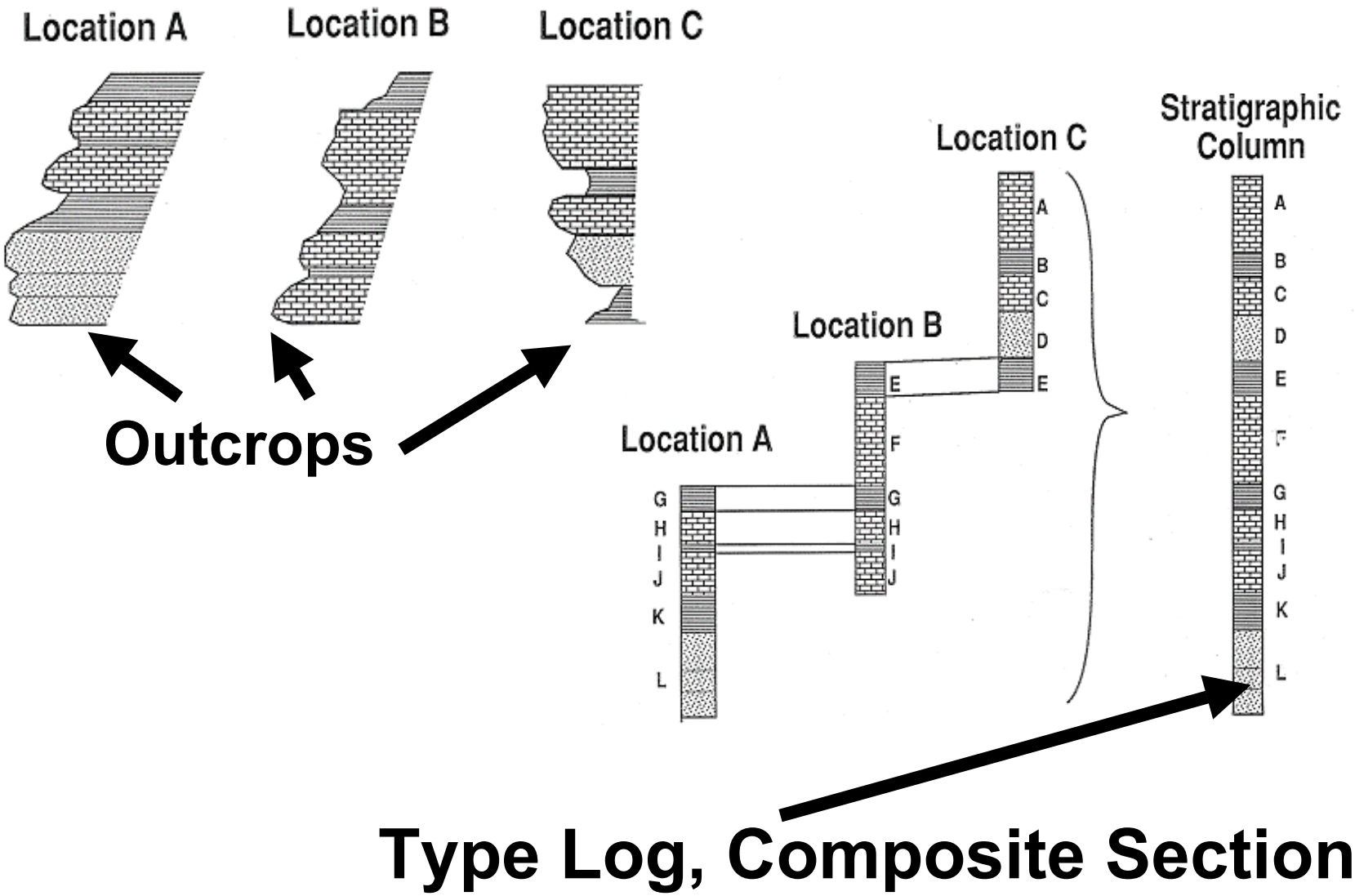
4.4 billion year zircon crystals
Reported in W Australia

$^{235}U/^{207}Pb$ ratios -- half life 704 My
$^{238}U/^{206}Pb$ ratios -- half life 4,500 My

Relative ages determined by bracketing of sediments by igneous rocks that can be dated

Other isotopic techniques include
$^{13}C/^{12}C$, $^{18}O/^{16}O$, $^{87}Sr/^{86}Sr$

Correlation : beds in common



Correlation Definition

- **Determination of equivalence:**
  - **Establishes relative structural (present day domain) and stratigraphic (palaeo domain) configuration of reservoir**
  - **Correlation model drives the internal reservoir architecture**
- **Data used**
  - **Well log data (include mud logs, core data, dipmeter)**
  - **Seismic data**

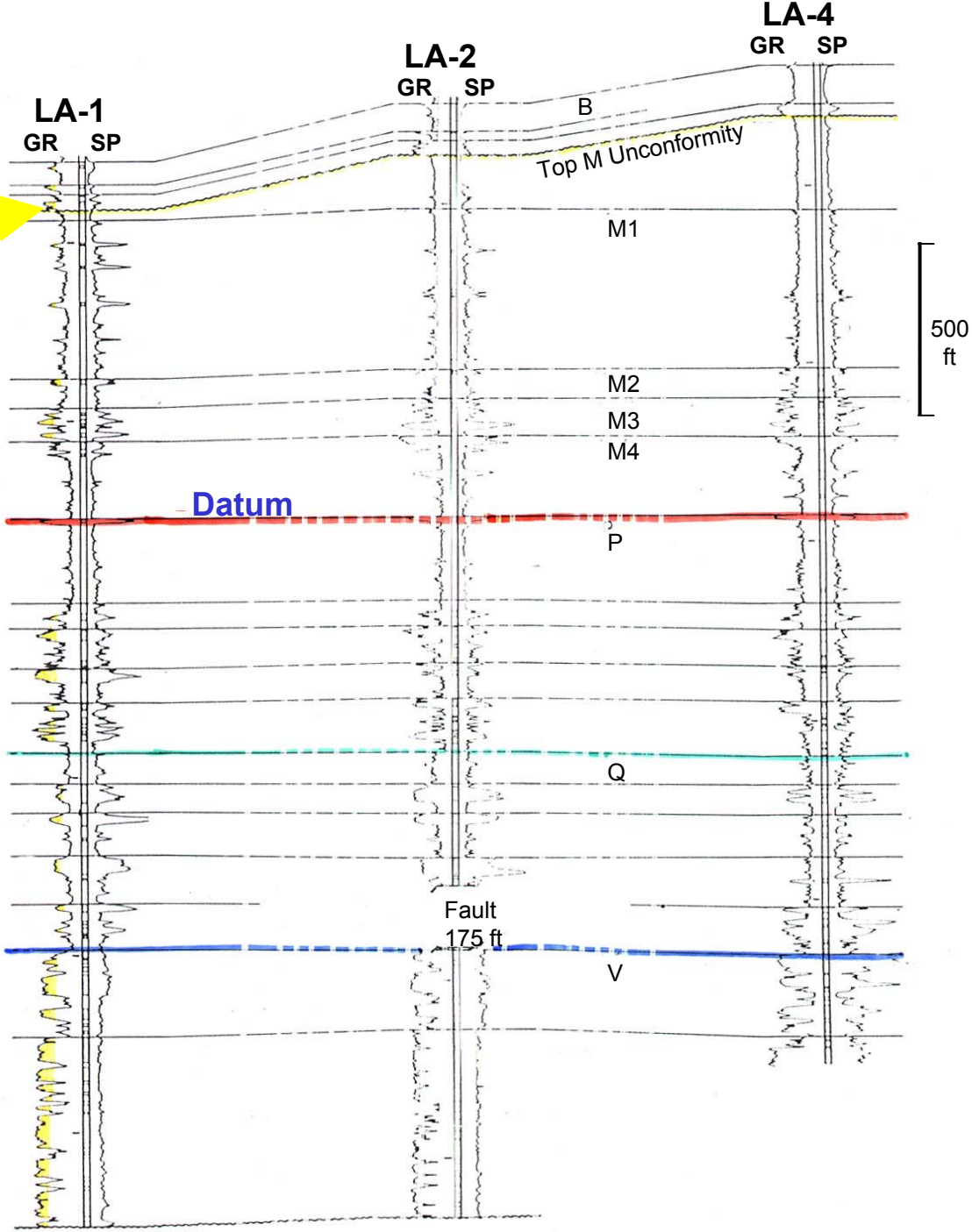
How to Correlate?

Well logs….

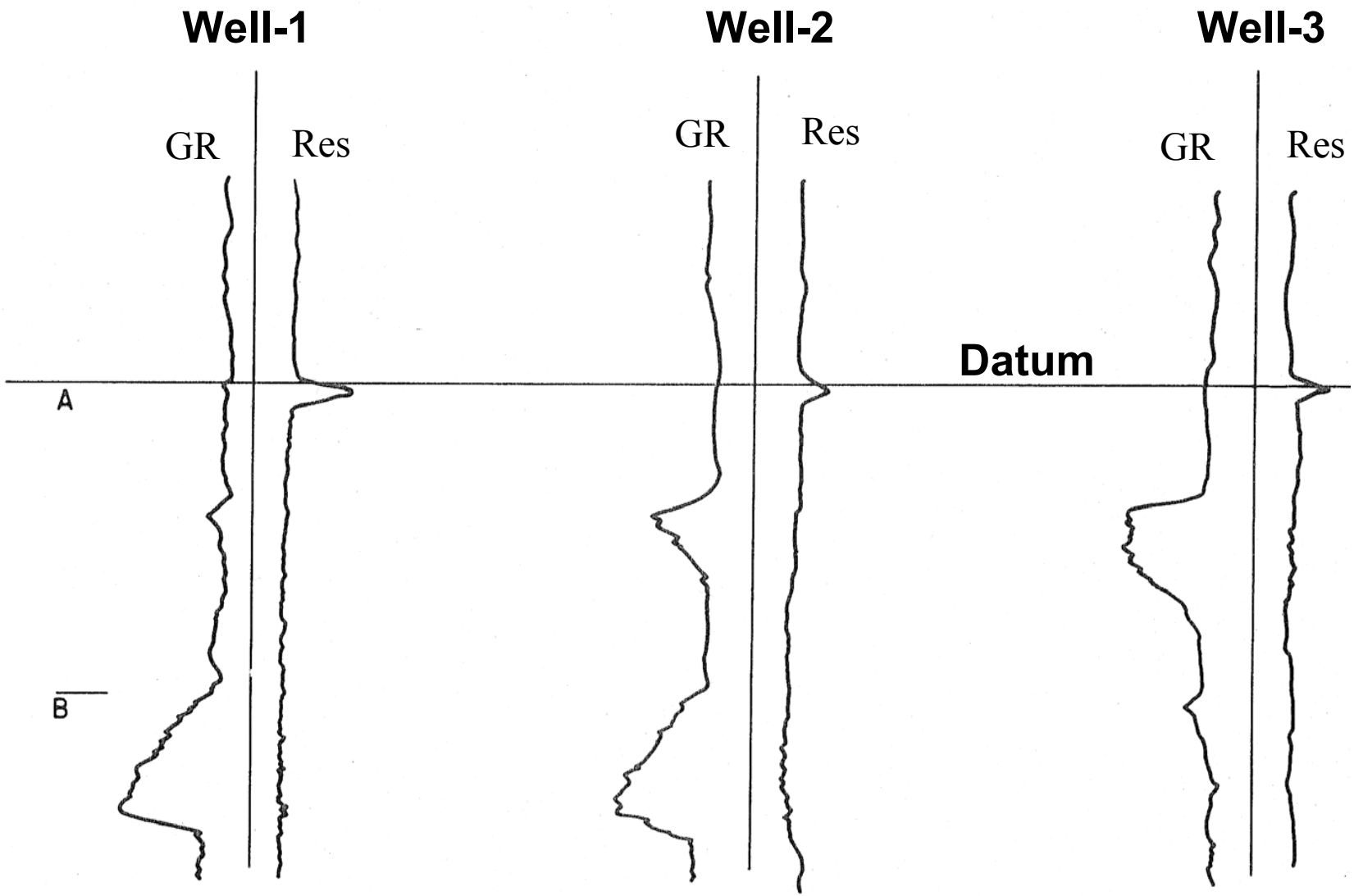
- **Identify event or marker – laterally continuous and present in all wells e.g. a shale**
- **This provides a datum (may need more than 1)**
- **Align wells to this shale (palaeodomain)**
- **Identify other roughly parallel shales**

unconformity

Correlation panel with datum



EP00 - Correlation Exercise



Correlation – Uses?

- Offset wells – tops prognosis
- Subsurface hazards (pressures, H2S etc)
- Reservoir layering
- N/G distribution – volumetrics
- Architecture – flow unit connectivity

Stratigraphic Principles to Correlation

Using surfaces (visible in seismic?)

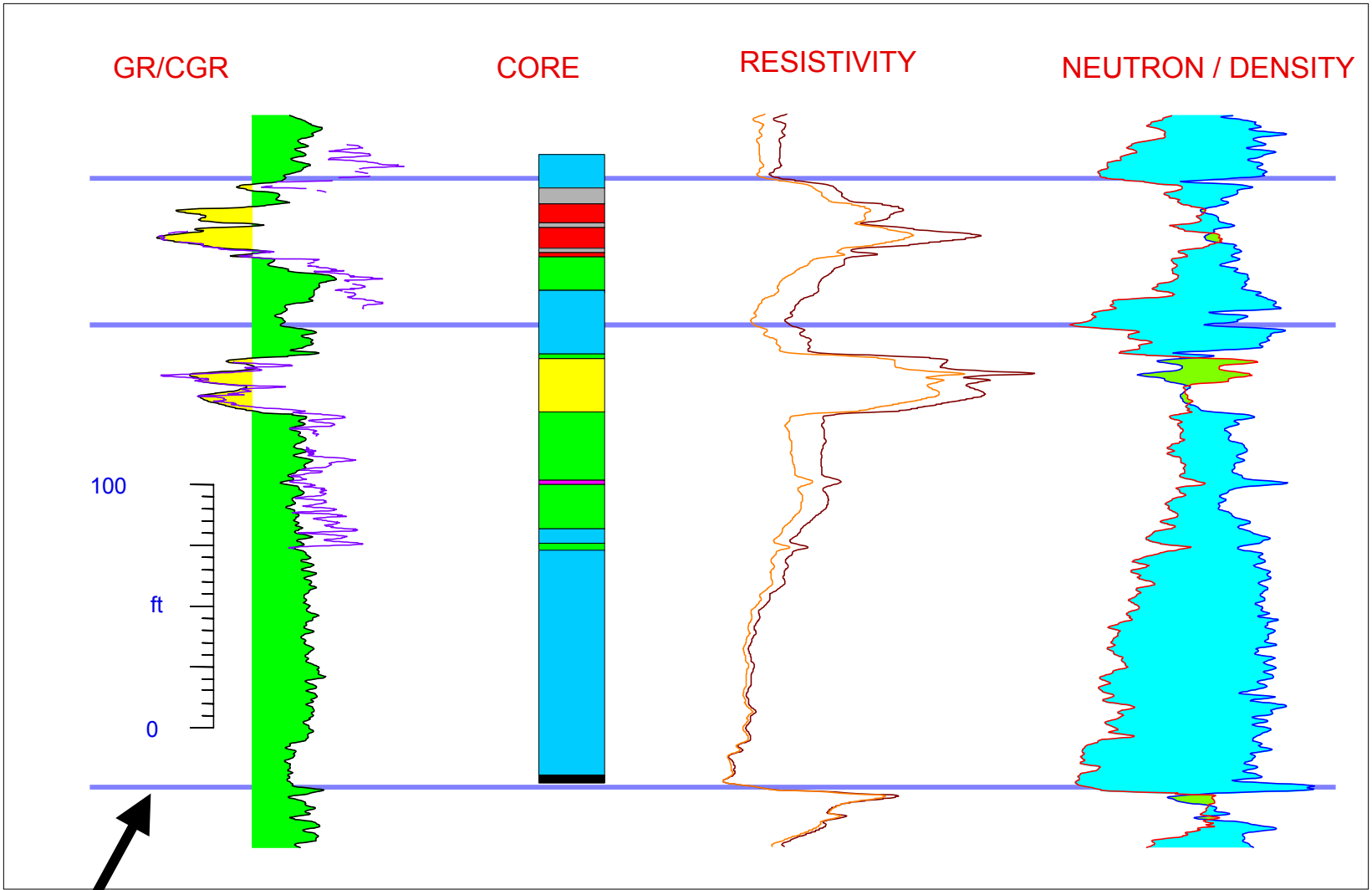
- Seismic scale first, hang well data in reservoir framework
  - Sequence boundaries – exposure surface, unconformity
  - Flooding surfaces - shales
  - Volcanic ash bands

G180 - Seismic Architecture Exercise

- Interpret the main unconformities bounding coastal sediment packages

- These unconformities are termed sequence boundaries.

Correlation of flooding surfaces



Reservoir Geology Consultants

Correlation Process Controls

There are several processes to apply to your well data, guided by:-

- Type of stratigraphic principles that you apply
- Type of depositional environment that your reservoir represents
- Type of data available
- Correlation complications
- The immediate use requirements.

So a process that works in one field will not necessarily work into the next.
Be prepared to generate several correlation realizations from the same data.