Subsurface Geology Structure

At each stage of a field life cycle raw data has to be converted into information, but for the information to have value it must be influence decision making and profitability.

Methods:

Well-to-Well correlation -- Sequence

Geological Mapping -- Subsurface Geology Research

Contents:

- **Well Correlation**
- **Subsurface Structure of Oil and Gas Fields**

Practices:

- **Well to Well Correlation**
- **Geological Cross Section**

Chapter 3 Well Correlation

Well correlation is used to establish and visualise the lateral extent and the variation of reservoir parameters. In carrying out a correlation we subdivide the objective sequence into lithologic units and follow those units or their generic equivalent laterally through the area of interest.

By correlation we can establish lateral and vertical trends of those parameters throughout the structure. This will enable us to calculate hydrocarbon volumes in different parts of a field, predict production rates and optimise the location for appraisal and development wells.

Chapter 3 Well Correlation

Section 1 Stratigraphic Division Unit

Section 2 Stratigraphic Correlation

Section 3 Lithofacies Correlation

Section 4 Oil Bed Correlation

Section 1 Stratigraphic Division Unit

(Field wide)

I. Rock-stratigraphic unit

II. Biostratigraphic unit

III. Sequence stratigraphic unit

Field wide

Rock-stratigraphic unit

Biostratigraphic unit

Sequence stratigraphic unit

Section 1 Stratigraphic Division

I. Rock-stratigraphic unit

Rock Stratigraphic Unit **is defined by formation lithology feature, has certain thickness and steady around some scope, is bounded by unconformity on the top or bottom.**

•Unit: group, formation, member, bed

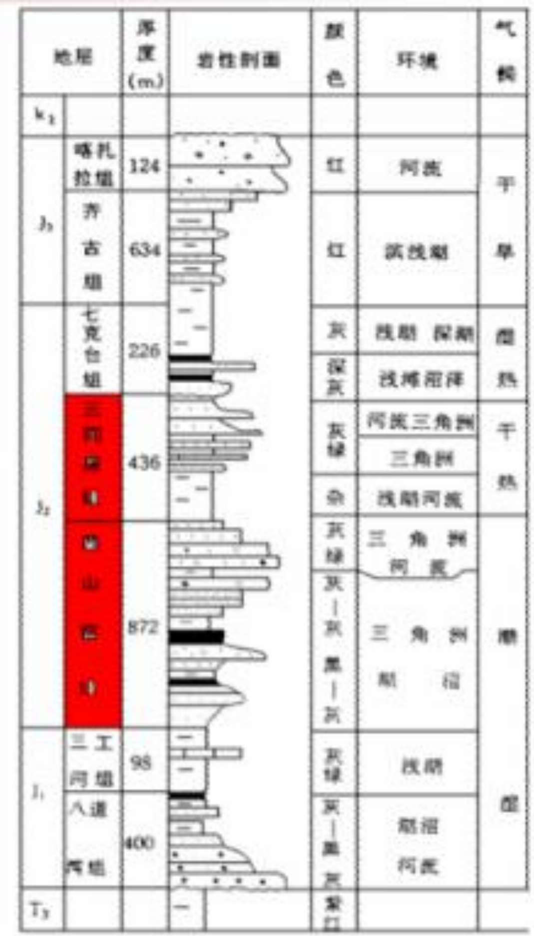
•Characteristics:

1. Lithology uniform;

2. distribution limited;

3. non-isochron

Mainly used in area with few fossil



Section 1 Stratigraphic Division

Field wide

Rock-stratigraphic unit

Biostratigraphic unit

Sequence stratigraphic unit

II. Biostratigraphic unit

Stratigraphic unit divided by the continuity and periodicity of biological evolution.

•Basic unit: biozone

• index fossil

Wide distribution;
Evolution fast;
Many

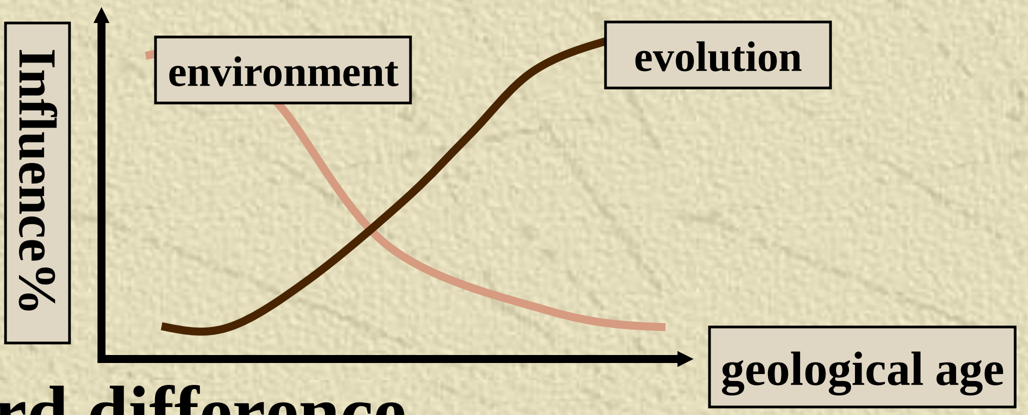
Field wide
Rock-stratigraphic unit
Biostratigraphic unit
Sequence stratigraphic unit

II. Biostratigraphic unit

Reasons for biozone diachronism:

(1) human factor

(2) unbalanced biological evolution in time and space



(3) standard difference

Field wide

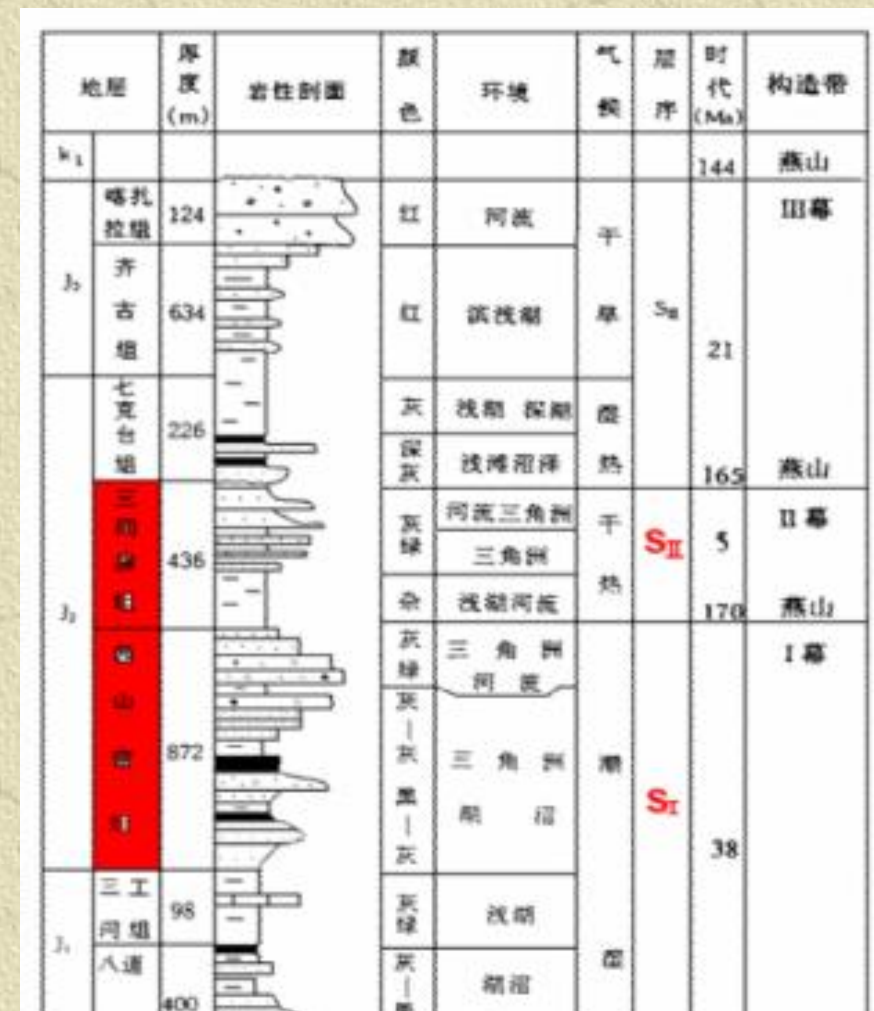
Rock-stratigraphic unit

Biostratigraphic unit

Sequence stratigraphic unit

III. Sequence stratigraphic unit

Sequence include any relatively conformable of genetic connected strata, the top and bottom boundary is unconformities and corresponding conformities.(Mitchum， 1977).



Sequence,
para sequence sets,
para sequence,
measures 、
layer、
lamina set 、 lamina

On a larger scale for example in a regional context, seismic stratigraphy will help to establish a reliable correlation. It is employed in combination with the concept of sequence stratigraphy. This technique, initially introduced by Exxon Research and since then considerably refined, postulates that global (“eustatic”) sea level changes create unconformities which can be used to subdivide the stratigraphic record.

These unconformities are modified and affected by more local (“relative”) changes in sea level as a result of local tectonic movements, climate and the resulting impact on sediment supply. The most significant stratigraphic discontinuities used in a sequence stratigraphic approach are:

(1) Regressive surfaces of erosion, caused by a lowering of sea level

(2) Transgressive surfaces of erosion, caused by an increase in sea level

(3) Maximum flooding surfaces at times of “highest” sea level

Relative sea level changes affect many shallow marine and coastal depositional environments.

Sequence stratigraphy integrates information gleaned from seismic, cores, well logs and often outcrops.

In many cases it has increased the understanding of ***reservoir geometry*** and ***heterogeneity*** and improved the correlation.

Sequence stratigraphy has also proved a powerful tool to predict presence and regional distribution of reservoirs.

Field wide

Section 1 Stratigraphic Division Unit

I. Rock-stratigraphic unit

II. Biostratigraphic unit

III. Sequence stratigraphic unit

Chapter 3 Well Correlation

Section 1 Stratigraphic Division unit

Section 2 Stratigraphic Correlation

Section 3 Lithofacies Correlation

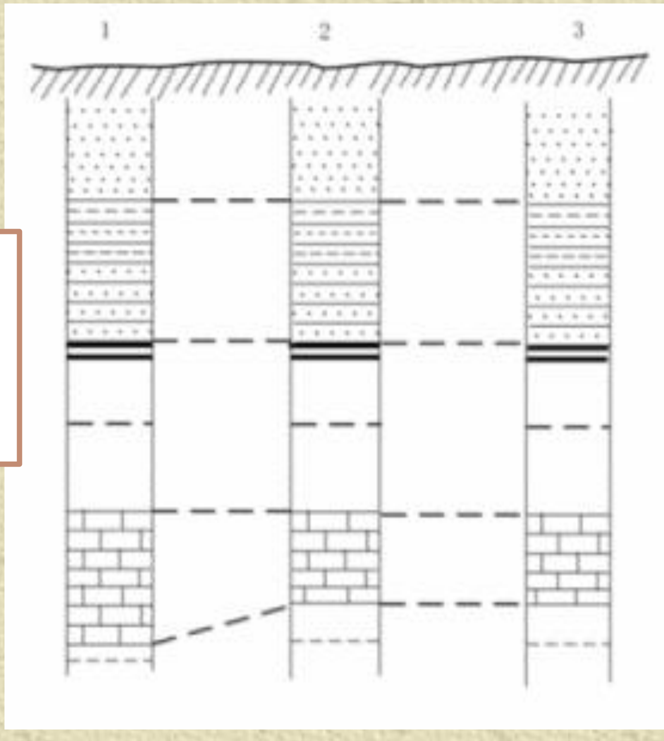
Section 4 Correlation of Oil Beds

Section 2 Stratigraphic Correlation

Foundation

Based on Rock Record

Basis?



▲ **sedimentary sequence**

sedimentary environment and provenance difference in different periods

vertical difference of rock record
(vertical division)

▲ **same sedimentary environment and period**

lateral similarity of rock record
(lateral correlation)

I.Scope and Range
II.Method
III. Procedures

I. Scope of Stratigraphic Correlation

1. Global Correlation

Palaeontological and absolute age

2. Regional Correlation

Palaeontological population features

3. Field Correlation

Palaeontological population and combination features, Lithology and sedimentary features

4. Oil Beds Correlation （Chronostratigraphic unit correlation）

lateral similarity

Field wide

II. Correlation Methods

1. Lithological correlation
2. Lithofacies correlation
3. Well logging curve correction
4. Paleontological correction
5. Geochemistry correlation
6. Structure correlation
7. Clay mineral correlation

1. Lithological Correlation

Use lithology and lithological association, sedimentary cycle to conduct stratigraphic correlation, tracing lateral lithological distribution pattern.

- **marker bed correction**
- **cyclic correlation**

1.Llithological correlation

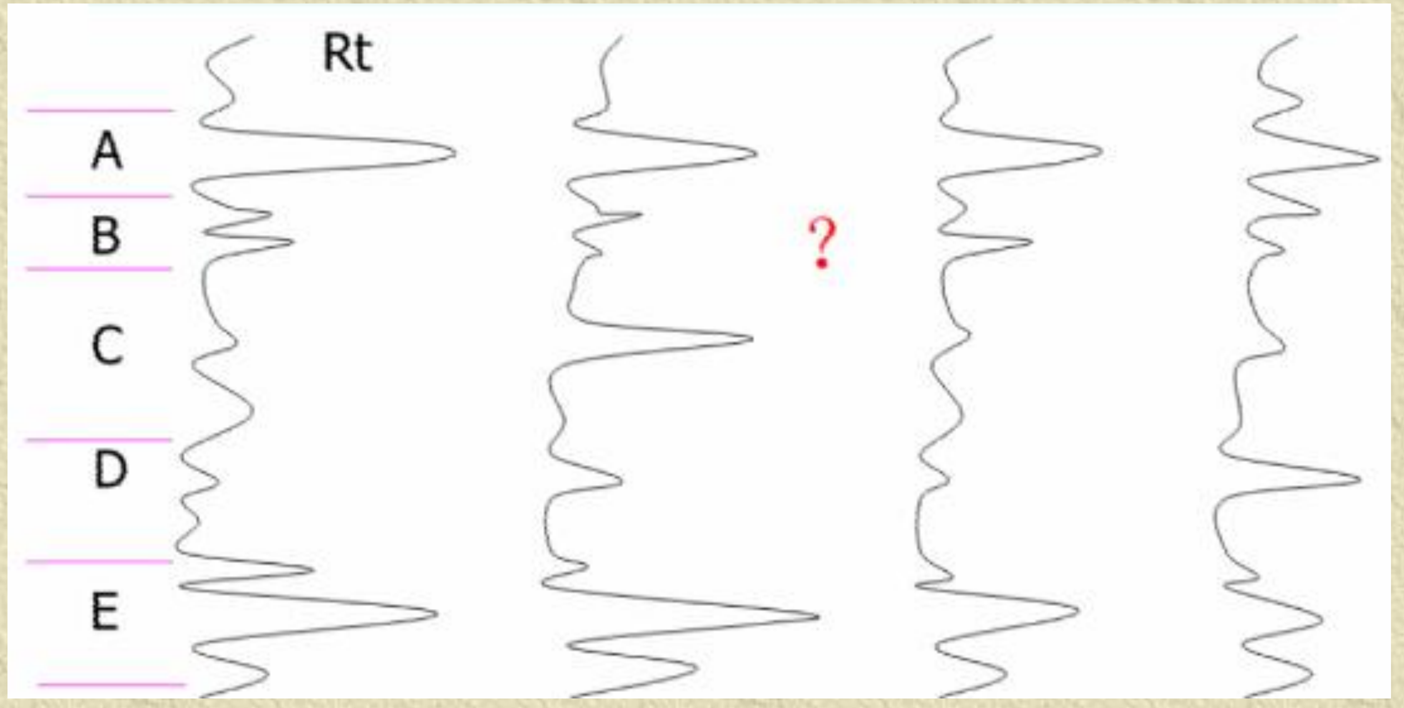
(1) Marker bed correlation

Use regional stable, easily recognized and wide distributed formation as marker bed.

- Marker bed or standard mark is important indicator because it is special lithology which is easy to identify on the profile and logging curve. In most situation, it is isochronous mark such as steady mudstone, thin carbonate rock (limestone and dolomite), oil shale and thin coal bed and so on.

Marker bed

Concept：obvious characteristic, wide distribution, isochronic formation or lithologic interface.



Example

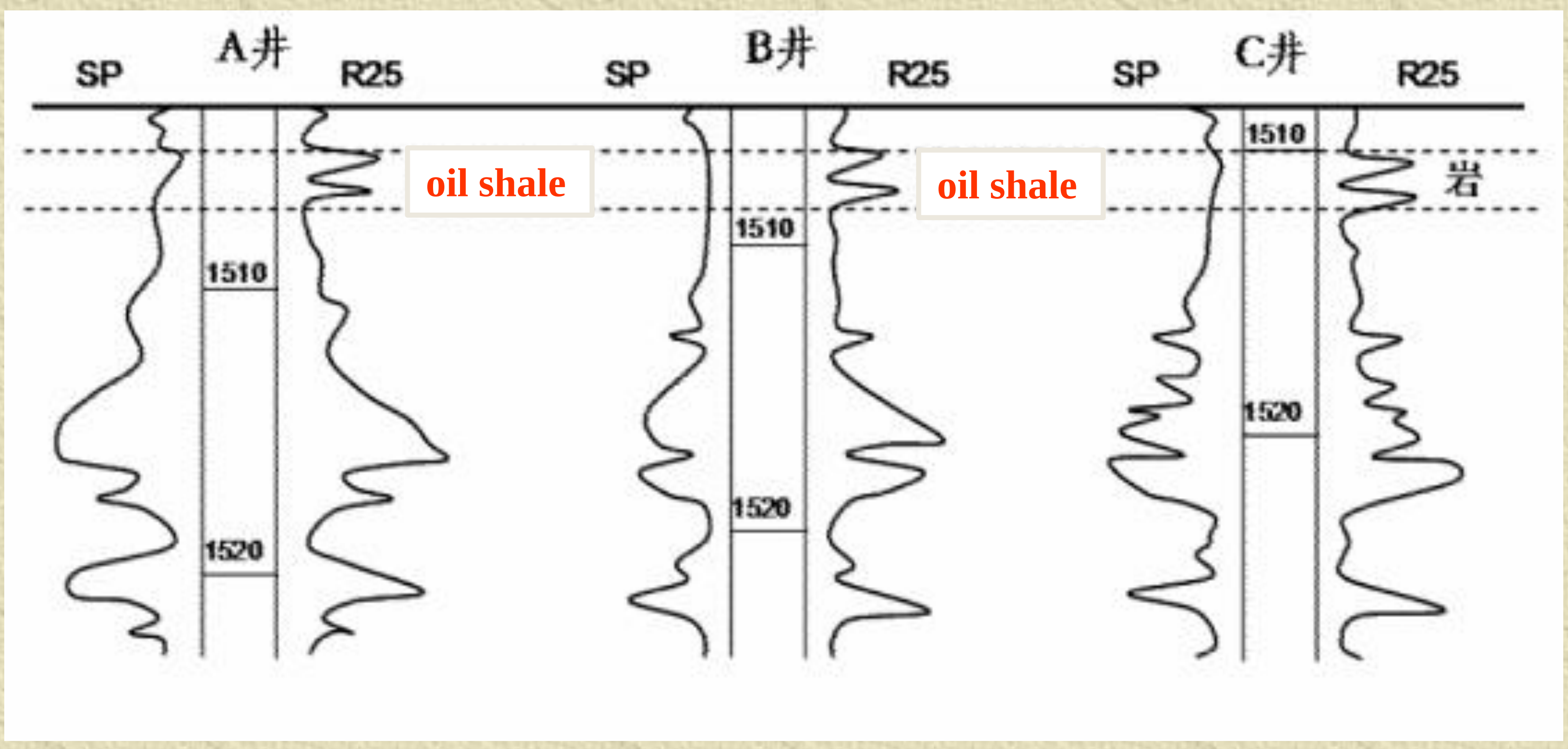
A good datum plane would be a continuous shale because we can assume that it represents a "flooding surface" present over a wide area. Since shales are low energy deposits we may also assume that they have been deposited mostly horizontally, blanketing the underlying sediments thus "creating" a true datum plane.

Isochonism?

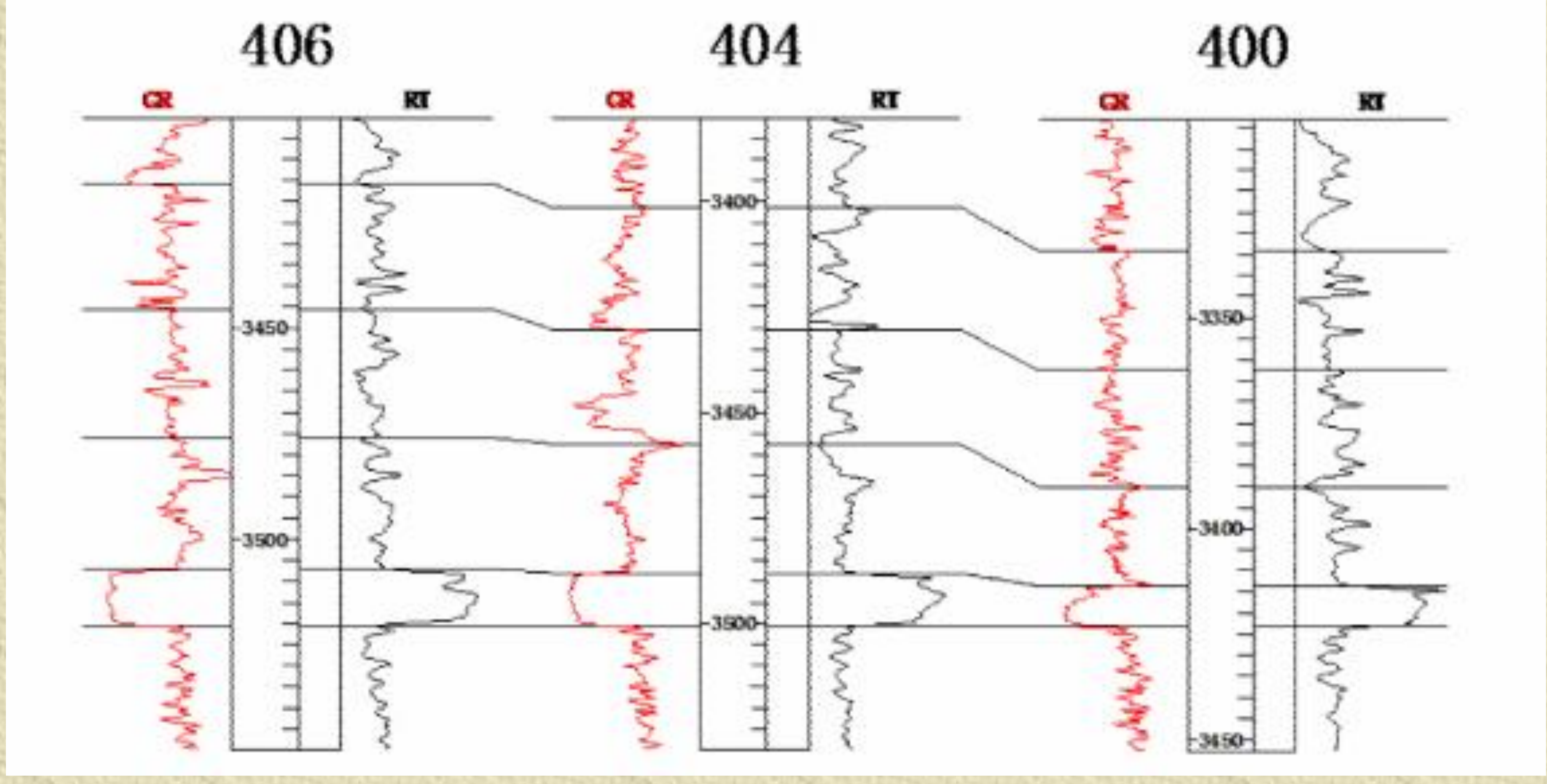
wide sedimentation in the same period

Marker bed associated with flooding

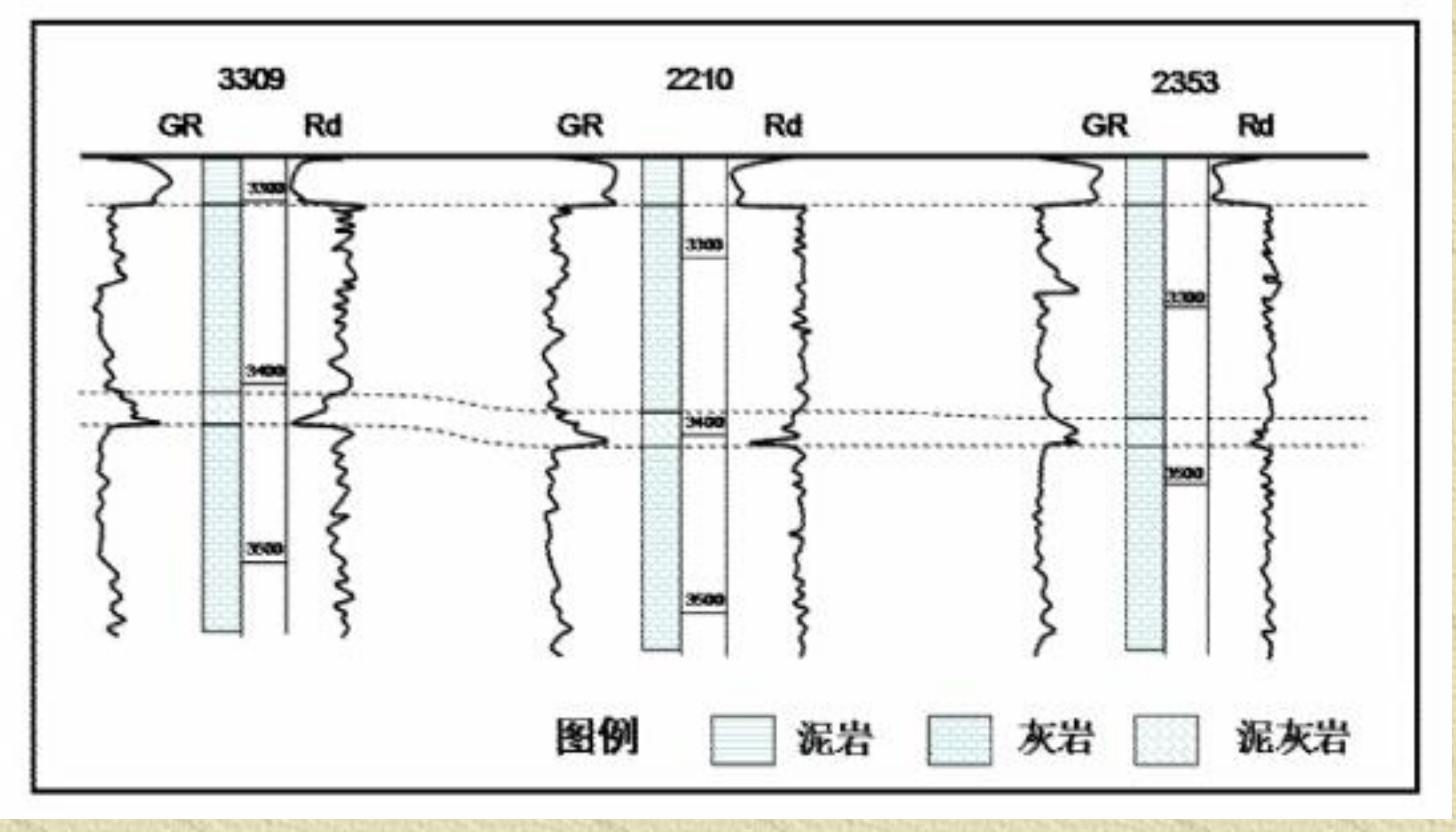
flooding: large-scale rapid transgression of flooding.



lagoonal facies, lacustrine facies oil shale？



Thin limestone in clastic rock?



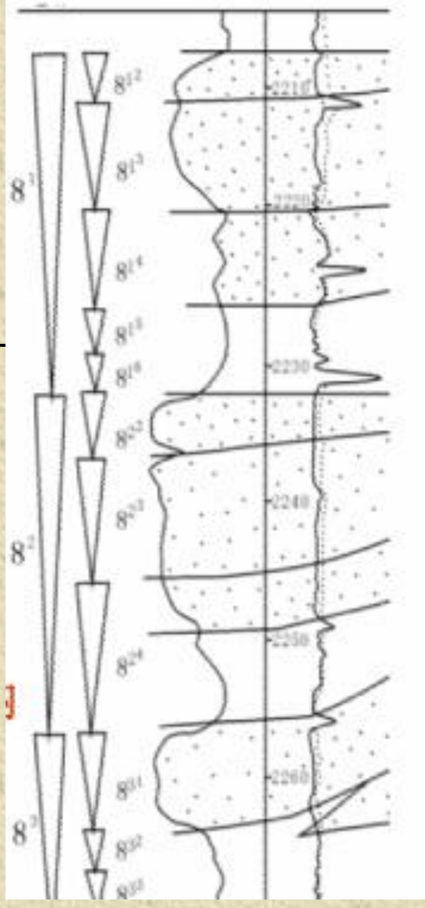
Thin bed mud in carbonate rock

1. lithological correlation

(2)cyclic correlation

macro cycle
mesocycle } allocycle

epicycle
microcycle } autocycle



Cycle is another important indicator. Cycle has different scale. High scale cycle can be used in large scope, and lower scale cycle in small scope.

We can identify many standard marks and different cycles on the profile by using logging curve.

2.Lithofacies Correlation

Lithofacies: **the sum of connate deposit in a geomorphic unit**

Facies sequence-----facies analysis and correlation

Applied range:

(1) Lithology and thickness variation;

(2) Unconformity and tectonic movement;

(3) Area with few drilling data

3. Well logging curve correlation

Well logging data including a great amount of geological information are the main sources applied to study formation correlation.

Condition: **area with little lithologic variation**

Principle: **similarity of well logging curve,**

or based on stable electrical logo layer.

Method: **controlling correlation by long interval curves,**

then correction layer by layer.

Advantages(1) accurate depth;

(2) continuous well logging of full well section

Common curves: **R, SP, GR, Cal**

4. Palaeontological correction

identification → statistics → biozone → correlation

5. Geochemistry correlation

Based on microelement content in rock and other kinds of element contents.

V/Ni>1 marine

V/Ni<1 terrestrial

V--Vanadium, Ni-- Nickel

6.Structure Correlation

According to unconformity and parallel unconformity to divide formations and conduct stratigraphic correlation.

7. Clay mineral correlation

II. Correlation methods

1. Lithological correlation
2. Lithofacies correlation
3. Well logging curve correction
4. Palaeontological correction
5. Geochemistry correlation
6. Structure correlation
7. Clay mineral correlation

III. Correlation procedures

1. Correlation Principle
2. Correlation Procedures
3. Correlation Results

III. Correlation procedure

1. Correction Principle

A. Data collection and compilation

B. in complex study area, establish type well and establish marker bed.

type well:

continuous coring,

interval integrity,

No stratigraphic break or degradation

marker

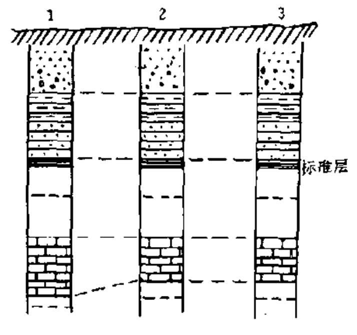


图 4－1 岩性对比示意图

C. notice large-scale facies change

2.Correlation procedures

A. Select type well

B. Define markers

C.Select key section

D.Well correlation

E.Correlation mapping

F. Enclose all profiles

G. Fill uniform Hierarchical data table

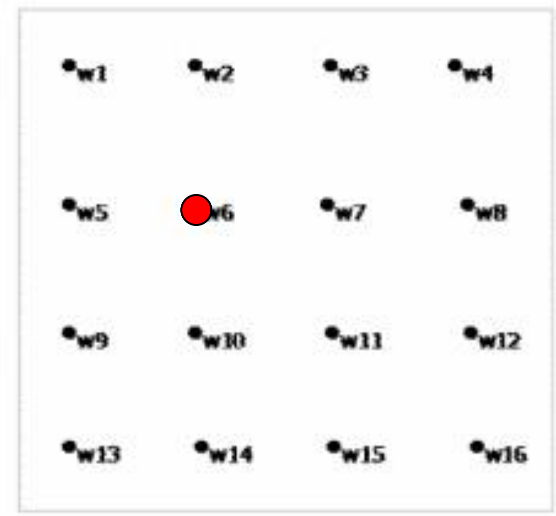
Regional Hierarchical data table

	w1	w2	w3	w4
A	1612		1615	
B	1650	1640	1655	1660
C	1693	1672	1710	1723
D	1712 1742	1722	1766	1770

2.Correlation procedures

A. Select type well

B. Define markers



Select type well or standard well which has high quality data (including wellsite geologic data, well logging data and lab analysis data).

Standard mark and cycle must be analyzed on the standard well profile.

2.Correlation procedures

A. Select type well

B. Define markers

C.Select key sections

Select correlation sections

In most case, we will select several the sections which are parallel to depositional direction because of the little change of lithology along the direction.

Meanwhile, we should select several assistant sections which are vertical to depositional direction. It makes network correlation sections for master and assistant sections.

2.Correlation procedures

A. Select type well

B. Define markers

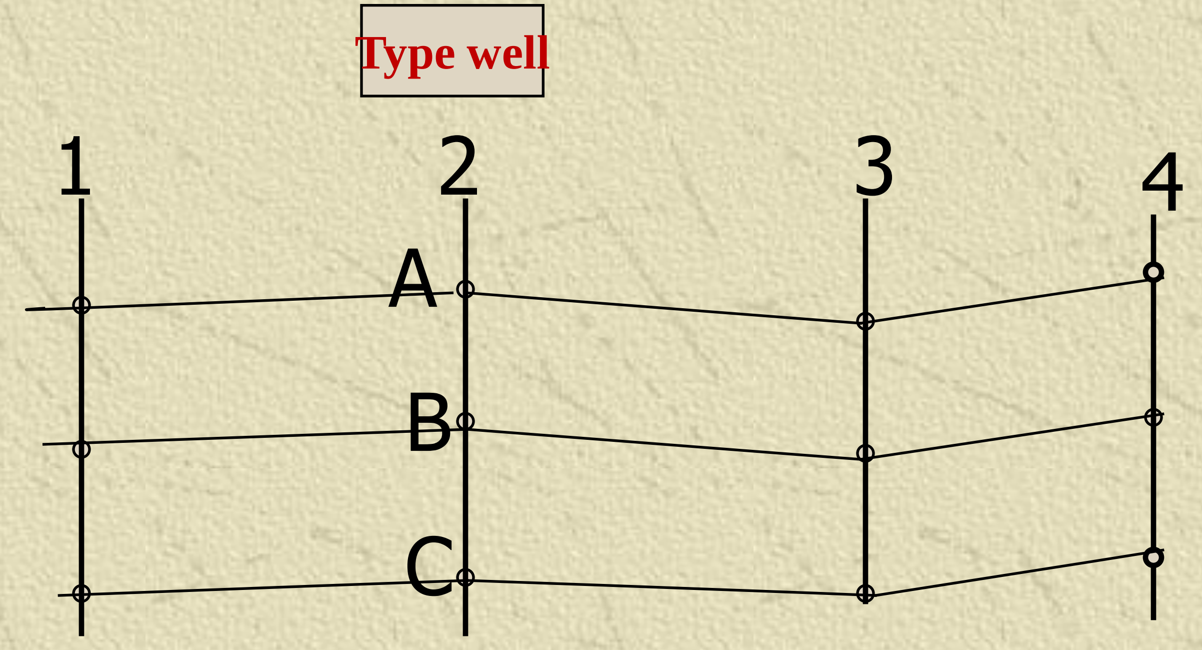
C.Select key section

D.Well correlation

correlation will be begun to do starting from standard well from near to far across the master and assistant section.

E.Correlation mapping

correlation will be begun to do starting from standard well(type well) from near to far across the master and assistant section.



2.Correlation procedures

A. Select type well

B. Define markers

C.Select key section

D.Well correlation

E.Correlation mapping

We connect correlation line between wells. If we find the change of formation thickness unreasonable, we should inspect correlation from two ways, the first is unreasonable for formation dividing, and the second is we may meet some geologic matter such as fault or unconformity.

If it is the first case, we must be careful to inspect formation dividing.

If it is the second case, we will do analysis of geologic matter other wells. If there is local change, such as formation thickness between two or three wells, we can infer that fault may be. Thus fault point should be determined on the well profile. Meanwhile, different fault point on the different wells will be assembled on the cross section.

We correlate all “events” by comparing the markers and log response. In many instance correlations are ambiguous. Where two or more correlation options seem possible, the problem may be resolved by checking whether an interpretation is consistent with the geological model and by further validating it with other data.

For instance, pressure data that will indicate whether or not sands in different wells communicate.

2.Correlation procedures

A. Select type well

B. Define markers

C.Select key section

D.Well correlation

E.Correlation mapping

F. Enclose all profiles

G. Fill uniform Hierarchical data table

If all the geologic interpretation is reasonable on the correlation section, all divided data will be recored in the form. This is a correlation results which will be used to do subsurface geology works.

3. Correlation Results

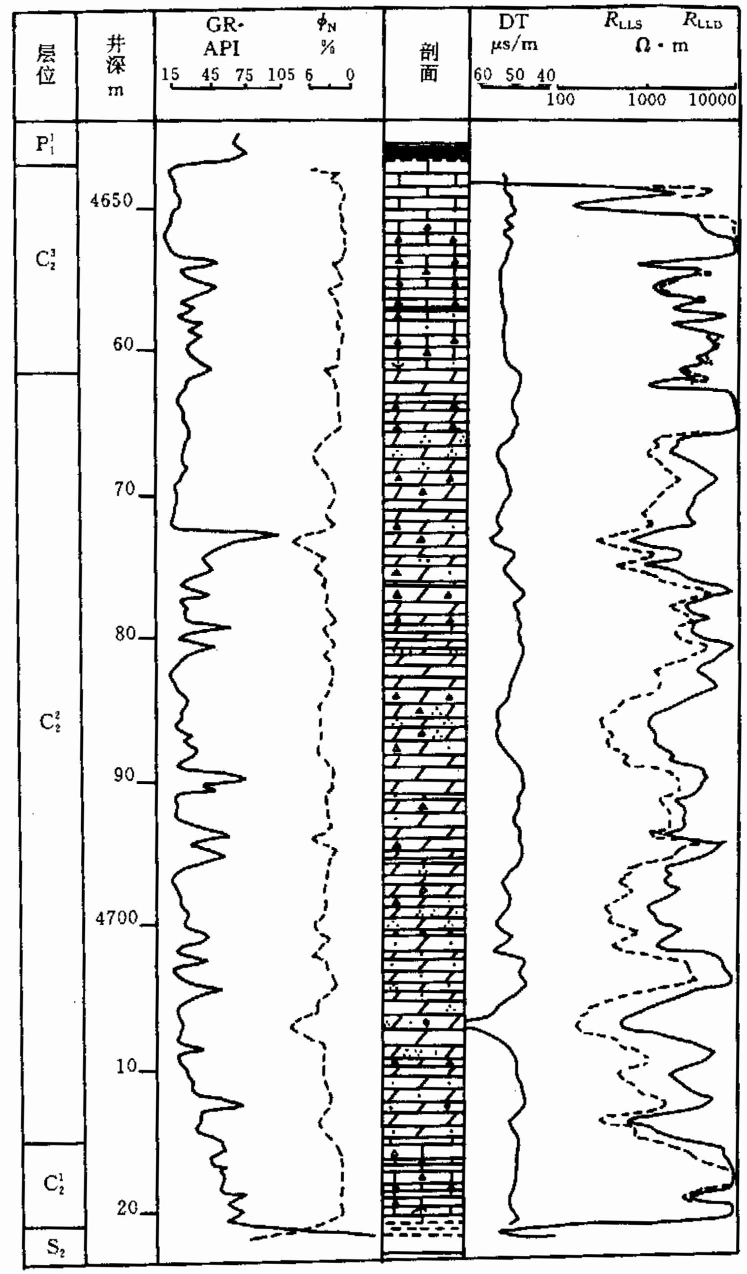
Correlation is a process of geologic study again and again. We can know features of formation distribution, fault, unconformity and facies distribution from correlation.

Master profile:

Using the average thickness of the formation to draw histogram, reflex the abstract lithologic characteristic.

Generalized columnar section:

Profile consisting of sections with the most complete and most obvious curve markers in each formation.



Generalized columnar section

Chapter 3 Well Correlation

Section 1 Stratigraphic Division

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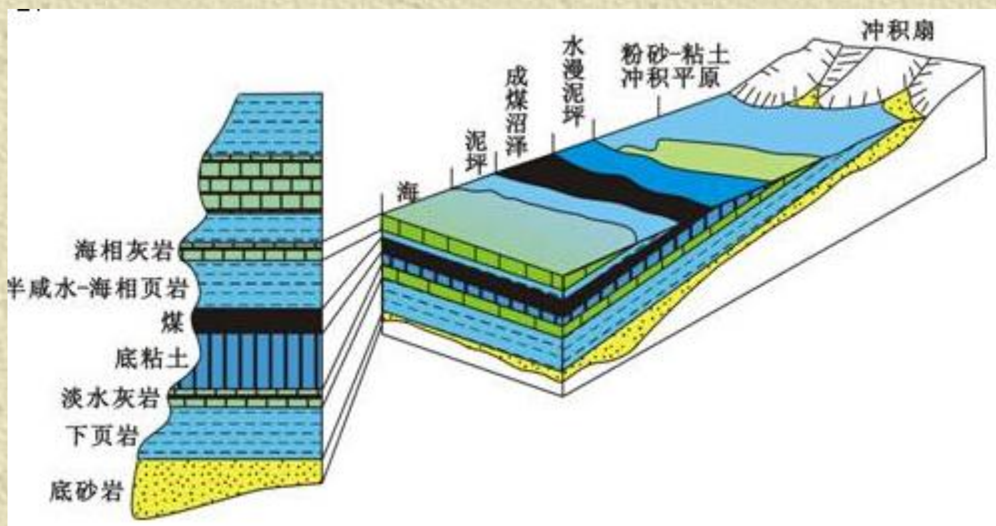
Section 3 Lithofacies Correlation

Section 4 Correlation of Oil Beds

Section 3 Lithofacial Correlation

On the lateral causes similar closely adjacent to phase in a vertical appeared in turn without interval

The vertical progression of facies should be the same as corresponding lateral facies changes



I. Well loggings of Interpretation Sedimentary Environment

II. SP Geological Significance

I.Well loggings of Interpretation Sedimentary Environment

1. Spontaneous Potential
2. Natural GR---- clay content
3. Interval transit time--- rock structure
4. Micro electric log-- micronormal， microinverse
5. Risitivity---Pore structure, fluid property, mineralization, lithology
6. Dipmeter log
7. NGS---natural gamma-ray spectrometry
8. FMS----formation microscanner

I.Well loggings

of Interpretation Sedimentary Environment

1.SP(Spontaneous Potential)

Eda: **Electrodynamic potential**

$$Eda = -k \frac{\lg Rmf}{\lg Rw}$$

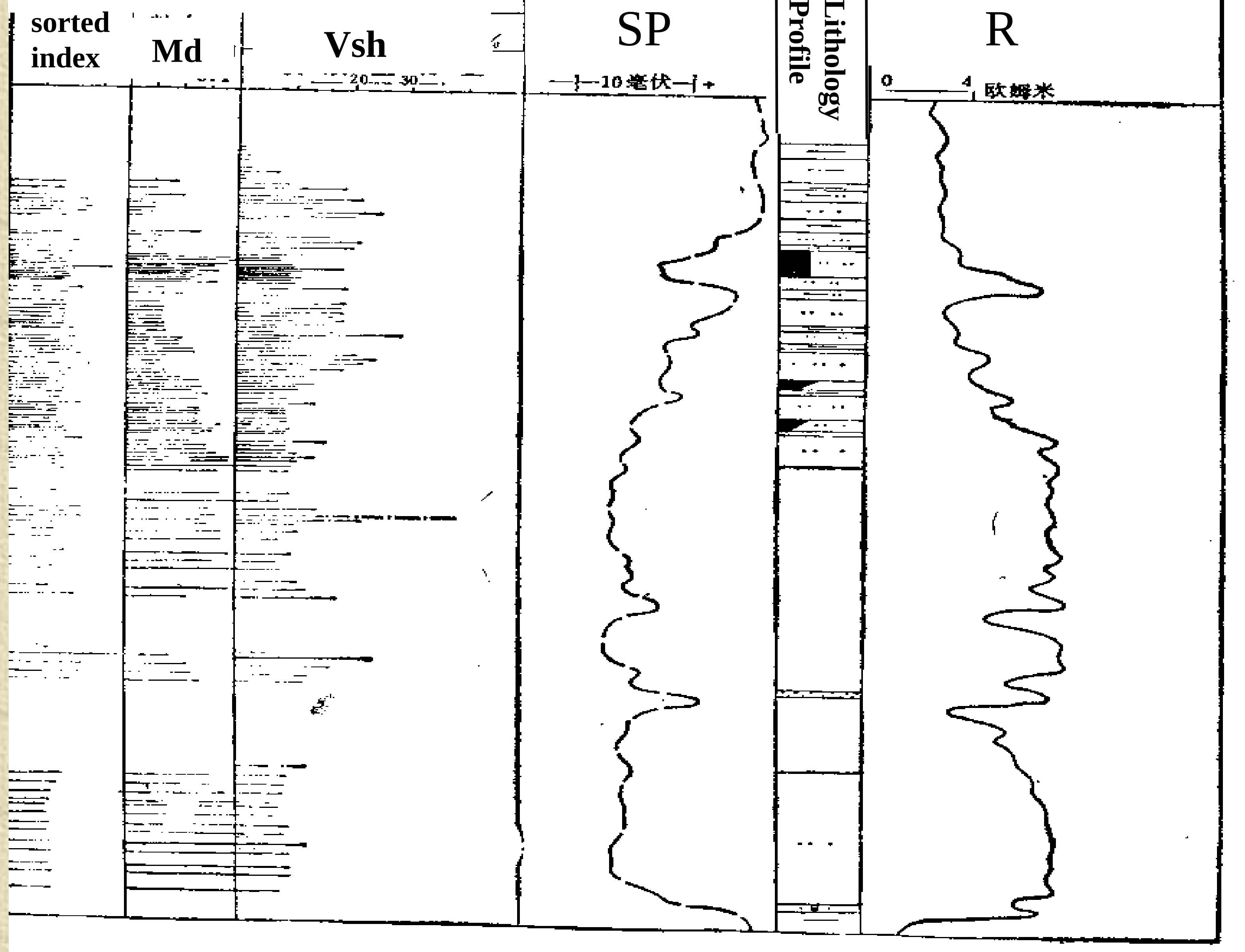
Eda depends on:

(1) The difference between the formation water salinity and drilling fluid salinity;

(2) Pore structure

(3) Hydrodynamic force

Oil bed structure



I.Well loggings

of Interpretation Sedimentary Environment

2. Natural GR---- clay content

3. Interval transit time ---- rock structure Δt-----Φ

4. Micro electric log-- micronormal， microinverse

5. R---pore structure, fluid property, mineralization, lithology

6. dipmeter log ----direction of dip, dip

7. NGS---natural gamma-ray spectrometry

   ---U(uranium), Th(thorite), K(potassium) → Vsh

   →Sedimentary Environment

8. FMS---formation microscanner

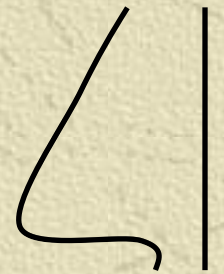
II. SP Geological Significance

Curve morphological
Amplitude
Smooth degree

The SP curve is important in geological correlation because the shapes of these curves in different wells for certain geologic horizons will be comparable.

1.Curve morphological feature

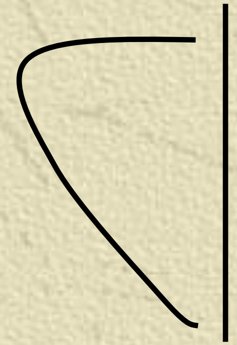
A.bell



Positive cycle

- Typical environment:
- Point bar

B. Funnel



Inverse cycle

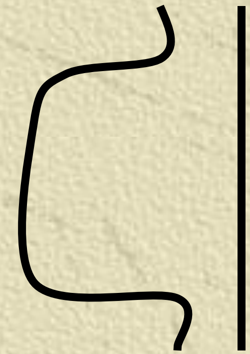
- Typical environment：
- debouch bar

Curve morphological
Amplitude
Smooth degree

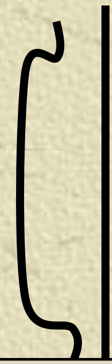
II. SP Geological significance

1. Curve Morphological Feature

C. Cylindrical

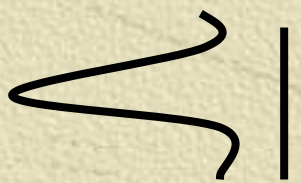


•Box



•Barrel

D. Finger



•Typical environment：

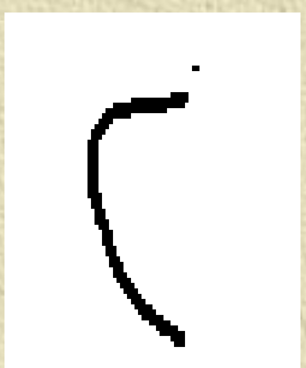
•Sand beach

II. SP Geological significance

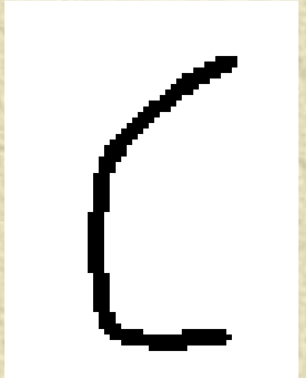
Curve morphological
Amplitude
Smooth degree

1.Curve morphological feature

E.Funnel-Box



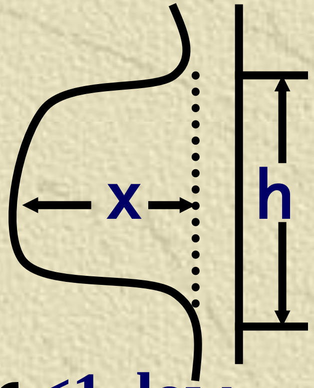
F.Box-Bell



II. SP Geological significance

Curve
morphological
Amplitude
Smooth degree

2. Amplitude of curves



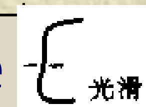
x/h: <1 low; 1-2 moderate; >2 high

$$\Delta SP = \frac{SP - SP\min}{SP\max - SP\min}$$

Curve morphological
Amplitude
Smooth degree

II. SP Geological significance

3. Smooth degree

- smooth curve 

- micro tooth 

- tooth 

1. Hydrodynamic energy and provenance supply;
2. Reflect one phase sedimentation or multi-phase sedimentation

Section 3 Lithofacial Correlation

Sedimentary facies: is a distinctive rock unit that forms under certain conditions of sedimentation, reflecting a particular process or environment.

Lithofacies: The rock record of any particular sedimentary environment, including rock color, lithological association sedimentary structure and so on.

→ **Interpret sedimentary process, infer sedimentary environment**

- **Individual well facies analysis**
- **Lithofacial correlation**

Chapter 3 Well Correlation

Section 1 Stratigraphic Division

Section 2 Stratigraphic Correlation

Section 3 Lithofacies Correlation

Section 4 Correlation of Oil Beds

Section 4 Correlation of Oil beds

Oil bed correlation is done on the base of formation correlation. When we are doing oilfield development geologic works, in order to determine development interval and study oil bed heterogeneity, we should do oil bed correlation.

- Oil layers correlation is the foundation for subsurface geological research in oilfield
- Understand the spatial distribution pattern by dividing oil layers in each well, and divide oil layers of the same geological time.

Correlation of Oil layers: the correlation of oil bearing sequence which have been identified in regional stratigraphic correlation in an oil field.

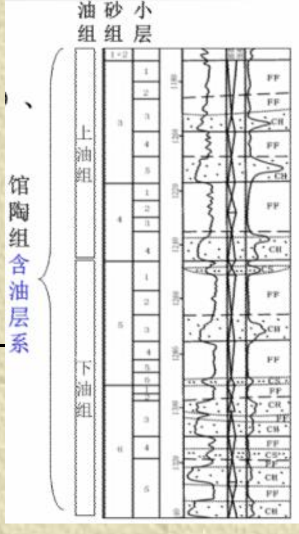
Section 4 Correlation of Oil beds

Correlation of Oil Layers: the correlation of oil bearing sequence which have been identified in regional stratigraphic correlation in an oil field.

I. Correlation Unit of Oil Beds

II. Sedimentary Cycle Graduation

III . Oil Correlation Method



Section 4 Correlation of Oil Beds

I. Correlation Unit of Oil Beds

Objective： research the layer series of development, provide geologic basis for arranging well pattern

- **reservoir characteristic**： uniformity of lithology and oil storage property
- **interlayer**： the thickness and distribution range

single sand layer(substratum, individual layer, single layer)
sand group
reservoir group
oil bearing sequence

•The smaller the correlation unit of oil layers, the better uniformity of reservoir property, and better lateral connectivity.

Correlation of Oil beds

I. Correlation Unit of Oil Beds

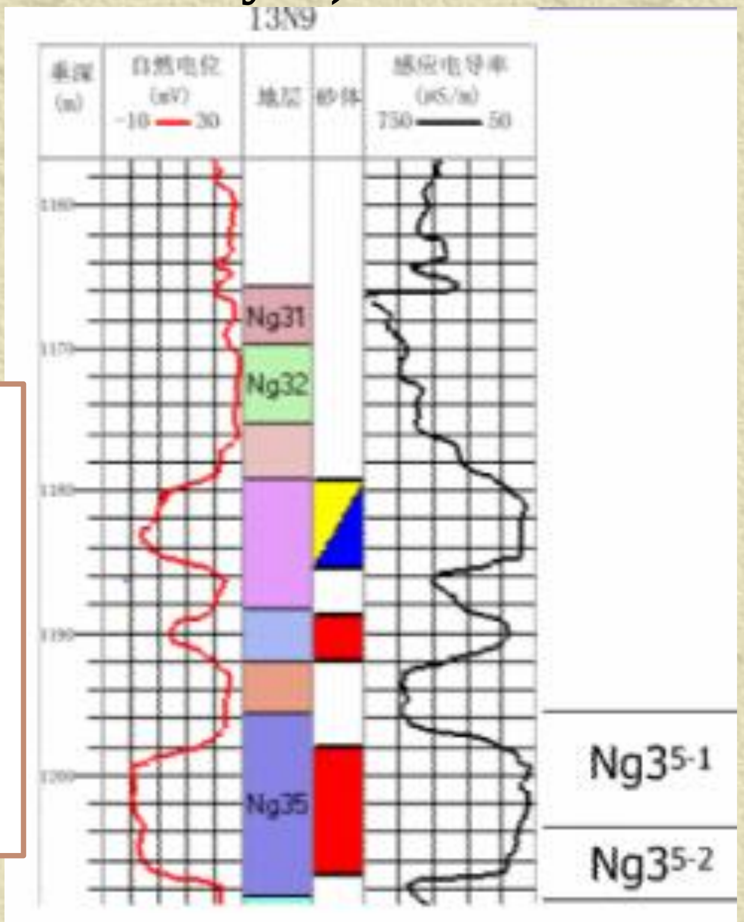
1. Single sand layer (substratum, individual layer): the smallest unit consists the reservoir system. Equal to the Coarse part of sedimentary rhythm. It has certain thickness and distribution range in the same oil field , and the lithology and oil storage property is uniform within the sand layer. It is divided by interbeds, and area of divided single sand layer is bigger than the connected area between sand layers, Single sand layer do not have independent hydrodynamic system, that is, it can not be independent development unit.

Correlation of Oil beds

1. Single sand layer(substratum, individual layer)

- certain **thickness** and distribution **range**
- divided by **interbed,**

divided area bigger than connected area



Single sand layer is one single bed which may be one microfacies, for example: channel sand, point bar, mouth bar, beech sand, dalta front sheet sand, it make small cycle which contain one microfacies.

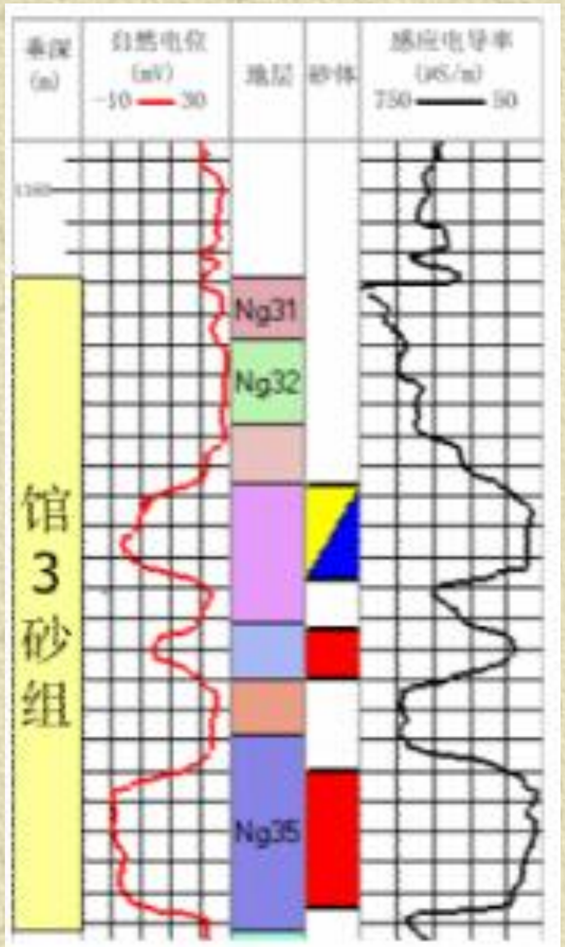
Single SP curve shape will be used to determine this small cycle.

Correlation of Oil beds

—— Stratigraphic unit classification

2. Sand group

- Composed by adjacent single sand layers.
- Uniform lithology in the sand group
- Sand groups are divided by steady interbeds



Independent development systems

Section 4 Correlation of Oil Beds

I. Correlation Unit of Oil Beds

3. Reservoir group： composed of several sand groups with similar reservoir property, the cap and bottom bed is thick impermeable mudstones. Distributed in the same facies, and belongs to the same sedimentary system.

The reservoir group is divided into several independent development systems based on heterogeneity and pressure characteristics.

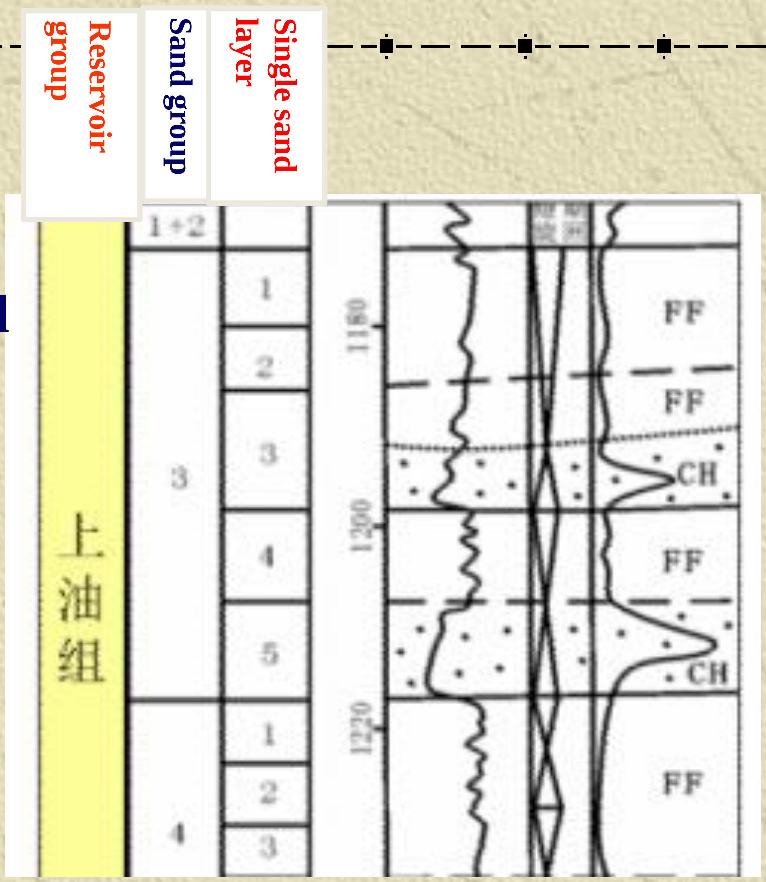
Correlation of Oil Beds----

classification of stratigraphic units

3. Reservoir group

▲ **Composed of several sand groups with similar oil layer property.**

▲ **The top and bottom is thick impermeable mudstone.**



Sand package is assembly of beds which has the same genesis, such as river bed, delta bed and beech or bar bed etc. it make a middle cycle which contain a depositional sequence, such as one delta sequence. We can use SP curve association shape to divide it into progressive, regressive and stacking cycle.

Section 4 Correlation of Oil beds

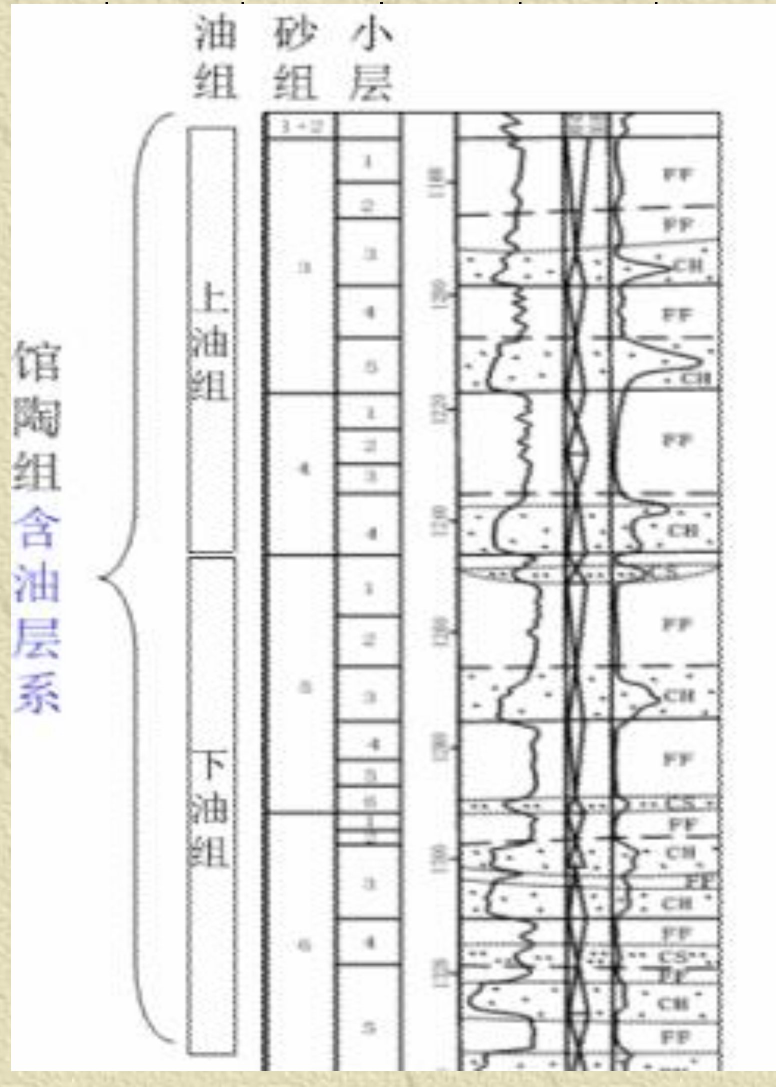
I. Correlation unit of oil layers

4. Oil bearing sequence, oil-bearing series: combination of several reservoir groups, a set of source-reservoir-cap rock association with same sedimentary origin. Within an Oil bearing sequence, the sedimentary origin, oil and water, as well as rock types features are relatively the same.

Correlation of Oil Beds----
classification of stratigraphic units

4. Oil bearing sequence

- combination of reservoir groups.
- Similar sedimentary origin, rock types and oil-water characteristic in the same oil bearing sequence.



Top and bottom surface of reservoir unit is uniform with the stratigraphic-age boundary.

(isochronous)

Section 4 Correlation of Oil Beds

I. Correlation Unit of Oil Beds

single sand layer
sand group
reservoir group
oil bearing sequence

•The smaller the correlation unit of oil layers,
the better uniformity of reservoir property, and better lateral connectivity.

Yanqi basin Baolang oilfield

oil bearing sequence

oil group

substratum

- **I oil group：**
- **Baozhong block——I1,I2,I3**
- **Baobei block——I1,I2**

Section 4 Correlation of Oil beds

II. Classification of Sedimentary Cycle

By Individual Reservoir Lithologic features and evolution

By Individual reservoir at all levels of depositional cycle in combination

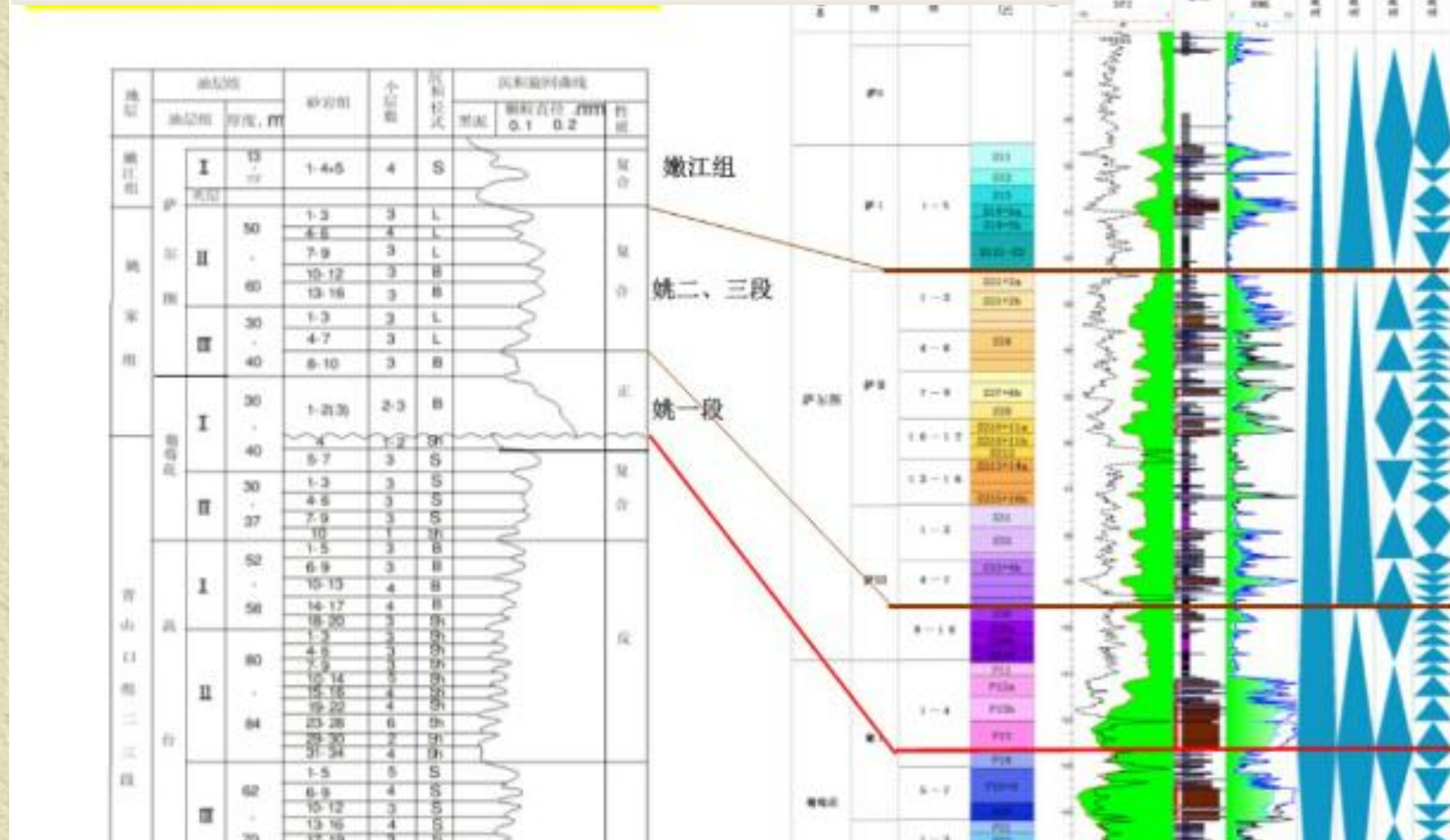
Section 4 Correlation of Oil beds

II. Classification of Sedimentary Cycle

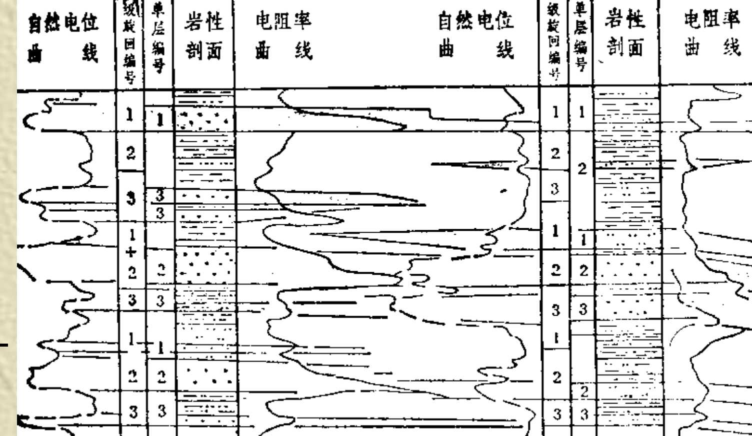
- **4th level sedimentary cycle(**rhythm **)**
- **3rd level sedimentary cycle**
- **2nd level sedimentary cycle**
- **1st level sedimentary cycle**

Positive Rhythm,
Inverted Rhythm

Daqing oil field main oil bed sedimentary division



Section 4
Correlation of Oil beds



II. Classificaiton of Sedimentary cycle

4th level sedimentary cycle(rhythm): within a sedimentary event, in a sedimentary mode, due to the current energy periodical change of water, the combined rhythm formed.

Single sand layer

- where **delta sandstone** most developed, single sand layer has thickness of 20-30m, Medium-fine sand, Cross-bedding ,Positive rhythm ,
Half deep lacustrine facies ,Deep lake facies, outer margin single sand layer thickness less than 3m, siltstone, Horizontal bedding , rhythm not obvious.

Section 4 Correlation of Oil Beds

II.Cassification of Sedimentary Cycle

3rd level sedimentary cycle: within a sedimentary event, continuous deposition by different depositional mode, equal to sand group. Concentrational develped oil bearing sand stone has certain connectivity, with stable mudstone interlayer, can be the basis for identifying cyclic boundary.

- **Like sand group, oil bearing sand stone has certain connectivity**
- **With stable mudstone interlayer**

Section 4 Correlation of Oil Beds

II.Classification of Sedimentary Cycle

2^{nd} level sedimentary cycle : in a uniform sedimentary setting, the continuous deposition composed of multi sedimentary events. Resemble depositional system or reservoir group.

Section 4 Correlation of Oil Beds

II. Classification of Sedimentary Cycle

1st level sedimentary cycle: within the same petroliferous basins, in a certain period, in different sedimentary backgrounds, the continuous deposition composed of multi sedimentary events and different depositional mode, that is, 1st level sedimentary cycle is formed in a certain period of basin evolution.

Section 4 Correlation of Oil Beds

II. Classification of Sedimentary Cycle

- By Individual reservoir Lithologic features and evolution
- By Individual reservoir at all levels of depositional cycle in combination

4th level sedimentary ycle(rhythm)
3rd level sedimentary cycle
2nd level sedimentary cycle
1st level sedimentary cycle

Section 4 Correlation of Oil Beds

III. Correction Methods of Oil Bed

Correlation process is the same not only to formation correlation but also to oil bed correlation.

cycle-thickness correlation

"cycle comparison and hierarchical controlling"

Correlation of Oil beds

III. Oil bed correction

cycle-thickness correlation

(1)Condition: stable depositional environment

such as lacustrine facies and delta-front facies

(2)Definition: controlled by standard layer or marker, according to the relationship between the order of sedimentary cycle and thickness ratio, conduct correlation step-by-step from large to small till to the single layer.

Correlation of Oil Beds

III. Oil bed correction

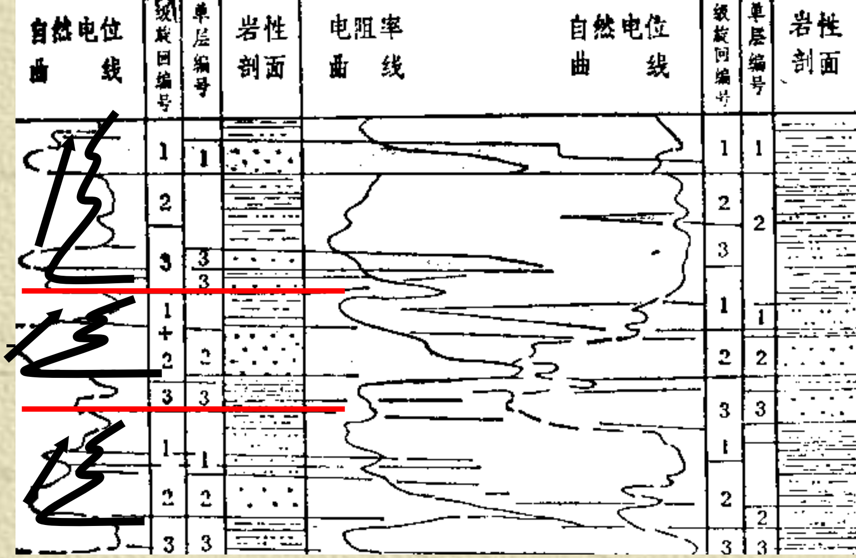
cycle-thickness correlation

(3)procedure：

A. use marker and 2nd level sedimentary cycle to correlate reservoir group；

- **the distribution of markers**
- **2nd sedimentary cycle feature**

Correlation of Oil Beds

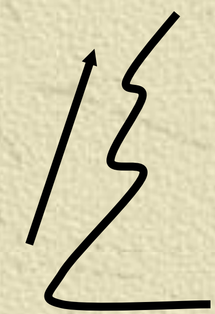


III. Oil bed correction

cycle-thickness correlation

(3)procedure：

B.use 3rd level sedimentary cycle ----sand group；



- **lithological association**
- **evolution**
- **cycle**
- **well log curves combination characteristic**

Section 4
Correlation of Oil Beds

III. Oil bed correction

cycle-thickness correlation

(3)procedure：

C.use 4th level sedimentary cycle, lithology and thickness to conduct time-stratigraphic unit correlation of single sand layer.

- relative development degree of single sand layer
- stability of mudstone layer

Section 4 Correlation of Oil Beds

3rd level sedimentary cycle	4th level sedimentary cycle	Single layer	lithology
	1	1	— .... • • •
	2		
	3		

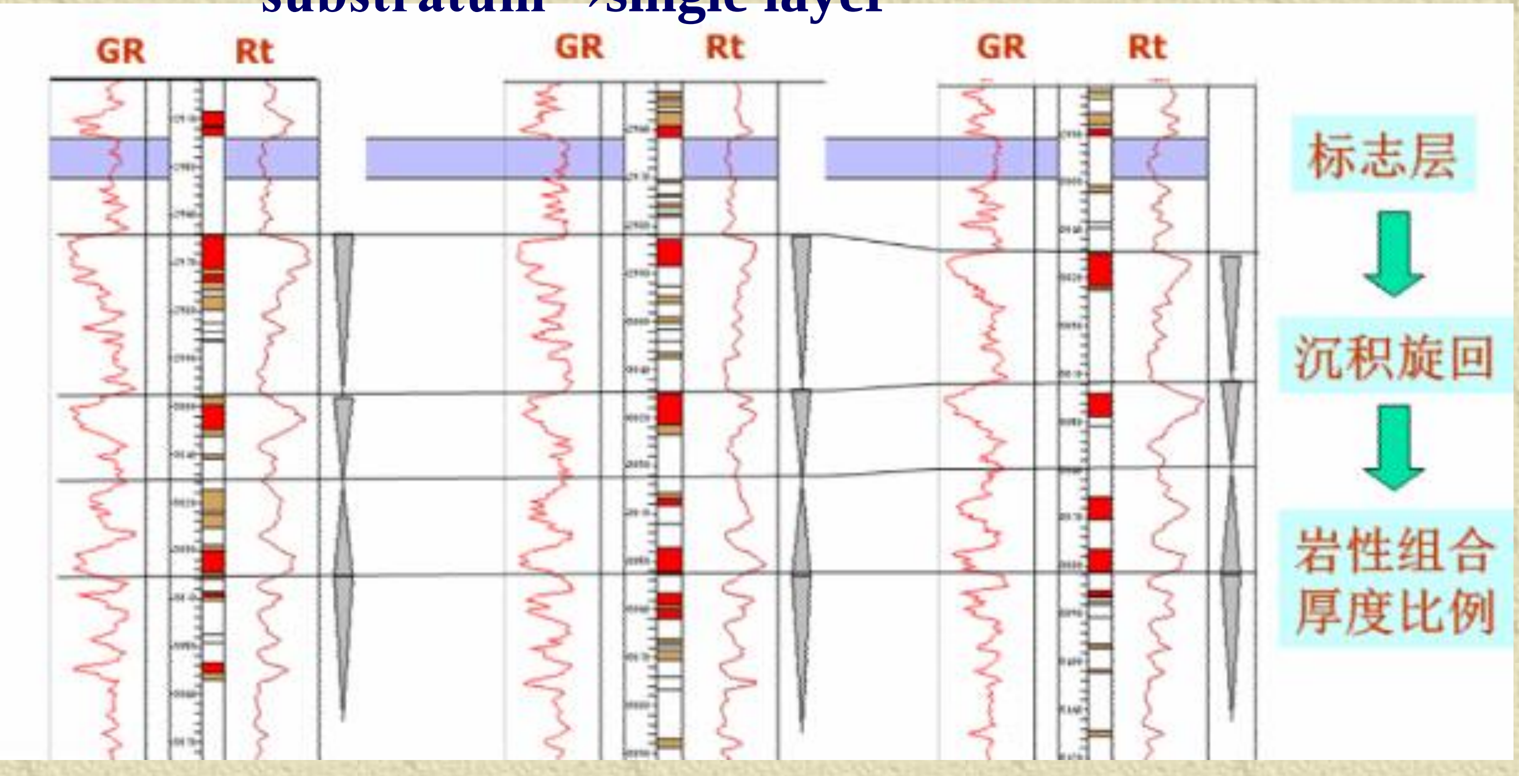
	rhythm	Single layer	lithol ogy
	1	1	— • • •
	2		
	3		

Correlation of oil layers----methods

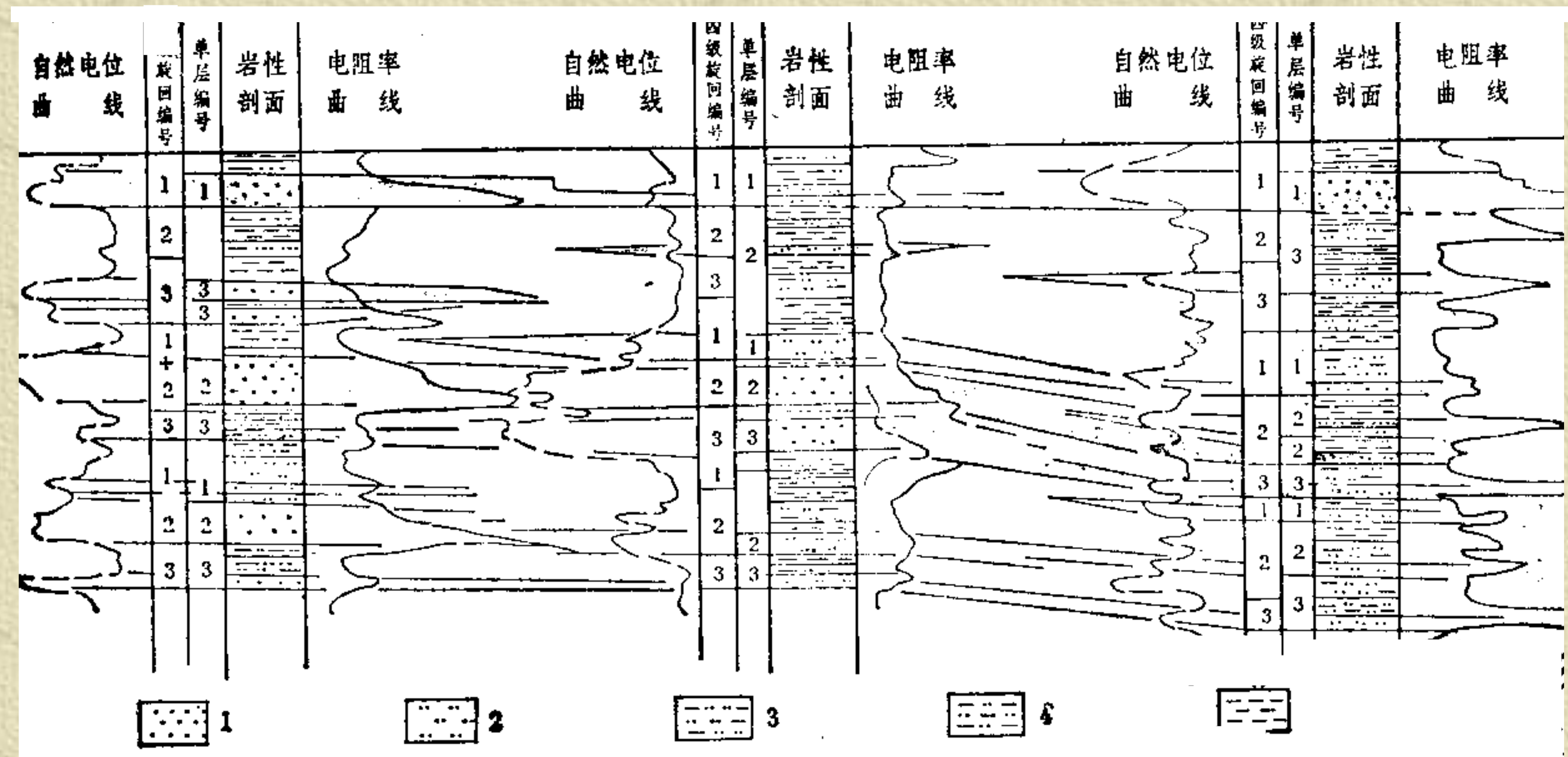
hierarchical control

Reservoir group→sand group→substratum→single layer

step by step comparison



Correlation of Oil Beds



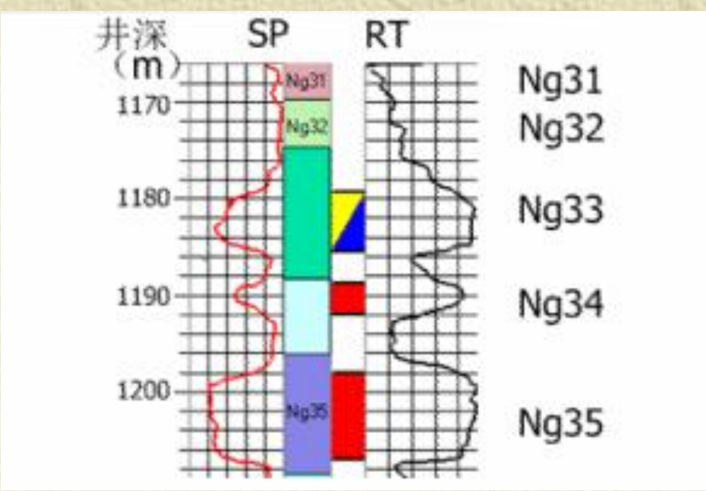
oil beds correlation map

Section 4 Correlation of Oil Beds

Cycle-thickness correlation：

controlled by standard layer, according to the relation between the order of sedimentary cycle and thickness ratio, conduct correlation step-by-step from large to small till to the single layer.

Correlation of oil layers-methods



Result list

substratum data table

油层组	砂层组	小层	小层井段 m	砂岩井段 m	有效厚度，m		有效孔隙度%	渗透率
					一类	二类		
上油组	Ng3	Ng35	1622-1643	1634-1634	10		20	125

Section 4 Correlation of Oil Beds

IV. Reservoir Characteristic Research

1. Plane graph
2. Profile chart
3. Block diagram, fence diagram
4. Reservoir physical property map

Chapter 3 Well Correlation

Section 1 Stratigraphic Division

Section 2 Stratigraphic Correlation

Section 3 Lithofacies Correlation

Section 4 Correlation of Oil Beds

Section 4 Correlation of Oil Beds

IV. reservoir characteristic resea

1.Plane graph

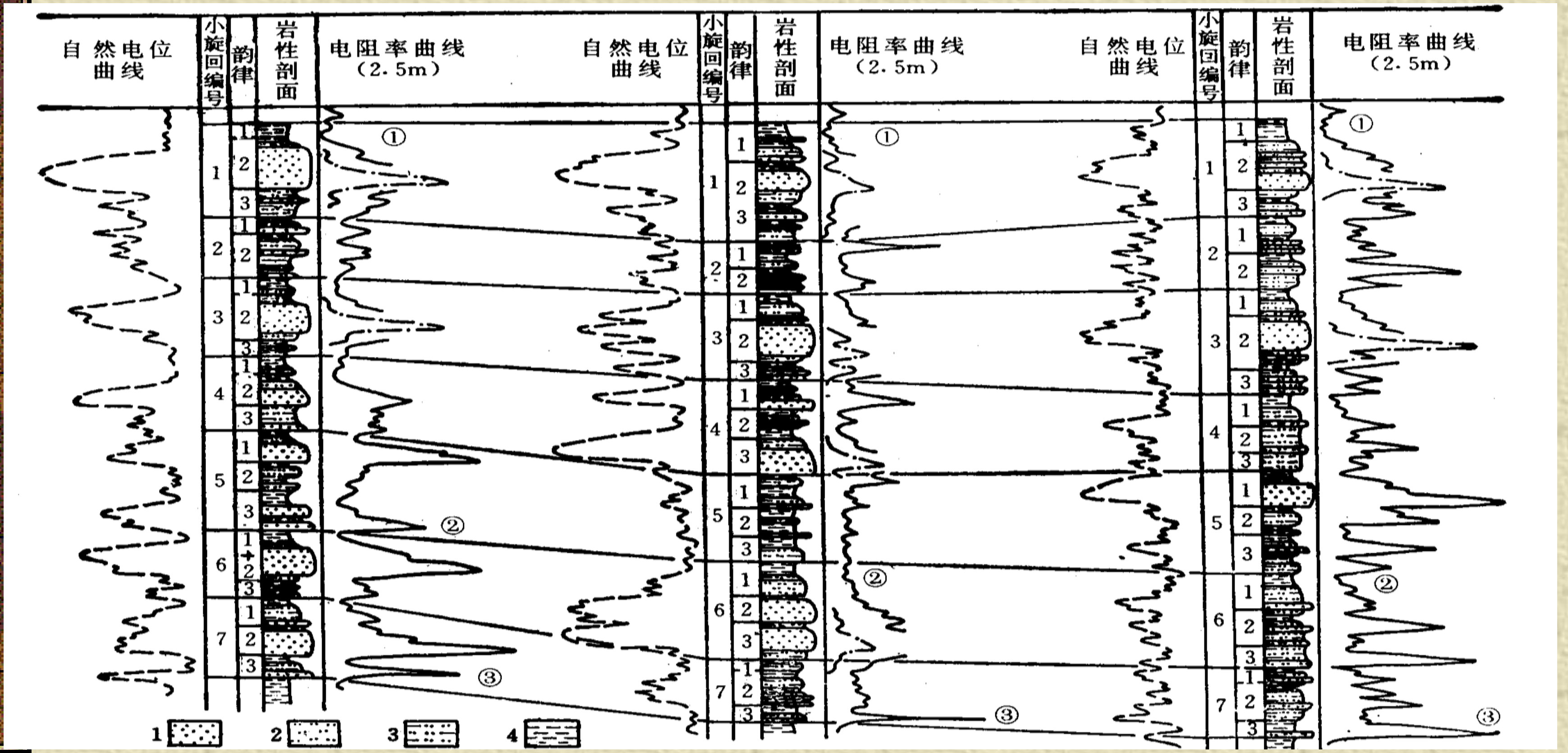
Yao Er in the north of Daqing Oilfield

Facies distribtion in the top of third member

Section 4 Correlation of Oil Beds

IV. reservoir characteristic research

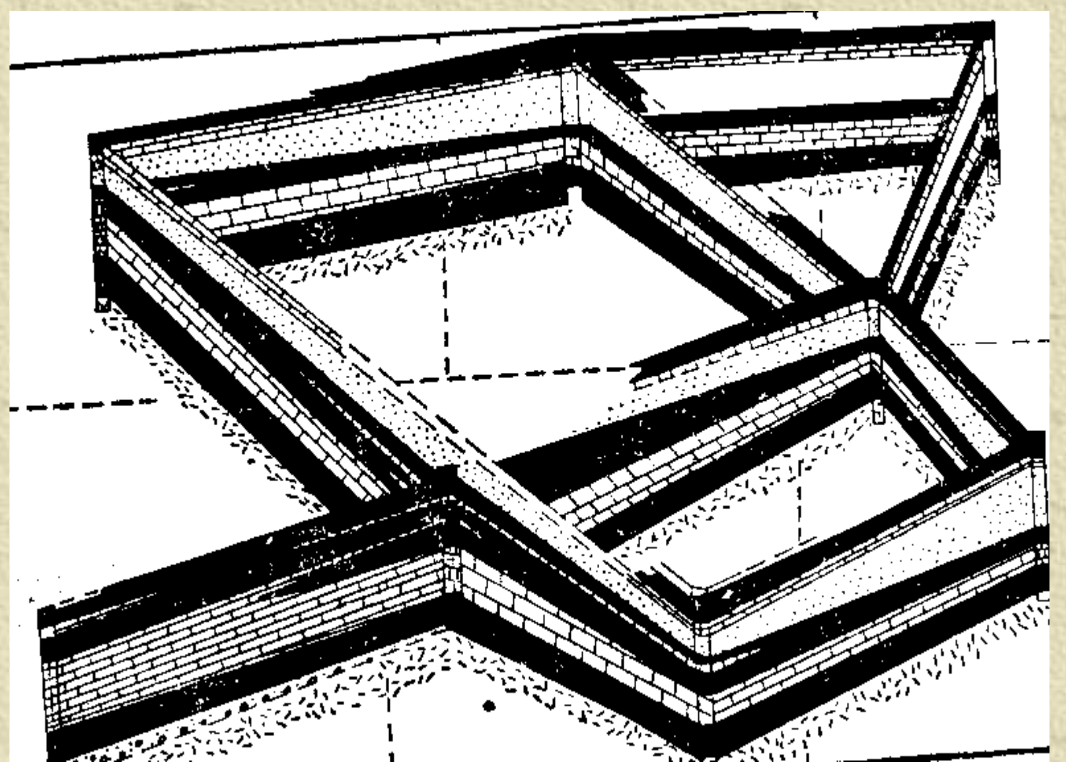
2. profile, section

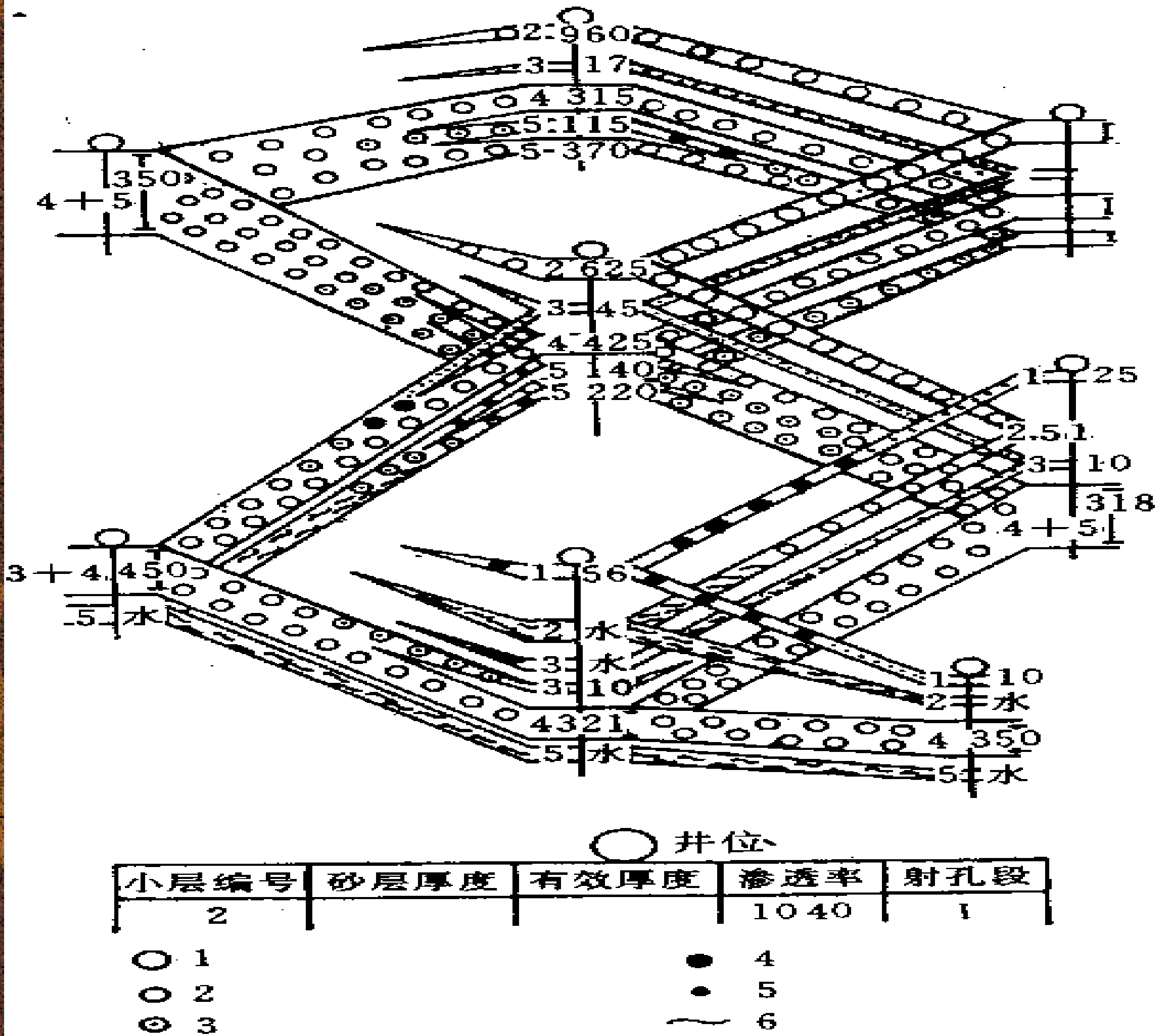


Correlation of Oil Beds

Ⅳ. reservoir characteristic research

3. block diagram, fence diagram





2 960
3 17
4 315
5 115
5 370
350
4＋5
2 625
3 45
4 425
5 140
5 220
1 25
2 51
3 10
318
4＋5
3＋4 450
5 水
1 56
2 水
3 水
3 10
4321
5 水
1 10
2 水
4 350
5 水
井位
小层编号
砂层厚度
有效厚度
渗透率
射孔段
2
1040
I
1
2
3
4
5
6

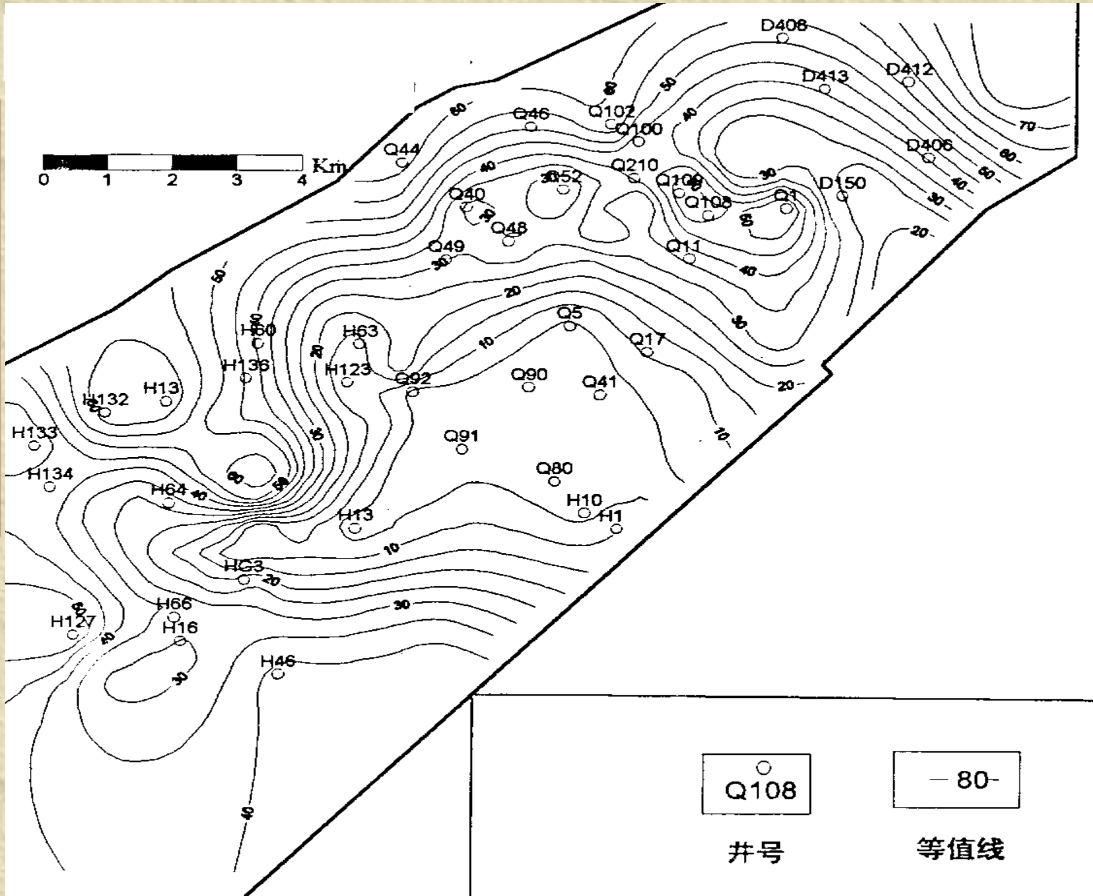
图 4－10　油层连通图

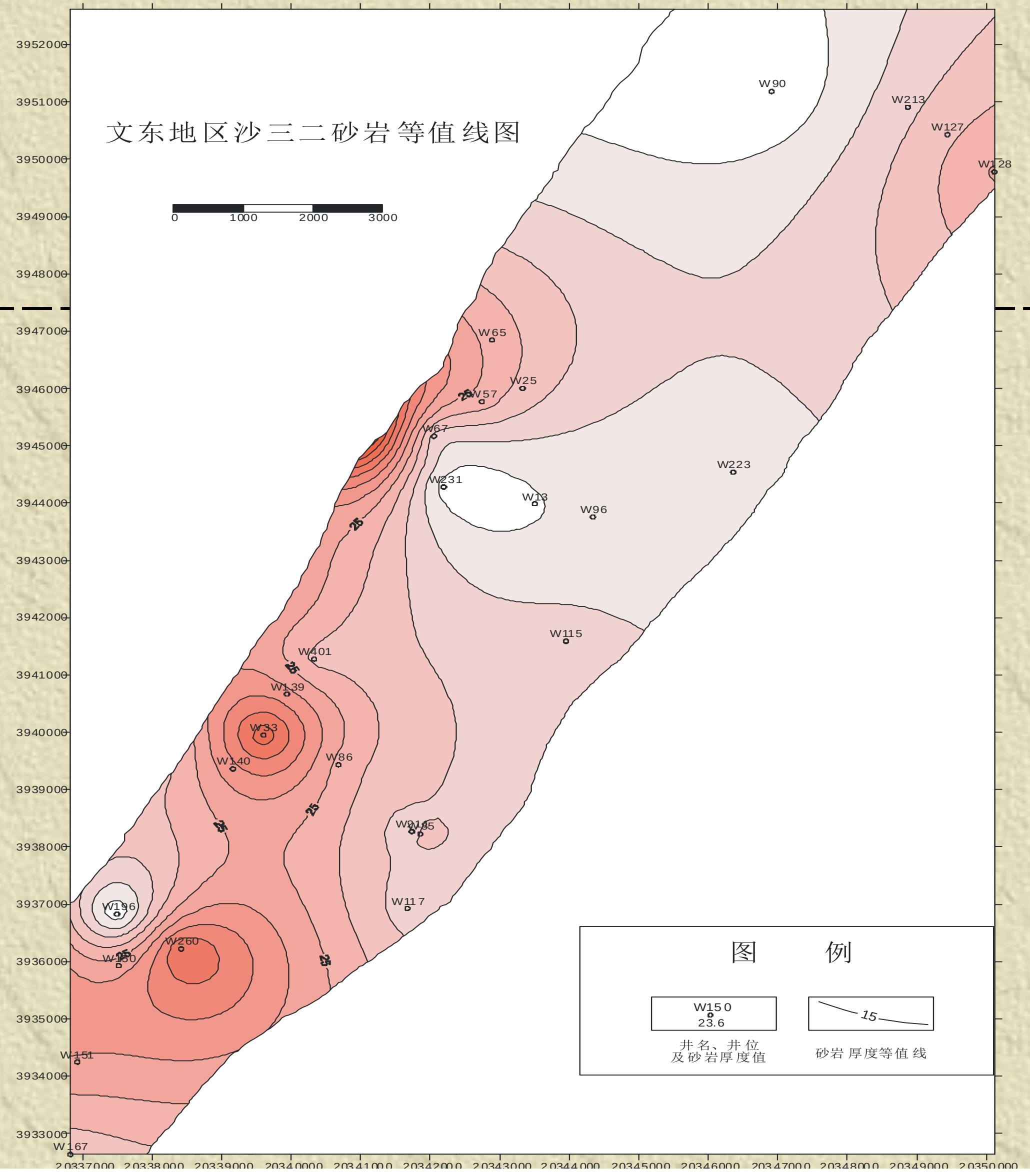
Section 4 Correlation of Oil Beds

IV. reservoir characteristic research

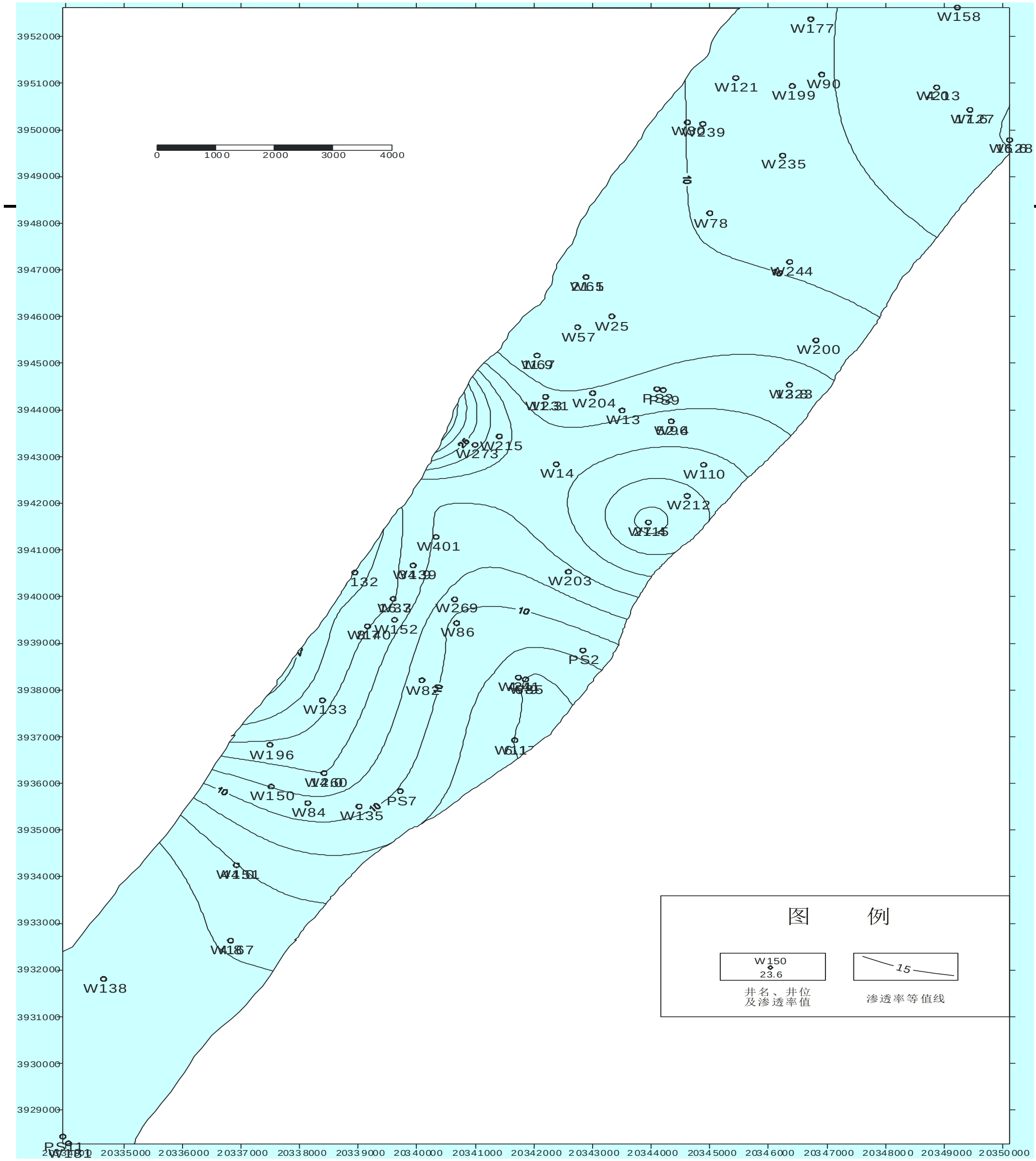
4.Reservoir physical property map

Reservoir quality maps are used to illustrate the distribution of reservoir parameters such as net sand, porosity or reservoir thickness.





•Sandstone isopach map



•Permeability Contour map

Chapter 3 Well Correlation

Section 1 Stratigraphic Division

Section 2 Stratigraphic Correlation

Section 3 Lithofacies Correlation

Section 4 Correlation of Oil Beds

Comprehensive Questions:

1. **What's the main stratigraphic division units for a field wide?**
2. **Explain the definition of rock stratigraphic unit?**
3. **What's the characteristics of rock stratigraphic unit?**
4. **What features of index fossil have?**
5. **Explain the sequence stratigraphy unit?**
6. **What is the basis of formation correction?**
7. **Explain the scope of stratigraphic correlation.**
8. **Sum the main formation method in an oil field.**
9. **Analysis the features of marker bed.**
10. **What are common logging curves to be used correction?**
11. **Explain the type well or standard well.**
12. **Describe the correlation procedures**
13. **How to select correlation sections?**
14. **What are factors to influence the SP curve?**
15. **Draw the SP curve morphology of point bar and debouch bar, and explain their sedimentary features.**
16. **Oil bed correction**
17. **How to define oil bed correction unit?**
18. **Analysis the features of single oil method**
19. **Explain the cycle-thickness correlation method**