Subsurface Geology of Oil and Gas Fields

Chapter 4 Subsurface Structure Research

Subsurface Structure Research

- Exploration arrangement
- Reserves calculation
- Development design
- Dynamic analysis

Research Contents

Section 1 Subsurface Structure Overview

Section 2 Fault Research

Section 3 Geology Section Mapping

Section 4 Structure Map of Oil and Gas Fields

Section 5 Palaeostructure Research Method

Chapter 4 Subsurface Structure Research

Contents
Methods

The basic features of subsurface structure

Fold:

bedding fluctuation

Fault:

bedding offset

Chapter 4 Subsurface Structure Research

Subsurface Structure Overview

Contents
Methods

Exploration Phase

Research Range：

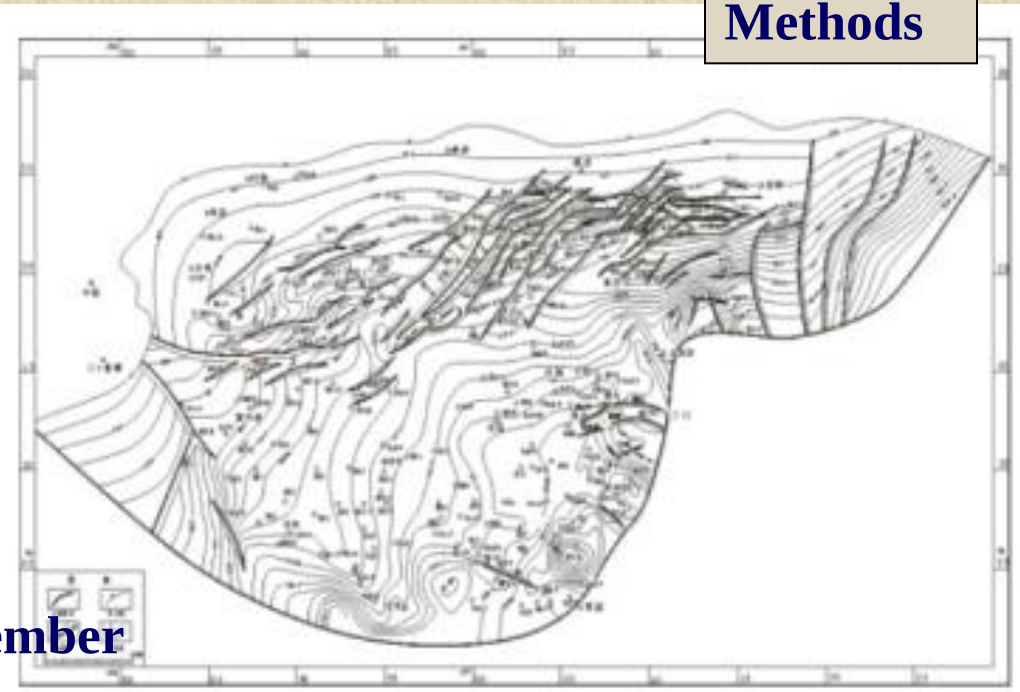
Basin, Depression
Structural zone

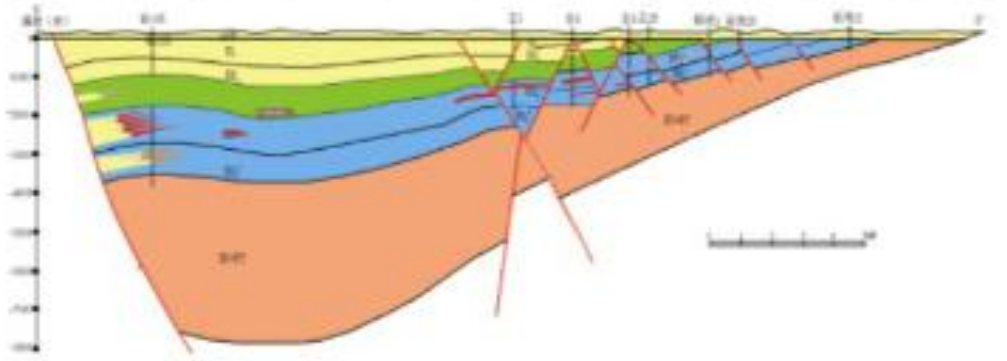
Mapping unit

Rock-stratigraphic unit:
System, series, formation, member

Contents

Structural distribution，
Structural evolution,
Trap description





Large range, thick ---- seismic data

Chapter 4 Subsurface Structure Research

Section 1 Subsurface Structure Overview

Development Phase

Research Range：

oil-gas field

Mapping unit

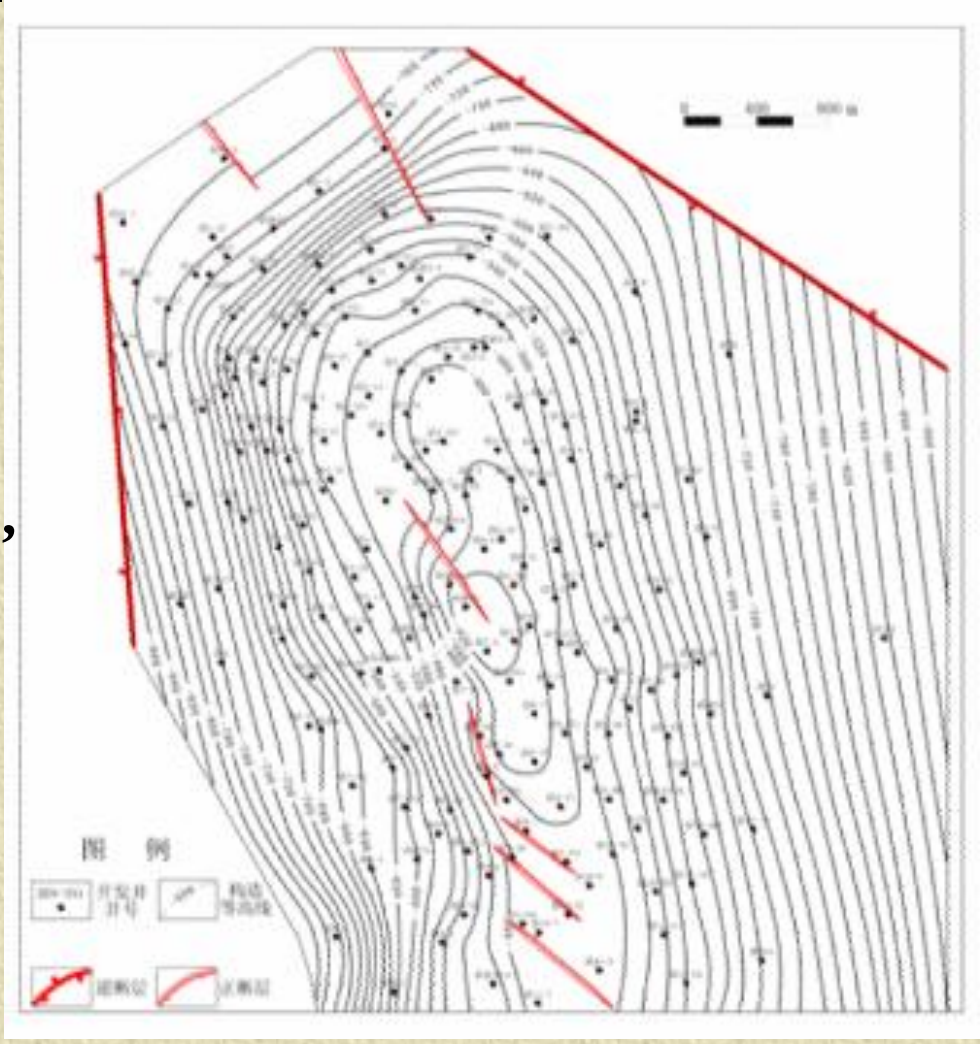
oil beds unit----

reservoir group, sand group,

single sand bed

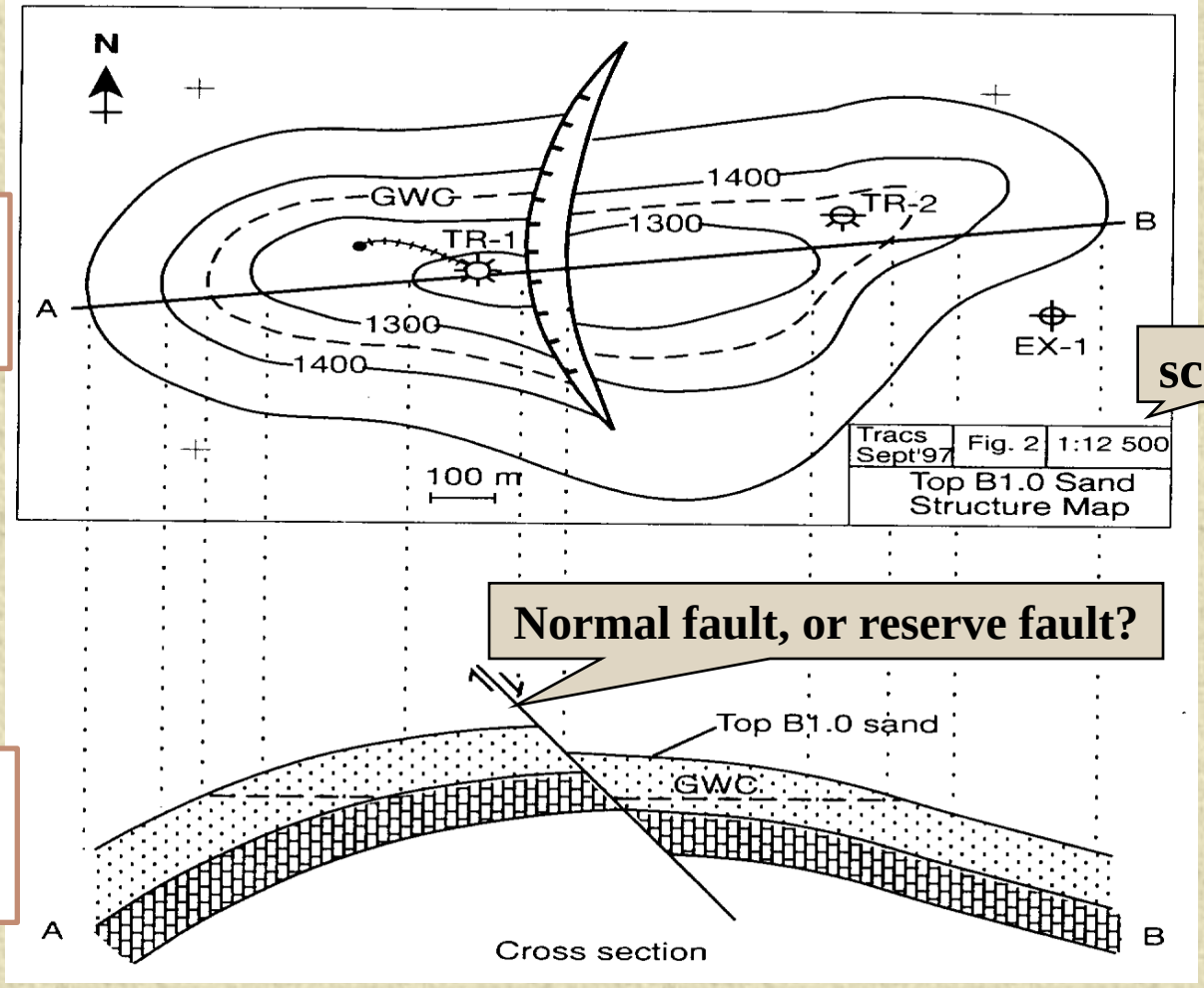
Contents

Trap fine description



Structure contour map

Structure section map



Structure map

Structure contour map displays the shape and extend of the hydrocarbon accumulation, indicates the OWC and display the location of wells and fault.

Structure section map shows structure feature, fault and anticline.

Geology Profile Mapping

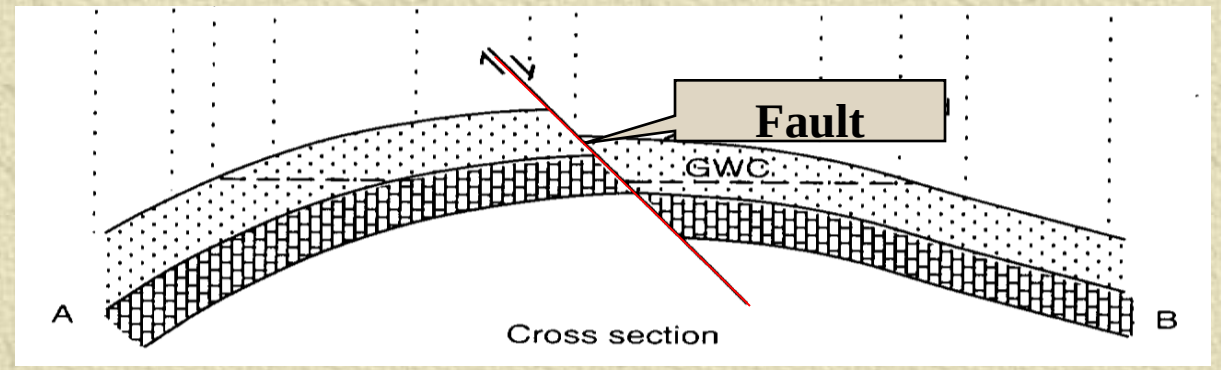
Geology profile of oil and gas field is the vertical section along some directions

Cross profile, cross section:

--------Vertical to construction axial direction

Profile section, elevation section:

--------Parallel to the construct axis



Geology Profile Mapping

Cross profile
Longitudinal diagram

Cross profile：

To display the shape and extent of a hydrocarbon accumulation

To indicate the dip and strike of the structure.

To display the location of faults，fold and the fluid contacts

Geologic profiles illustrate in two dimensions the relation between stratigraphy, structure, and topography. The detail included on such profiles depends on the amount of data available for plotting, scale of the profile, and purpose of its construction.

Correlation of stratigraphic units within rock sequences is the basis of these cross sections. The stratigraphic data plotted are obtained from geophysical information and from drill holes.

The quality of the profiles depends directly on the accuracy of data with which the geologist has available, and on his ability to interpret and use these data.

Exercises 4 Geologic Section Mapping

I. Data

II. Correlation

III. Geologic Section Mapping

IV. Comprehensive Questions

I. Data

Table 4 Locations of wells

Distances between 16 wells along a west-east line are given in table.

Well No.	Well Spacing m	Well No.	Well Spacing m
1-2	641	9-10	244
2-3	381	10-11	427
3-4	305	11-12	229
4-5	641	12-13	336
5-6	351	13-14	625
6-7	412	14-15	342
7-8	189	15-16	464
8-9	153		

Well No.1 is the most westerly

I. Data

Youngest

Table 5 Summary description of stratigraphic units

L	Coarse-grained, gray sandstones, unconsolidated conglomerates, and gravels
K	Red, silty to sandy shale
J	Cross-bedded, arkosic sandstone and conglomerate
I	Gray-black, thin-bedded shale
H	Tan to brown dolomite with chert streaks
G	Red mudstone with discontinuous layers of evaporite
F	Very dense, gray limestone to highly coralline limestone
E	Dark gray, calcareous shale and coralline limestone
D	Medium-grained, calcareous sandstone to arenaceous, eoralline and algal limestone (locally well developed)
C	Black, cherty, shale with streaks of white bentonite
B	Fine- to medium-crystalline, gray fossiliferous limestone
A	Fine-grained, gray, quartzitic sandstone

Oldest

I. Data

Table 6.—Description of lithology penetrated in wells

	Well No. 1 (Elev. 85m; T.D.1945m)
0-290	Poorly sorted, very coarse-grained, friable, gray sandstone
-412	Massive, red siltstone and sandy shales; some thin streaks of fine-grained, pink sandstone
-519	Coarse-grained, feldspathic sandstone; thin calcareous streaks
-686	Thin-bedded, lack highly fissile shale
-770	Dark brown, fine-crystalline dolomite with chert
-1235	Red mudstone with some anhydrite
-1312	Very dense, gray limestone
-1510	Dark gray, calcareous, hard shale
-1754	Gray, calcareous, hard, brittle sandstone
-1824	Black shale with streaks of bentonite; some chert
-1945	Gray-white, fine-crystalline, vuggy limestone with few fossils

Exercises 4 Geologic Section Mapping

I. Data

II. Correlation

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IV. Comprehensive Questions

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	Well No. 2 (Elev. 520'; T.D. 6750')
0-390 L	Loosely consolidated conglomerates and sandstones; considerable caving in hole
-488 K	Silty red shale with occasional thin streaks of sandstone
-583	Coarse-grained, cross-bedded sandstone
-639	Black shale; thin-bedded; slightly silty in lower part
-720	Fine-crystalline, light tan dolomite containing streaks and lenses of white chert
-1195	Interbedded red mudstone and thin anhydrite layers
-1204	Massive, coarse-crystalline anhydrite
-1272 -1268	Dense to fine-crystalline, gray-white limestone Gray, calcareous, hard, brittle sandstone Dark gray, highly calcareous, hard, brittle shale
-1631	Hard, gray, calcareous sandstone; few streaks of thin, sandy limestone
-1956	Medium-crystalline, gray-white limestone; few poorly preserved fosses; lost circulation at 5365 feet
-2058	Very hard, fine-grained sandstone; penetration 2-feet-per-hour with rock bit

Exercises 4 Geologic Section Mapping

I. Data

II. Correlation

III. Geologic Section Mapping

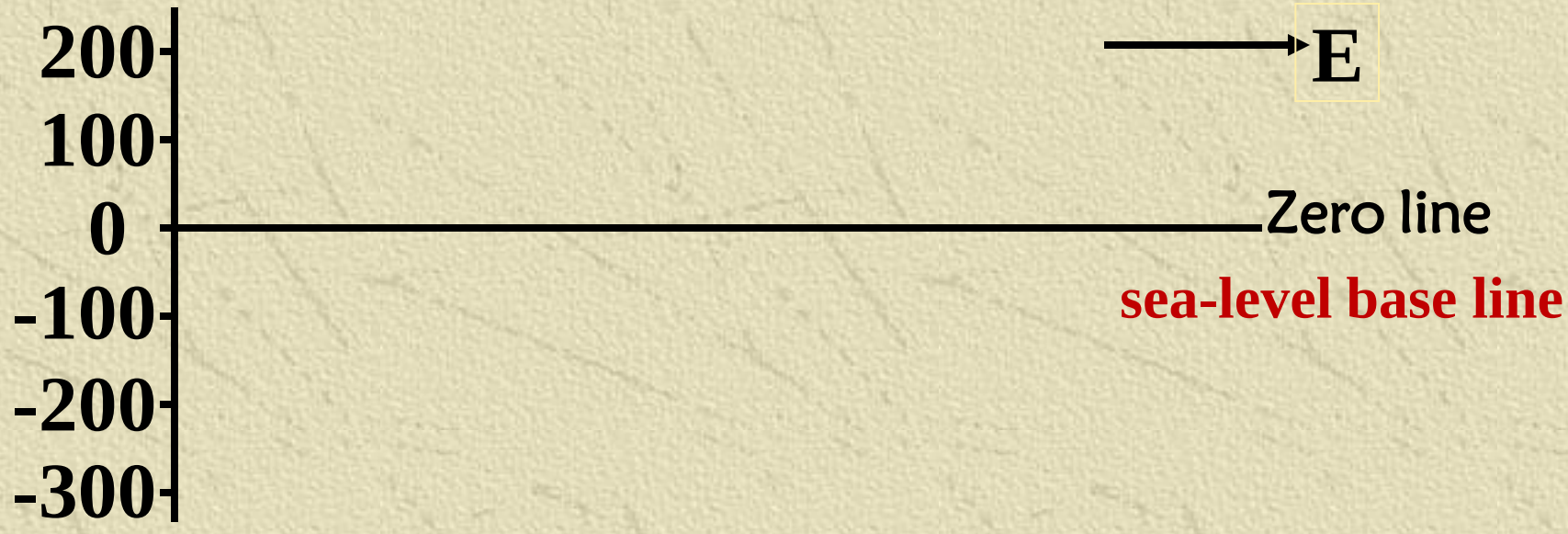
IV. Comprehensive Questions

Geology Profile Mapping

1. Plotting selected section line according to scale

Draw a sea-level base line
Mark the profile direction

1 : 20000



Geologic Section Mapping

2. **Wells are marked on the section line**

Locate the position of each well on a scale of 1:20000.

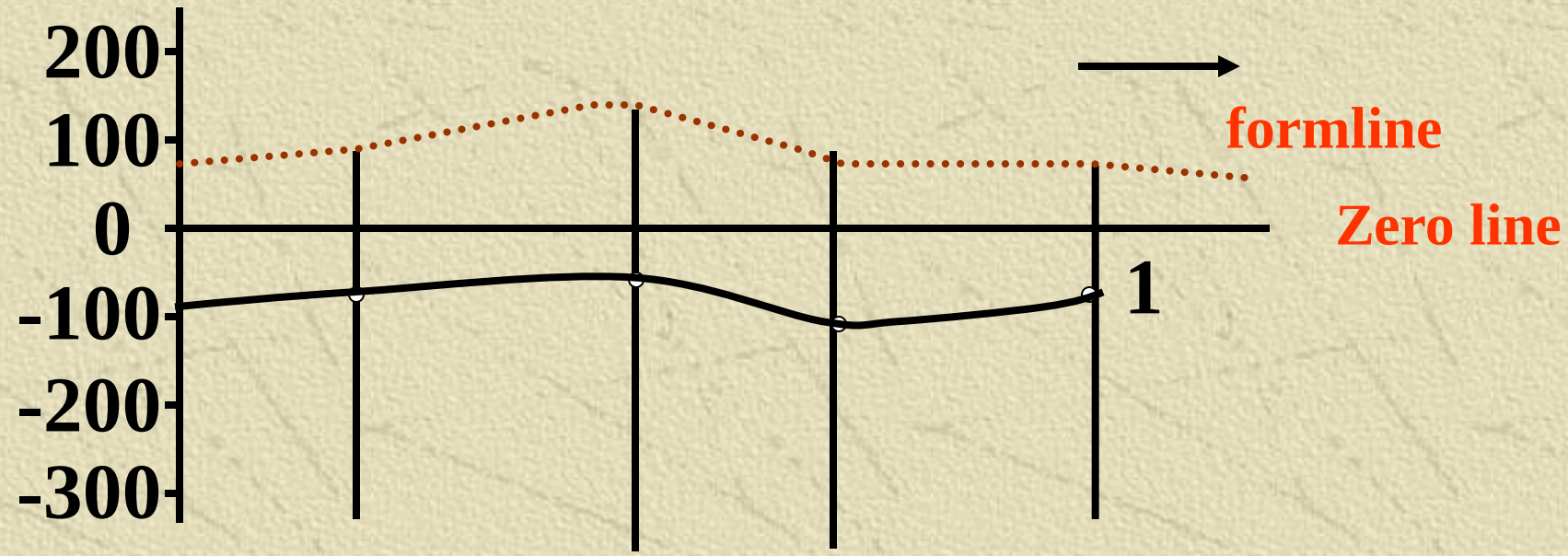
Plotting formline according to well head elevation

Well head elevation: **The distance between ground level to sea level**

Geologic Section Mapping

3. Mark results of correlation and fault point on well profile

To connect the same strata boundary with smooth line and fault line on the section.



Geologic Section Mapping

4. Legend and Table

Mapping unit	
Draftsman	
Mapping time	
Authorization	

5. Description

1. **Draw a sea-level base line.**
2. **Locate the position of each well on a scale of 1:20000.**
3. **On the same scale, plot the ground elevations above the sea-level datum line; from these ground-elevation points plot the total depth of each well.**
4. **In table 6 identify the lithologic units as penetrated in each well according to the "key" lithologic description given in table 5 and place the formation letter (L,K,J, etc.) to the left of their respective tabular depth intervals**
5. **The positions of the identified stratigraphic units determined in step 2 are then plotted on the well lines according to depths.**
6. **Having identified and plotted all lithologic units in each well, establish correlations between the wells and develop the cross section.**
7. **The final drawing should include a formation legend, graphic scale, and also well numbers, and arrows indicating relative direction of fault movement.**

Exercises 4 Geologic Section Mapping

I. Data

II. Correlation

III. Geologic Section Mapping

IV. Comprehensive Questions

IV. Comprehensive Questions

1. Indicate the most favorable positions for accumulation of oil and gas on the cross section.
2. List the various conditions under which a formation may be repeated in the same well.
3. Under what conditions may a formation exhibit anomalous thickness?
4. List the major shows while drilling through the fault.
5. Discuss the relative ages of the faults in the cross section.
6. From the cross section is it possible to demonstrate divergence of a crestal and an axial surface?
7. Summarize the geological feature of the cross profile briefly.