



Structural Geology

(Geol 305)
Semester (071)

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INTRODUCTION

Objectives

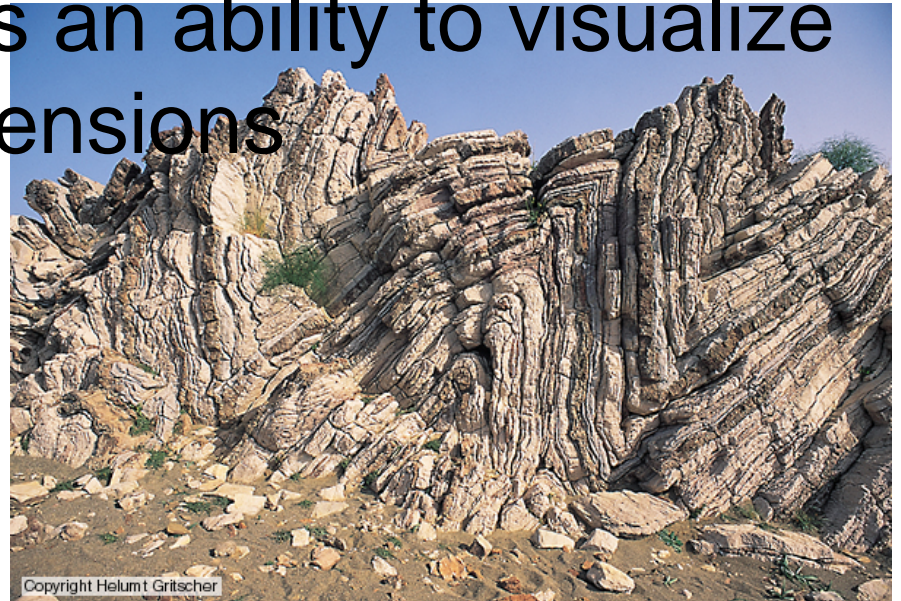
By the end of this unit you will be able to know:

1. *The definition of structural geology*
2. *The difference between structural geology and tectonics*
3. *What are the different type of deformations?*
4. *Factors controlling structures*
5. *Structures according to scale and presence.*
6. *Importance of structural geology.*

Structural Geology

The word structure is from Latin struere (to build)

Structural Geology: Deals with the origin, geometry and kinematics of structures' formation. it requires an ability to visualize objects in three dimensions



Structural Geologists concerns with

Why

Parts of earth folded (bend) & other faulted (broken)

How

The structures are related Geologic processes are related & in what scale

When

Structures are formed in geologic time & in relation to each other

Three important issues structural geologist should deal with time, scale & location

Structural Geology and Tectonics

Both concerned with the reconstruction of motion that shaped the Earth's outer layers

Structural Geology:

Involve studying outcrop
and microscopic size
local structures such as:

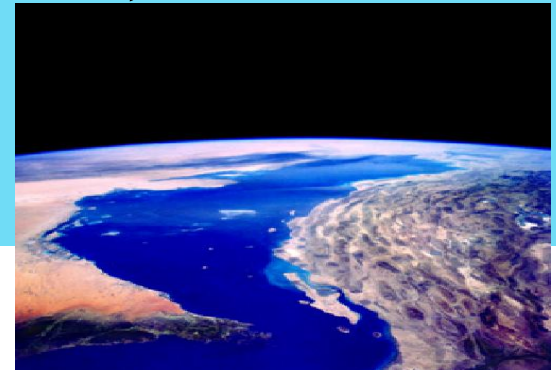
Non tectonic structures and
Folds, faults, and other
related structures



Tectonics

involve the study of larger
features, and regional
structures such as:

mountain ranges, parts of
continents, trenches,
island arcs, and oceanic
ridges



What Plate Tectonics is?

Plate Tectonics deal specifically ***with plate generation, motion, and interaction***

Tectonic structures: are produced in rocks in response to stress generated by plate motion within the Earth.

They include all kinds of faults folds along with other structures. They makeup the tectonic framework of the earth.



Factors Controlling type of Structures Formation On Earth Crust

- 1. The prevailing temperature and pressure*
- 2. Composition*
- 3. Anisotropy or isotropy*
- 4. Amount and character of fluids within the rock mass*
- 5. The layering*
- 6. How rapidly the mass is deformed and orientation of stress applied*

Anisotropy: *Is the contrast in properties with direction between and within individual layers.*

Isotropy : *Is the lack of contrast in properties with direction between and within individual layers.*

Deformation types

- **DUCTILE DEFORMATION:** *Is a continuous deformation that produces certain kind of folds, ductile faults, cleavage and foliation.*
- **BRITTLE DEFORMATION:** *Is a discontinuous deformation that produces folds, brittle faults and joints.*
- **PLASTIC DEFORMATION:** *Permanent change in shape of a solid that does not involve failure by rupture*
- **ELASTIC DEFORMATION:** *A nonpermanent deformation, which disappears when the stress is released*

Definitions

- **Plastic**: Capable of being deformed permanently without rupture
- **Elastic**: Body in which strains are instantly and totally recoverable.
- **Ductile Rock**: Able to sustain 10% of deformation before fracturing.
- **Brittle Rock**: Fracture at less than 3-5% of deformation

Type of Structures According to Different Scales

SCALE: is very important in structural geology because we try to understand the small scale structures and relate them to larger scale structures and ultimately the crustal deformation

Mesoscopic structures:

Structures observed in hand specimens and outcrop

Microscopic structures:

Structures observed by microscope.

Macroscopic structures:

Structures observed in mountainside to map-scale.



Type of Structures According to their Presence

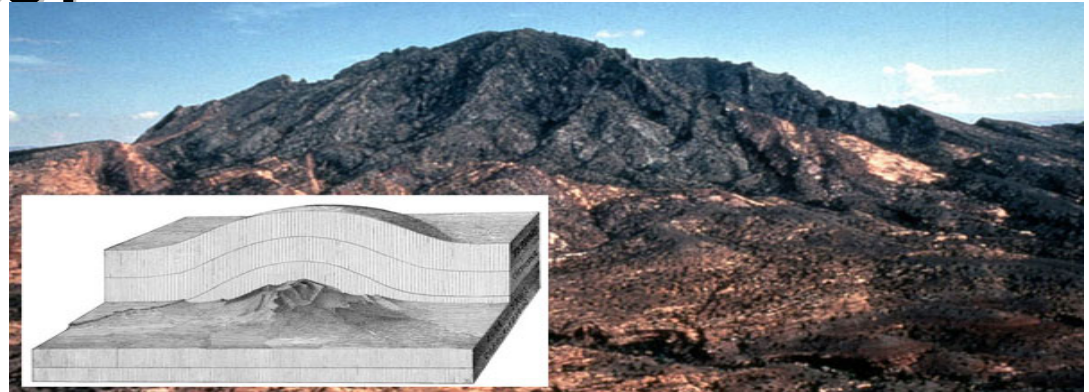
- Non-penetrative structures: Occur as a single features, **example; single major fault, or fold**



- Penetrative structures: Occur on any scale that we may choose, **example; cleavage, foliation and some folds.**



What Structural Geologists Should do in Studying Structures?



- Map the geometry of structures accurately in the **field and construct an accurate geologic map.**
- **Measure the orientation of small structures** in the field to know the shapes and relative position of larger structures
- **Study the sequence of development** and superposition of different kinds of structures to determine the sequence condition of deformation.
- **Try to apply rock-mechanics data** to relate structures to stresses that present in the Earth at the times of deformation.
- **Try to compare structures in one area with those else-where that may have formed by similar-mechanism.**
- **Utilize the geophysical data and other geology disciplines.** Geophysical data such as gravity, magnetic, and seismic

IMPORTANCE OF STRUCTURAL GEOLOGY AND ITS RELATIONSHIP TO OTHER FIELDS

- **Engineering:** Problems such as construction of bridges, dams, power plants, highways, and airports, and beneath buildings problems

- **Environmental:** Problems such as land use, planning, earth quake hazard, volcanic hazard, waste isolation and disposal, control of the distribution of ground water

- **Petroleum and mining geology:** Understanding the geometric techniques, projection of faults geologic contacts, larger trends of regional processes that control the concentration of mineral and hydrocarbons

