

# Structural Geology

(Geol 305)  
Semester (071)

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# INTRODUCTION

# Objectives

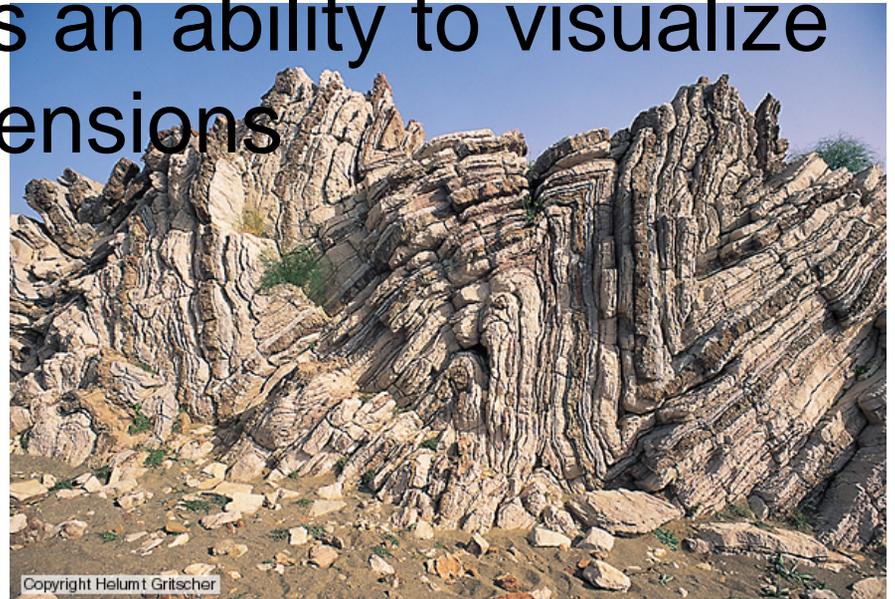
By the end of this unit you will be able to know:

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*

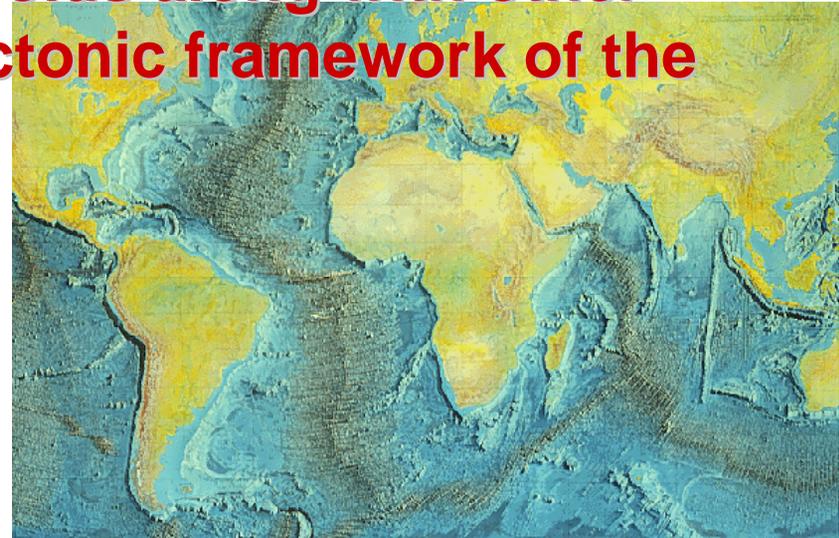


# What Plate Tectonics is?

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:

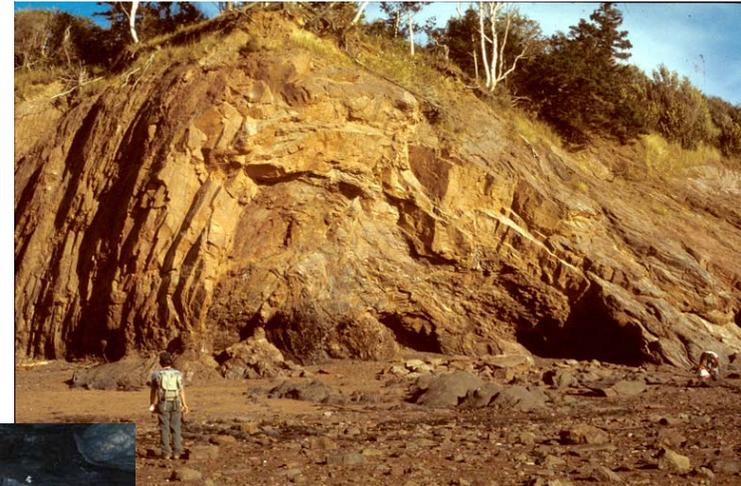
Structures observed in hand specimens and outcrop

## Microscopic structures:

Structures observed by microscope.

## Macroscopic structures:

Structures observed in mountainside to map-scale.



# Type of Structures According to their Presence

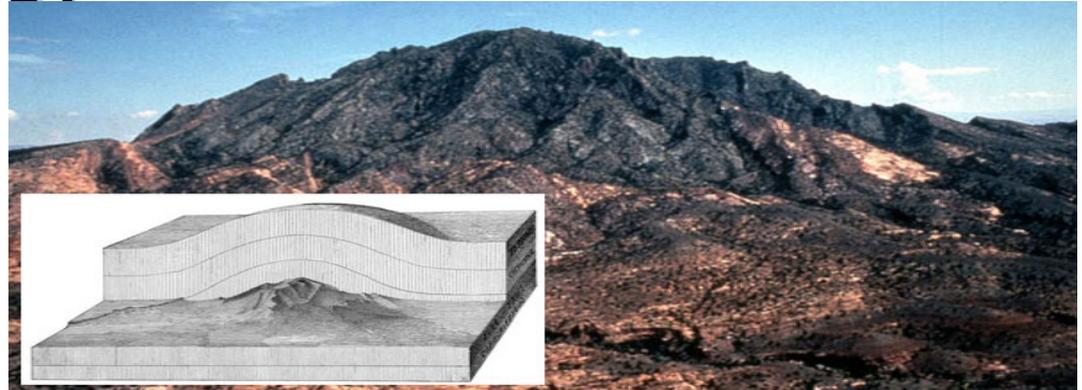
- Non-penetrative structures: Occur as a single features, **example; single major fault, or fold**



- 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

