STRUCTURAL GEOLOGY

Elective Sem II

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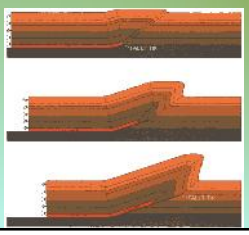
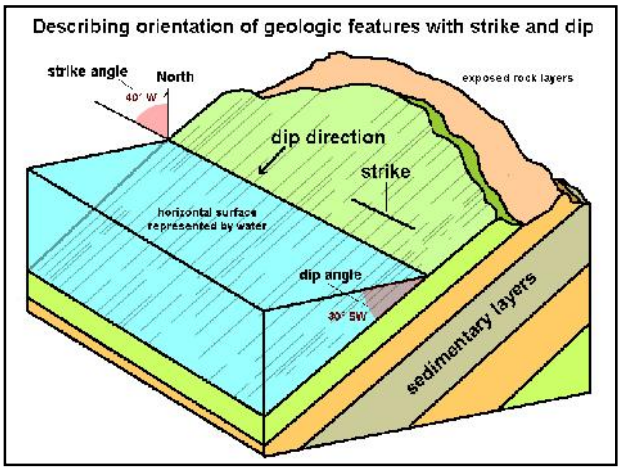
STRUCTURAL GEOLOGY

- Structural Geology is study of change in rock structure (Deformation) due internal/external forces such as stress and strain.
- These forces applied due to tectonic activities of earth.



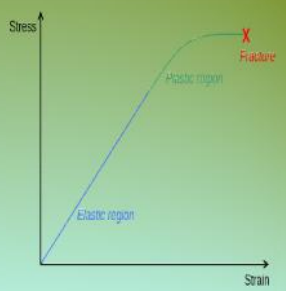
BASIC TERMINOLOGY

- **Strike and dip** refer to the orientation or attitude of a geological feature.
- The **strike** line of a bed, fault, or other planar feature, is a line representing the intersection of that feature with a horizontal plane.
- The dip gives the steepest angle of descent of a tilted bed or feature relative to a horizontal plane, and is given by the number (0°-90°) as well as a letter (N,S,E,W) with rough direction in which the bed is dipping.
- The dip direction is the azimuth of the direction the dip as projected to the horizontal (like the trend of a linear feature in trend and plunge measurements), which is 90° off the strike angle.



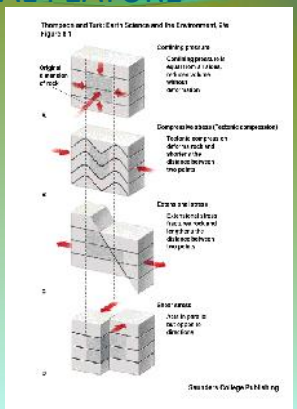
TECTONIC FORCES AND ROCK BEHAVIER

- Rocks behavior during tectonic force is easily understand by Stress–strain curves and its depends upon the temperature of the Rock, direction of force, timing and the speed of the forces applied on it.



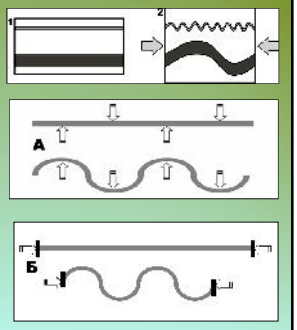
GEOLOGICAL FEATURE

- Tectonic collision deforms crustal rocks producing geologic structures.
  - Folds
  - Faults
  - Joints and Fractures

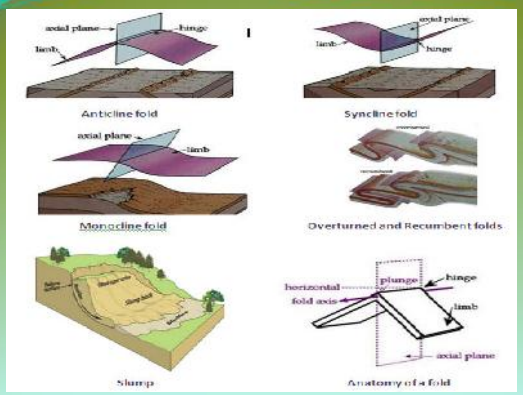


FOLD

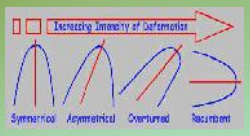
- Rocks are bent by crustal deformation into a series of wave-like undulations called folds.
- Most folds result from compression stresses which shorten and thicken the crust.

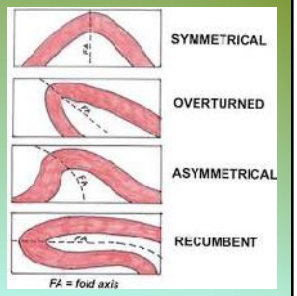


TERMINOLOGY AND TYPE OF FOLD

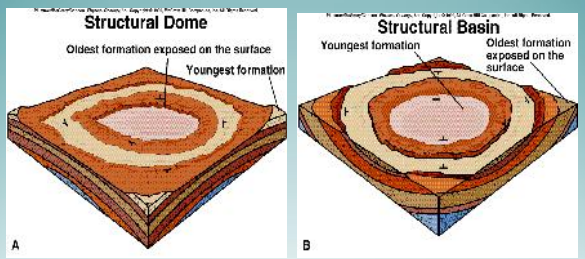


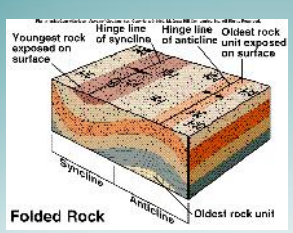
TYPE OF FOLD ON THE BASIS OF INTESITY OF DEFORMATION





Anticlines and Synclines are common in fold and thrust belts related to mountain belts.

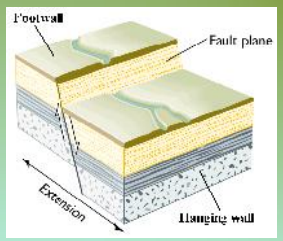




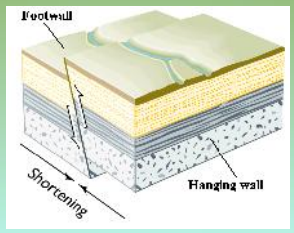
FAULT

Faults are breaks in rock units were movement has occurred. There are three major types of faults.

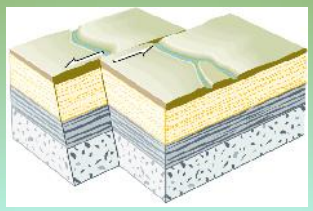
(1) Normal – Hanging wall (top surface) moves down relative to the footwall (bottom surface), caused by tension (extension)

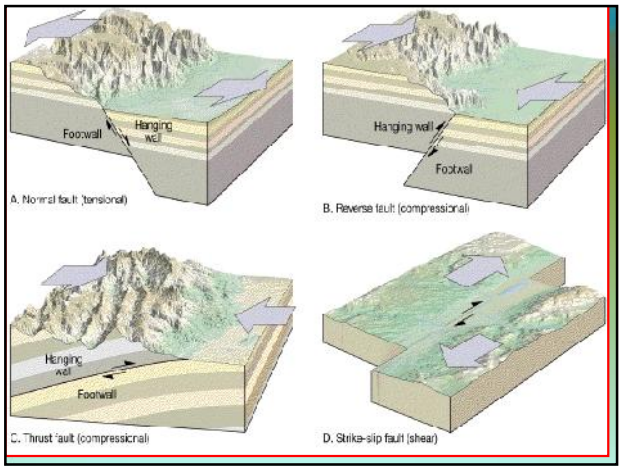


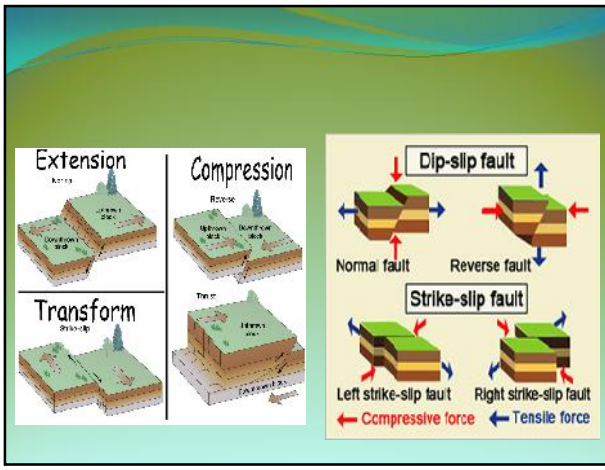
(2) Reverse – Hanging wall moves up relative to the footwall, caused by compression (shortening).
Reverse faults have dips greater than 45° and thrust faults have dips less then 45°.

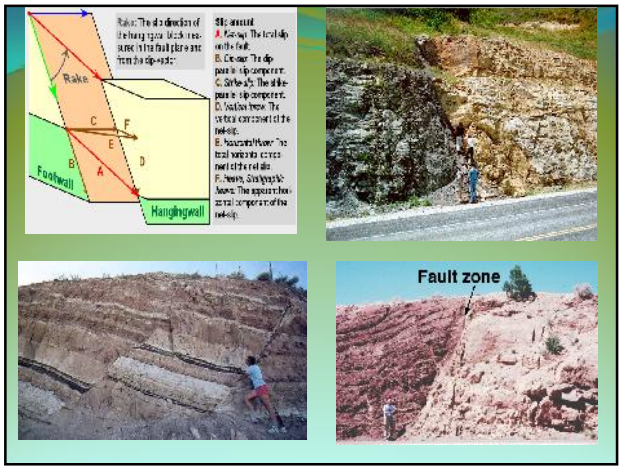


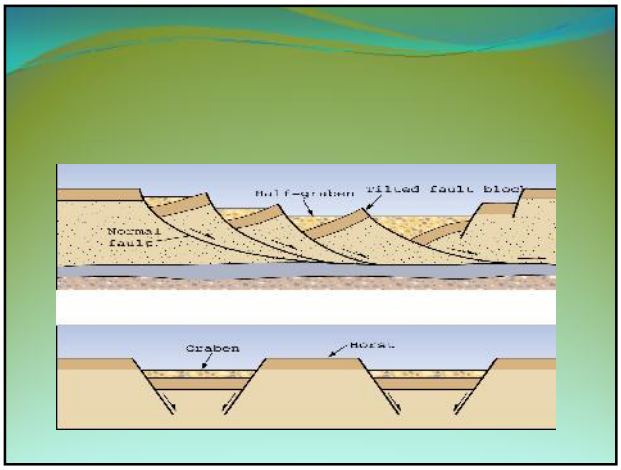
(3) Strike-Slip – Movement along the fault is horizontal, parallel to the strike of the fault plane. If, standing on one side of the fault, the block on the other side is displaced to the right, the fault is termed right-lateral. If the block on the other side is displaced to the left, the fault is termed left lateral.









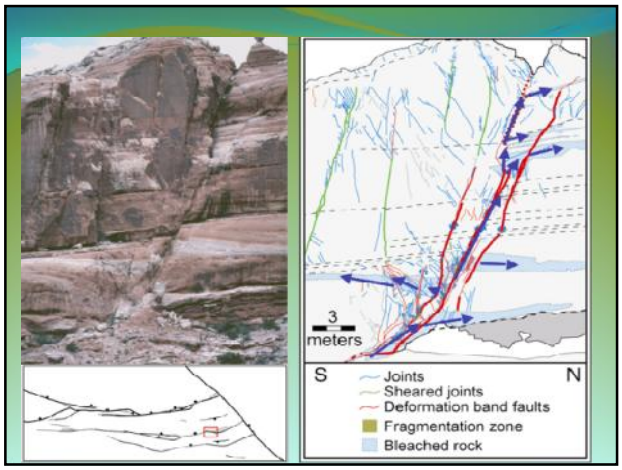


JOINTS

- They are fractures with no offset.
- Joints normally have a regular spacing related to either the mechanical properties of the individual rock or the thickness of the layer involved.
- Joints generally occur as sets, with each set consisting of joints sub-parallel to each other.
- Joints form in solid, hard rock that is stretched such that its brittle strength is exceeded (the point at which it breaks).
- When this happens the rock fractures in a plane parallel to the maximum principal stress and perpendicular to the minimum principal stress (the direction in which the rock is being stretched). This leads to the development of a single sub-parallel joint set. Continued deformation may lead to development of one or more additional joint sets.

TYPE OF JOINTS

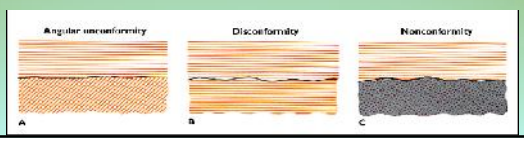
- Joints can be classified into three groups depending on their geometrical relationship with the country rock:
- *Strike joints* – Joints which run parallel to the direction of strike of country rocks are called "strike joints"
- *Dip joints* – Joints which run parallel to the direction of dip of country rocks are called "dip joints"
- *Oblique joints* – Joints which run oblique to the dip and strike directions of the country rocks are called "oblique joints".



UNCONFORMITIES

Unconformities are surfaces where erosion has occurred and represent gaps in the geologic record. There are three types of unconformities

- Angular Unconformity – An unconformity in which the upper and lower layers are not parallel
- Disconformity – An unconformity in which the upper and lower layers are horizontal
- Nonconformity – An unconformity in which the upper layers overlie metamorphic or igneous rocks



APPLICATION OF STRUCTURE GEOLOGY

- Engineering Issues
  - Bridges
  - Dams
  - Power Plants
  - Highway Cuts
  - Large Buildings
  - Airports
- Environmental Issues
  - Earthquake hazard
  - Location of landfill sites
  - Contamination cleanup
  - Distribution of groundwater
  - Mineral exploration

USE OF STRUCTURAL GEOLOGY IN MODERN DEVELOPMENT

- The study of structural geology has been of prime importance in Economic Geology, Petroleum Geology and Mining Geology.
- Folded and faulted rock strata commonly form traps for the accumulation and concentration of fluids (Petroleum and natural gas). Faulted and structurally complex areas are notable as permeable zones for hydrothermal fluids fluids and the resulting concentration areas for base and precious metal ore deposits. Deposits of gold, silver, copper, lead, zinc and other metals, are commonly located in structurally complex areas.
- Structural geology is a critical part of Engineering Geology, which is concerned with the physical and mechanical properties of natural rocks. Structural fabrics and defects such as faults, folds, foliations and joints are internal weaknesses of rocks which may affect the stability of human engineered structures such as dams, road cuts, open pits mines and tunnels for various purpose.

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- Geotechnical risk, including earthquakes can only be investigated by inspecting a combination of structural geology and geomorphology. In addition areas of Karst landscapes which are underlain by underground caverns and potential sinkholes or collapse features are of importance for these scientists. In addition, areas of steep slopes are potential collapse or landslide hazards.
- Environmental Geologist and hydrogeologist need to understand structural geology because structures are sites of ground water flow and penetration, which may affect, for instance, seepage of toxic substances from waste dumps, or seepage of salty water into aquifers.
- Plate Tectonics is a theory developed during the 1960s which describes the movement of continents by way of the separation and collision of crustal plates. It is in a sense structural geology on a planet scale, and is used throughout structural geology as a framework to analyze and understand global, regional, and local scale features.

MAP SYMBOLS