STRUCTURAL GEOLOGY

- Structural Geology is the study of the three-dimensional distribution of rock units with respect to their deformational histories.
- The primary goal of structural geology is to use measurements of present-day rock geometries to uncover information about the history of deformation (strain) in the rocks, and ultimately, to understand the stress field that resulted in the observed strain and geometries.

IMPORTANCE OF STRUCTURAL GEOLOGY

- The study of geologic structures has been of prime importance in economic geology, both petroleum geology and mining geology. Folded and faulted rock strata commonly form traps for the accumulation and concentration of fluids such as petroleum and natural gas. Faulted and structurally complex areas are notable as permeable zones for hydrothermal fluids and the resulting concentration areas for base and precious metal ore deposits.

- 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 pit mines and underground mines or road tunnels.

- Geotechnical risk, including earthquake risk can only be investigated by inspecting a combination of structural geology and geomorphology.
- Environmental geologists and hydrogeologists or hydrologists need to understand structural geology because structures are sites of groundwater flow and penetration, which may affect, for instance, seepage of toxic substances from waste dumps, or seepage of salty water into aquifers.

FAULTS

- A fault is a fracture across which two blocks have slipped; the displacement of adjacent blocks is parallel to the fault plane.
- Faulting corresponds to the brittle failure of an under formed rock formation or, alternatively, involves frictional sliding on a pre-existing fault plane.
- Faulting occurs when the maximum differential stress (maximum stress minus minimum stress) exceeds the shear strength of an intact rock formation, or the frictional strength of a pre-existing fault.

TYPES OF FAULTS

There are three types of faults

- **Normal faults: (Gravity)**
- **Reverse faults: (Thrust)**
- **Strike-slip faults: (Transverse)**

NORMAL FAULTS

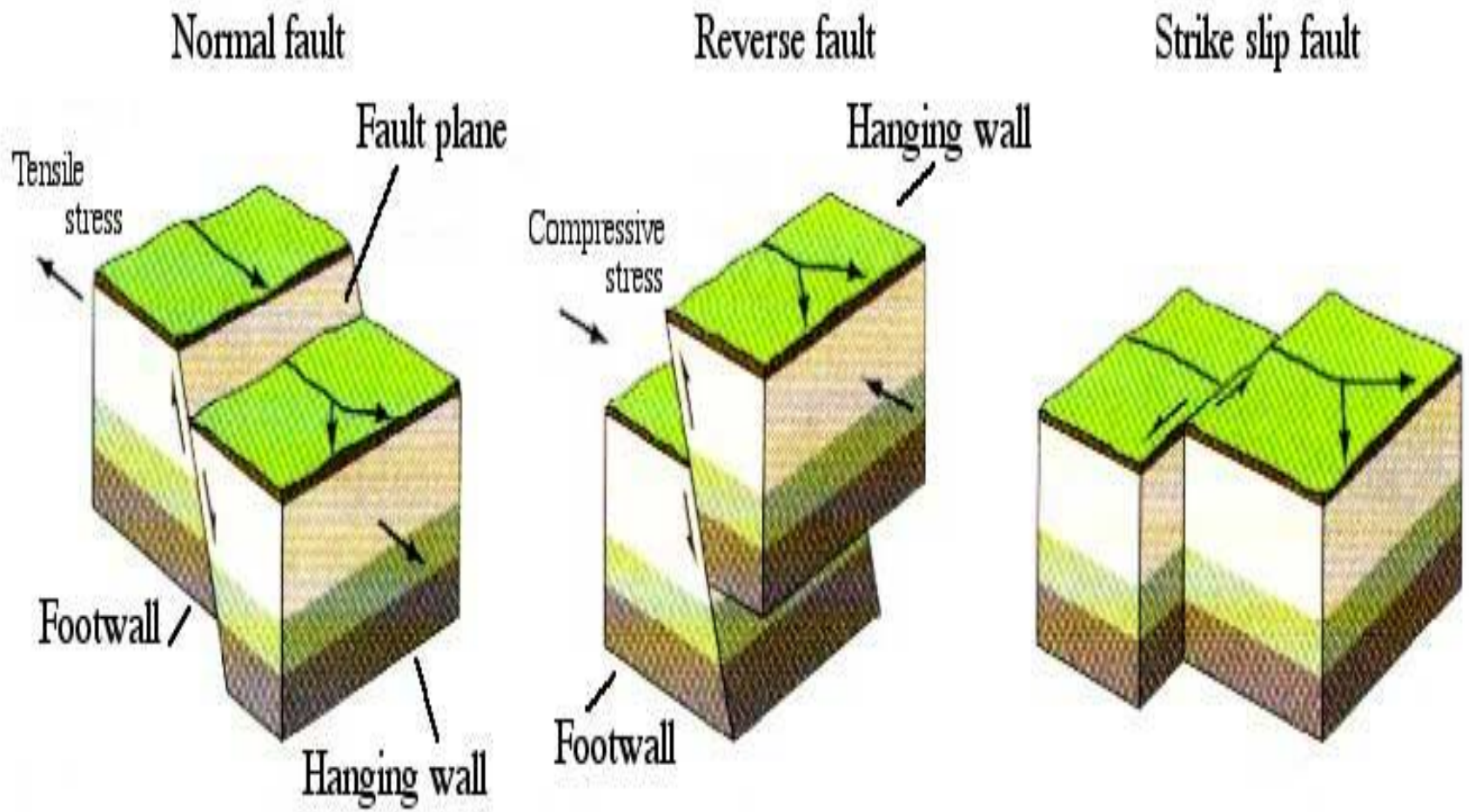
- The hanging wall moves down the dip of the fault relatively to the footwall
- Tectonic regime in extension (the largest stress axis is vertical).
- The fault plane usually makes a high angle with the surface (> 45 degrees).
- Also known as gravity fault.

REVERSE FAULTS

- The hanging wall moves up the dip of the fault relatively to the footwall
- Tectonic regime in compression (the smallest stress axis is vertical).
- The fault plane usually makes a low angle with the surface (< 45 degrees).
- Also known as thrust fault.

STRIKE-SLIP FAULTS

- The blocks move horizontally past one another
- Probably the most well known and well studied fault of this type is known as the San Andreas Fault of California. This fault is on the boundary between the Pacific and North American Plates. Actually anything crossing this fault zone is either slowly torn apart, or offset. These faults can be very long; the San Andreas is nearly 600 miles long.


Normal fault
Reverse fault
Strike slip fault
Fault plane
Tensile stress
Footwall
Hanging wall
Hanging wall
Compressive stress
Footwall

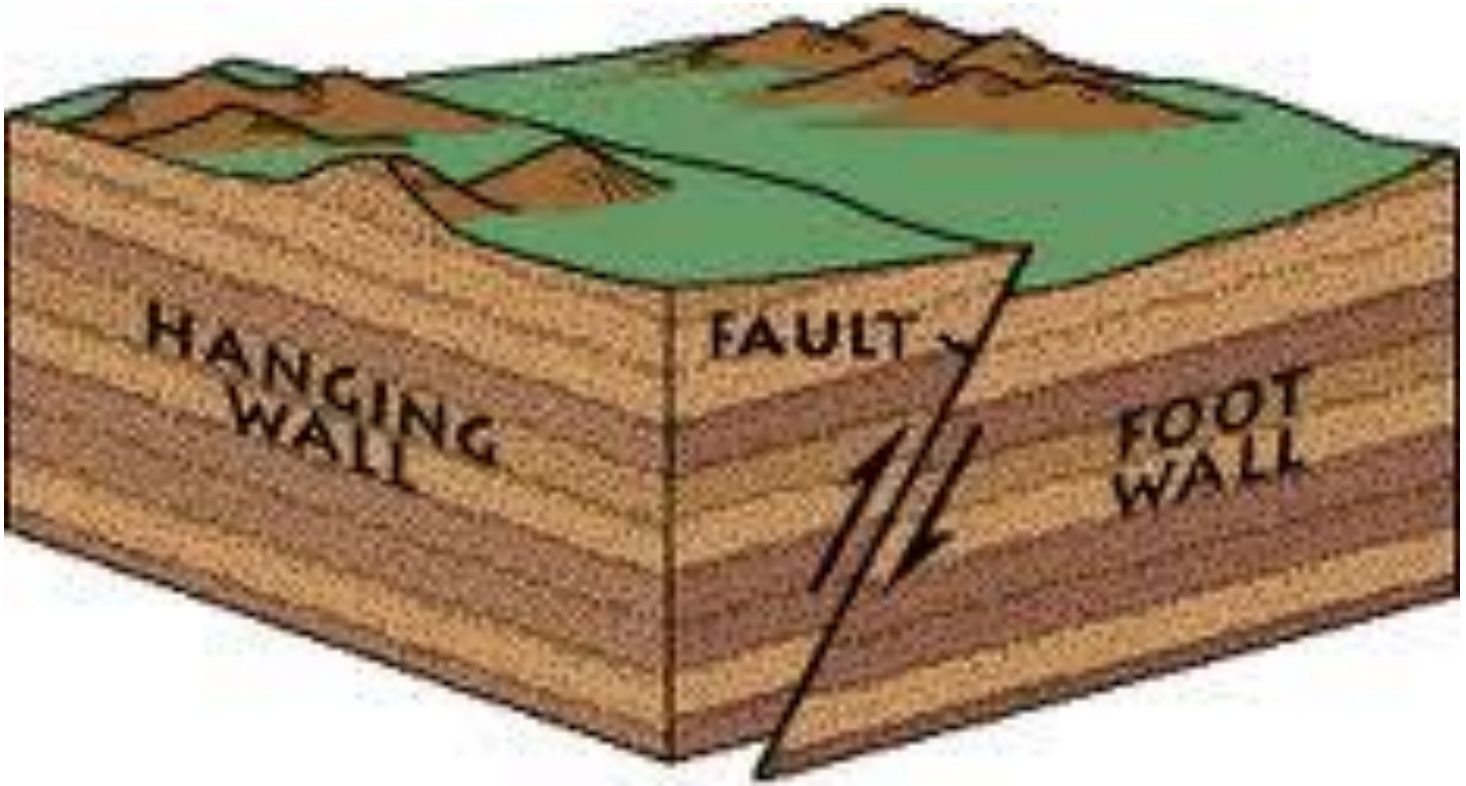
FAULT TERMINOLOGIES

- **Hanging Wall**:

  The surface of block that is on top of the plane of the fault.

- **Footwall:**

  The surface or block that lies below the plane of the fault.

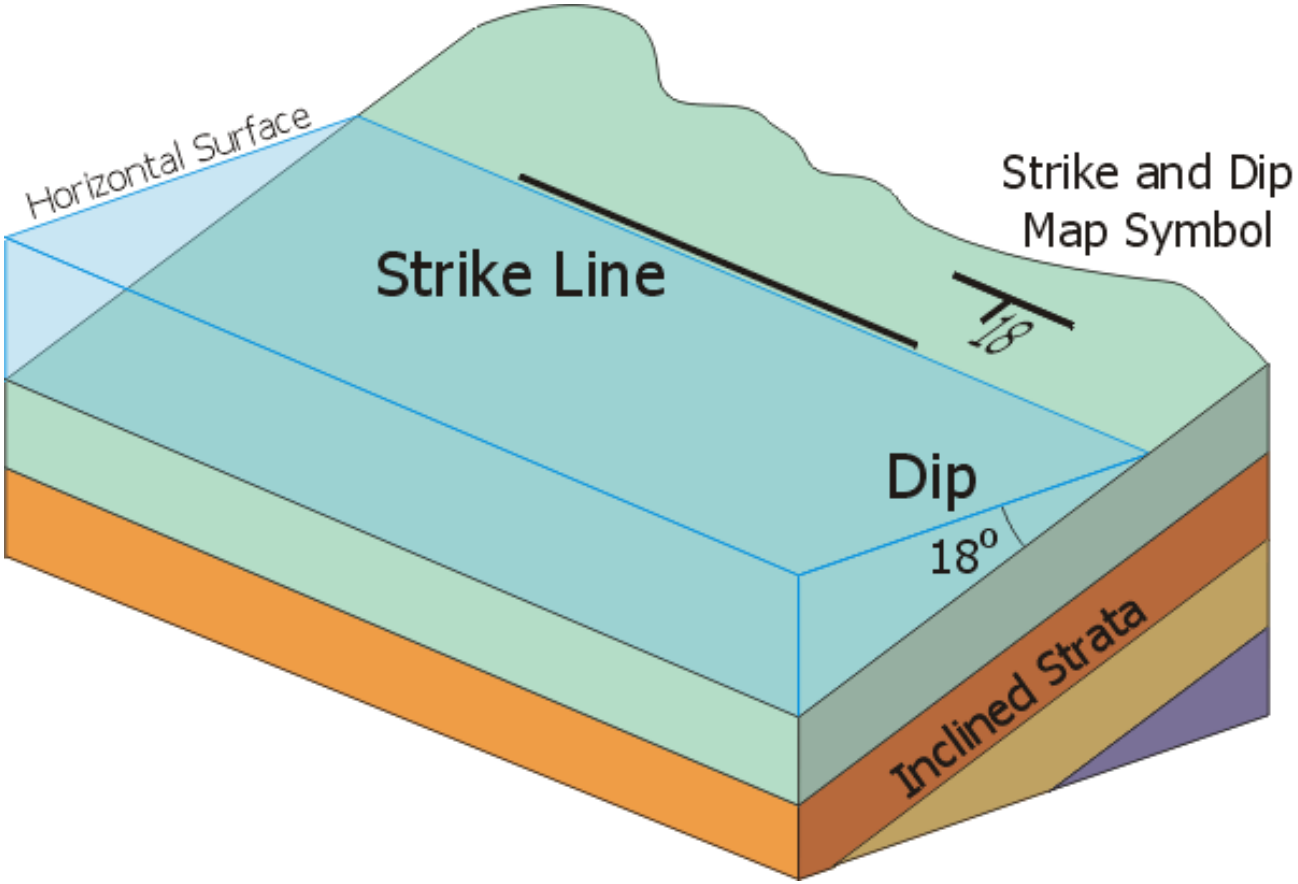

HANGING WALL
FAULT
FOOT WALL

- **Strike:**

  The direction in which the fault runs. Strike of the fault is the trend of a horizontal line in the plane of the fault.

- **Dip:**

  Dip is the angle between a horizontal surface and the plane of the fault and is measured in a vertical plane that strikes at right angles to the fault. The dip direction is perpendicular to the strike direction.

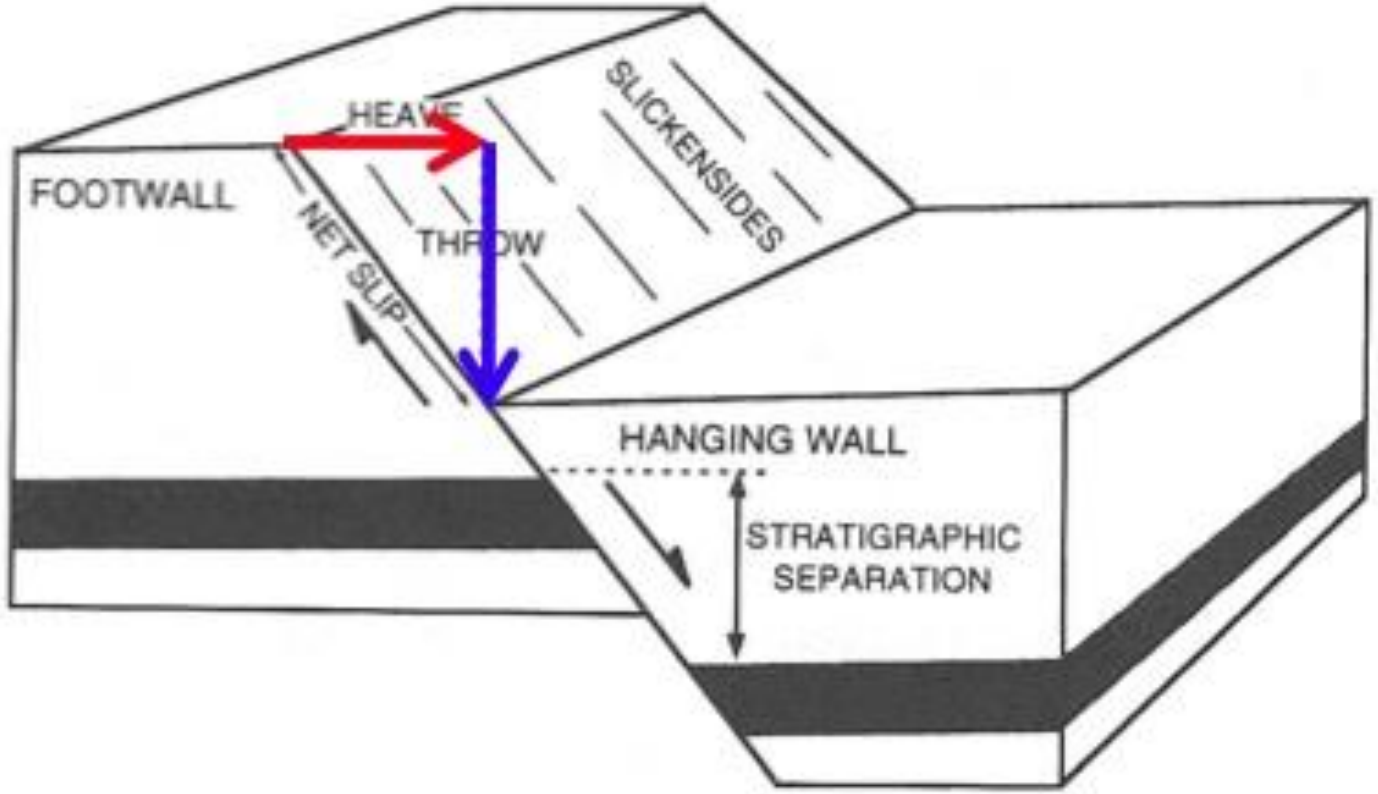

Horizontal Surface
Strike Line
Strike and Dip
Map Symbol
18
Dip
18°
Inclined Strata

- **Throw:**

  The throw of a fault is the vertical component of the apparent displacement of a bed, measured along direction of dip of the fault.

- **Heave:**

  The heave of a fault, in a like manner, is the horizontal component of the apparent displacement. It is also known as gape.

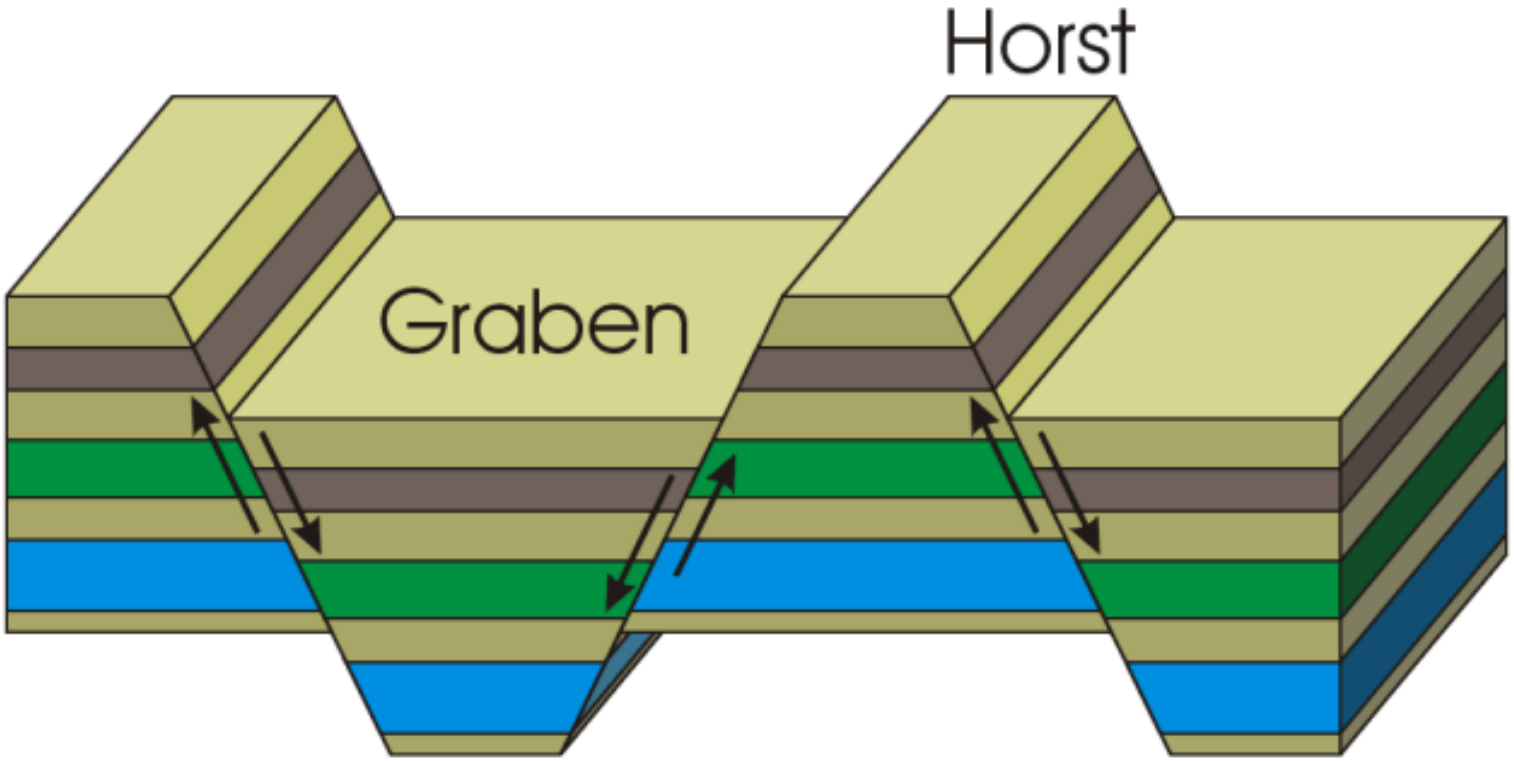

HEAVE
SLICKENSIDES
FOOTWALL
NET SLIP
THROW
HANGING WALL
STRATIGRAPHIC
SEPARATION

- **Graben:**

  when a block of rock falls between two faults. Huge, relatively flat bottomed valleys, like Death Valley in California, are created in this way.

- **Horst:**

  when a block of rock is pushed up between two faults. Large plateau surfaces form in this fashion.


Horst
Graben