STRUCTURES AND DISCONTINUITIES ROCKS (04)

I Main Topics
- A Review of first three lectures
- B Geologic, engineering, and hydrologic significance of structures
- C Types of structures

I I Failure of geologic materials (e.g. earthquakes, landslides, avalanches) and fluid flow very commonly is localized along pre-existing structures (structures can be reactivated)

Recognition of potentially hazardous condition

III Types of structures *(Characterization)*
- B Planar Discontinuities (see handout)
  - 1 Fractures: structural discontinuities (all rock types).

    A fracture is classified according to the relative motion across it. Fractures commonly occur in parallel sets and thus impart anisotropy (directional variability) to rocks.
    - a Joints: opening mode fractures
    - b Faults and fault zones: shearing mode fractures
    - c Dikes: opening mode fractures that contain igneous rock
    - d Dimensions of fractures

Dimension	Joint	Fault/ fault zone	Dike
Thickness	0^+ - 1 cm	0^+ - 1 km	0^+ - 10 km
Slip	0	0^+ - 100's km	0
In-plane dimensions	0 - ~ 100 m	0^+ - ~1000 km	0^+ - ~1000 km

  - 2 Bedding planes (sedimentary rocks & volcanic rocks)
    - a Sedimentological discontinuities
    - b Some individual bedding planes extend for tens of km
    - b Bedding planes can slip and become faults or landslide slip surfaces
  - 3 Foliation (metamorphic rocks & igneous rocks)
    - a preferred alignment of minerals in planes.
    - b Concentrations of aligned weak minerals (e.g. mica, talc) provide potential failure surfaces.

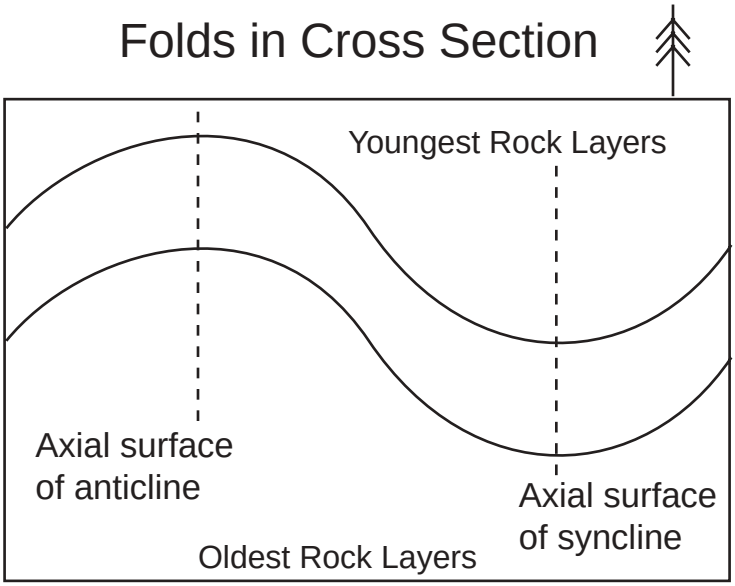
B Shear zones

http://earth.leeds.ac.uk/shearzones/

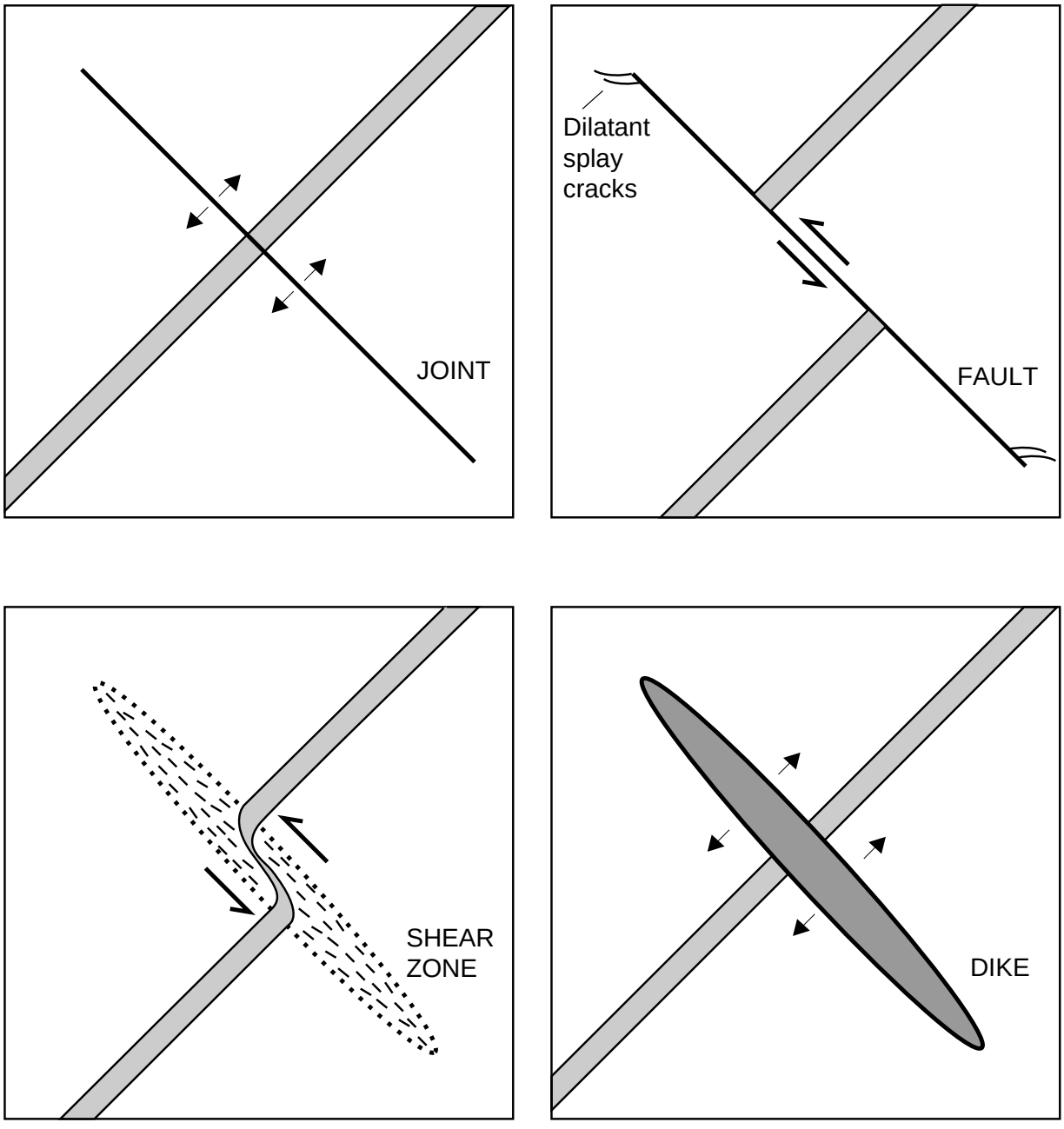
1 Deformation is continuous across a shear zone
2 Rock within shear zones commonly is foliated
3 Shear zones common in plutonic & metamorphic rocks

C Folds

1 Require rocks to be layered or bound by parallel discontinuities; folds occur in all rocks, *including (rarely) some plutonic rocks*!
2 Folding commonly causes bedding places to slip
3 Types
   a Anticlines
      i Oldest rocks in center of fold
      i i Usually "A-shaped"
   b Synclines
      i Youngest rocks in center of fold
      i i Usually "U-shaped"



FOUR PLANAR GEOLOGIC STRUCTURES



For joints and dikes (opening mode fractures) the relative displacement of originally neighboring points on opposing walls is perpendicular to the fracture

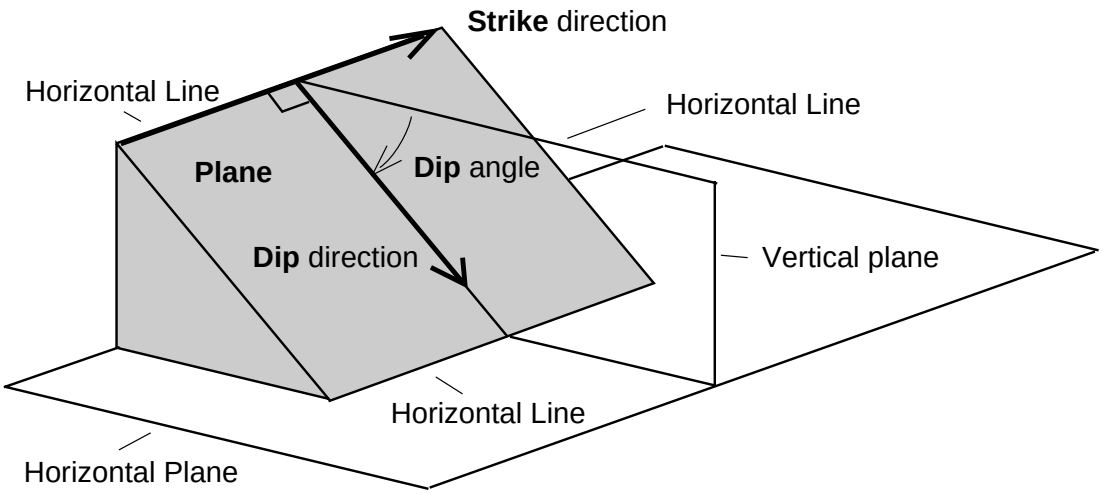
For shear zones and faults, the relative displacement of neighboring points is parallel to the feature

Deformation (displacement) is discontinuous across a fault

Deformation (displacement) is continuous across a shear zone

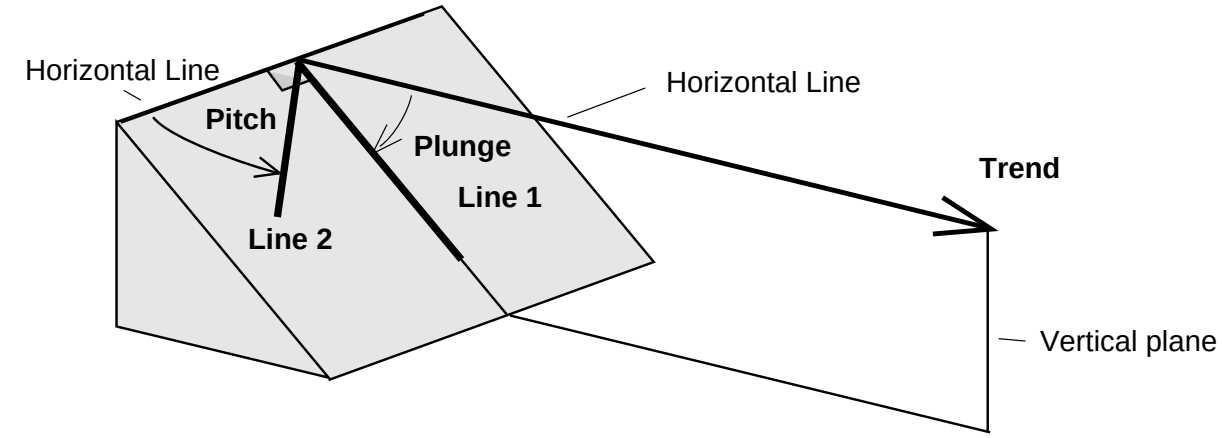
ORIENTATION OF LINES AND PLANES

PLANES



Right hand rule for strike and dip directions: If thumb on right hand points in the direction of strike the fingers on the right hand should point in the direction of dip

LINES



Need to define orientation of plane for the pitch (rake) to have meaning

The POLE to a plane is a line that is perpendicular to the plane.
The trend of the pole is opposite the direction a plane dips.
The plunge of a pole and the dip of a plane sum to 90°.

Geologic Conventions for Measuring Orientations

Compass Bearings

By quadrant (relative to north or south). The angle does not exceed 90°

By 360° azimuth (0° - 360°)

Examples

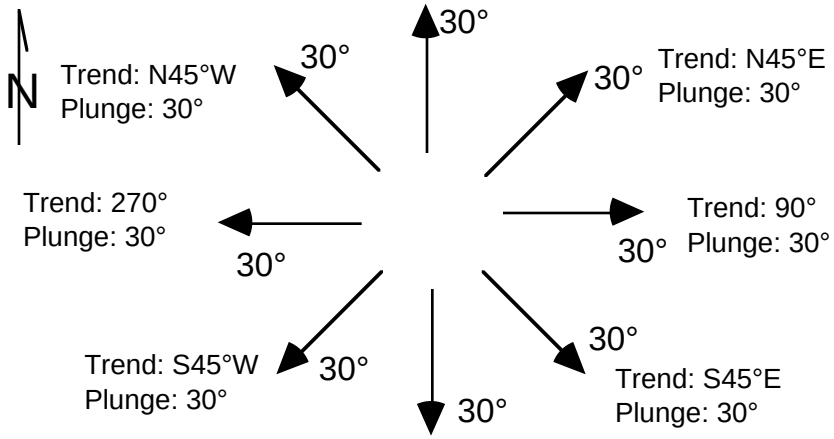
N0°E	N45°E	N90°E	S45°E	S0°E	S45°W	S90°W	N45°W
0°	45°	90°	135°	180°	225°	270°	315°

Lines

Trend: A compass bearing

Plunge: An inclination below horizontal

Examples: The lines below all plunge at 30°. Their trends vary according to the table above



Planes

Strike: A compass bearing along a horizontal line in a plane

Dip: An inclination below horizontal

Examples: The planes below all dip at 70°. Their strikes vary according to the table above