

Geologic Structure

I. Part I – Folds

1. Rock Deformation

- a. Stress
 - i. Force applied to an area
 - ii. Pressure
 - iii. Differential stress – magnitude of stress is greater in one direction
- b. Rock Strength
 - i. Rock's resistance to deformation (stress)
- c. Strain
 - i. A rock's response to stress
 - ii. Deformation resulting in change of shape or position
 - iii. Elastic deformation
 - iv. Deformation is reversible, after stress is removed, materials return to original shape, i.e. A rubber band
 - v. Plastic deformation
 - vi. Deformation is permanent
 - vii. Rock flow in response to stress
 - viii. Need high pressures and temperatures, generally deep in earth's interior, i.e. Taffy
 - ix. Brittle deformation
 - x. Deformation is permanent
 - xi. Rock break (fracture) or lose cohesion
 - xii. Generally low temperature and low pressure, common in shallow crust, i.e. Peanut brittle

2. Types of Stress

- a. Tension or Extensional Stress
 - i. Stress move away from each other (pull apart)
 - ii. Rock lengthens
 - iii. Common in divergent boundaries, but not sole locale
 - iv. Ductile deformation – stretching and thinning of rock
 - v. Brittle deformation – fracturing and faulting
- b. Compressional Stress
 - i. Stress presses (squeezes) rock together
 - ii. Rock shortens
 - iii. Common at convergent boundaries
 - iv. Ductile deformation – shortening and thickening of rock – rock folds
 - v. Brittle deformation – fracturing and faulting
- c. Shear Stress
 - i. Stress creates a lateral shift in the rock
 - ii. Rock slides past other rock
 - iii. Common at transform boundaries
 - iv. Results in faults

3. Folds

- a. Ductile deformation

- b. Compressional stress
 - c. Horizontal rocks are deformed
 - d. Fold Terminology
 - i. Limb – the sides of the fold
 - ii. Axial plane (hinge plane) – imaginary plane that divides the fold into two equal parts, marks location of maximum curvature
 - iii. Fold axis (hinge line) – the line formed by the intersection of the hinge plane and a bedding plane
 - e. Syncline
 - i. A fold with the youngest beds in the middle
 - ii. Generally trough shaped, with limbs dipping toward the center
 - f. Anticline
 - i. A fold with the oldest beds in the middle
 - ii. Generally arched shaped, with limbs dipping away the center
 - g. Monocline
 - i. Folds with only one limb
 - ii. Often Associated with faults
 - h. Fold Symmetry
 - i. Symmetrical fold – limbs of the fold dip at the same angle
 - ii. Asymmetrical fold – limbs of the fold dip at different angles
 - iii. Overturned Fold – Fold where one limb has been tilted beyond vertical
 - iv. Recumbent Fold – Overturned fold where the limbs are nearly horizontal
 - i. Plunging Fold
 - i. The hinge line or fold axis is inclined
4. Dome
- a. Broad upwarping or vertical displacement
 - b. Oldest beds in the middle
 - c. Large areal extent
 - d. Circular Structure
 - e. Ozark Dome
5. Basin
- a. Broad downwarping
 - b. Youngest bed in the middle
 - c. Large areal extent
 - d. Circular Structure
 - e. Ex. Illinois Basin or Michigan Basin
- II. Part II - **Faults Review Section 5.3 Pg 117-120**
1. Faults
 - a. A results of brittle deformation
 - b. Fractures in the Earth's crust where displacement has occurred
 2. Fault Terminology
 - a. Footwall – block that lies above the fault plane
 - b. Hanging wall – block that lies below the fault plane
 3. Classes of Faults

- a. Dip-Slip
 - i. Movement is primarily vertical
- b. Strike Slip
 - i. Movement is along strike
- c. Oblique-Slip
 - i. Movement is both vertical and along *strike*
- 4. Dip-Slip Fault – Normal Fault
 - a. Extensional Stress
 - b. Hanging wall moves down with respect to footwall
 - c. Horst – raised block of material bounded by two normal faults
 - d. Graben – trough (valley) bounded by two normal faults
- 5. Dip-Slip Fault – Reverse Fault
 - a. Compressional Stress
 - b. Hanging wall moves up with respect to footwall
- 6. Dip-Slip Fault – Thrust Fault
 - a. Compressional Stress
 - b. Low-angle reverse fault (fault plane $< 45^\circ$)
 - c. Displacement can be 100's km (~60 miles)
 - d. Typically associated with folds
- 7. Strike-Slip Fault
 - a. Shear Stress
 - b. No vertical movement
 - c. Movement parallel to fault plane
 - d. Left-lateral strike-slip faults: movement of opposite plate is to the left
 - e. Right-lateral strike-slip faults: movement of opposite plate is to the right
- 8. Joints
 - a. Brittle deformation at low pressure
 - b. Tension fractures with NO DISPLACEMENT