

Slope Systems – Mass Wasting

1. Mass Wasting
 - a. The downslope transfer of material through the direct action of gravity
 - b. Component of erosion and transport of sediment
 - c. Follows weathering, which weakens and breaks the rock
2. Controls on Mass Wasting
 - a. Primary driving force is **GRAVITY**
 - b. Requires weathering of rock or unconsolidated material
 - c. Force mechanics: For the rock to move downslope force (A) has to be greater than the resistance force (R) holding it up, e.g. include friction.
3. Secondary Controls
4. Factors that either weaken cohesion forces or increase downslope force
5. Factors
 - a. Saturation of Material
 - i. Addition of water
 - ii. Lubricates the material (decreases cohesion)
 - iii. Adds weight (increases downslope force)
 - iv. Increases pore pressure (increases downslope force and decreases cohesion)
 - b. Over-steepening of the Slope
 - i. Can be human-induced or by natural processes – increases the downslope force.
 - ii. Stream undercutting a valley wall (headward erosion, bank erosion, etc.).
 - iii. Waves cutting cliffs on a shoreline.
 - iv. Construction of roads, buildings, homes etc.
 - v. Angle of Repose
 1. The steepest angle material can create yet remain stable
 2. Function of
 - a. Particle size
 - b. Particle shape
 - c. Moisture Content
 - c. Slope Modification
 - i. Removal of Vegetation
 1. Roots of plants and trees hold regolith together
 2. Plants and trees remove water from the soil
 3. Removal decrease cohesive force
 - ii. Building of structures
 1. Depending upon the structure and the location, either a decrease in cohesive force &/or increase downslope force due to added weight will occur
 - d. Ground Vibrations
 - i. Earthquakes – decrease cohesion forces
 1. Initiates movement (it is easier for a particle to move than it is to begin to move)
 2. Liquefaction induced slides
 - ii. Human induced – blasting for construction, large equipment, etc.
 - e. Expansion/Contraction Cycles
 - i. Movement of material due to
 - ii. Wetting and drying cycles
 - iii. Freeze-thaw cycles
6. Classification of Mass Wasting

- a. Type of Material
 - i. Bedrock - Rock
 - ii. Unconsolidated material - Debris
 - 1. Soil
 - 2. Regolith
 - 3. Sediment
 - b. Rate of movement
 - i. mm/yr
 - ii. km/hr
 - c. Type of Motion
 - i. Fall – free-fall of detached particles, slope steep enough that material falls to base
 - ii. Slide – material remains cohesive and moves along a well-defined surface
 - iii. Flow – material moves downslope as a viscous flow (most are saturated with water)
7. Creep
- a. Slow downslope movement – mm/yr
 - b. Process so slow one cannot observe it in action
 - c. Expansion/contraction cycles play a key role
 - d. Enhanced by burrowing organisms, periods of prolonged rains or snow
8. Debris Flow
- a. Mixture of rocks, mud, & water
 - b. Moves as a viscous fluid
 - c. Common after heavy rains
 - d. Rapid movement – up to 50 km/hr, the more water present the faster the rate of movement
 - e. Common in semi-arid regions and along volcanoes (lahars)
9. Slump
- a. Slow to rapid movement
 - b. Material moves as a coherent unit along a curved surface (spoon-shaped)
 - c. Blocks of material rotate
 - d. Debris flows commonly associated with slump
10. Land-Rock Slide
- a. Movement of material along a defined slippage plane
 - b. Sudden and rapid movement
 - c. Large blocks of rock detach along bedding planes, joints, fractures, etc.
 - d. Occur on steep slopes
 - e. Can be triggered by rain falls or ground vibration
 - f. Fastest and most destructive type of mass wasting
11. Rock Fall (Rock Avalanche)
- a. Sudden and rapid free fall movement of rock
 - b. Occur on steep slopes
 - c. Forms talus piles
 - d. Can grade into a rockslide if material greater a slope greater than the angle of repose
12. Subaqueous Slope Failure
- a. Mass failure in which the material movement occurs below water