

GLG 110 – Chapter 9 – SLOPE PROCESSES, LANDSLIDES, AND SUBSIDENCE

- **Mass wasting** is the downhill movement of rocks, soil +/- water, under the direct influence of gravity. Mass wasting is the step that generally follows weathering to erode a landscape.
- The controlling force of mass wasting is gravity. Addition of water, oversteepening (beyond the angle of repose) of slopes, seismic shaking (earthquakes), addition of weight to a slope, and removal of vegetation can increase the likelihood of and even trigger mass wasting
- The eruptions of snow- and ice-capped volcanoes commonly trigger large mass wasting events involving the rapid downslope movement of water-saturated mud and rock flows termed **lahars**. These are often significantly larger hazards than the lava and ash erupted by the volcanoes because they can travel so rapidly and for such large distances (tens of kilometers or more).
- The **angle of repose** is the steepest angle that a pile of sediments or soil can maintain without collapsing. This is generally between 25 and 40 degrees. The larger and more angular the particles, the higher the angle of repose will be. Loose, dry sand (as in dunes, etc.) typically has an angle of repose of 33 to 34 degrees.
- There are many different processes lumped under the term “mass wasting”. These processes are categorized and described on the basis of (1) the **type of material** involved (debris, mud, earth, or rock); (2) the **type of motion** (fall, slide, flow); and (3) the **rate of movement** (rapid or slow).
- The rapid forms of mass wasting include **slump**, (the downward sliding of a mass of rock or soil moving as a unit along a curved surface); **rockslide** (blocks of bedrock breaking loose and sliding downslope); **debris flow** (rapid flow of soil and rocks mixed with water); and **earth flow** (an unconfined flow of saturated, clay-rich soil that often occurs in humid areas after heavy rains or snowmelt). The fastest versions of these processes are termed rock and debris **avalanches**.
- The slowest forms of mass wasting include **creep**, the gradual downhill movement of soil and fractured rock layers; and **solifluction**, a type of soil flow that is common in areas with **permafrost** (permanently frozen ground) under a thin soil layer that thaws (but remains saturated) in the warmer months.
- In wet climates, limestone will get highly dissolved by groundwater, and **caves** and **karst** topography (from sinkholes that form by collapse into empty caves). The danger of sinkholes is greatly increased when man drops the water table and empties out these cave systems, removing the buoyancy force that helped hold up the cave roofs. Florida is an area where this geologic hazard is significant today.
- In other areas, excessive pumping of groundwater can lead to **ground subsidence**, or a dropping of the land surface, which can produce earth cracks and destroy buildings and roads. Arizona has experienced this in the past due to excessive pumping for irrigation of crops like cotton in the Phoenix and Casa Grande areas.