MASS WASTING

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MASS MOVEMENT

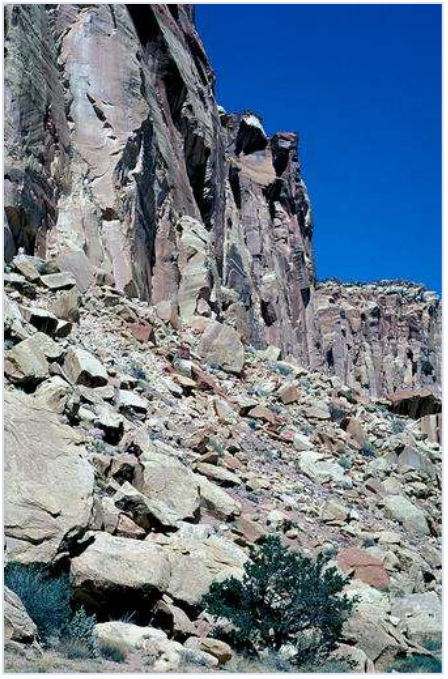
- Moving Mass on the Earth's surface
- • Gravity pulls the rocks, soils and debris on a downward slope, naturally, without any chemical change.
- • This downward movement is called as mass – movement or mass-wasting.
- • Landslides, mudflows and rockfall, belong to this category of geomorphic processes.
- • It is also called as mass-movement.

Mass Wasting

Mass wasting is a rapid form of erosion that works primarily under the influence of gravity in combination with other erosional agents. Mass wasting occurs very quickly and can result in either small or large scale changes to the landscape depending on the type of event.

- Rock Falls
- Landslides
- Debris / Mud Flows
- Slumps
- Creep

Rock Fall



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Landslide

Photo source: SCGS

Significance of Mass Wasting

- • Mass-wasting is a natural phenomena which and be aggravated through human interventions
- • Mass-wasting processes are occurring continuously on all slopes; some act very slowly, others occur very suddenly.
- • Mass-wasting may lead to severe natural disasters by affecting the life and building structures in different places.
- • Understanding of mass-wasting will certainly help to mitigate the impacts of these hazards and plan the development activities

Forces for movements

- • Two forces involved in a mass standing are the driving force and the resisting force.
- • The standing mass has the driving force due to its weight. The slope and substratum have the resisting force.
- • When the driving force exceeds the resisting force, then the mass becomes unstable and moves down or falls.
- • When the gravitational force acting on a slope exceeds its resisting force, failure of slope occurs in holding the mass.

Factors responsible

- • change in the slope angle
- • weakening of the material by weathering
- • increased water content
- • changes in the vegetation cover
- • Overloading • Increase in Shear Stress
- • Decrease in Shear Strength

Rock Falls

- Rock falls occur when rocks become dislodged, because their change in potential energy becomes to great to maintain, and the potential energy becomes kinetic energy which causes the rock fragment to fall, restoring equilibrium. As a result the rocks fall, roll, or bounce downhill.
- The rocks may be loosened by a recent rainfall or snow melt-water event that facilitates the movement of the rock before they fall from the force of gravity.
- Rock falls often form piles of loose rock below their source and are sometimes referred to as talus or scree.
- Large volumes of talus may form a talus slope, talus apron, or talus cone depending on its shape. Talus tends to stabilize near an angle of 35° (referred to as the angle of repose), or the steepest angle maintained before changes in energy lead to gravitational erosion. This balance is easily disrupted by changes in environmental conditions, addition of weathered materials, or other factors that lead to mass wasting.

Photo courtesy of SCGS

Fragments are breaking off from this rock exposure and collecting down-slope from their source. The fragments of fallen rock are angular and include a variety of different sizes. The tree growing above this boulder may also be contributing through biological weathering where the roots are penetrating into the cracks in the rock.

Landslides

- Landslides are mass-wasting events where large amounts of weathered rock material slide down a hillslope or mountain side primarily by gravity related erosion.
- Landslides occur very quickly and move with incredible speed and destruction, often removing or covering everything in their path.
- Nearly all landslides are triggered by an earthquake, or lubricant agent such as rainfall, or a snow or ice melt-water event.
- During intensive rainfall, soil and weathered rock material become unstable and loosened from the saturated conditions that separate the individual grains and other material fragments. The increased fluid pressures coupled with the loosened materials succumbs to gravity related erosion and the weathered materials plunge downhill as a powerful landslide.
- Landslides are a natural hazard that can cause serious damage to people and other obstacles in their path. Many earth scientists study landslides in order to predict their occurrence and prevent negative impacts to humans and infrastructure.

This landslide event occurred in Jones Gap State Park in the Mountain Bridge Wilderness Area of South Carolina. Boulders, trees, soil, and other weathered material tumbled down this hill-slope after 8" of heavy rain fell over 2-days.

Photo source: SCGS

Classification based on Speed and direction

Slurry Flows

- •Solifluction
- •Mudflows
- •Debris flows
- •Lahars Slides
- •Planar
- •Rotational

Debris and Mud Flows

- Debris and mudflows are mass-wasting events that form when heavy rainfalls produce large amounts of runoff that transport eroded soils, sediments, and plant debris down slope where the flows eventually spreads out across valley bottoms.
- Sometimes the debris and mudflows follow existing drainage paths and other times they carve out new paths as they flow downhill
- Debris and mudflows can carry particles of a range of sizes from clays (mud) to large debris and boulders; however, debris flows consists primarily of coarse-grained materials and mudflows consist primarily of fine-grained materials.
- The consistency of a debris or mudflow is representative of a thick, muddy sludge carrying rocks, twigs, branches, trees, and other available debris
- Debris flows are natural hazards that pose a threat to communities in their path

This debris flow flooded and destroyed several homes as it carried, mud, trees, and boulders through a valley in Colorado's Rocky Mountain Range.

Slump

- Slumps are a fairly common form of mass wasting where the rock or soil collapses, breaks off from the hill slope, rotates slightly, and slumps downhill.
- If the slump occurs as a large consolidated mass of materials it is considered coherent, if it occurs as a mass of unconsolidated materials or sediments it is referred to as incoherent.
- Slumping can cause damage to houses, roads, and other infrastructure.

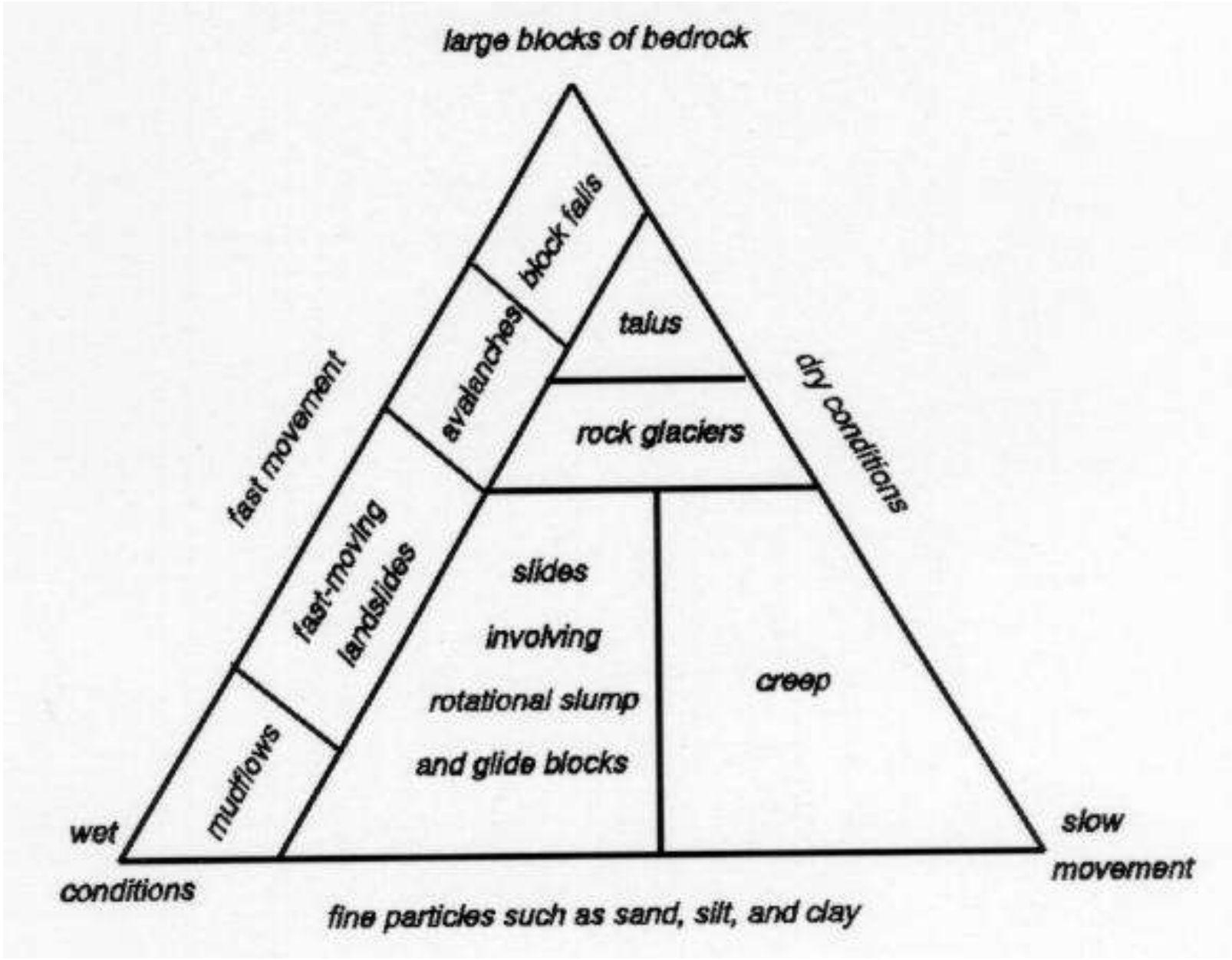
This slump failure in California poses a threat to homes developed along the edge of the cliff.

The asphalt from the road surface makes it easy to see the soil displacement from this slump.

Creep

- Creep is the slowest mass-wasting process and involves a very gradual downhill movement of soil, bedrock, and weathered rock fragments.
- Usually, the entire slope is slowly creeping downhill as a complete unit.
- Creep processes occur to some degree on nearly every hillslope because of gravity.
- Creep is evident by bent or extended tree trunks that are adjusting to the slow movement of the soil, regolith, and weathered material they are rooted into.
- Freeze-thaw cycles and saturated conditions may accelerate creep processes but usually only for a short time-period
- Solifluction is a certain form of creep where frozen tundra soils thaw out and gently 'flow' or sag downslope

The bent, leaning trees in this image are an indication of soil creep. The soil beneath the tree roots is slowing creeping downhill, as a result the tree trunks curve upslope in order for the trees to remain upright.


large blocks of bedrock
block falls
talus
avalanches
rock glaciers
fast movement
dry conditions
fast-moving landslides
slides involving rotational slump and glide blocks
creep
mudflows
wet conditions
slow movement
fine particles such as sand, silt, and clay