CLASSIFICATION OF MASS WASTING PROCESSES (24)

I Main Topics
   A Mass wasting classification scheme
   B Types of geologic materials
   C Styles of mass wasting

II Mass wasting classification scheme

Varnes classification scheme (simplified)

<table>
<thead>
<tr>
<th>Process/Material</th>
<th>Fall</th>
<th>Topple</th>
<th>Slide</th>
<th>Spread</th>
<th>Flow</th>
<th>Avalanche (complex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock</td>
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<tr>
<td>&quot;Coarse soil&quot; (Debris)</td>
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<td>&quot;Fine soil&quot; (Earth)</td>
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<tr>
<td>Ice/snow analog</td>
<td>Glacier</td>
<td>Ice fall</td>
<td>Start of avalanche</td>
<td>Glacier</td>
<td>Avalanche</td>
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</tbody>
</table>
III Types of geologic materials

A Rock: material that requires blasting or heavy equipment to move

B Debris: loose material that contains a significant portion of coarse material (20%-80% > 2mm)

C Earth: loose material that primarily consists of fine material (80+% < 2mm)

IV Styles of mass wasting

A Falls
B Topples
C Slides
D Lateral spreads
E Flows
F Complex
A Falls

1. Free fall through air; with bouncing or rolling
2. Maximum speed: \(~10^2\) m/sec
3. Example: rock falls from cliffs

Rockfall at Yosemite National Park, CA

https://www.youtube.com/watch?v=H0YhlqP1BgE

Rockfall, South Tyrol, Italy

https://www.youtube.com/watch?v=-5SiQqSro1w
B Topples

1. Initiates as a tilting or overturning;
2. Generally requires steep fractures parallel to free face;
3. Maximum speed: \(~10^2\) m/sec;
4. Example: topples along banks of Mississippi River

https://www.youtube.com/watch?v=gv5e27rHT-NY

C Slides

1. Material moves parallel to (and maintains contact with) one or more surfaces or narrow zones of failure;
2. Speed: Highly variable (\(10^{-4}\) m/sec - \(10^1\) m/sec);
3. Main types:
   a. Rotational slide (slump): slip surface curved in cross section; Pure rotational slides usually in uniform engineering material;
   b. Translational slide: slip surface is roughly planar;
4. Examples:
   a. Manoa Valley slides;
   b. Small failures along highway cuts

https://www.youtube.com/watch?v=_zcjbF6omWI
C Slides

1. Material moves parallel to (and maintains contact with) one or more surfaces or narrow zones of failure.

2. Speed: Highly variable (10^9 m/sec - 10^2 m/sec)

3. Two many types of slides:
   a. Rotational slide (slump): slip surface curved in cross section. Pure rotational slides usually in uniform engineering material.
   b. Translational slide: slip surface is roughly planar.

4. Examples:
   a. Manoa Valley slides;
   b. Small failures along highway cuts.

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D Lateral spreads

1. Material on a shallow slope is extended; there may or may not be a well-defined failure surface.

2. Speed: Highly variable (10^9 m/sec - 10^2 m/sec)

3. Commonly triggered by shock to young quick clays.

E Flows

1. Deformation distributed through material in a relatively continuous fashion

2. Speed: Highly variable (10^9 m/sec - 10^2 m/sec)

3. Enormous variety of phenomena (e.g. bedrock flows, soil creep, silt flows, dry sand flows, debris flows, debris avalanches)

4. Similarity between earthflows, lava flows, glaciers

https://www.youtube.com/watch?v=8mK3eID074

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https://www.youtube.com/watch?v=ghAqOE6xxnE
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https://www.youtube.com/watch?v=Dct3JQn2m0o

F Complex

1. Movement is by a combination of the above main styles; this implies gradations between styles
2. Speed: Highly variable (10^{-9} \text{ m/sec} - 10^2 \text{ m/sec})
3. Examples: Elm, Switzerland; Nevado Huascaran; Blackhawk, CA
4. Includes many phenomena termed avalanches

https://www.youtube.com/watch?v=fK_3AneOujQ