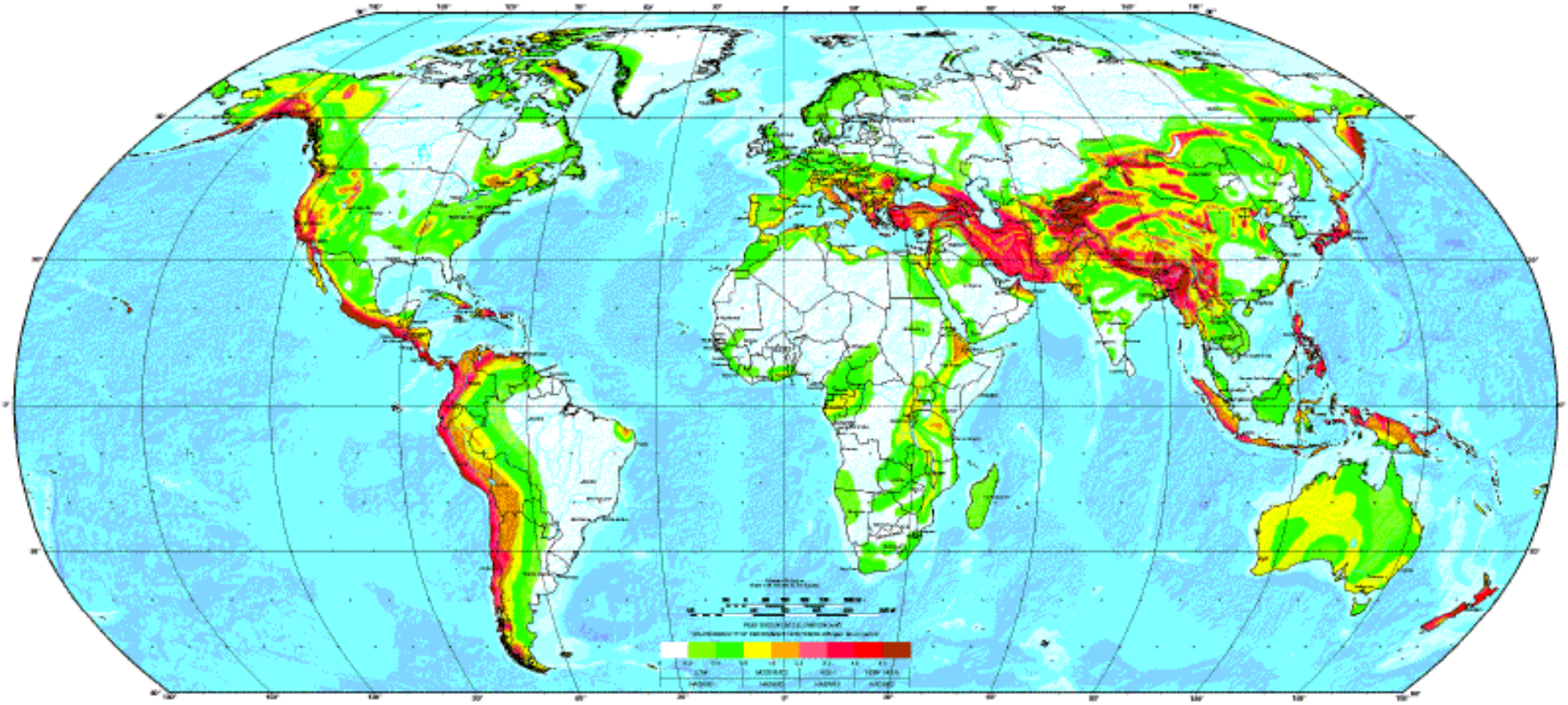
Identifying Geological Hazards: A Layman's Perspective



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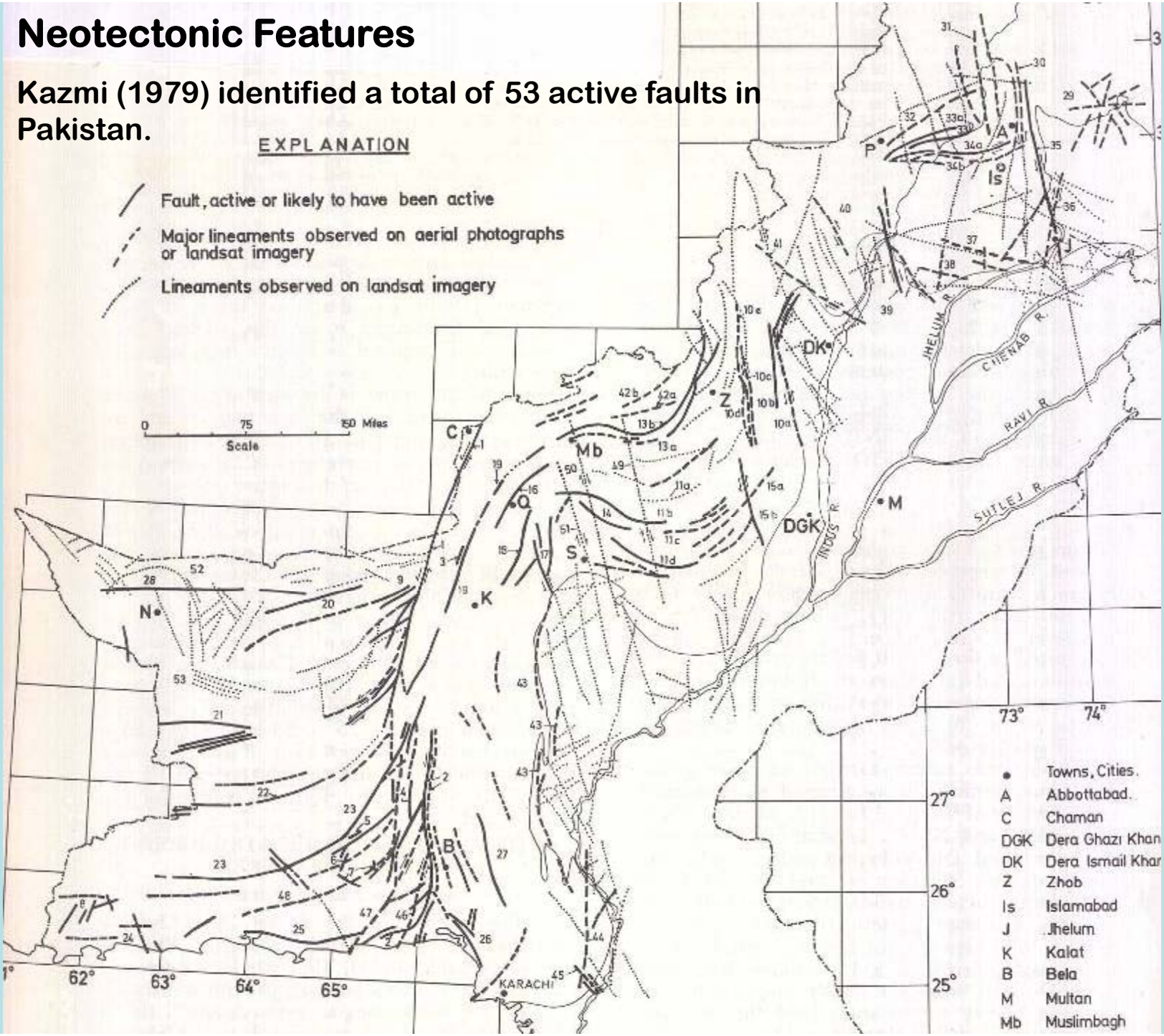
Terminology

Faults Fractures in bedrock along which movement has taken place

Active fault A fault that has moved recently

Neotectonic Features

Kazmi (1979) identified a total of 53 active faults in Pakistan.



Questions

- What are geological hazards?
- How to identify a potential hazard?

Hazards that are caused or are associated with geology include:

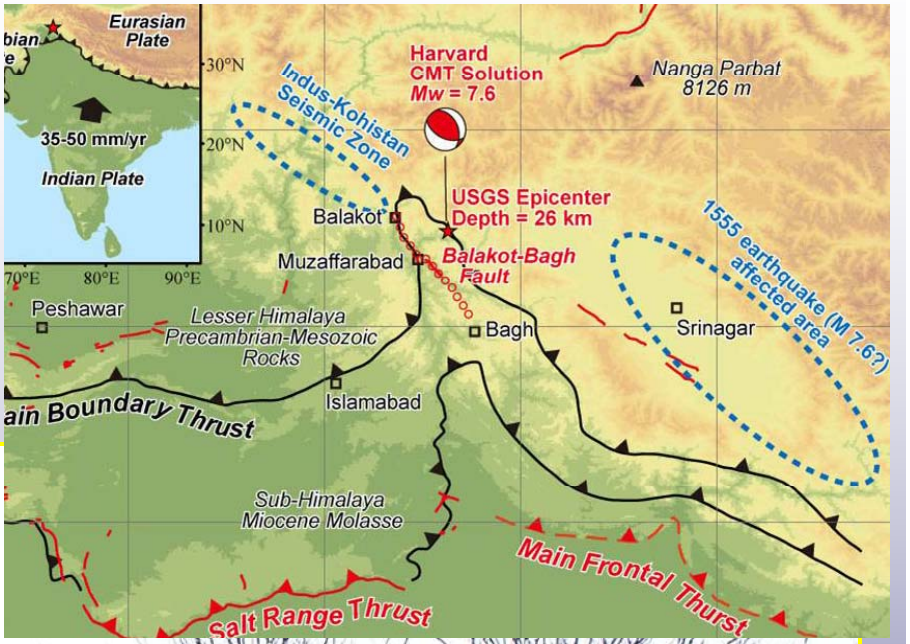
→ **Active Faulting with or without causing earthquakes. Active faults effects:**

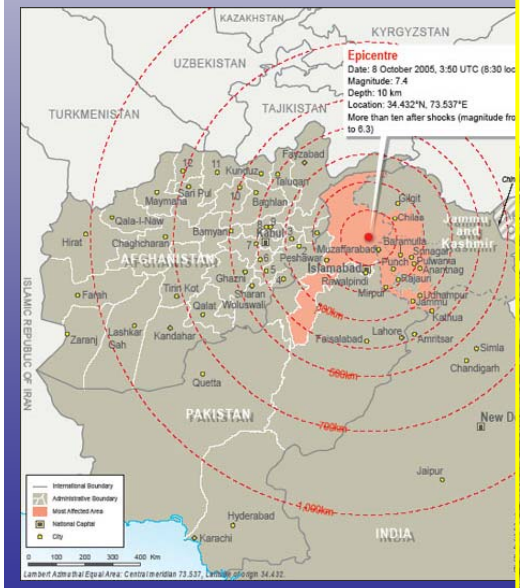
- **Earthquakes**
- **Landslides**
- **Effects on groundwater reservoir**
- **Land subsidence/elevation**
- **Topography/drainage modify**

→ **Mass Wasting (Land and/or rock slide, fall, flow, Creep). Mass wasting effects:**

- **Land loss (agriculture and/or forest)**
- **Property loss/damage**
- **Life loss**
- **Land subsidence (sink holes)**
- **Secondary effects (e.g. lake formation, water siltation)**

Active Fault Example– Pakistan Oct. 08, 2005 Earthquake





Mass-wasting Example– China May 12, 2008, Tangjiashan Lake

How to identify active faulting:

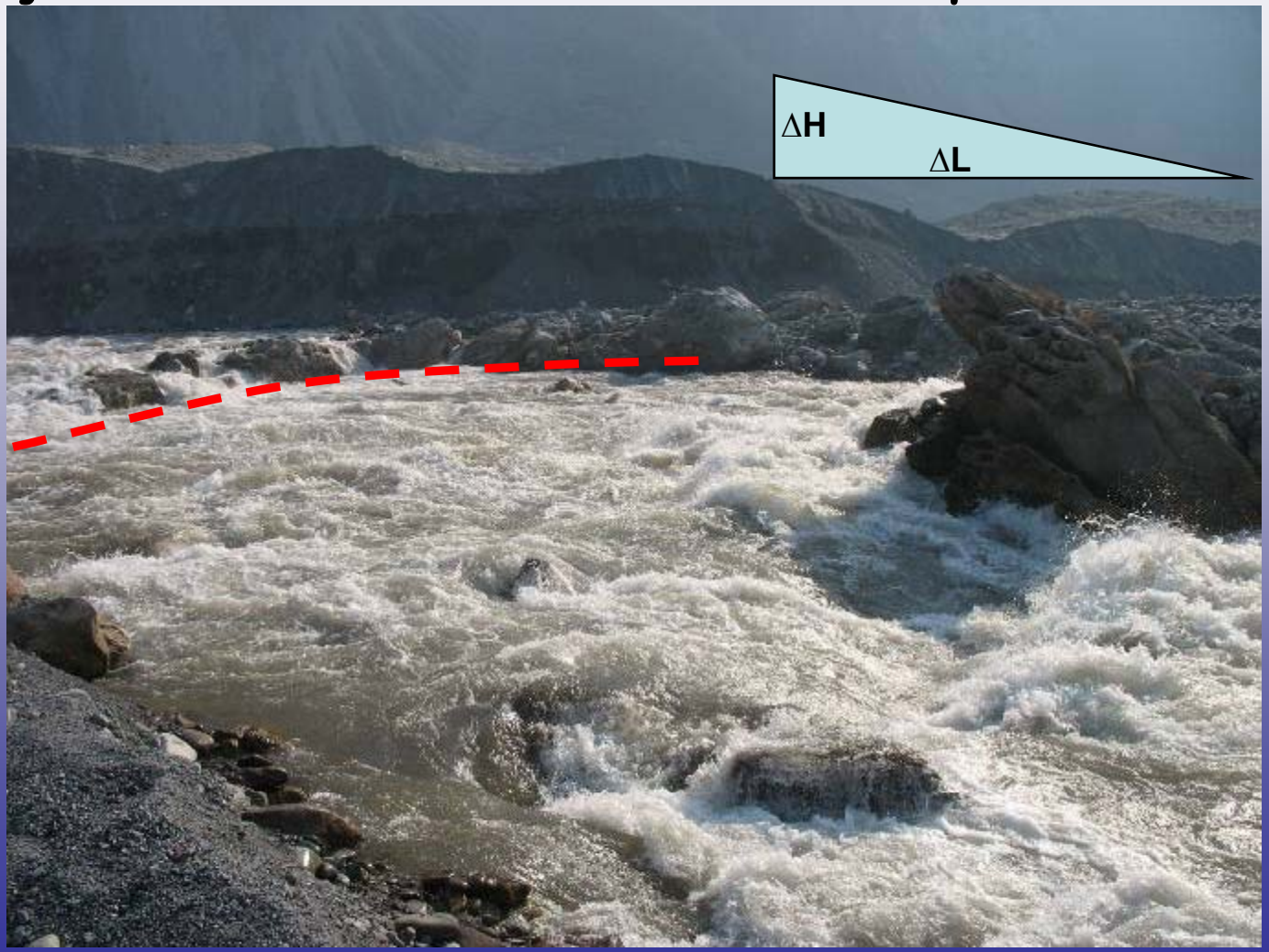
Discernable Displacement

River, stream or any other drainage channel off-set

How to identify active faulting:

Stream-Gradient Index

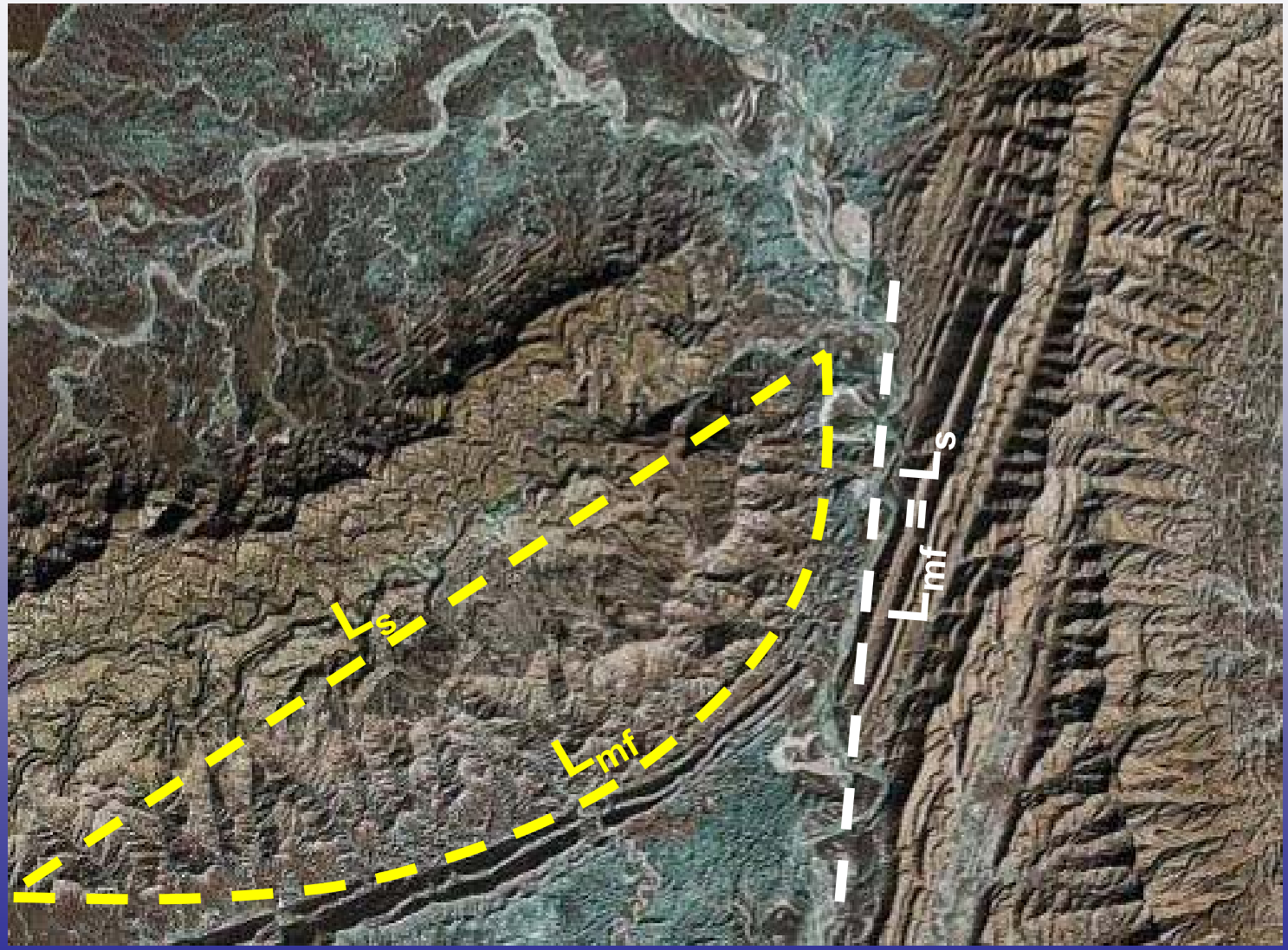
A pronounced drop in the stream-gradient index (= ΔH/ΔL) may be indicative of an active fault or scarp.



How to identify active faulting:

Mountain-Front Sinuosity

$S_{mf} = L_{mf}/L_s$ Smaller values indicate active uplift (faulting)



How to identify active faulting:

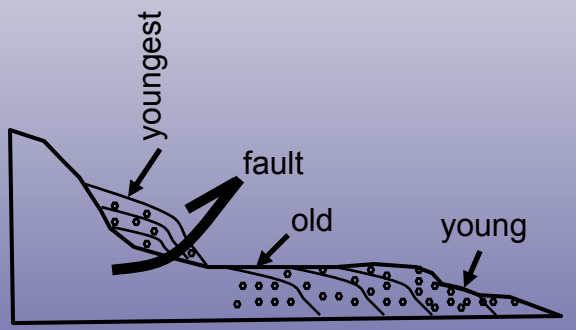
Ratio of Valley-Floor Width to Valley Height

This is simply the shape-factor of a valley. A U-shape valley must have been formed by slow process. A V-shape valley is usually developed by faster incision rate.

How to identify active faulting:

Alluvial Fans

If the mountain rises (e.g. due to active faulting) faster than the incision and deposition rate of the stream then younger rocks are deposited closer to the mountain.



How to identify active mass-wasting:

Rock Falls

These are either readily visible or large cracks in ground surface, undercutting by water or over-steepened cliffs may indicate potential rock fall hazard.

How to identify active mass-wasting:

Creep

Creep is a very slow downslope motion of rocks. It can be identified by

1. the curvature (convex downslope) of tree trunks

Creep with recent sliding--Active

Creep timing--Young & old trees

Creep (contd.)

2. the tilted posts of a fence

3. Cracks in building or soil/rock

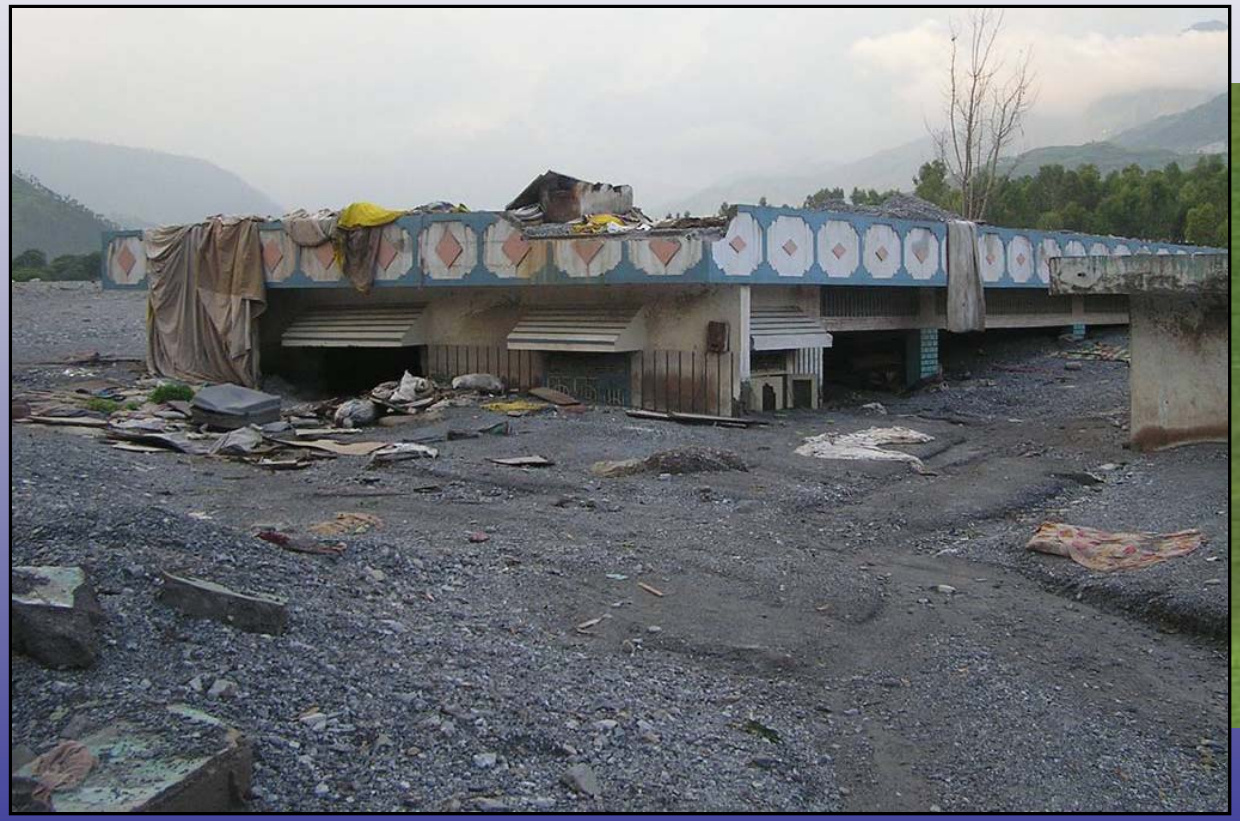
Creep (contd.)

4. Experiment →the curvature (convex downslope) of a wall over given amount of time may identify an active creep

How to identify active mass-wasting:

Flows

Usually occur in areas of excessive moisture. These are either readily visible as large flow masses of rock, water and soil or may be identified by lumps of soil flow on a slope,



How to identify active mass-wasting:

Land Subsidence (including Sink Holes)

Areas that are underlain by limestone are more vulnerable to land subsidence. A depression, vanishing water course or cluster of trees may indicate a potential or active subsidence.

Mitigating Mass-wasting

- **Monitoring and Forecasting**
- **Physical intervention**
  - **slope drainage (critical)**
  - **slope regrading**
  - **restraining structures (piles, buttresses etc)**
  - **vegetation**
- **Avoidance**
  - **land use restrictions**
  - **hazard mapping and land use zonation**
  - **Geological & engineering surveys before development**
  - **Insurance**
- **Warning and evacuation measures**
- **Raising Public Awareness**
  - **Masjid → schools → Electronic/print**
  - **Mandatory portion of Curriculum (Education)**

Thank you for your attention