LANDSLIDE RISK ASSESSMENT

1) Which type of landslide?
2) Which the "state of activity" of landslide?
3) Which the scale?
4) Which the objectives of the work?

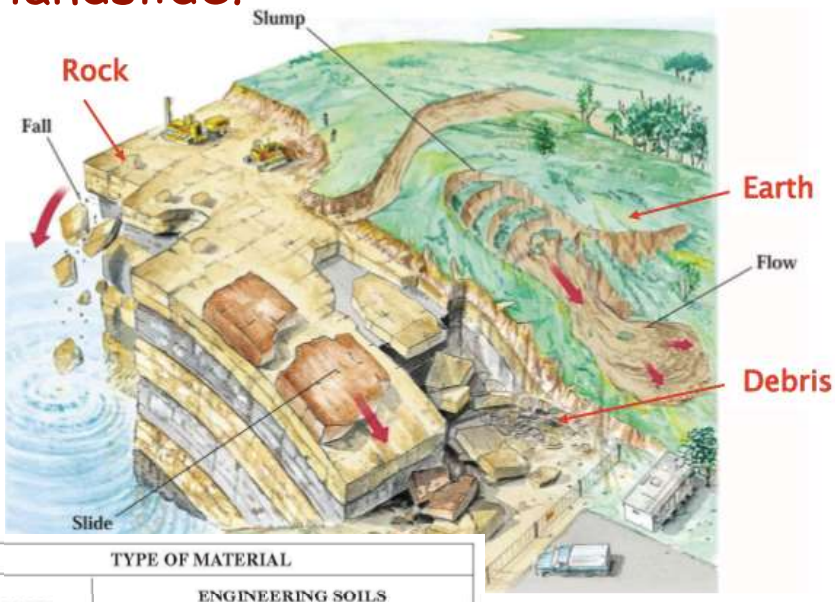
5) Which the approach to adopt?

PRESENTATION OUTLINES

1) Which type of landslide?

TYPE OF MOVEMENT

TYPE OF MATERIAL

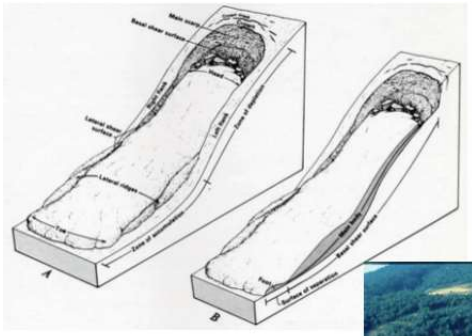


VARNES, 1978

TYPE OF MOVEMENT		TYPE OF MATERIAL		
		BEDROCK	ENGINEERING SOILS	
			Predominantly coarse	Predominantly fine
FALLS		Rock fall	Debris fall	Earth fall
TOPPLES		Rock topple	Debris topple	Earth topple
SLIDES	ROTATIONAL	Rock slide	Debris slide	Earth slide
	TRANSLATIONAL			
LATERAL SPREADS		Rock spread	Debris spread	Earth spread
FLOWS		Rock flow (deep creep)	Debris flow (soil creep)	Earth flow
COMPLEX		Combination of two or more principal types of movement		

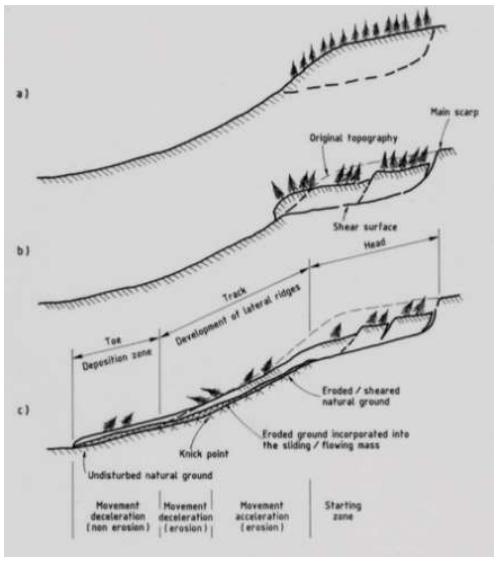
1) Which type of landslide?

COMPLEX LANDSLIDE:
ROTATIONAL SLIDE + EARTH FLOW



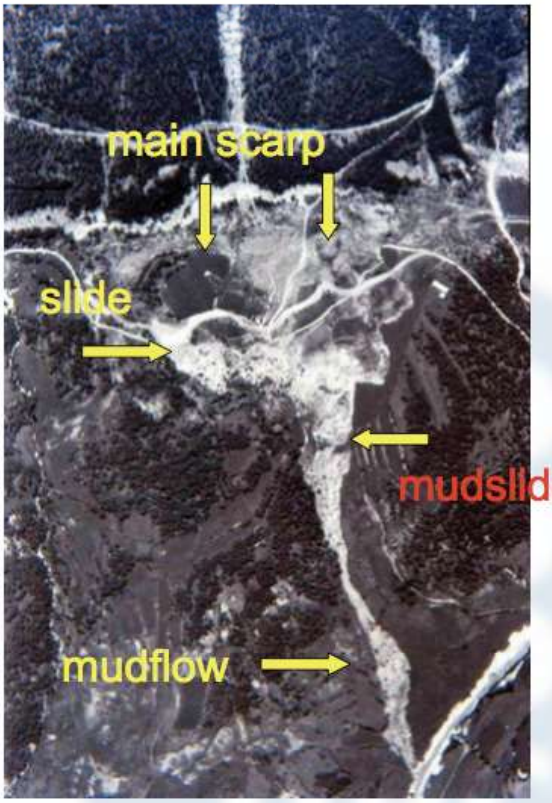
Earthflow sketch
Source: Keefer & Johnson, 1983

La Coma, Eastern Pyrenees



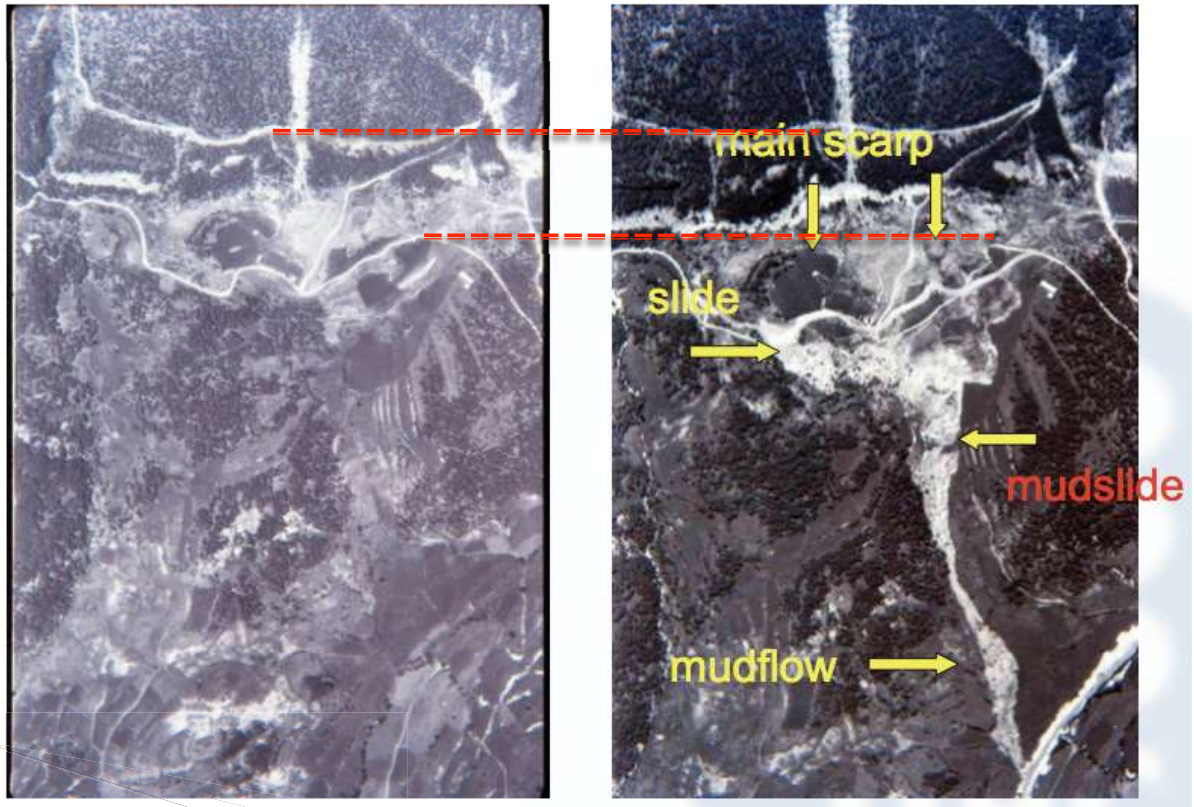
SOME EXAMPLES

COMPLEX LANDSLIDE:
TRANSLATIONAL SLIDE + EARTH FLOW



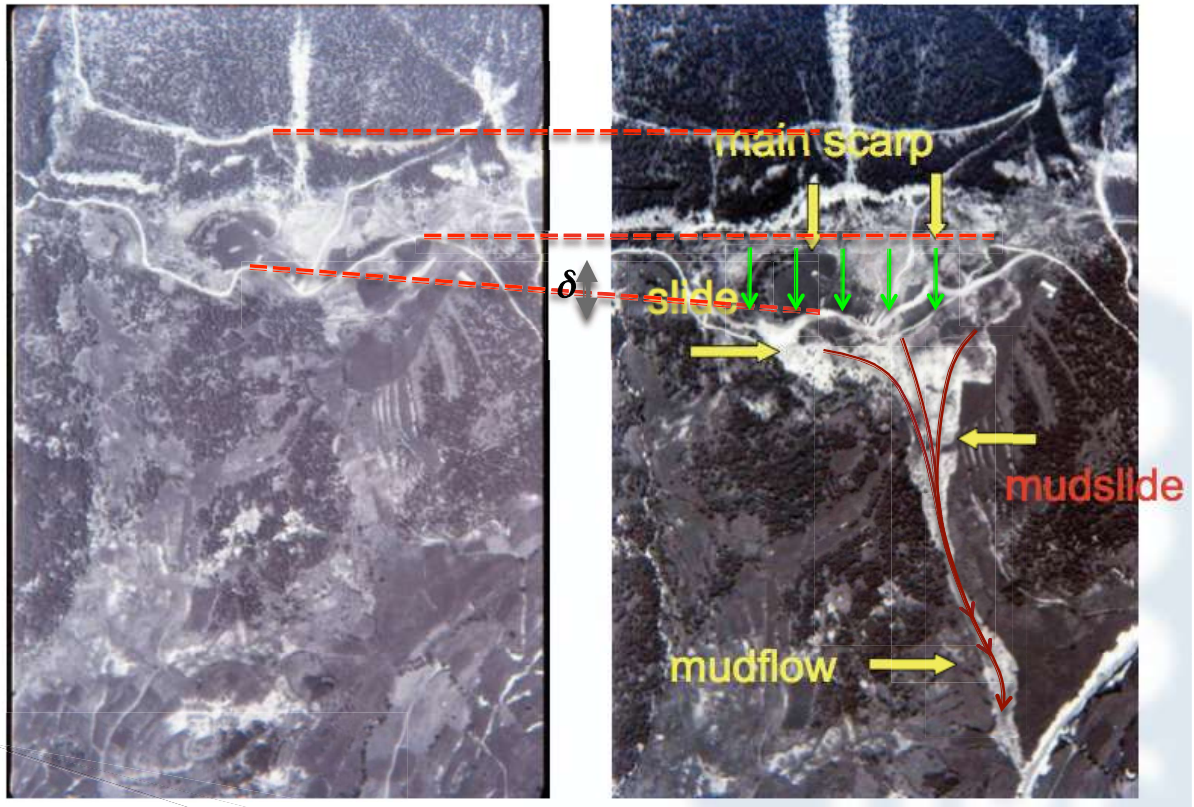
SOME EXAMPLES

COMPLEX LANDSLIDE:
TRANSLATIONAL SLIDE + EARTH FLOW



SOME EXAMPLES

COMPLEX LANDSLIDE:
TRANSLATIONAL SLIDE + EARTH FLOW



SOME EXAMPLES

EARTH SLIDE AND EARTH FLOW

The runout is strictly related to the landslide typology

SOME EXAMPLES

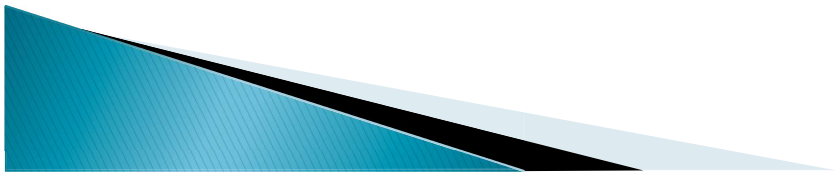
LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

LANDSLIDE RECOGNITION

-***Interpretation of map*** *Understanding maps (topographic, geomorphological,..)*

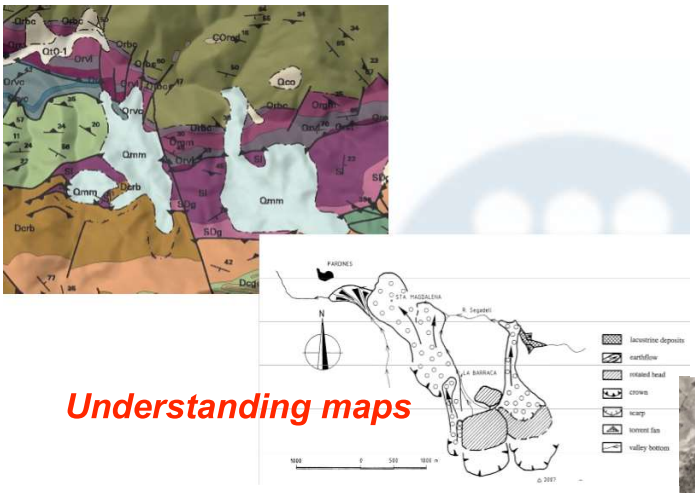
-***Aerial photo-interpretation***

-***Field Reconnaissance*** *Morphological evidences, deposits, vegetation, indirect evidence*

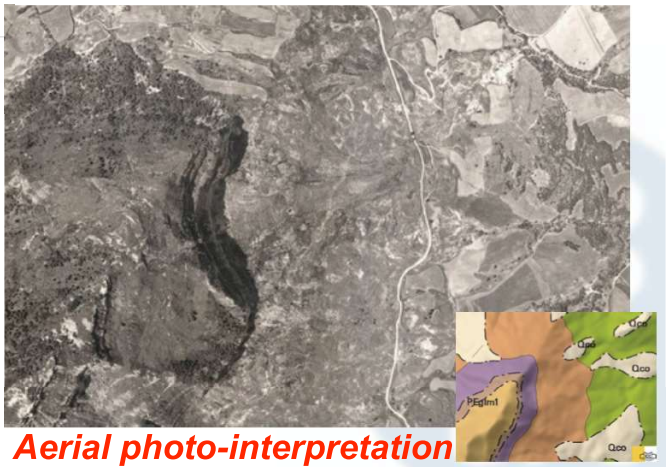


1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK



Understanding maps

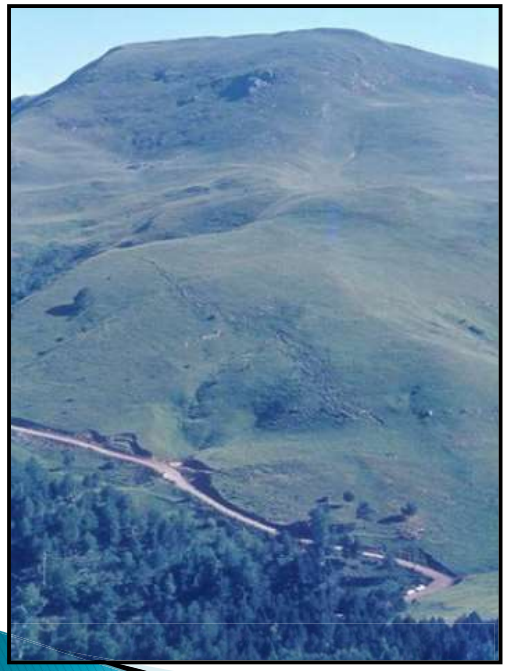


Aerial photo-interpretation

1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

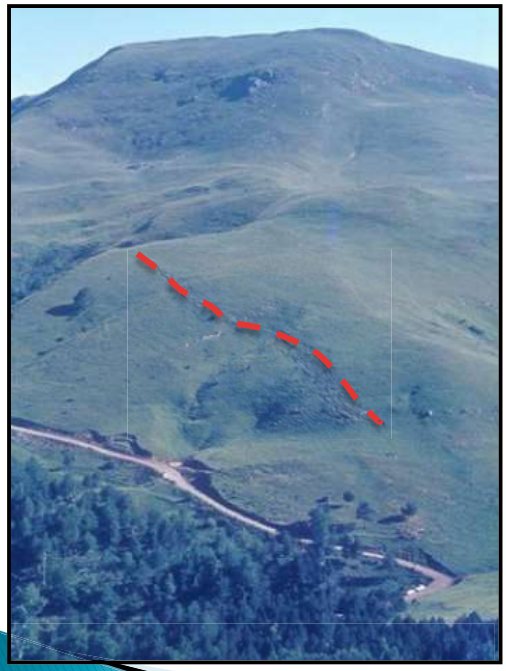
MORPHOLOGICAL EVIDENCES

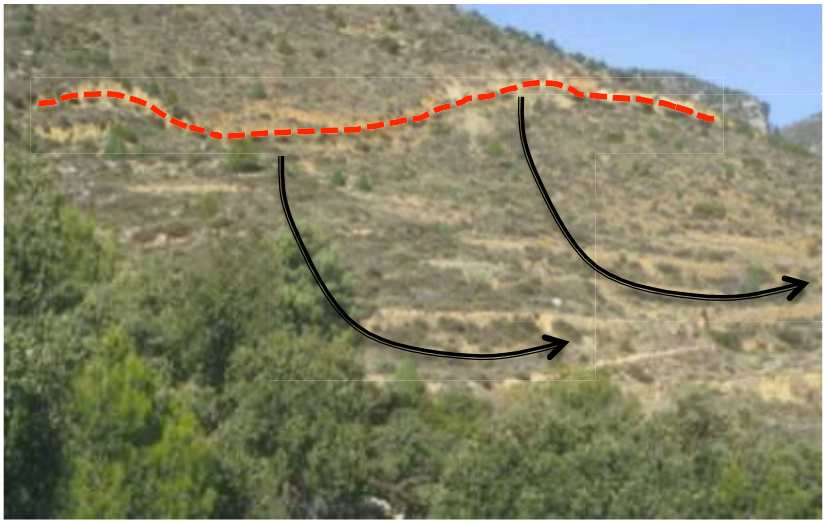


1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

MORPHOLOGICAL EVIDENCES





1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

DEPOSITION AREA

Type of material

kinematic reconstruction

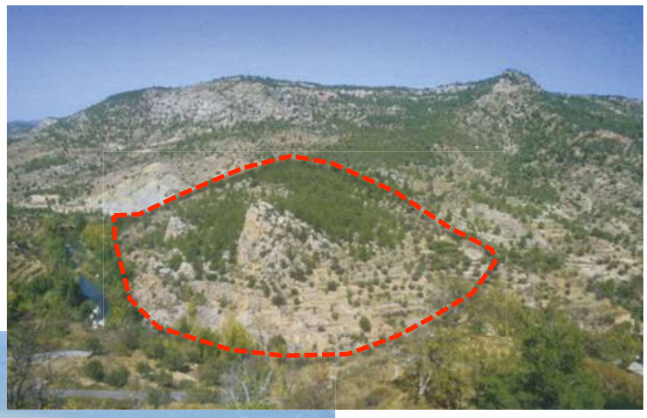
1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

DEPOSITION AREA

Type of material

kinematic reconstruction

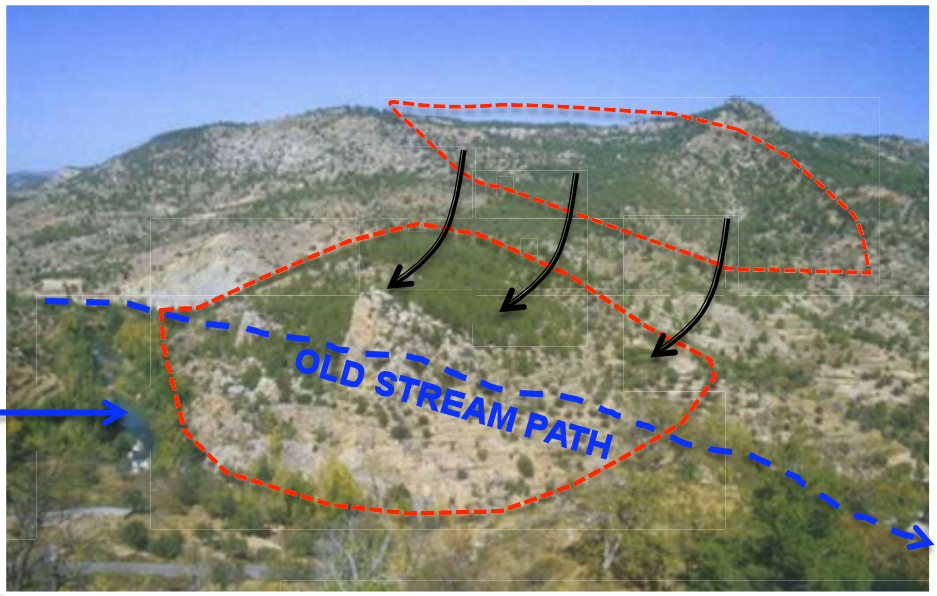


1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

DEPOSITION AREA

kinematic reconstruction



NEW
STREAM
PATH

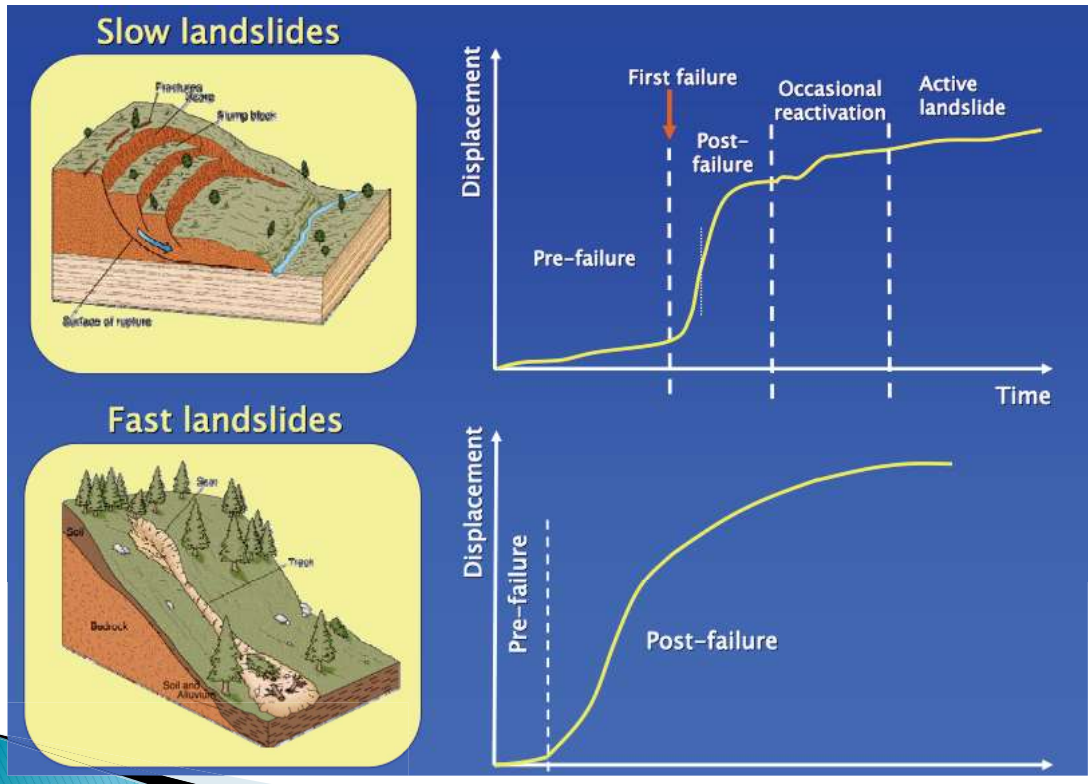
1) Which type of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK

VEGETATION – INDIRECT EVIDENCE

2) Which the "state of activity" of landslide?

LANDSLIDE IDENTIFICATION IS NOT ALWAYS AN EVIDENT TASK



SOME DEFINITIONS

Landslide Inventory (I): *This is an essential part of any landslide zoning. It involves the location, classification, volume, travel distance, state of activity and date of occurrence of landsliding in an area.*

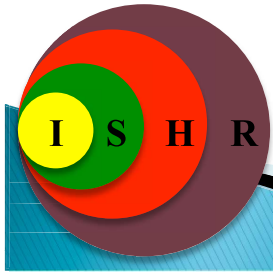
Landslide Susceptibility (S): *Areas prone to slope failure or that where a landslide may travel onto or retrogress into it.*

Landslide Hazard (H): *The probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon.*

Elements at Risk (E_r): *Means the population, properties, economic and social activity, etc., at risk in a given area.*

Vulnerability (V): *Means the degree of loss of a given element or set of elements at risk of a given magnitude. It is expressed on a scale from 0 (no damage) to 1 (total loss).*

Specific Risk (R_s): *Means the expected degree of loss due to a particular natural phenomenon. It may be expressed by the product of Hazard times Vulnerability*



Total Risk (R): *Means the expected number of lives lost, person injured, damage to property, or destruction of economy activity due to a particular natural phenomenon, and is therefore the product of specific risk and element at risk*