Natural Hazards and Disaster

Lab 7: Volcanoes and Land Slides (Question Set 5)

- Types of volcanoes
- Lahars
- Extreme eruptions
- Most common and deadly landslides

Question Set 5: Volcanoes and Landslides

1 What are the main types of volcanoes and what are the main characteristics of eruptions for these types?
2 What is a lahar?
3 Briefly describe the impacts of a VEI 7 eruption that took place during the Holocene.
4 What are the most common and most deadly landslides and what are their main characteristics?

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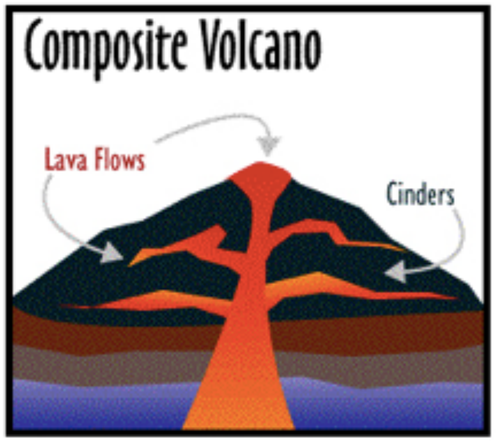
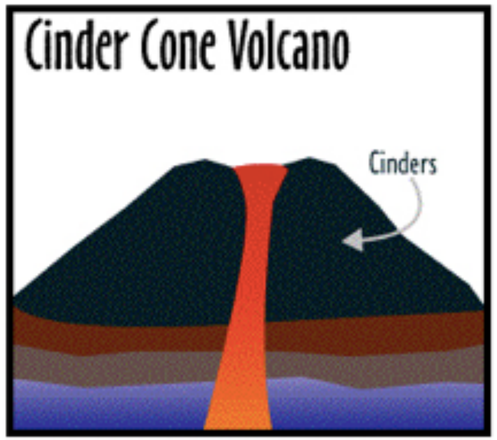
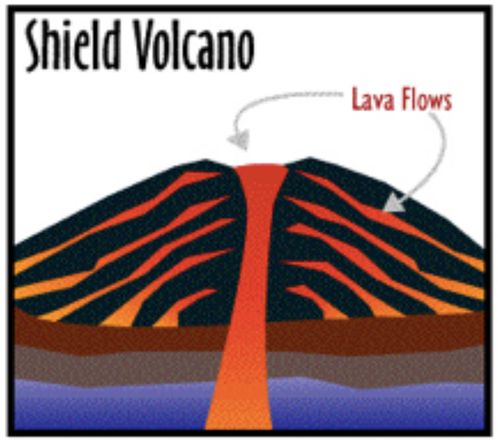
Three main types:

- stratovolcanoes (or composite volcanoes): conical, consists of layers
- cinder cone volcanoes: doesn't have layers, steep conical hills
- shield volcanoes: large shields.







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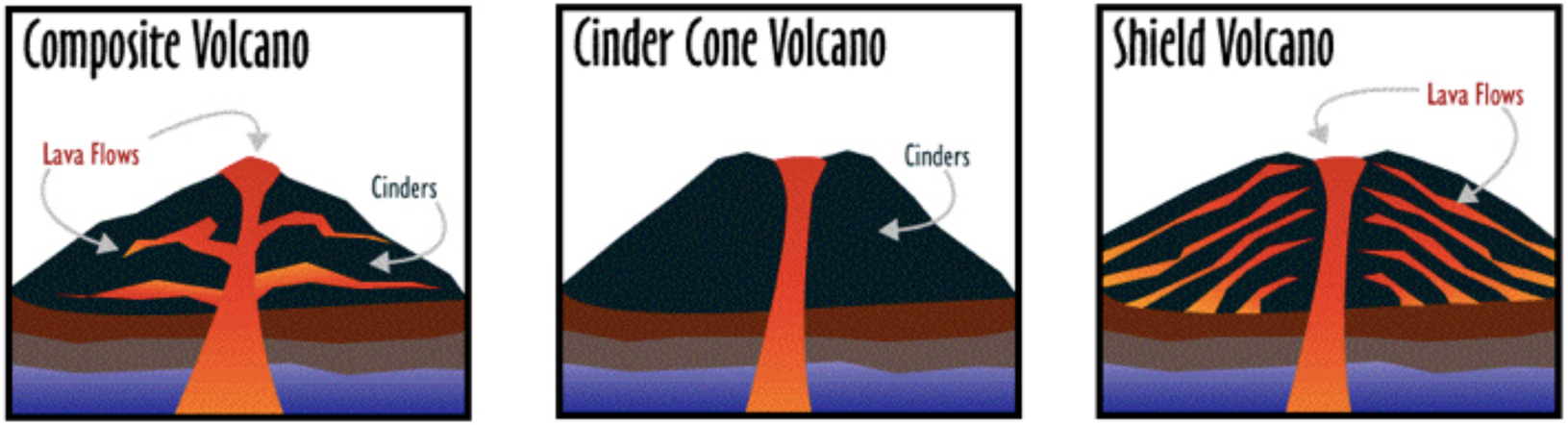

The volcano type depends on the type of magma and its viscosity:

- Volcanoes above subduction zones extrude silicarich, iron-poor lavas that are very viscous and can range widely in composition.
- Basaltic lava is very fluid.
- Mid-ocean ridge lava is predominantly basaltic.

Size of Volcanic Eruptions

Table 5. Classification of volcanic eruptions. V: ejecta volume; EC: eruption classification; D: description; PH: plume height; FE: frequency of eruption; O: known/estimated occurrences in the Holocene.

VEI	V	EC	D	PH	FE	O
0	< 10,000 m^3	Hawaiian	Effusive	< 100 m	Persistent	Many
1	> 10,000 m^3	Hawaiian/Strombolian	Gentle	100–1,000 m	Daily	Many
2	> 1,000,000 m^3	Strombolian/Vulcanian	Explosive	1–5 km	Weekly	3,477
3	> 10,000,000 m^3	Vulcanian/Pelean	Severe	315 km	Few months	868
4	> 0.1 km^3	Pelean/Plinian	Cataclysmic	1,025 km	≥1 yr	421
5	> 1 km^3	Plinian	Paroxysmal	2,035 km	≥10 yrs	166
6	> 10 km^3	Plinian/Ultra-Plinian	Colossal	> 30 km	≥ 100 yrs	51
7	> 100 km^3	Ultra-Plinian	Super-colossal	> 40 km	≥ 1,000 yrs	5*
8	> 1,000 km^3	Supervolcanic	Mega-colossal	> 50 km	≥10,000 yrs	0

* plus two suspected.

Plag et al., 2015

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2 What is a lahar and why are they dangerous?

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Rivers of tephra and water slurry, called lahars, are a danger to those who live near volcanoes.

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3 Briefly describe the impacts of a VEI 7 eruption that took place during the Holocene.

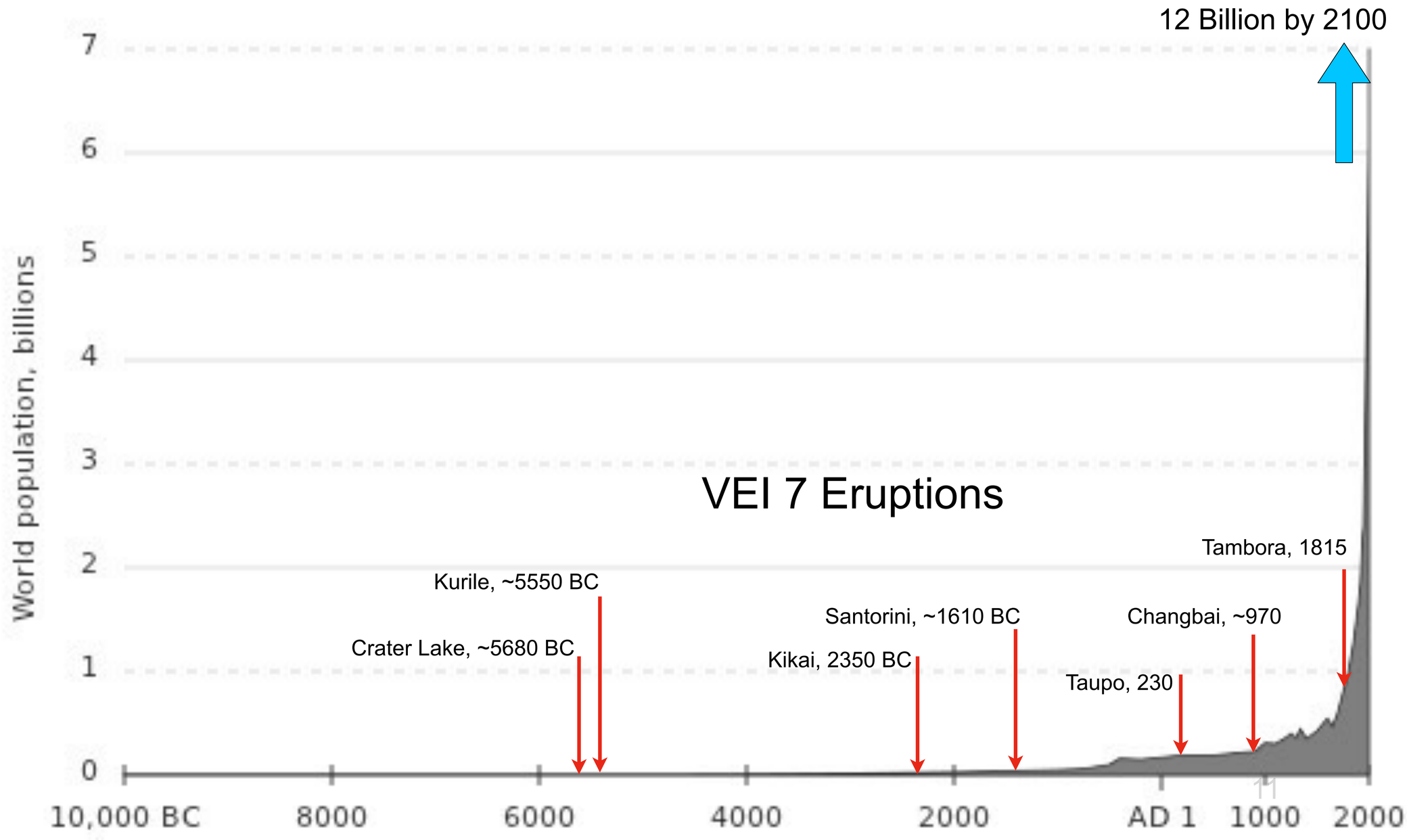
Large Eruptions

Year	Location	VEI	km^3	Deaths	Comment
2011	Puyehue-Cordon Caulle, Chile	4	30		
2010	Merapi, Indonesia	4		353	MCD: pyroclastic flows
2010	Eyjafjallajökull, Iceland	4	0.25	0	Caused severe traffic distortions
1991	Pinatubo	6	6-16	847	MCD: failing roofs
1985	Nevado de la Ruiz, Colombia	3	0.03	25,000	MCD: Lahar
1980	St Helens	5	1	57	
1919	Kelut, Indonesia			5,100	MCD: mudflows
1912	Novarupta, Alaska	6	15-30	unknown	
1902	Mount Pelee, Martinique	4	>0.1	29,000	MCD: pyroclastic flow
1902	Santa Maria, Guatemala	6	20	>5,000	
1883	Krakatau, Indonesia	6	21	36,000	MCD: tsunami
1882	Galunggung, Indonesia	5		4,000	MCD: mudflows
1815	Tambora, Indonesia	7	150	92,000	MCD: starvation
1783-85	Laki and Grimsvoth, Iceland	6	14	9,400	MCD: famine and fluorine poisoning; deaths are for Iceland only
1660	Long Island	6	30		
1650	Kolombo	6	60		
1631	Vesuvius, Italy			3,500	MCD: mud and lava flows
1600	Huaynaputina	6	30		
1580	Billy Mitchell	6	14		
1477	Baroarbunga, Iceland	6	10		
1280	Quilotoa	6	21		
969 ± 20	Changbai, China	7	76-116		
230	Taupo	7	120		
79	Vesuvius, Italy	5	2.8-3.8	3,400	MCD: Ash flows
1610 ± 14 BC	Santorini	7	99		
4350 BP	Kikai	7	80-220		
5550 ± 100 BC	Kurile	7	140-150		
5677 ± 50 BC	Crater Lake	7	150		
26500 BC	Oruanui, New Zealand	8			
73000 ± 4000 BP	Toba, Indonesia	8	2500-3000		Killed up to 60% of the global population; MCD: starvation
640000 BP	Yellowstone	8	1000		

VEI 7 / M 7:

- at least seven events in the Holocene
- ~5% - 10% chance that this will happen in the 21st century
- Will have very different impact than previously

Large Eruptions



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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		

4 What are the most common and most deadly landslides and what are their main characteristics?

- Rotational debris and earth slides, also known as slumps, are among the most common and they can also be the most deadly.
- These slides frequently become debris or earth flows that can travel significant distances as the loose material moves rapidly downhill, entrapping air and water so that the foot and toe of the slide behaves as a fluid.

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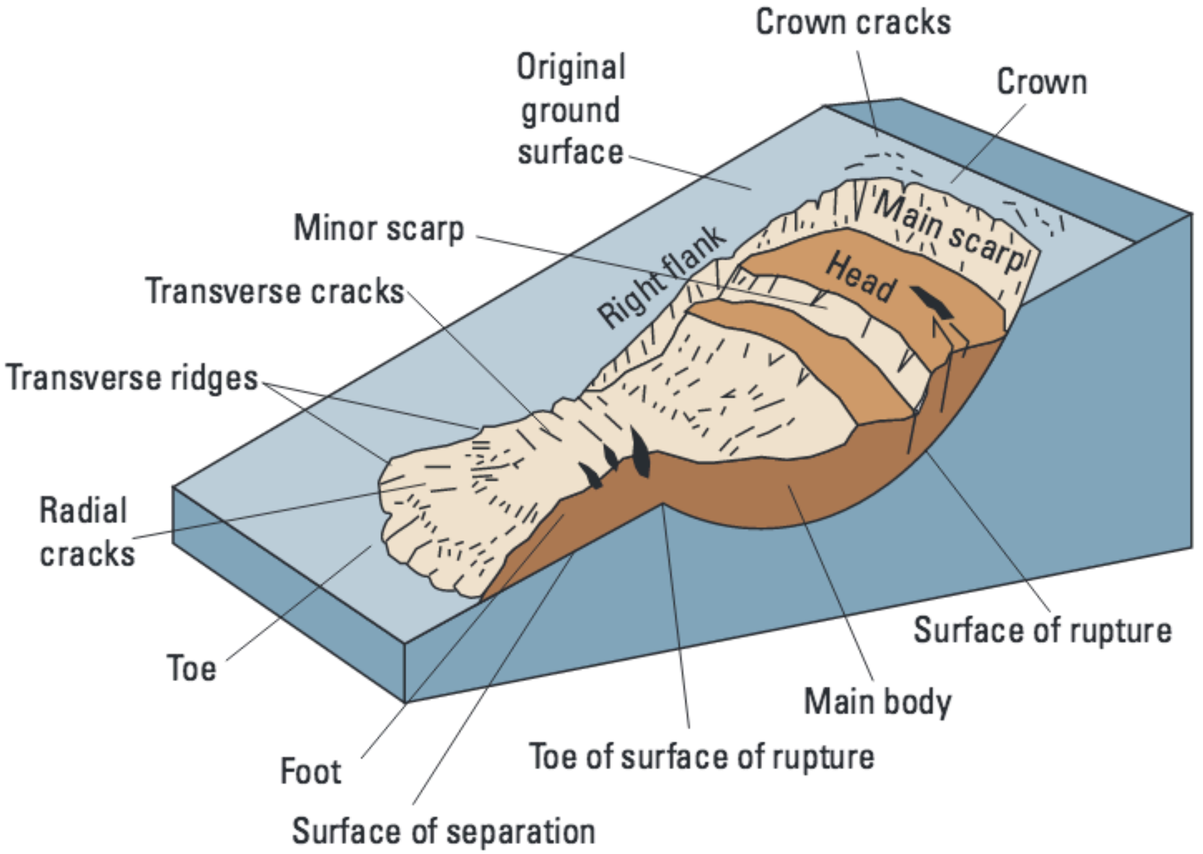

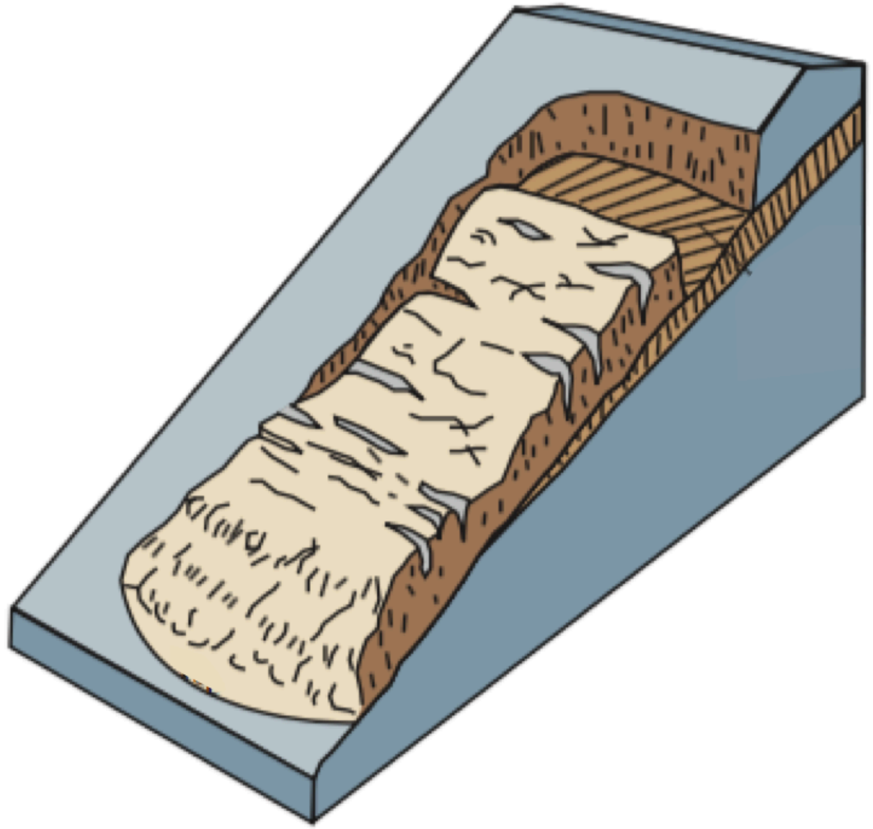

Left: General landslide terminology for a rotational slump or slide, in which the basal rupture surface is curved, Right: Same for a translational slide, in which the rupture surface is planar.

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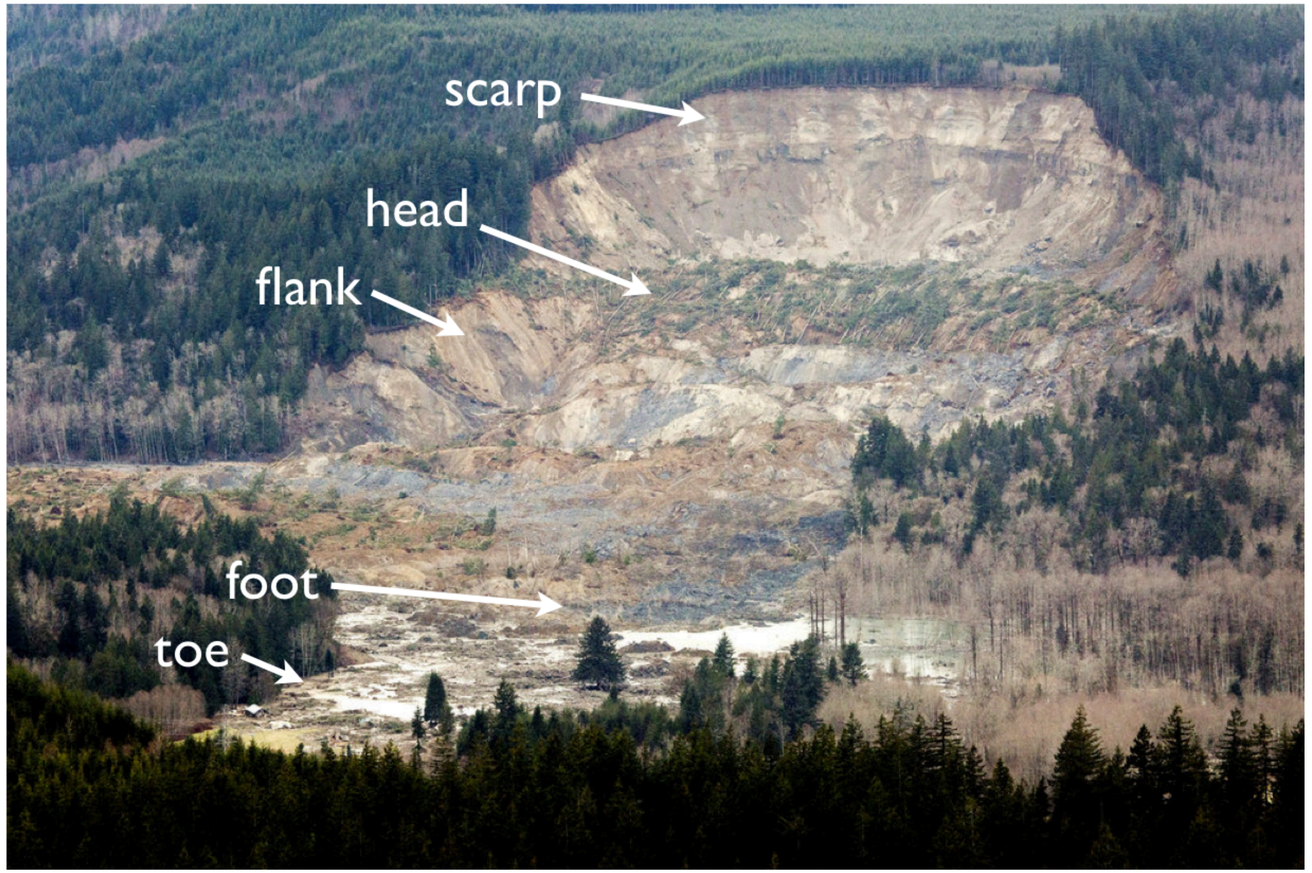

A rotational slide near Oso, Washington, U.S.A. on March 22, 2014, shows a clear scarp, flanks, and head. Run out of the slide's foot overwhelmed the community of Steelhead Haven on the other side of the valley, destroying homes and killing 43 people.