

What is Physical Geology?



Northern Wasatch Range, Salt Lake City, Utah

Rocks



cute

Metamorphic



Igneous

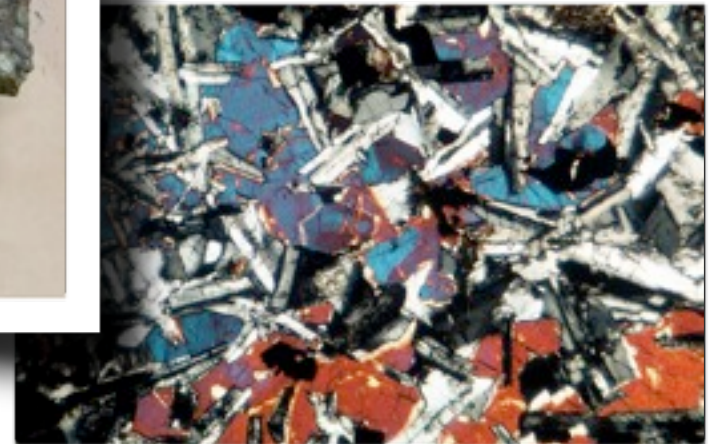


magical



Sedimentary

Volcanic (microscopic)



Volcanoes



2008 Chaiten Volcano, Chile



(Photo used with permission from Kenai Helicopters Hawaii.)

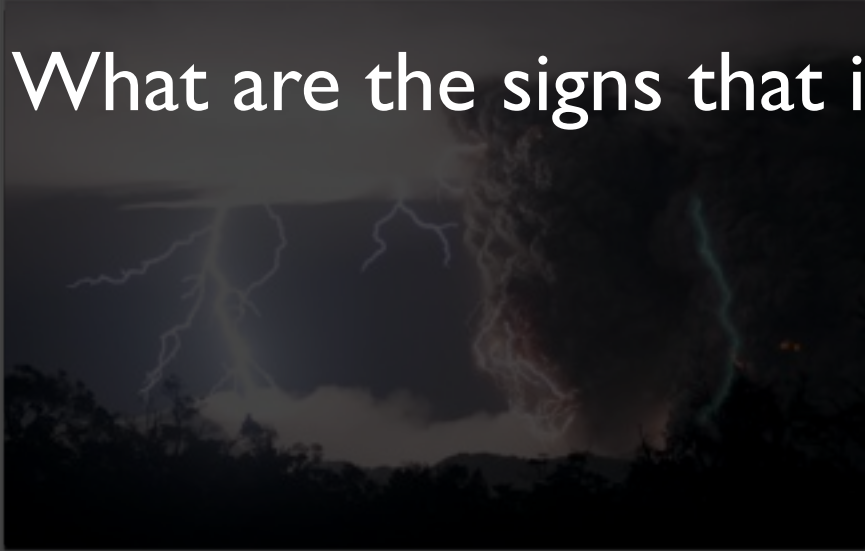
1984 Pu'u O'o Volcano, Hawaii



2006 Mount Saint Helens

Volcanoes

What are the signs that indicate an eruption is imminent?



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(Photo used with permission from Kenai Helicopters Hawaii.)

1984 Pu'u O'o Volcano, Hawaii

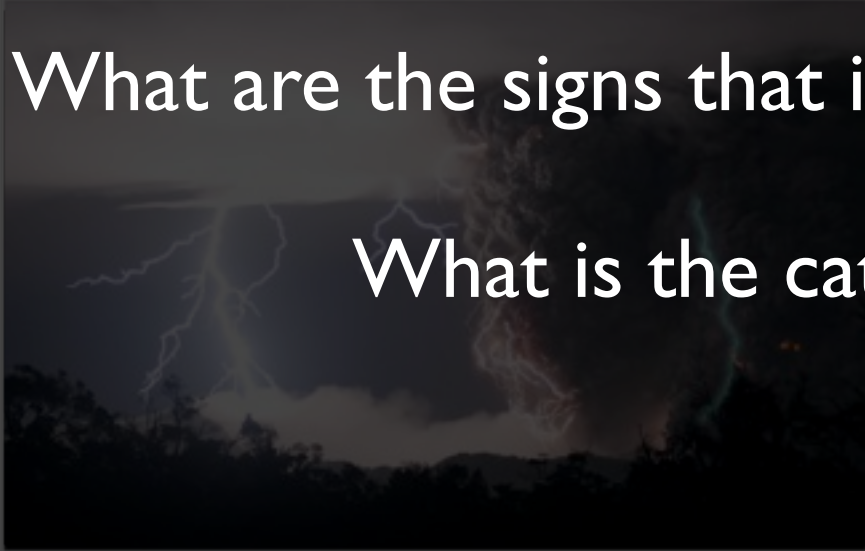


2006 Mount Saint Helens

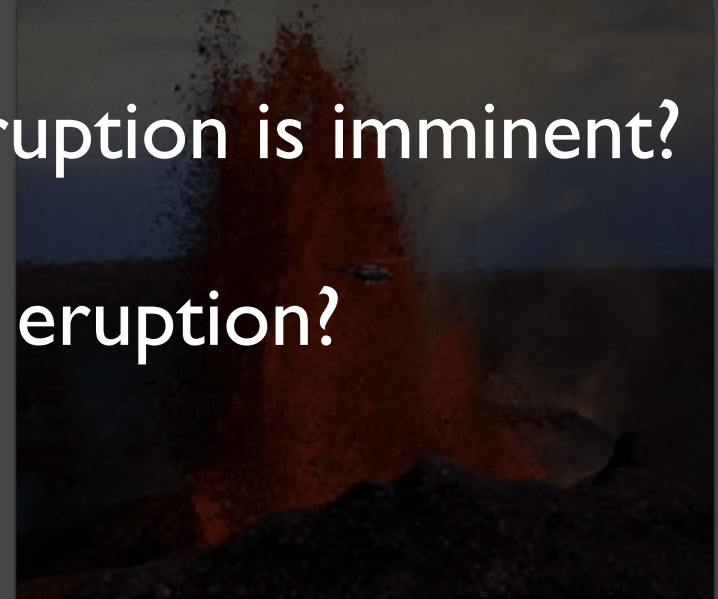
Volcanoes

What are the signs that indicate an eruption is imminent?

What is the catalyst for the eruption?



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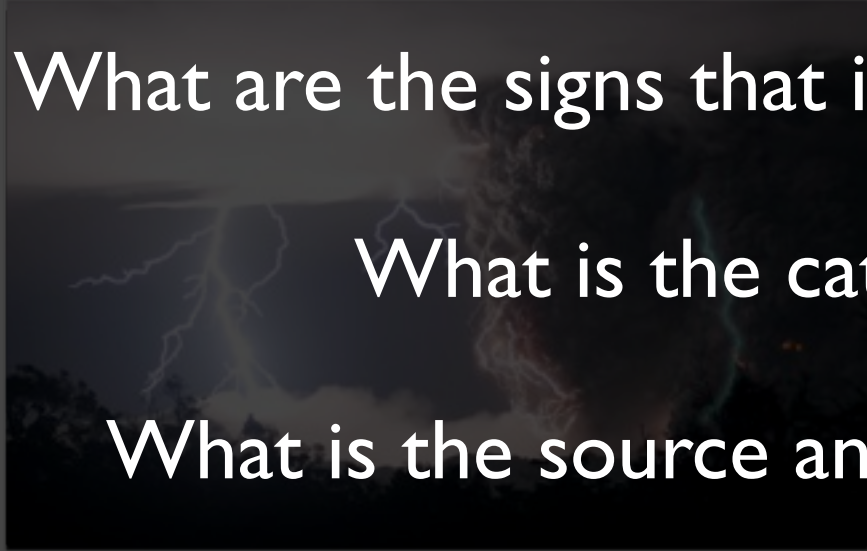
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Volcanoes

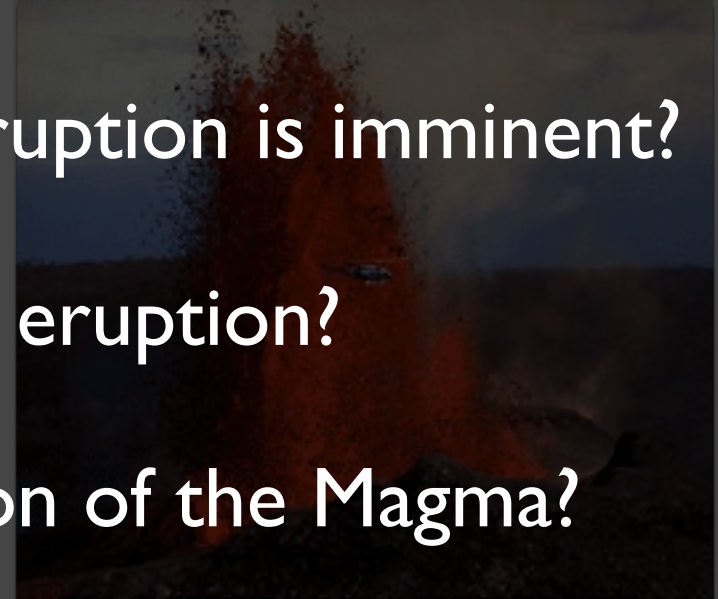
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What is the catalyst for the eruption?

What is the source and composition of the Magma?



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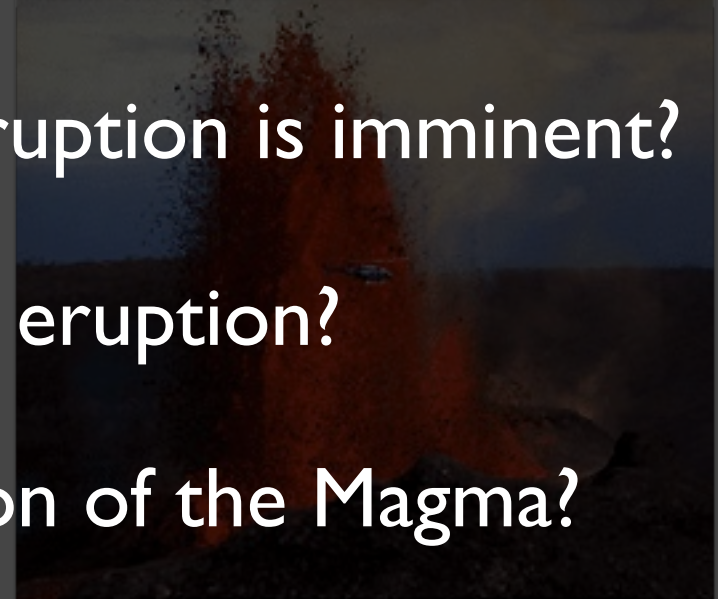
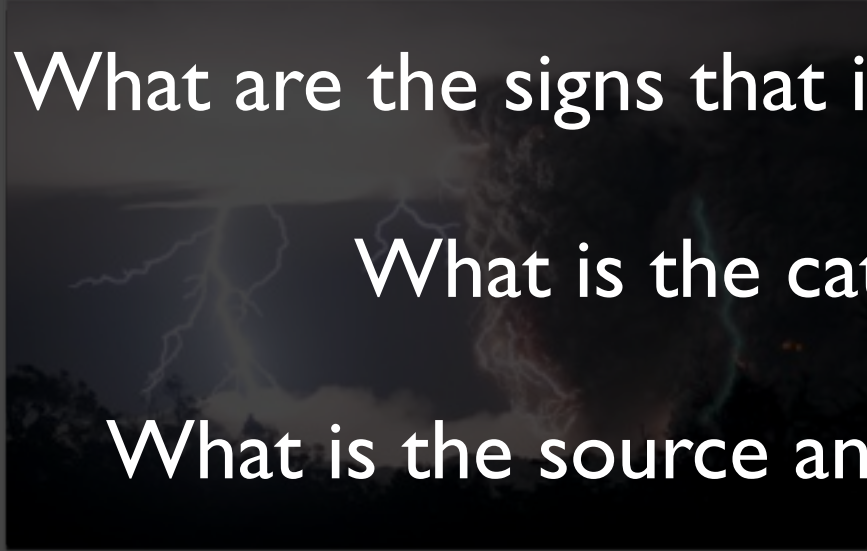
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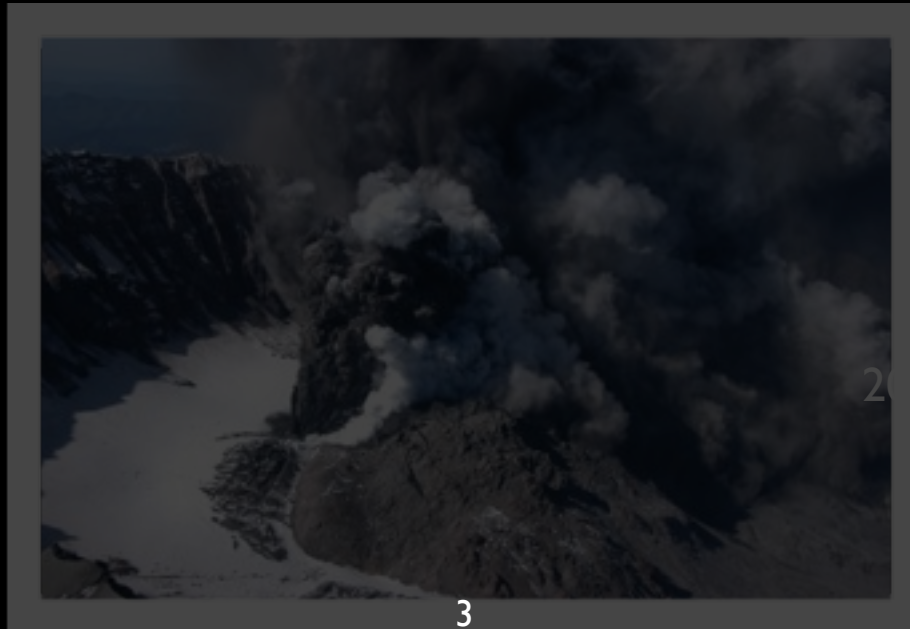
What controls the location of the Volcano?



(Photo used with permission from Kenai Helicopters Hawaii.)

2008 Chaiten Volcano, Chile

1983 Pitou Oia Volcano, Hawaii



2006 Mount Saint Helens

Volcanoes

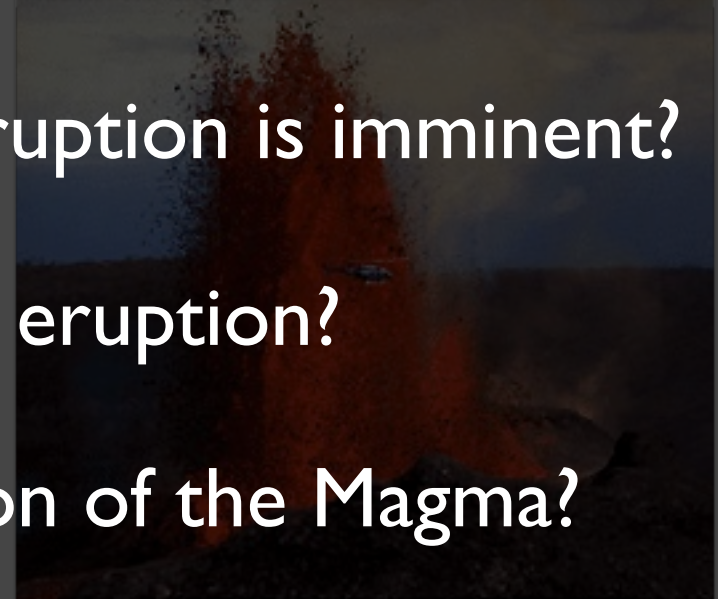
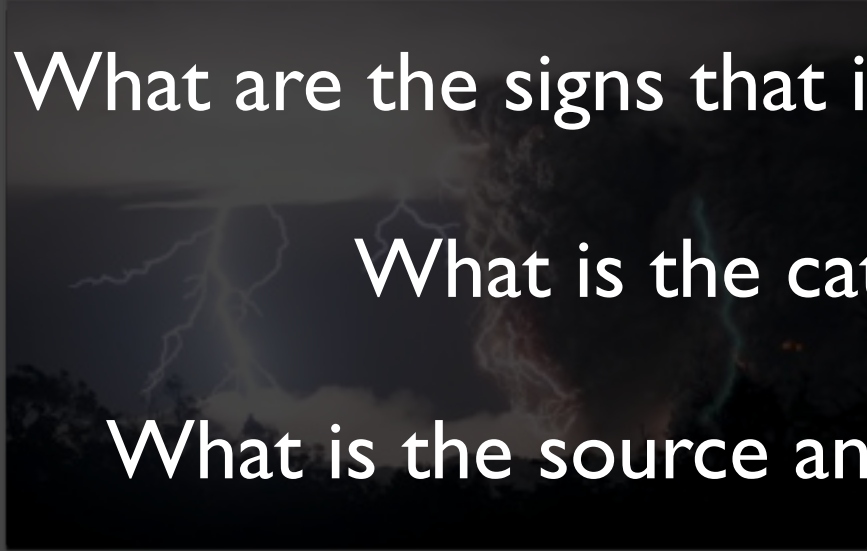
What are the signs that indicate an eruption is imminent?

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What is the source and composition of the Magma?

What controls the location of the Volcano?

Why are some eruptions violent and others peaceful?



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Volcanoes

What are the signs that indicate an eruption is imminent?

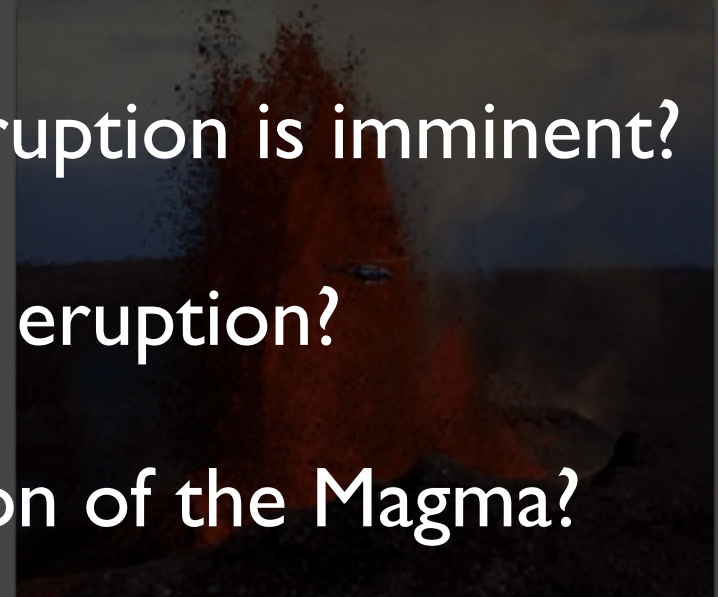
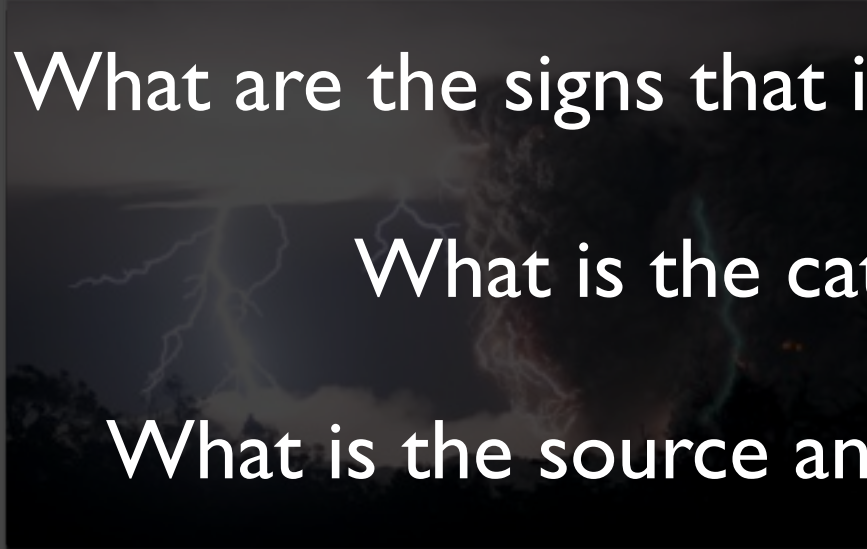
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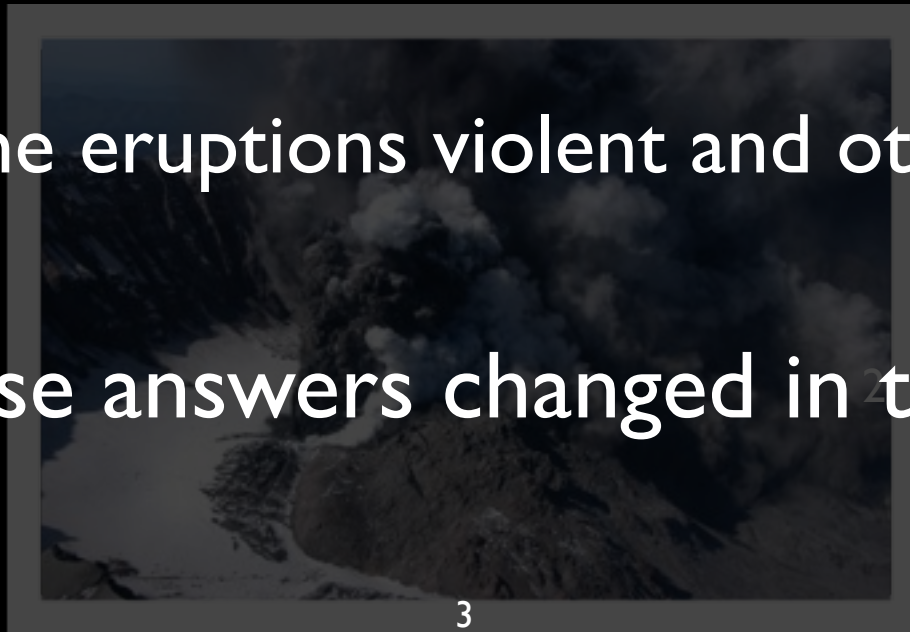
How have these answers changed in time and space?



(Photo used with permission from Kenai Helicopters Hawaii.)

2008 Chaiten Volcano, Chile

1983 Pitou Oia Volcano, Hawaii



2003 Mount Everest, Nepal

Deformation, Faults, and Earthquakes

San Andreas fault



2008 Sichuan China Earthquake Devastation

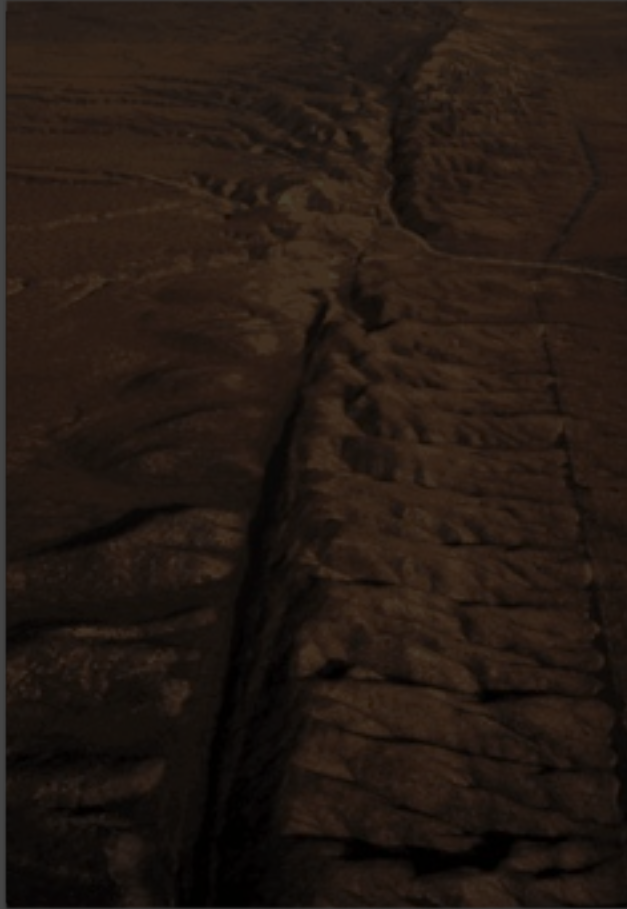
1954 Fairview Peak rupture
scarp



Deformation, Faults, and Earthquakes

San Andreas fault

How fast are faults moving?



2008 Sichuan China Earthquake Devastation

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scarp

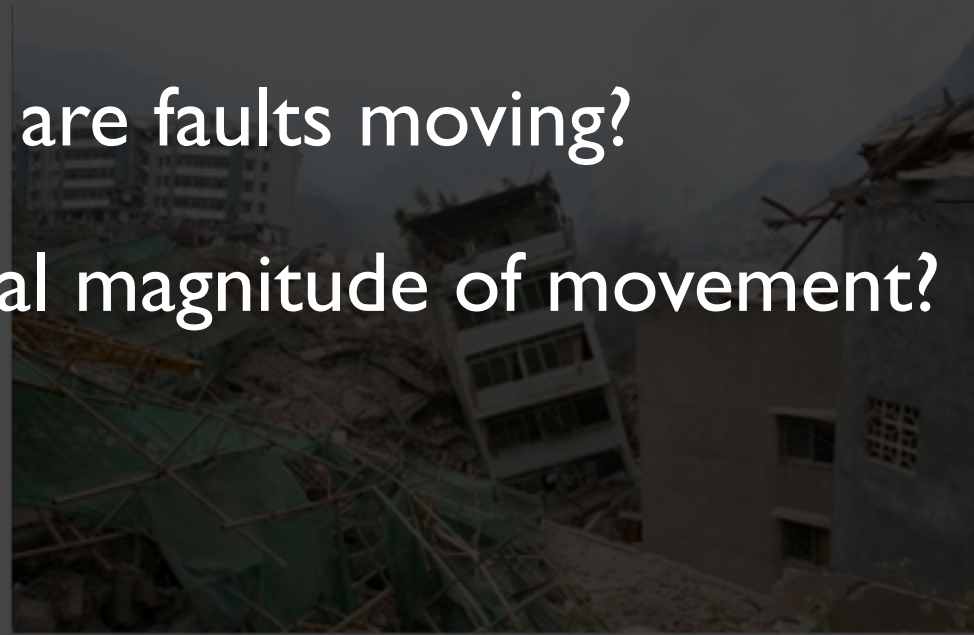
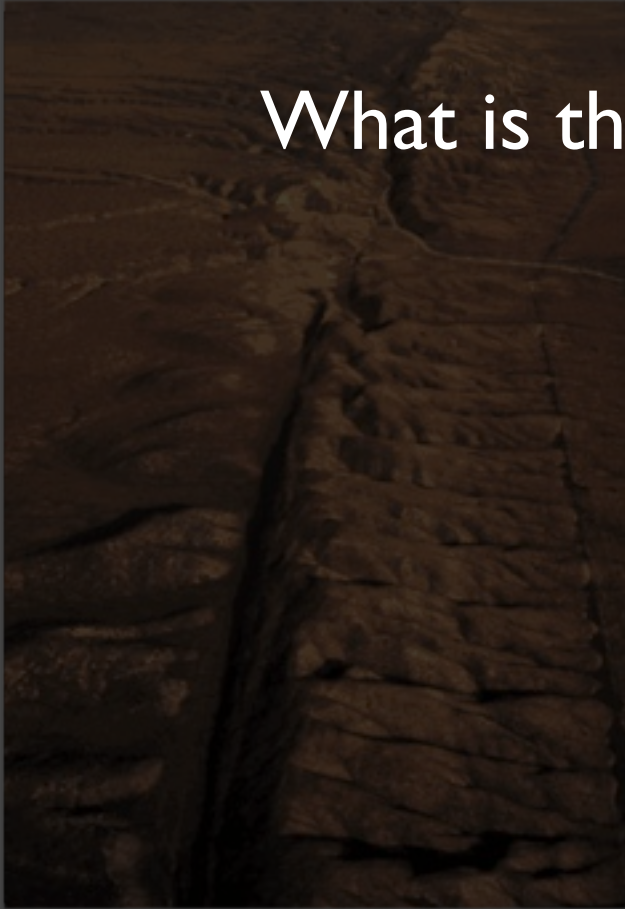


Deformation, Faults, and Earthquakes

San Andreas fault

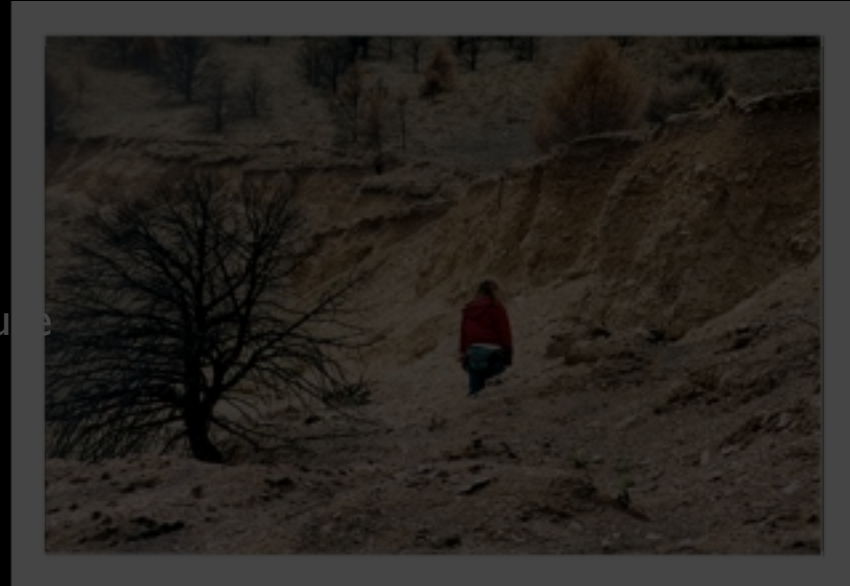
How fast are faults moving?

What is the total magnitude of movement?



2008 Sichuan China Earthquake Devastation

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scarp



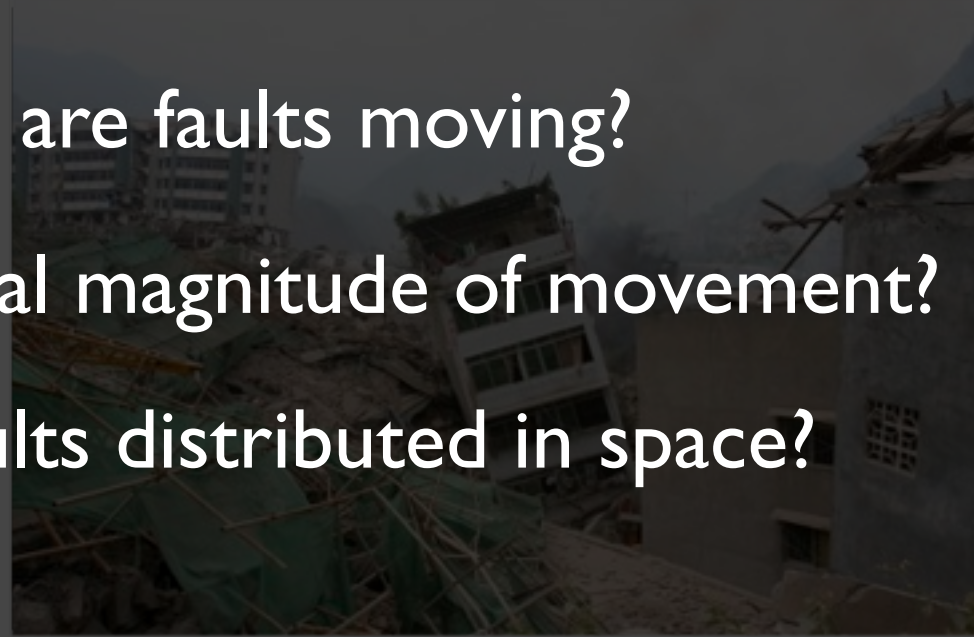
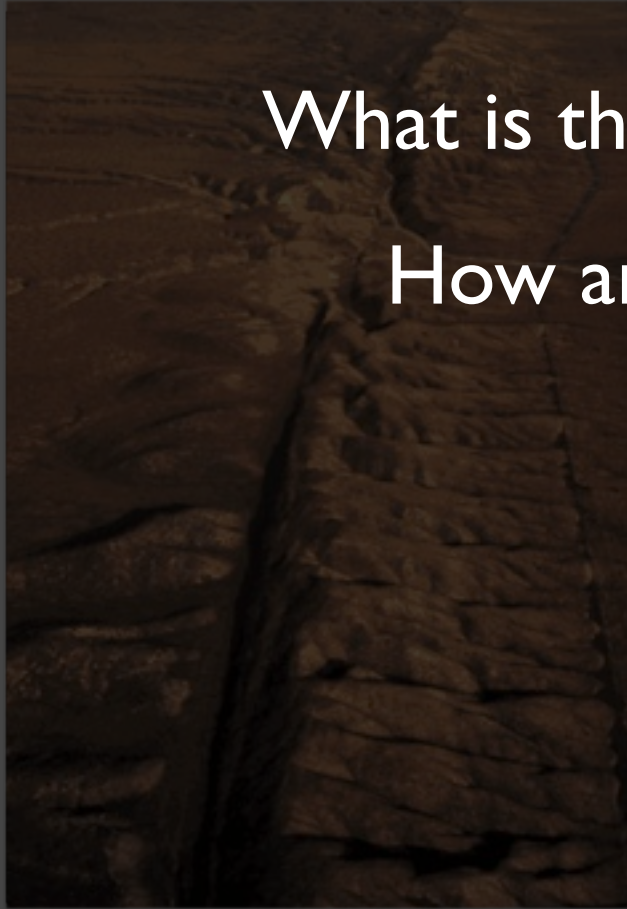
Deformation, Faults, and Earthquakes

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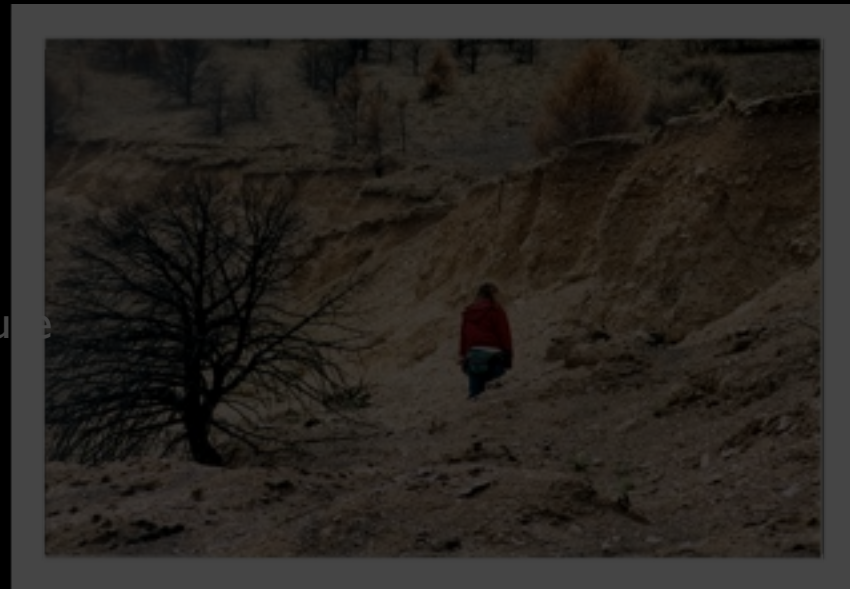
What is the total magnitude of movement?

How are faults distributed in space?



2008 Sichuan China Earthquake Devastation

1954 Fairview Peak rupture
scarp



Deformation, Faults, and Earthquakes

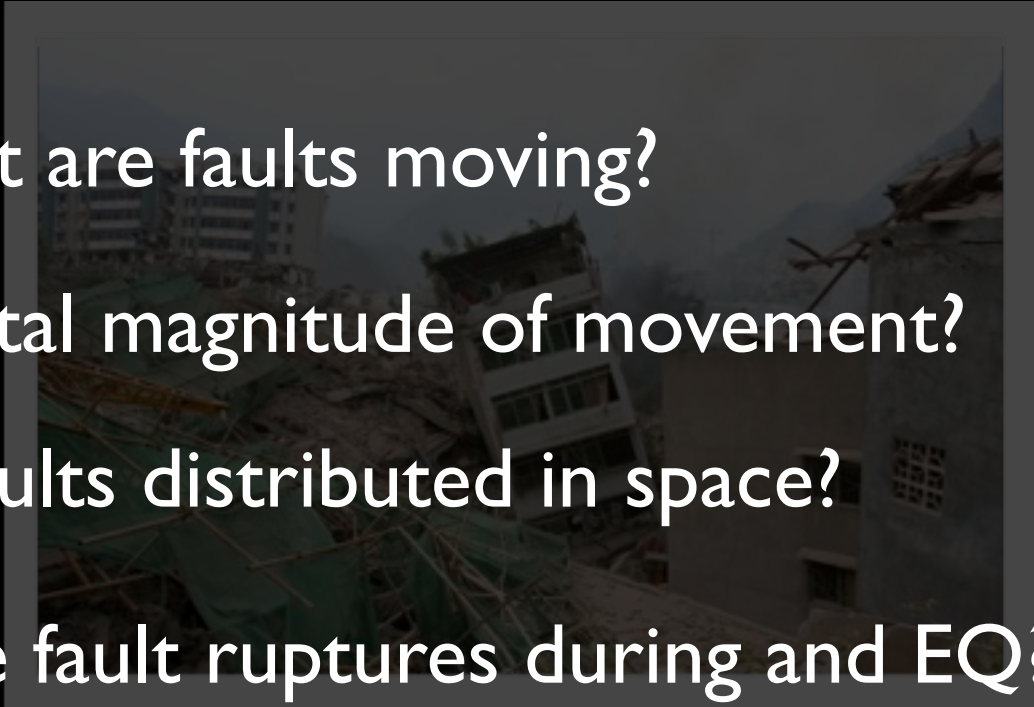
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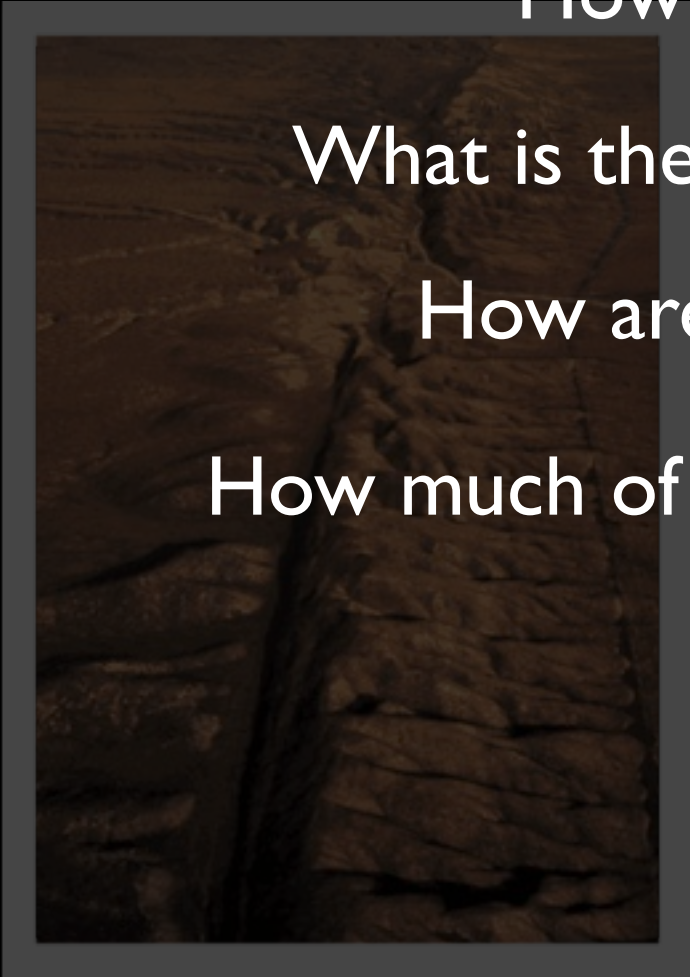
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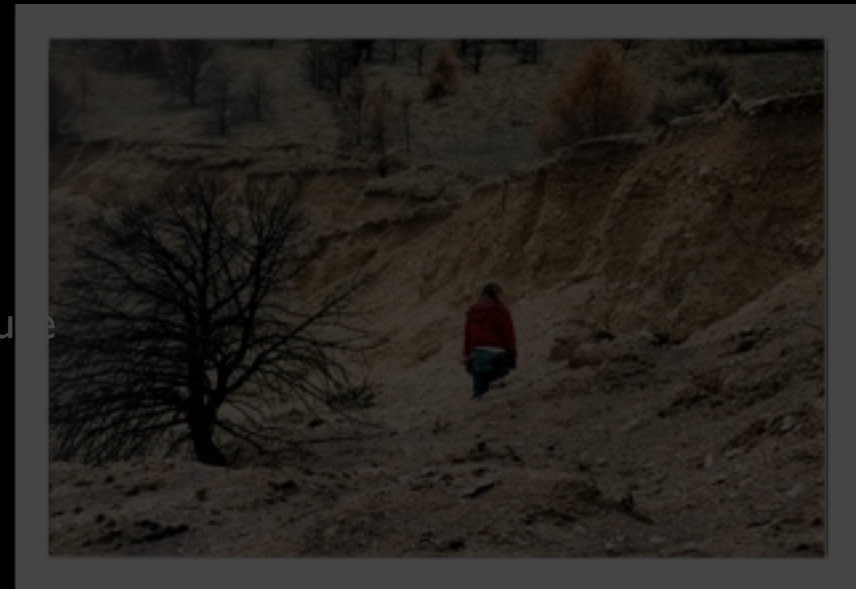
How much of the fault ruptures during an EQ?



2008 Sichuan China Earthquake Devastation



1954 Fairview Peak rupture
scarp



Deformation, Faults, and Earthquakes

San Andreas fault

How fast are faults moving?

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2008 Sichuan China Earthquake Devastation

How much ground shaking might we expect for a given EQ?

1954 Fairview Peak rupture
scarp

Deformation, Faults, and Earthquakes

San Andreas fault

How fast are faults moving?

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How are faults distributed in space?

How much of the fault ruptures during an EQ?

2008 Sichuan China Earthquake Devastation

How much ground shaking might we expect for a given EQ?

How have these answers changed in time and space?

1974
scarp

Mountains

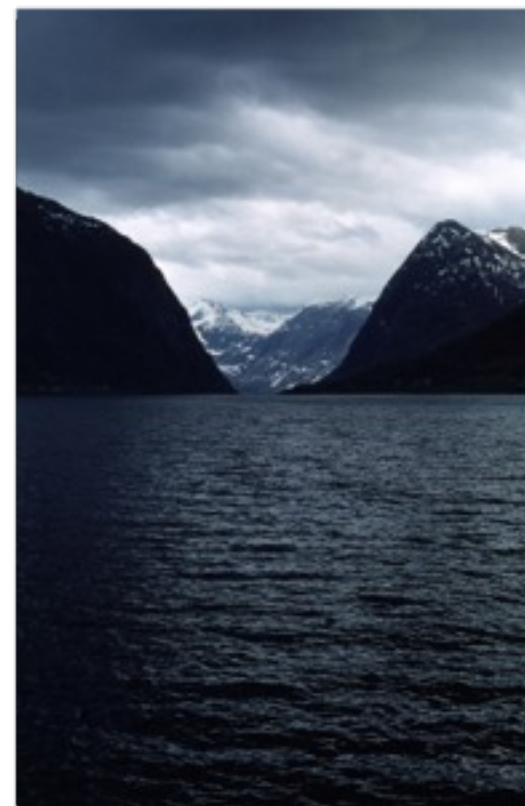


Sawtooth Mts, ID

Tian Shan
Mts., China



Southern Alps Ostler fault zone New Zealand



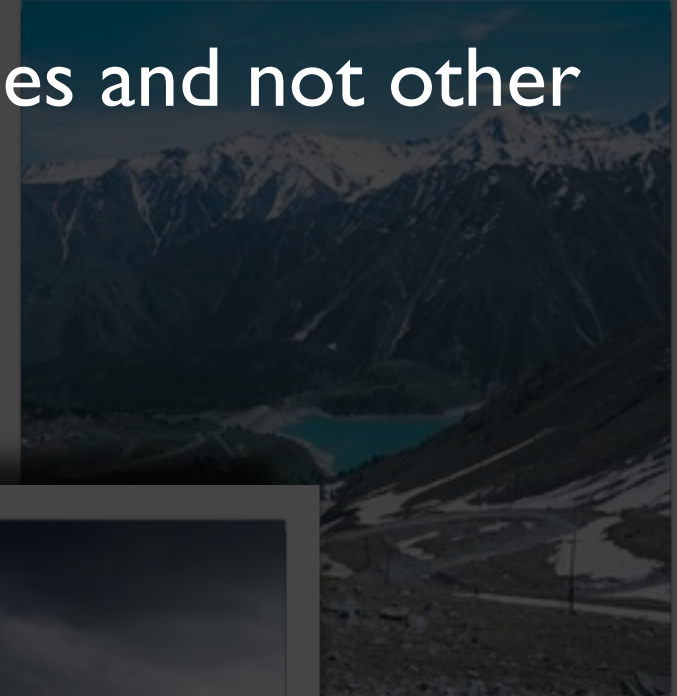
Nordfjord-Sogn
Detachment zone,
Norway

Mountains

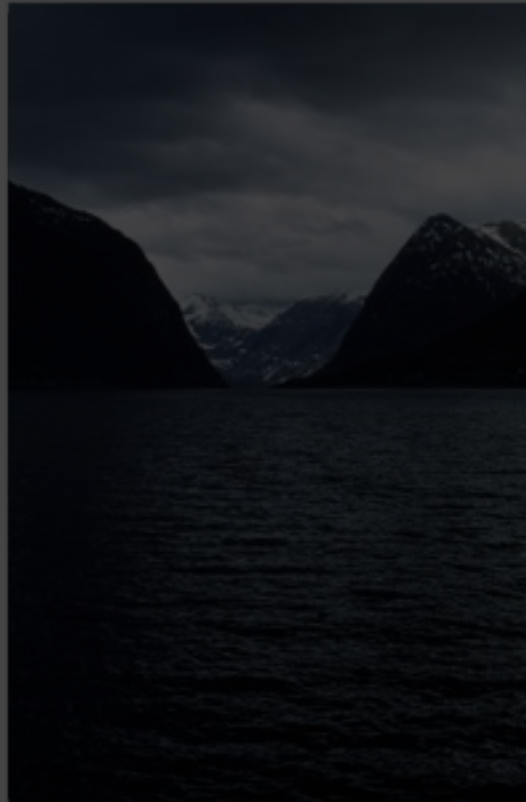
Why are there mountains in some places and not other places?



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Tian Shan
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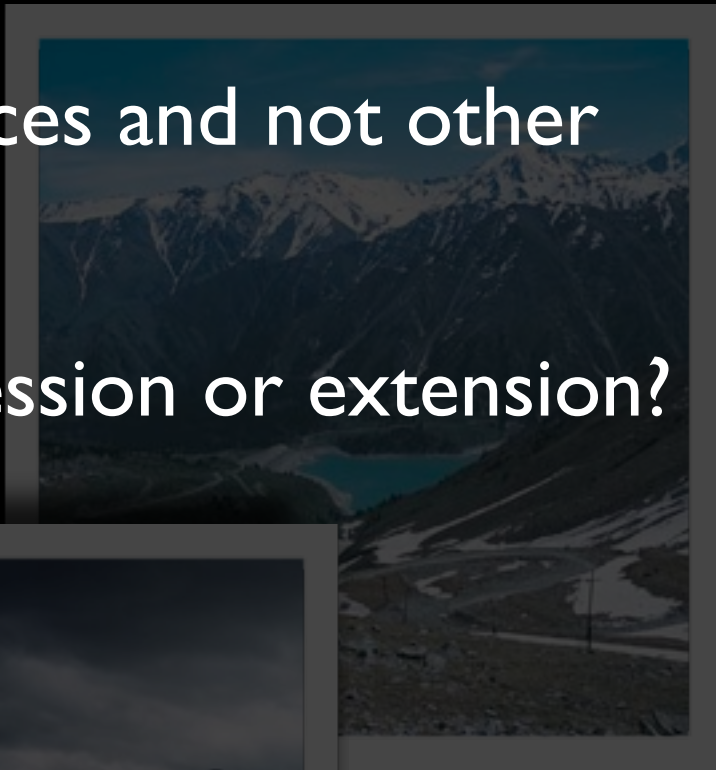


Southern Alps Ostler fault zone New Zealand

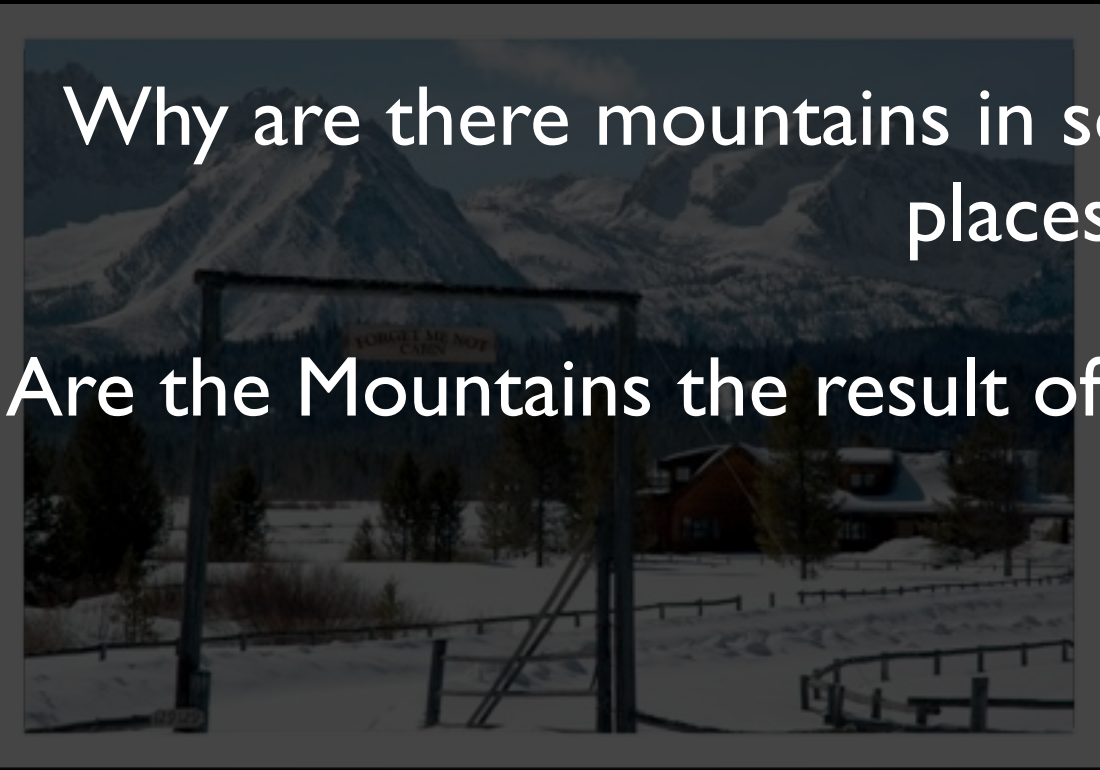
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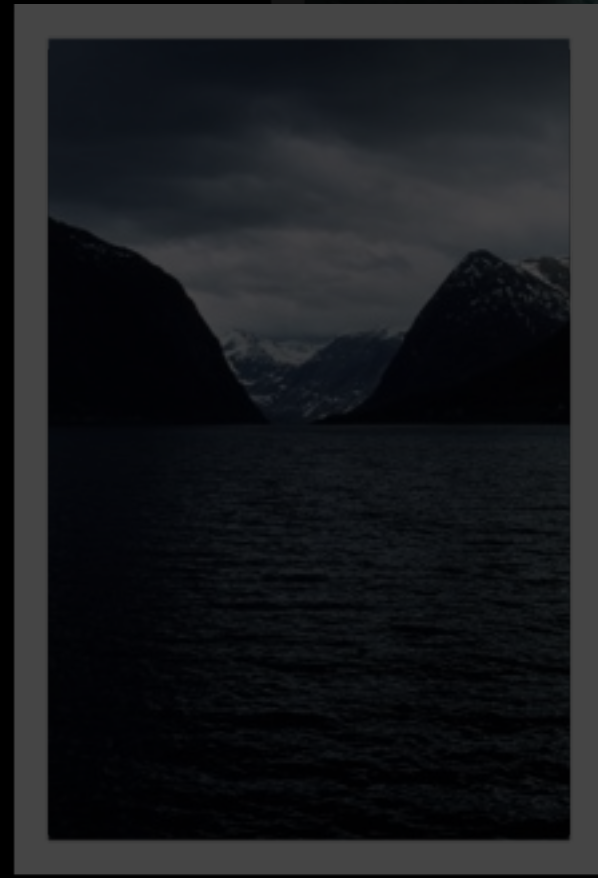
Tian Shan
Mts., China



Are the Mountains the result of compression or extension?



Sawtooth Mts, ID



Nordfjord-Sogn
Detachment zone,
Norway

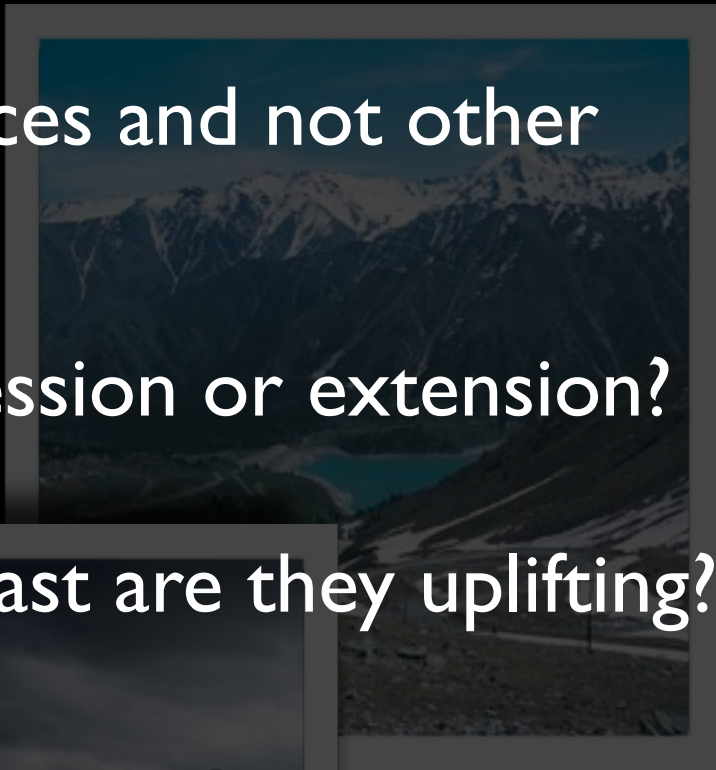


Southern Alps Ostler fault zone New Zealand

Mountains

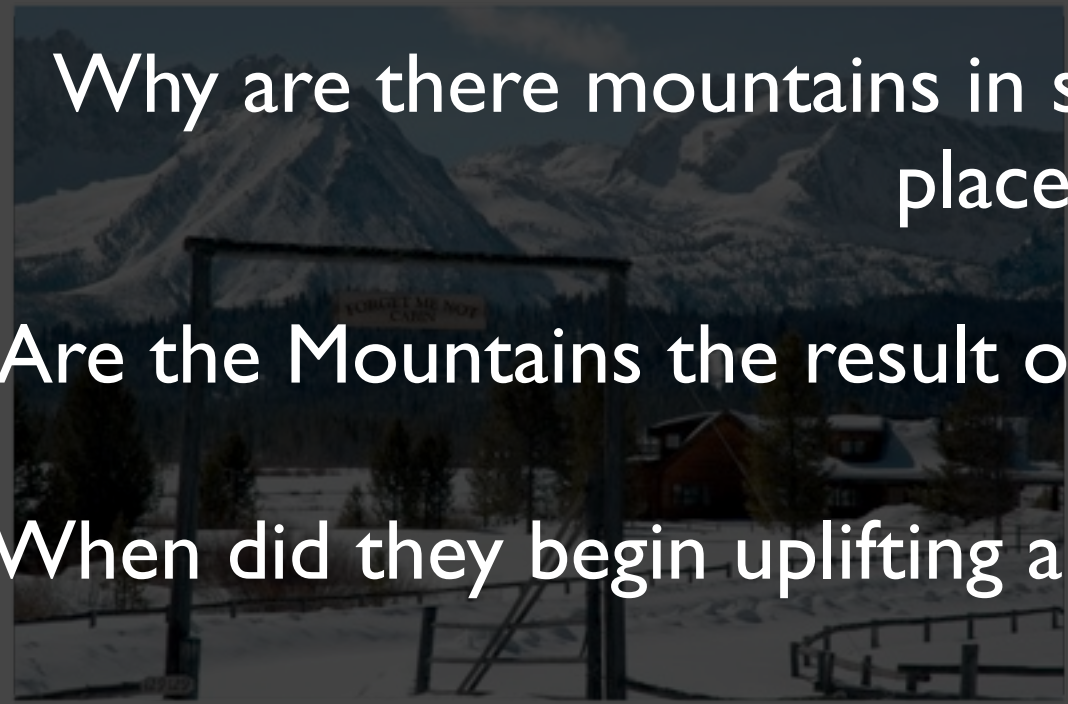
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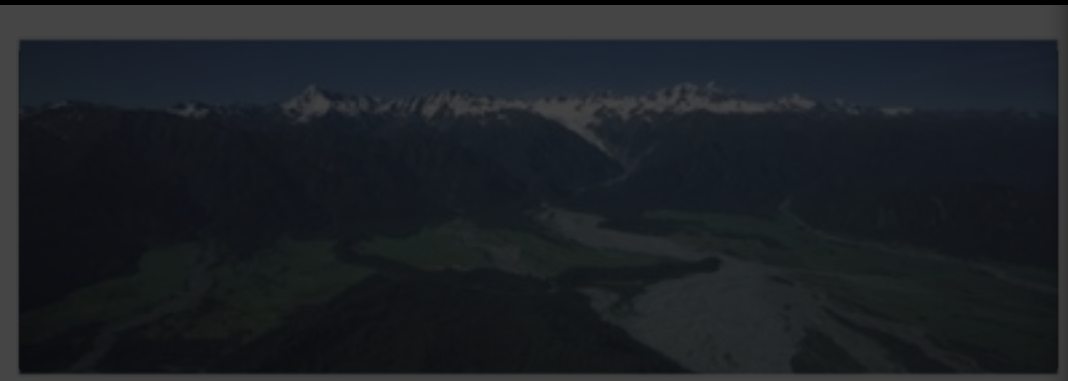


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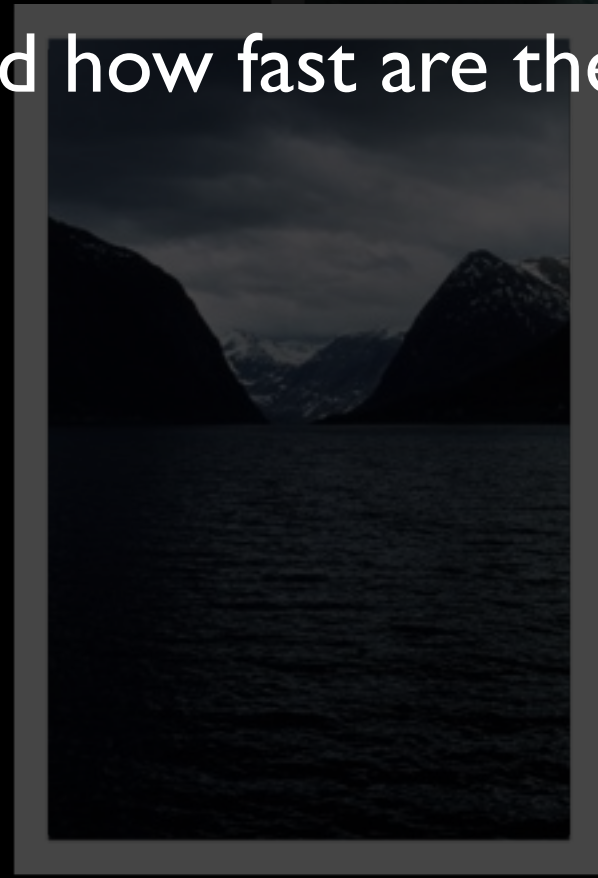
When did they begin uplifting and how fast are they uplifting?



Sawtooth Mts, ID



Southern Alps Ostler fault zone New Zealand



Nordfjord-Sogn Detachment zone, Norway

Mountains

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How many years can a mountain exist before it is washed to the sea?

Southern Alps Ostler fault zone New Zealand

Nordfjord-Sogn Detachment zone, Norway

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How have these answers changed in time and space?

Nordfjord-Sogn Detachment zone, Norway

Southern Alps Ostler fault zone New Zealand

Scientific Thinking and Geologizing

The Scientific Method

- Observations
- Hypothesis
- Experimentation
- Analysis
 - support or reject

Scientific Thinking and Geologizing

The Scientific Method

QUESTION EVERYTHING!

- Observations
- Hypothesis
- Experimentation
- Analysis
 - support or reject

Scientific Thinking and Geologizing

The Scientific Method

QUESTION EVERYTHING!

- Observations
- Hypothesis
- Experimentation
- Analysis
 - support or reject

- 1) How do you know that?
- 2) What is the evidence?
- 3) By what process?
- 4) When?
- 5) Why does/did it happen?
- 6) At what rate?
- 7) What is the scale?

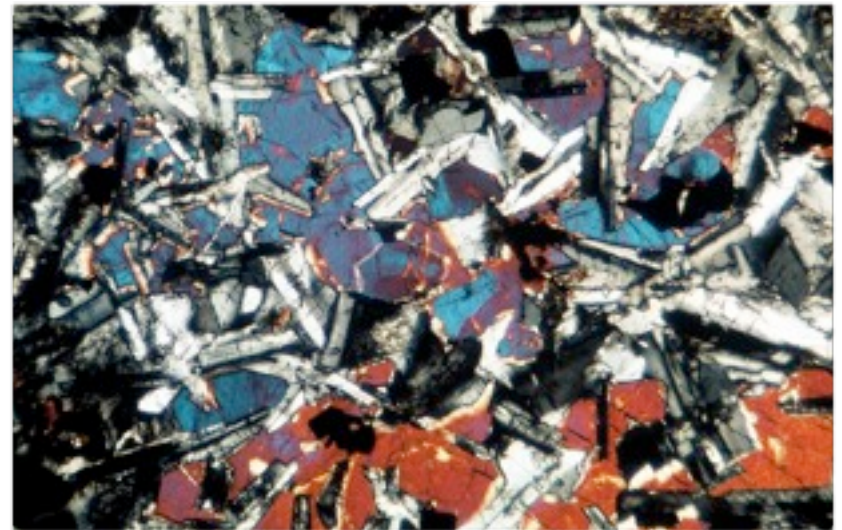
Rocks!

Metamorphic



Igneous

Volcanic (microscope)



Sedimentary

Rocks

Can you find the geologist?



What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

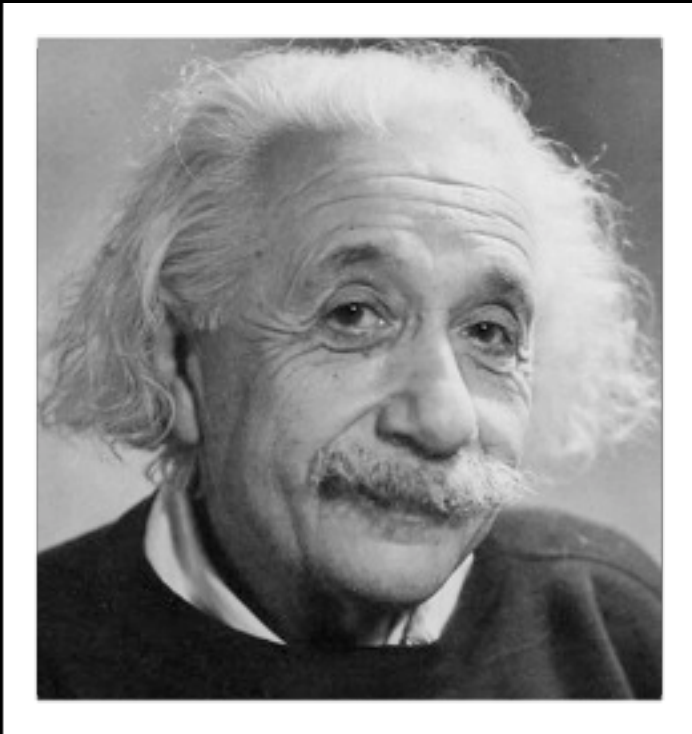
What a Geologist sees?



Northern Wasatch Range, Salt Lake City, UT

“We would be fools not to prepare ourselves for the 'impossible'. Why? In an infinite universe, anything is possible, even probable; given an infinite timeline everything can, and will happen.”

Albert Einstein



January							February							March							April						
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
						1			1	2	3	4	5				1	2	3	4							1
2	3	4	5	6	7	8	6	7	8	9	10	11	12	5	6	7	8	9	10	11	2	3	4	5	6	7	8
9	10	11	12	13	14	15	13	14	15	16	17	18	19	12	13	14	15	16	17	18	9	10	11	12	13	14	15
16	17	18	19	20	21	22	20	21	22	23	24	25	26	19	20	21	22	23	24	25	16	17	18	19	20	21	22
23	24	25	26	27	28	29	27	28	29					26	27	28	29	30	31		23	24	25	26	27	28	29
30	31																				30						
May							June							July							August						
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1	2	3	4	5	6					1	2	3							1			1	2	3	4	5
7	8	9	10	11	12	13	4	5	6	7	8	9	10	2	3	4	5	6	7	8	6	7	8	9	10	11	12
14	15	16	17	18	19	20	11	12	13	14	15	16	17	9	10	11	12	13	14	15	13	14	15	16	17	18	19
21	22	23	24	25	26	27	18	19	20	21	22	23	24	16	17	18	19	20	21	22	20	21	22	23	24	25	26
28	29	30	31				25	26	27	28	29	30		23	24	25	26	27	28	29	27	28	29	30	31		
														30	31												
September							October							November							December						
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
					1	2	1	2	3	4	5	6	7				1	2	3	4						1	2
3	4	5	6	7	8	9	8	9	10	11	12	13	14	5	6	7	8	9	10	11	3	4	5	6	7	8	9
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17	18	19	20	21	22	23	22	23	24	25	26	27	28	19	20	21	22	23	24	25	17	18	19	20	21	22	23
24	25	26	27	28	29	30	29	30	31					26	27	28	29	30			24	25	26	27	28	29	30
																					31						

The Geologic Time Scale

Phanerozoic – Visible Life

Eon	Era	Period	Epoch
Phanerozoic	Cenozoic	Quaternary	Holocene
			Pleistocene
		Tertiary	Pliocene
			Miocene
			Oligocene
	Mesozoic	Cretaceous	Eocene
			Paleocene
			Triassic
		Jurassic	
Paleozoic	Carboniferous	Permian	
		Pennsylvanian	
		Mississippian	
	Devonian		
	Silurian		
	Ordovician		
	Cambrian		
Proterozoic			
	Archean		

Cenozoic – “Recent Life”
(time of the mammals)

Mesozoic – “Middle Life”
(time of the Dinosaurs)

Paleozoic – “Old Life”
(complex life; coral fish, plants)

Proterozoic – Early Life (Eukaryotic)

Archean – “Ancient” (Prokaryotic)

Hadean – Beneath the Earth (no Rocks)

The Geologic Through Time

eon	era	period	epoch
Phanerozoic	Cenozoic	Quaternary	Subsistence Platycene
		Tertiary	Pliocene Miocene Oligocene Eocene Palaeocene
	Mesozoic	Cretaceous	
		Jurassic	
		Triassic	
	Paleozoic	Permian	Permian
		Carboniferous	Carboniferous
		Devonian	Devonian
		Silurian	Silurian
		Chelonician Cambrian	Frasnian Subsistence Miosynoptian
Proterozoic			
Achaean			



Acasta Gneiss
(Oldest rock exposed at the Earth's surface in Northern Canada)

The Geologic Through Time

eon	era	period	epoch	
Phanerozoic	Cenozoic	Quaternary	Subsolar Pleistocene	
		Tertiary	Pliocene	
			Miocene	
	Mesozoic	Cretaceous	Oligocene	
		Jurassic	Eocene	
		Triassic	Palaeocene	
	Paleozoic	Permian	Permian	Permian
			Carboniferous	Carboniferous
		Devonian	Devonian	Devonian
			Silurian	Silurian
Cambrian		Cambrian	Cambrian	
		Cambrian	Cambrian	
Proterozoic				
Achaean				



Acasta Gneiss
(Oldest rock exposed at the Earth's
surface in Northern Canada)

The Geologic Through Time

eon	era	period	epoch	
Eukaryotic	Cenozoic	Quaternary	Subsolar Pleistocene	
		Tertiary	Pliocene	
			Quaternary	
	Mesozoic	Cretaceous	Neogene	
		Jurassic	Oligocene	
		Tertiary	Quaternary	
	Prokaryotic	Paleozoic	Permian	Permo-Carboniferous
			Carboniferous	Carboniferous
			Devonian	Devonian
			Silurian	Silurian
Chickadee			Chickadee	
Proterozoic				
Achaean				



Stromatolites

Through out the Proterozoic beginning at 2.5 Ga Stromatolites convert our atmosphere from CO₂ to O₂

The Geologic Through Time

eon	era	period	epoch	
Phanerozoic	Cenozoic	Quaternary	Subsistence Platycene	
		Tertiary	Pliocene	
			Oligocene Miocene Pliocene	
	Mesozoic	Cretaceous		
		Jurassic		
		Triassic		
	Paleozoic	Permian	Permian	Permian
			Carboniferous	Carboniferous
		Devonian	Devonian	Devonian
			Silurian	Silurian
Cambrian		Ordovician	Ordovician	
		Cambrian	Cambrian	
Proterozoic				
Archaean				



The Cambrian
 “explosion of life”
 (Hard Parts Develop and
 extensive biodiversification
 happens in the oceans during the
 Paleozoic from 545 to 245 Ma)

The Geologic Through Time

eon	era	period	epoch	
Phanerozoic	Cenozoic	Quaternary	Subsolar Pleistocene	
		Tertiary	Pliocene Miocene Oligocene Eocene Paleocene	
	Mesozoic	Cretaceous		
		Jurassic		
		Triassic		
	Paleozoic	Permian	Permian	Permian
			Carboniferous	Carboniferous
		Paleozoic	Devonian	Devonian
			Silurian	Silurian
			Ordovician	Ordovician
Cambrian			Cambrian	
Proterozoic				
Achaean				



The Super Continent of Pangea forms
(Pangea formed during the late Paleozoic 300 Ma, and Broke
up in the Early Mesozoic 200 Ma)

The Geologic Through Time

eon	era	Period	Epoch	
Phanerozoic	Cenozoic	Quaternary	Subsolar Pleistocene	
		Tertiary	Pliocene	
			Miocene	
	Mesozoic	Jurassic	Oligocene	
			Eocene	
		Cretaceous	Tertiary	
	Paleozoic	Permian	Permian	Permian
				Carboniferous
		Carboniferous	Devonian	Carboniferous
				Silurian
Ordovician				
Proterozoic	Archaean	Cambrian	Proterozoic	
			Archaean	

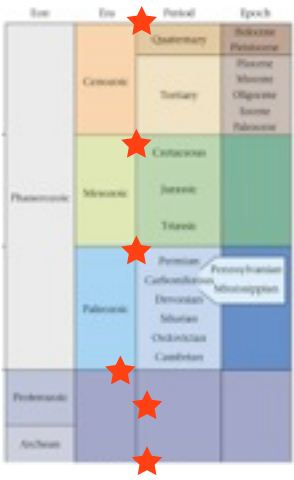


Famous Dinosaurs Lived
(75-75 Ma)

The Mesozoic (time of the Dinosaur
was from 245-65 Ma)



The Geologic Through Time



Modern Man (<2 myo)
The Cenozoic (time of mammals was
from 65 Ma to the present)

What a Geologist sees?

Is Geology Important to Society ?

Northern Wasatch Range, Salt Lake City, UT

Petroleum



Prudhoe Bay (North Slope) to
Prince William Sound



Copper Mine



Electrical conductor

- second only to silver



Bingham Canyon Mine, Salt Lake
City, UT



Diamond Mine

Kimberly, South Africa



Canada



Iron Mine



Hull-Rust Mine, Minnesota

Stone Quarry



North Carolina Granite



Yuke Mt Marble, Colorado



Lincoln Memorial Washington DC

How are they similar?
How are they different?

1.2 km deep x 4 km wide



34.8 km long x 1.6 km wide x 150m deep



300 meters across x 3.5 km deep

Next Quiz

- 1) Vocabulary a Review Chapters 1a.
- 2) Pre-reading Chapter 11