Today:

1) No Quiz Today
2) Pick up Revised Syllabus if you did not get one last week
3) Get Clickers out
4) Weathering Lecture
5) Begin: Sedimentary Rock Lecture

Just from looking at the shape of this Volcano, which is the best description?

A) low viscosity, high volatiles, high explosivity

B) high viscosity, high volatiles, low explosivity

C) high viscosity, low volatiles, high explosivity

D) high viscosity, high volatile, high explosivity

E) none of the above

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D) high viscosity, high volatile, high explosivity

E) none of the above

What type of volcano is this?

A) Volcanic dome

B) Continental caldera

C) Scoria cone

D) Shield volcano

E) Stratovolcano

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This volcano is probably located at_____.

A) convergent continental collision zone

B) continental rift

C) divergent boundary

D) convergent subduction zone

E) none of the above

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A) the location of where the melt was generated

B) partial melting of the asthenosphere

C) decompression of the asthenosphere

D) the high mafic content of the magma.

E) fractional crystallization

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Weathering, Erosion, and Deposition
=
Sedimentary Rocks

A Story of Rock Recycling

Weathering

The process that breaks up and corrodes solid rock, in place, eventually transforming it into sediment.

Mechanical Weathering

reduction of rock/grain size by physically breaking (disintegration) without changing the composition.

Chemical weathering

conversion of unstable mineral and bulk rock composition (dissolving) into stable compounds at the Earth's surface.

(a)

(b)

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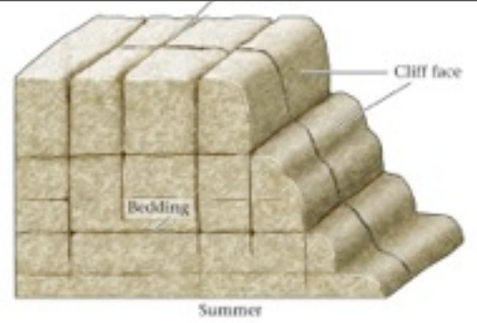
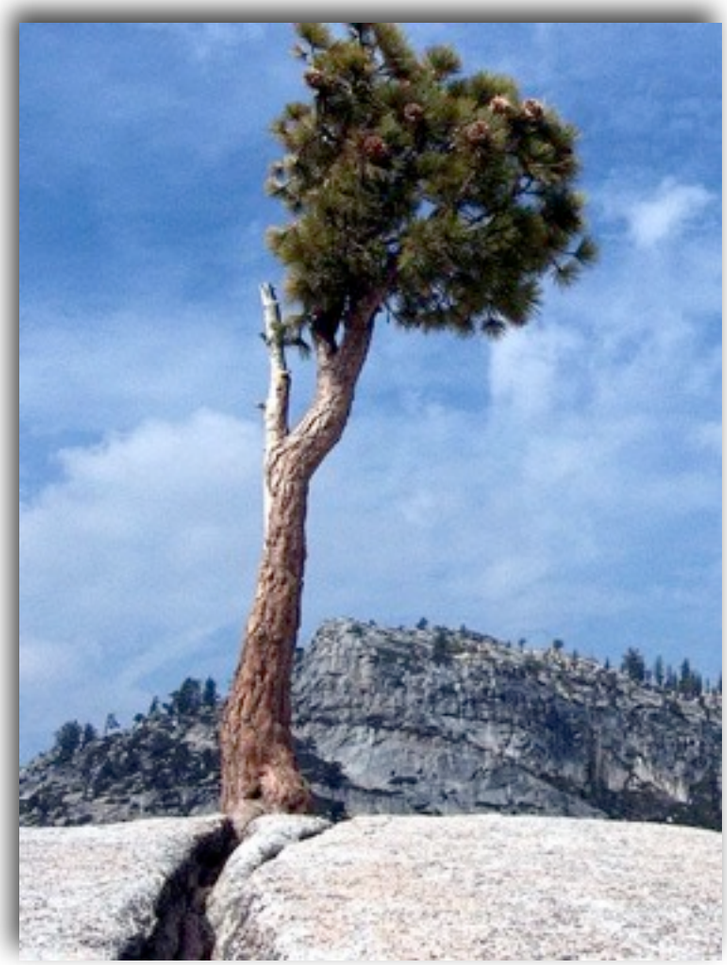
(a)

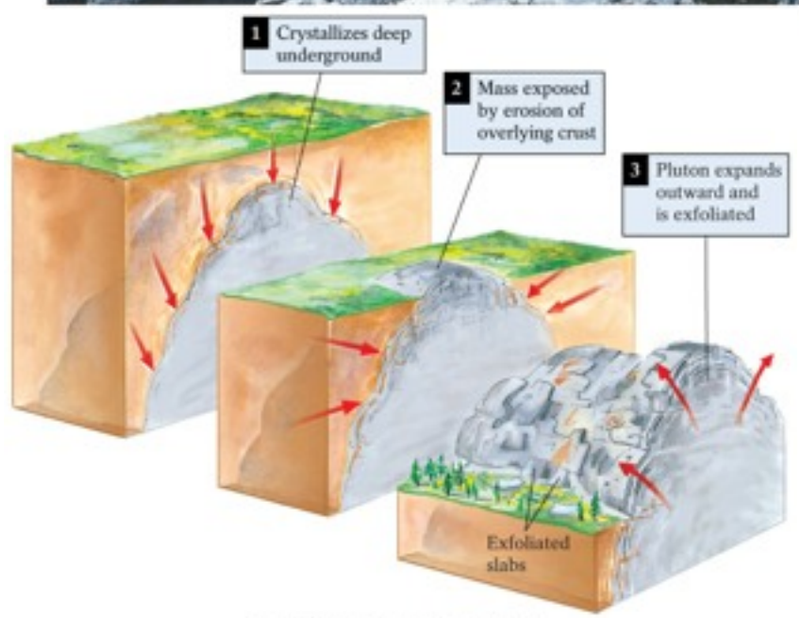
(b)

Physical/Mechanical Weathering

Frost Wedging
Root Wedging
Salt Wedging
Thermal expansion/contraction
Exfoliation

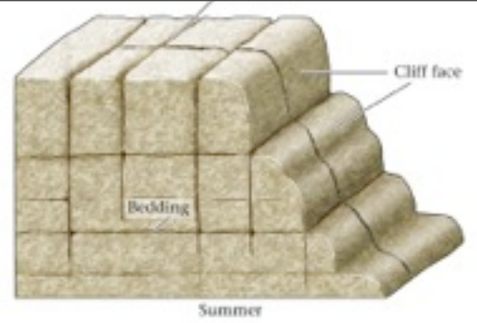




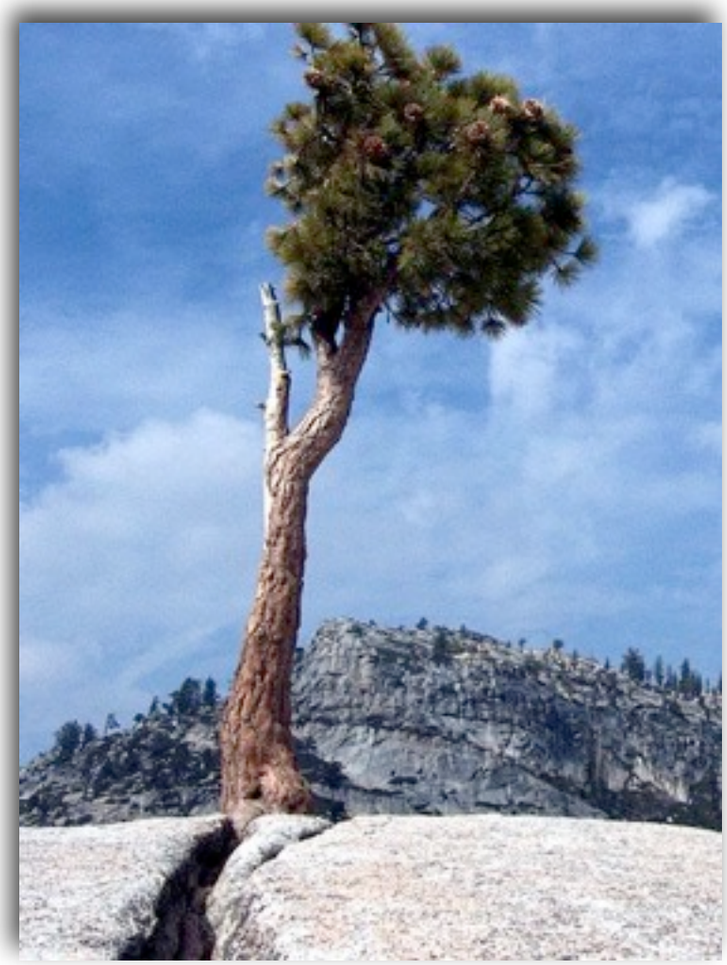


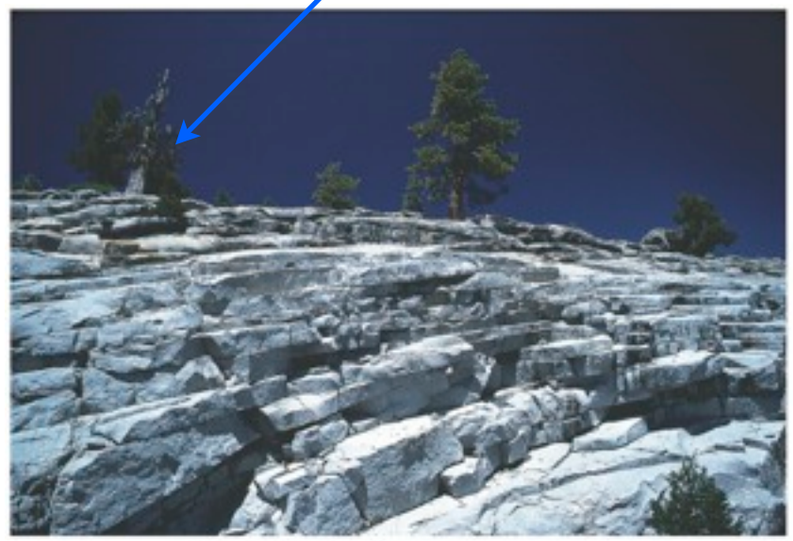
Physical/Mechanical Weathering

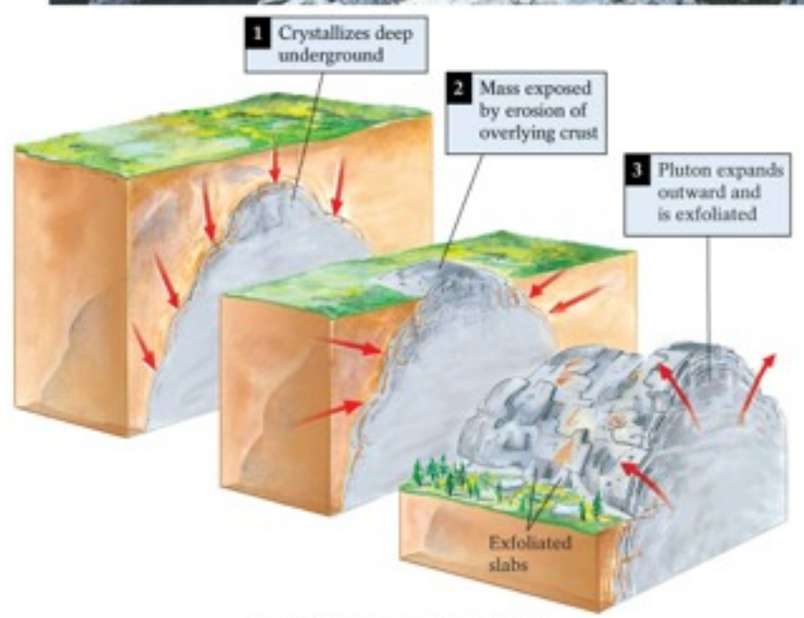
Frost Wedging
Root Wedging
Salt Wedging
Thermal expansion/contraction
Exfoliation



Frost and root wedging takes advantage of exfoliation cracks







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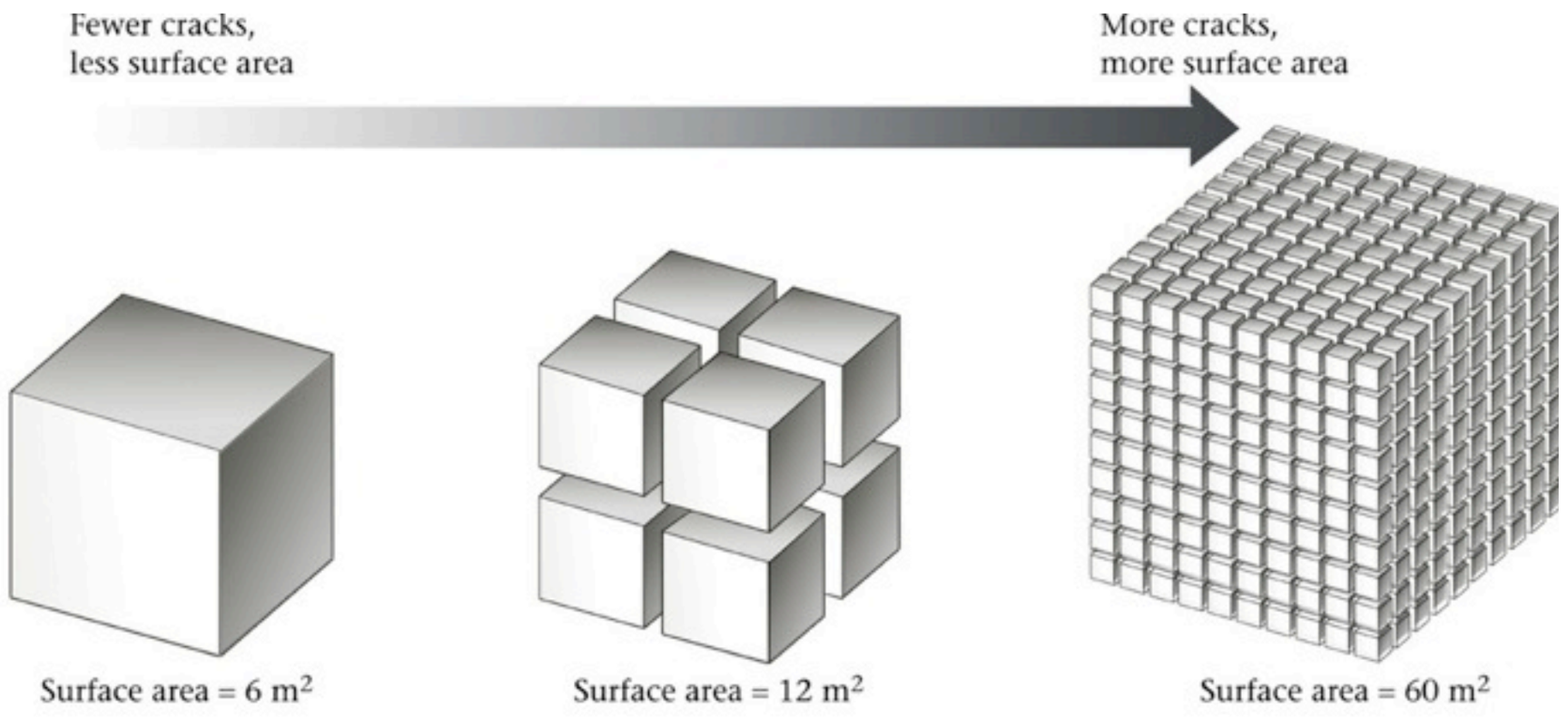
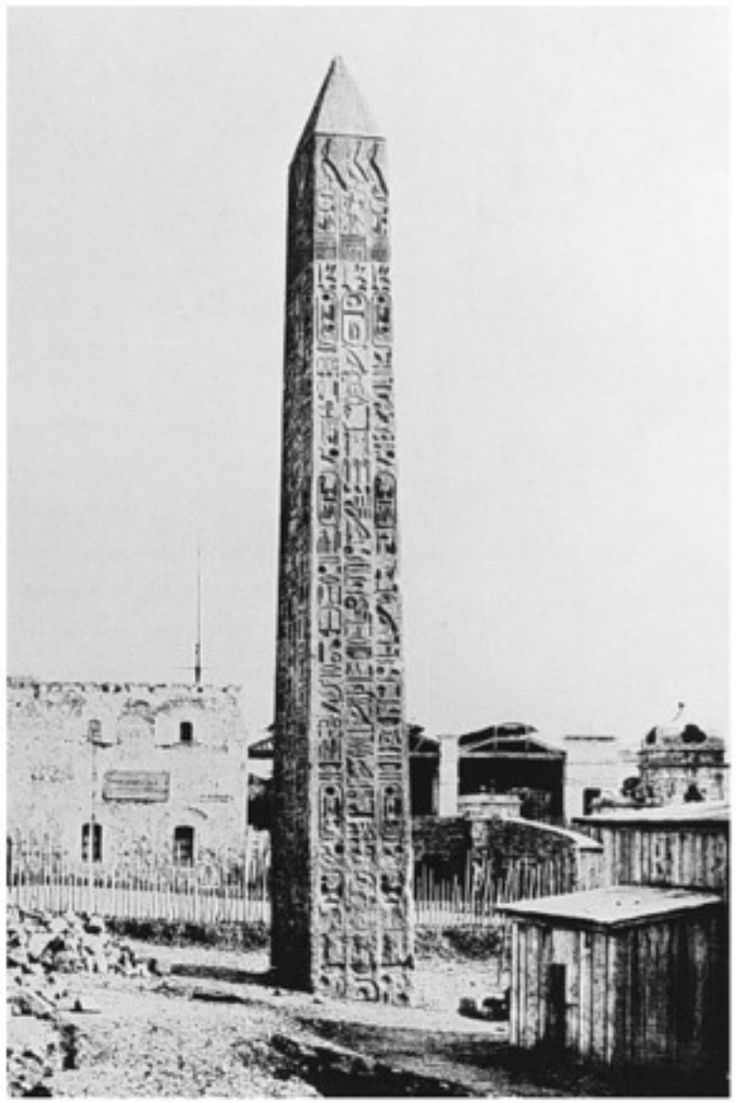


Chemical Weathering

Dissolution
Hydrolysis
Oxidation



(a)

(b)

Chemical Weathering

Dissolution

$$H_2O + CO_2 \quad <--> \quad H_2CO_3$$

(carbonic acid)

Chemical Weathering

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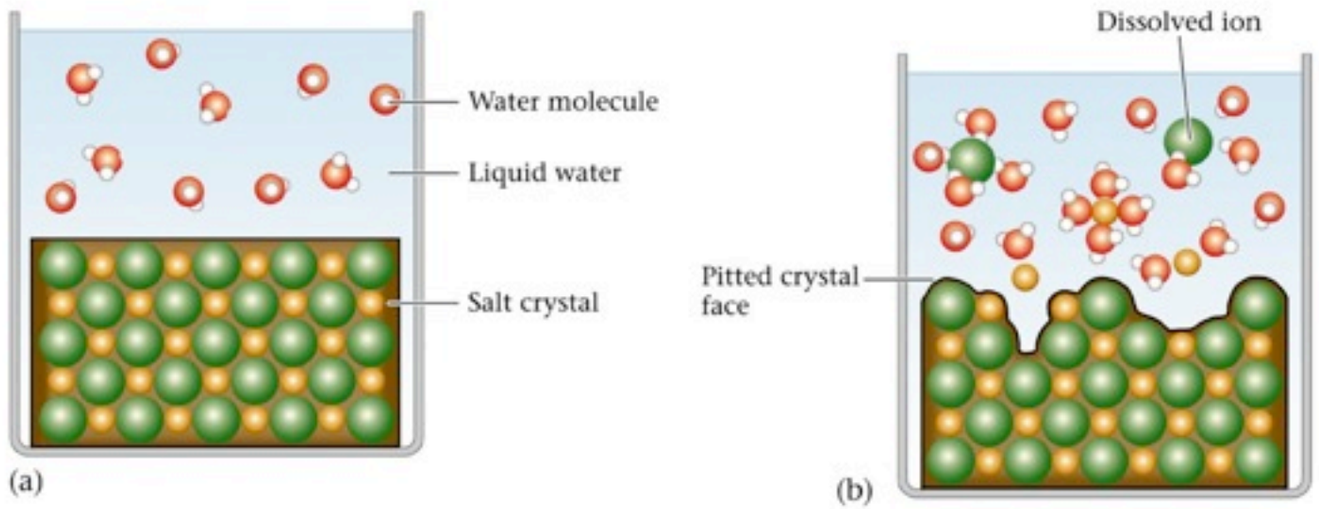
$$H_2CO_3 + CaCO_3 \quad <--> \quad Ca^{+2} + 2HCO_3^-$$

(Calcite/Limestone) (Bicarbonate)



Chemical Weathering

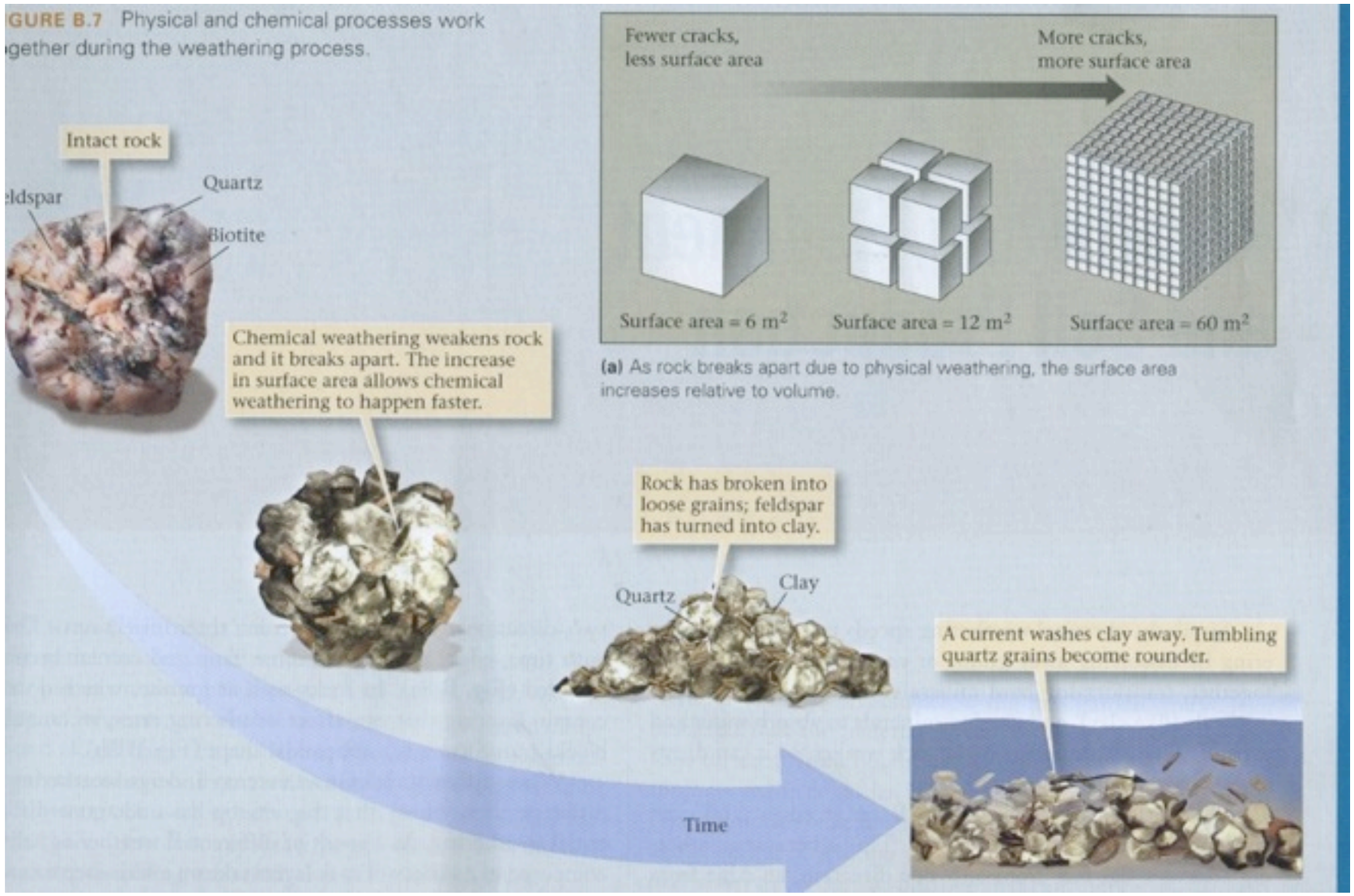
Hydrolysis

$$2KAlSi_3O_8 + 2H^+ + 9H_2O \rightarrow Al_2Si_2O_5(OH)_5 + 4H_4SiO_4 + 2K^{+2}$$

Potassium Feldspar

Kaolinite clay

Silicate acid



Chemical Weathering

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Kaolinite clay

Silicic acid

Chemical Weathering

Oxidation

$(Mg, Fe)_2SiO_4 + 2H_2O$

Olivine

Olivine

Chemical Weathering

Oxidation

$$(Mg, Fe)_2SiO_4 + 2H_2O \rightarrow 2FeO + H_2SiO_4$$

Olivine — Ferrous iron — Silicic acid

Olivine

Chemical Weathering

Oxidation

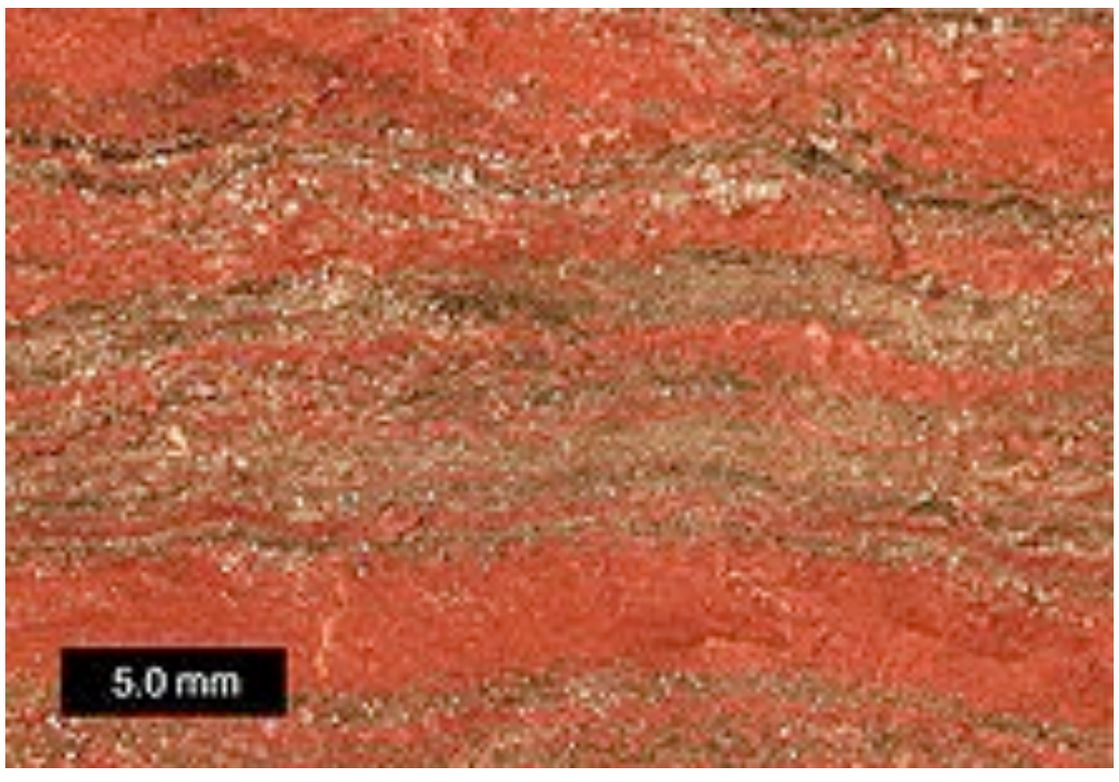
$(Mg, Fe)_2SiO_4 + 2H_2O \rightarrow 2FeO + H_2SiO_4 \rightarrow 2FeO + 2H_2O$

Olivine — Ferrous iron — Silicic acid

Fe_2O_3

Hematite (rust)

Olivine --> Hematite



Where do the Ions go?

$$H_2CO_3 + CaCO_3 \text{ <--> } Ca^{+2} + 2HCO_3^-$$

(Calcite/Limestone) (Bicarbonate)

COMPARISON BETWEEN OCEAN WATER AND RIVER WATER

Chemical Constituent	Percentage of Total Salt Content	
	Ocean Water	River Water
Silica (SiO_2)	—	14.51
Iron (Fe)	—	0.74
Calcium (Ca)	1.19	16.62
Magnesium (Mg)	3.72	4.54
Sodium (Na)	30.53	6.98
Potassium (K)	1.11	2.55
Bicarbonate (HCO_3)	0.42	31.90
Sulfate (SO_4)	7.67	12.41
Chloride (Cl)	55.16	8.64
Nitrate (NO_3)	—	1.11
Bromide (Br)	0.20	—
TOTAL	100.00	100.00

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	Ocean	
	1.1	
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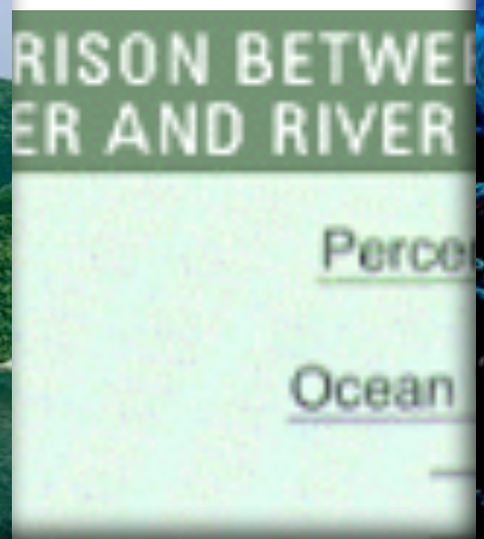
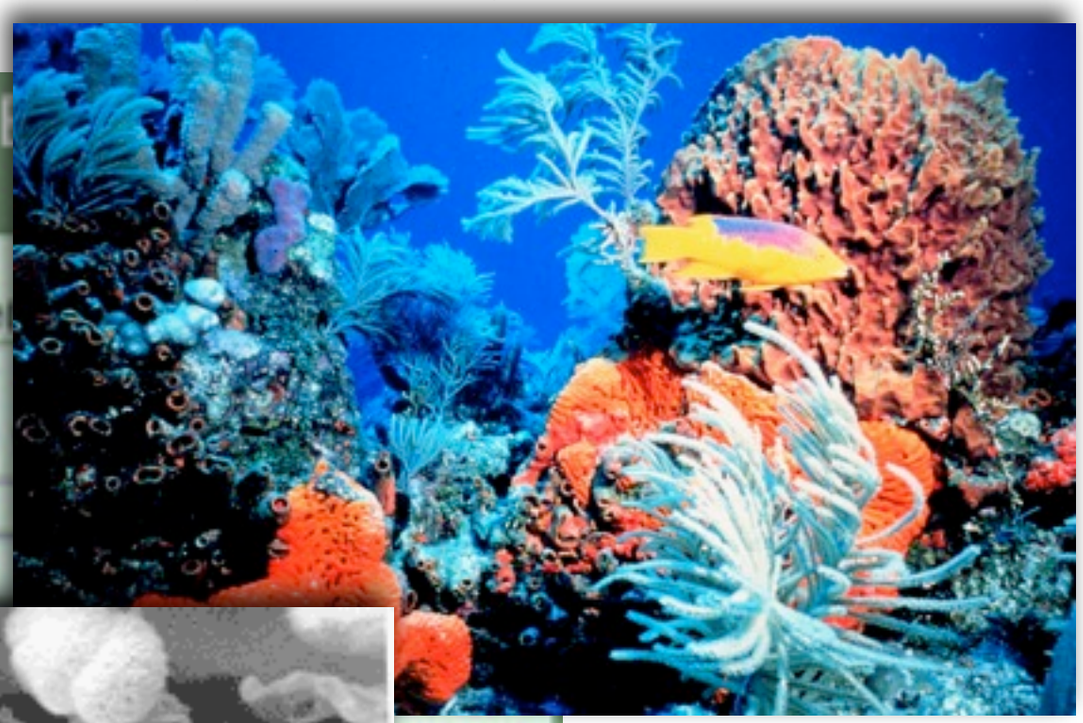
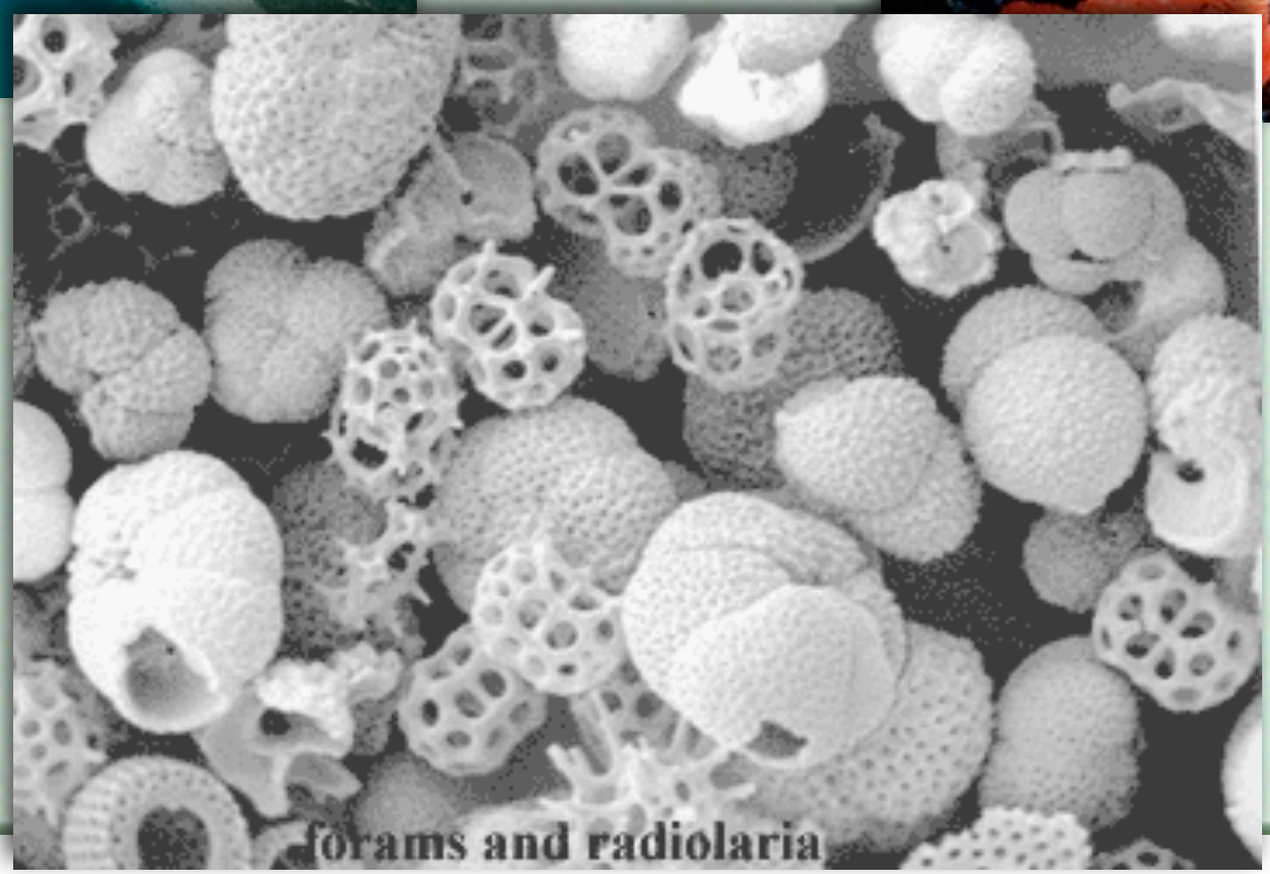






Where do the Ions go?

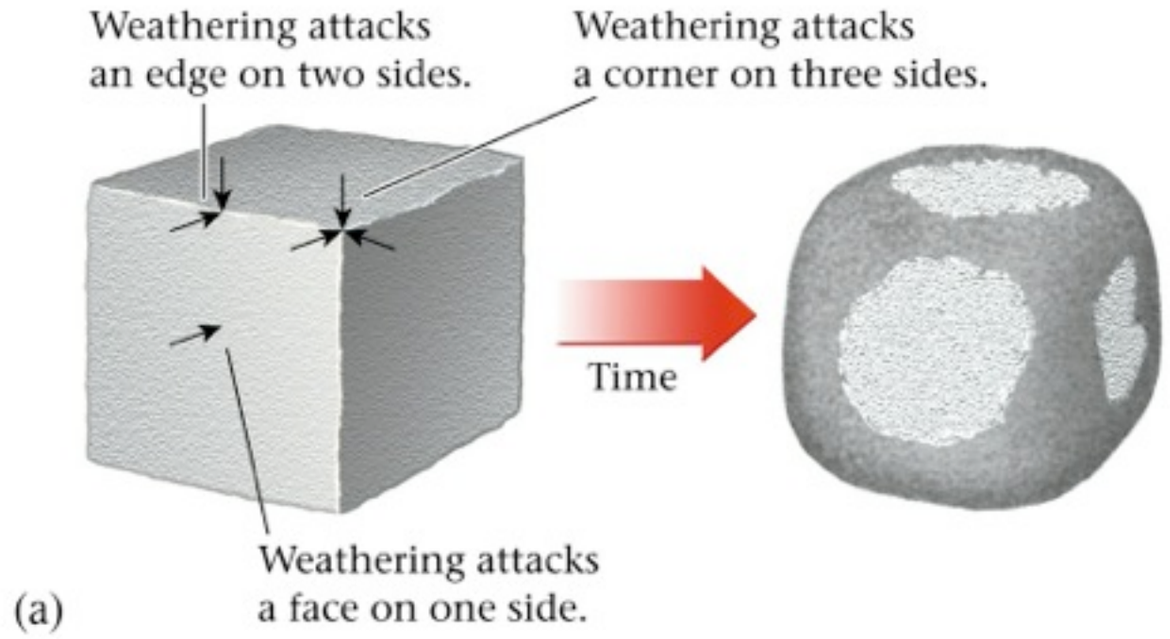
Chemical Sedimentary Rocks

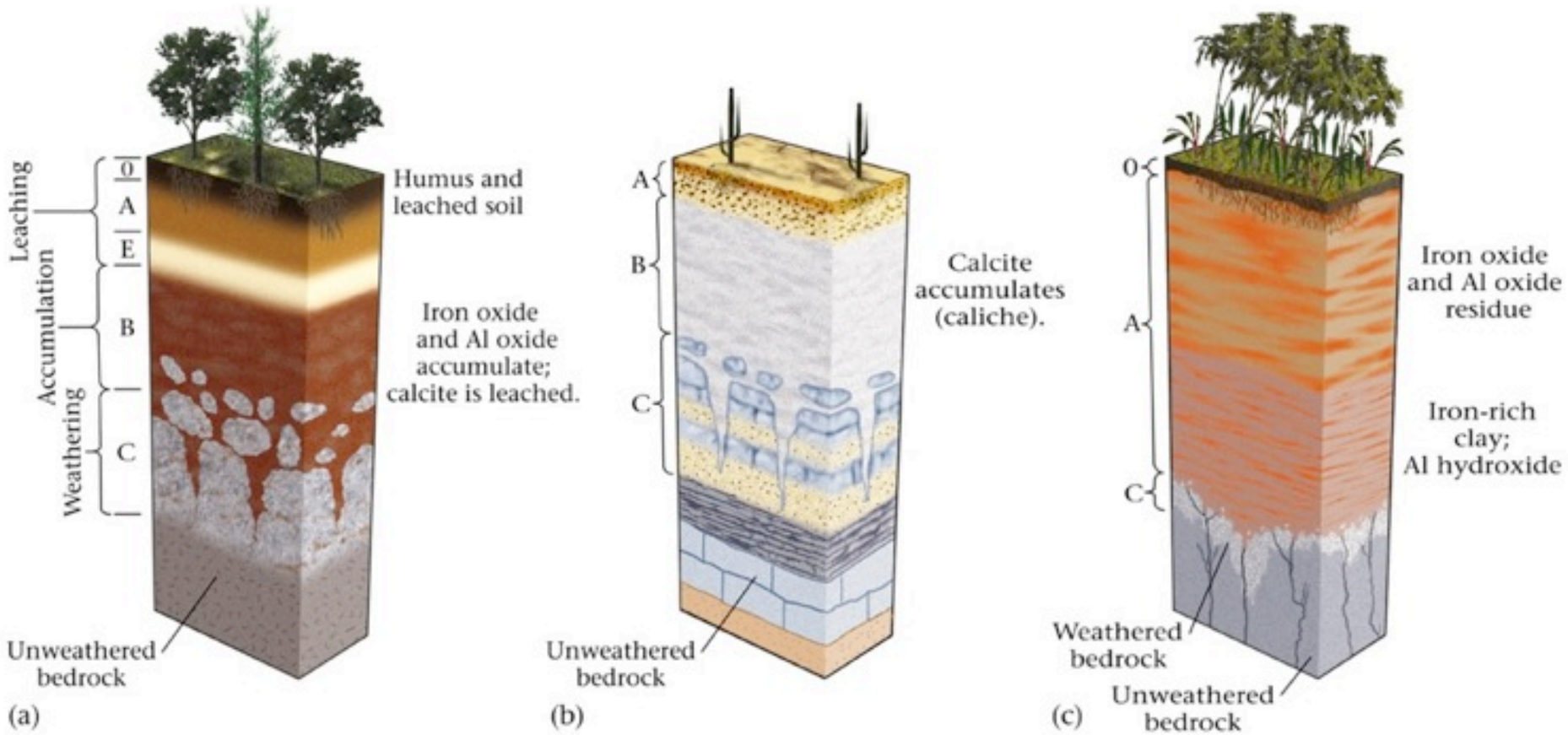
Limestone ($CaCO_3$)
Chert (SiO2)

Cements

Calcite ($CaCO_3$)
Silica (SiO2)
Hematite (Fe_2O_3)

Subsurface Weathering



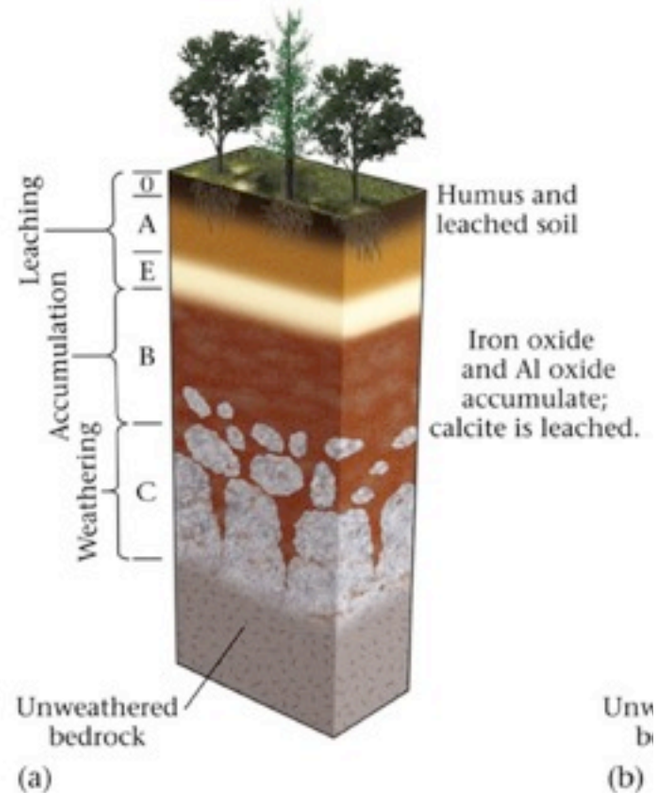


Weathering of Common Rocks

Rock	Primary Minerals	Residual Minerals*	Leached Ions
Granite	Feldspars	Clay Minerals	Na^{+}, K^{+}
	Micas	Clay Minerals	K^{+}
	Quartz	Quartz	---
	Fe-Mg Minerals	Clay Minerals + Hematite + Goethite	Mg^{+2}
Basalt	Feldspars	Clay Minerals	Na^{+}, Ca^{+2}
	Fe-Mg Minerals	Clay Minerals	Mg^{+2}
	Magnetite	Hematite, Goethite	---
Limestone	Calcite	None	Ca^{+2}, CO_3^{-2}

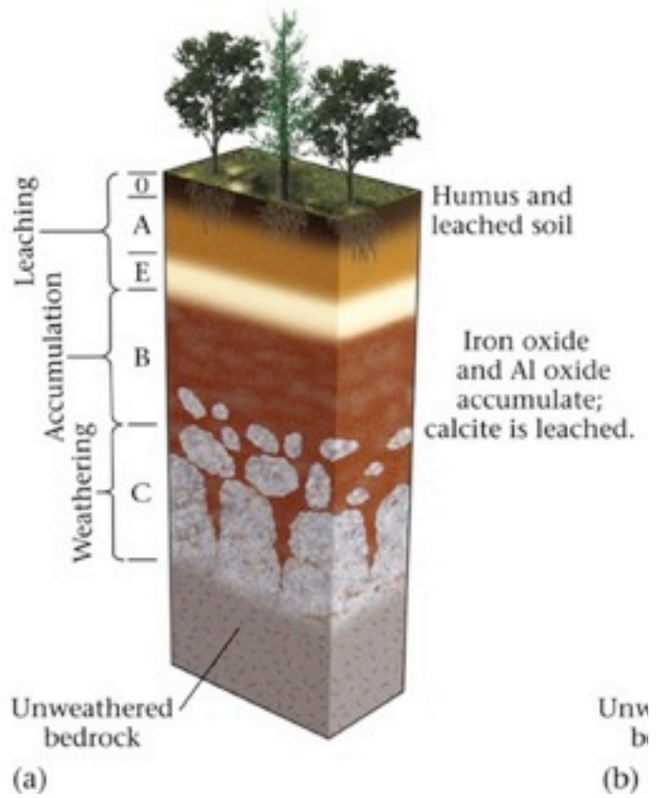
Subsurface Weathering

Chemical Weathering



Subsurface Weathering

Chemical Weathering



Subsurface Weathering

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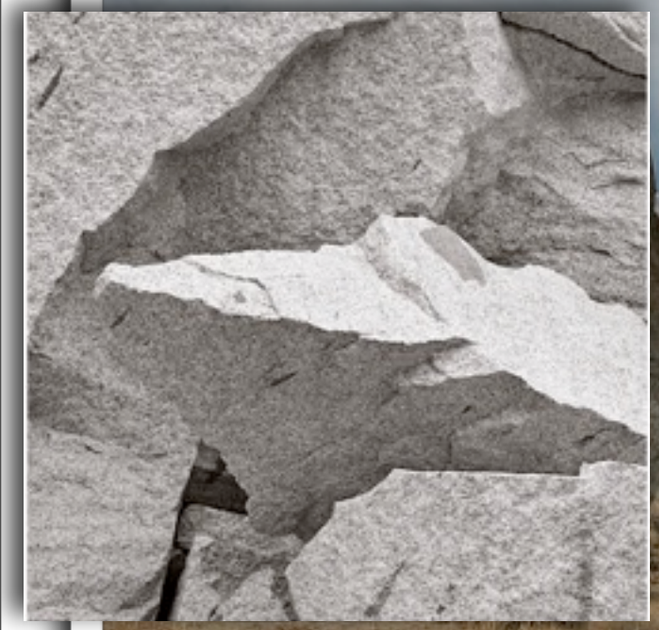
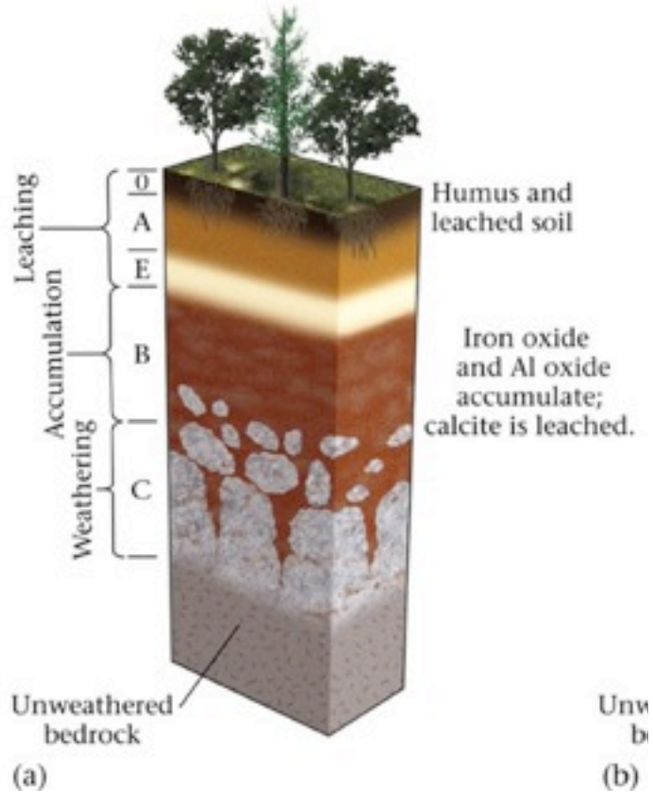
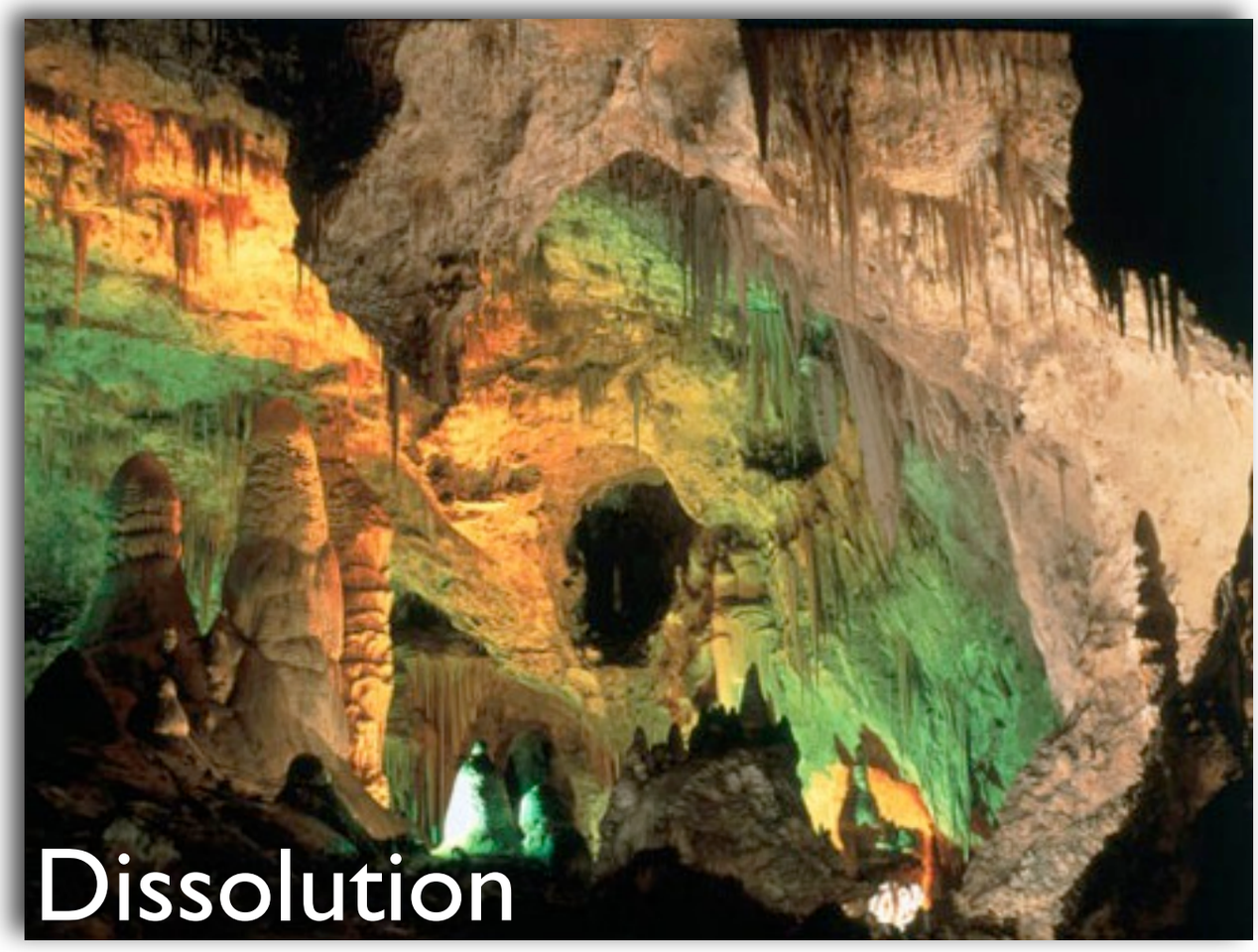
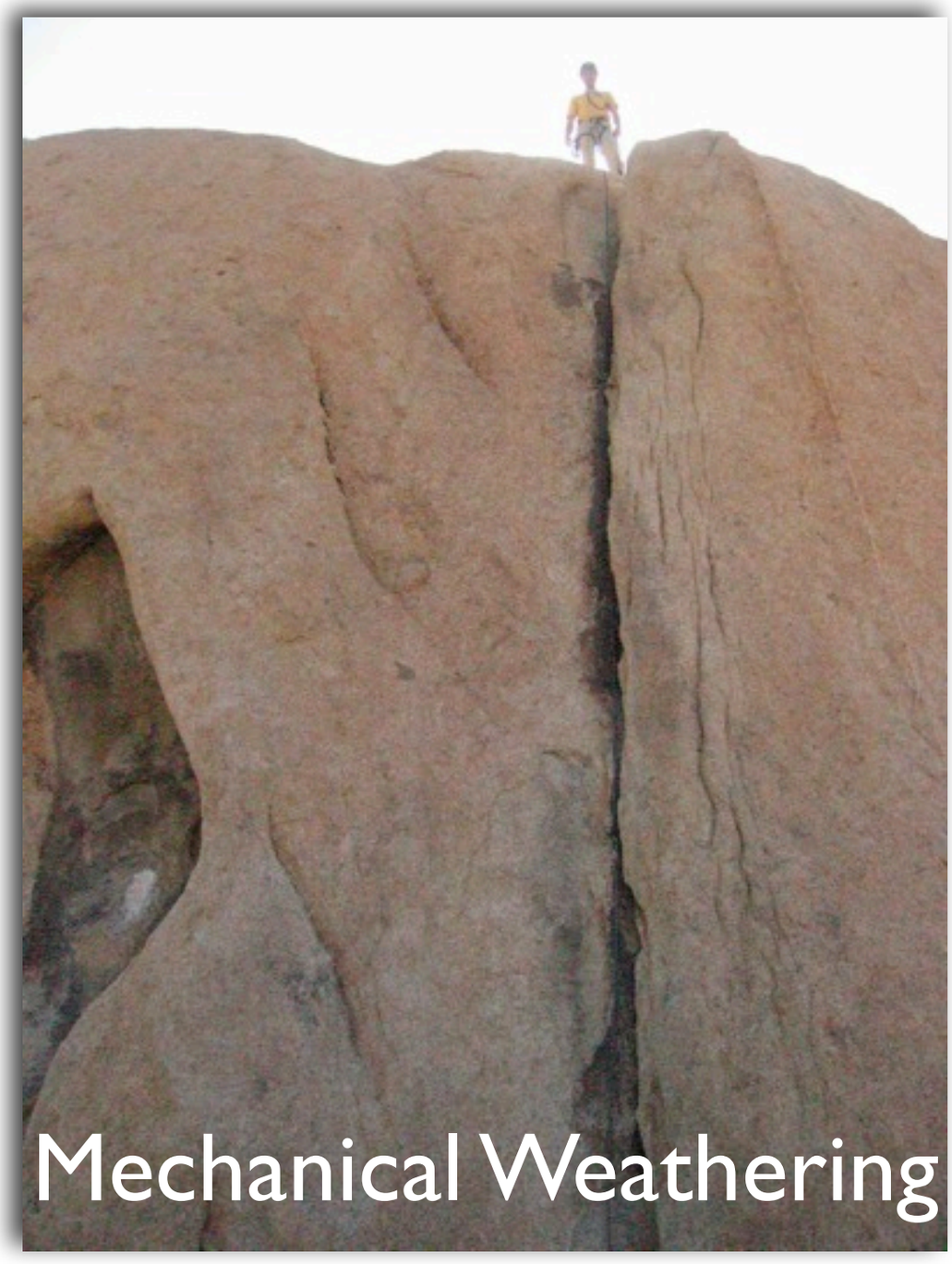




Enjoying Weathering

Spelunking Carlsbad Caverns.





Cool crack climbs, Joshua Tree NP

Erosion

Refers to the combination of processes that separates weathered bedrock (sediment)is transported to a new location.

River Erosion

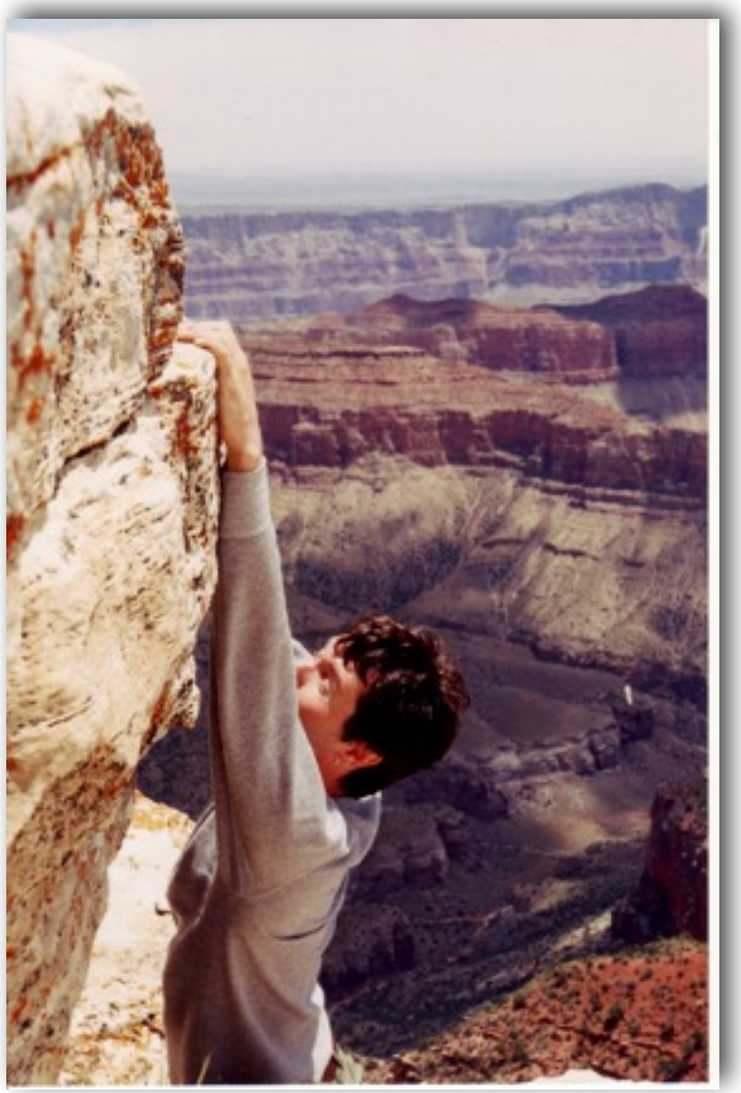
Glacial Erosion

Surface Run off

Coastal erosion

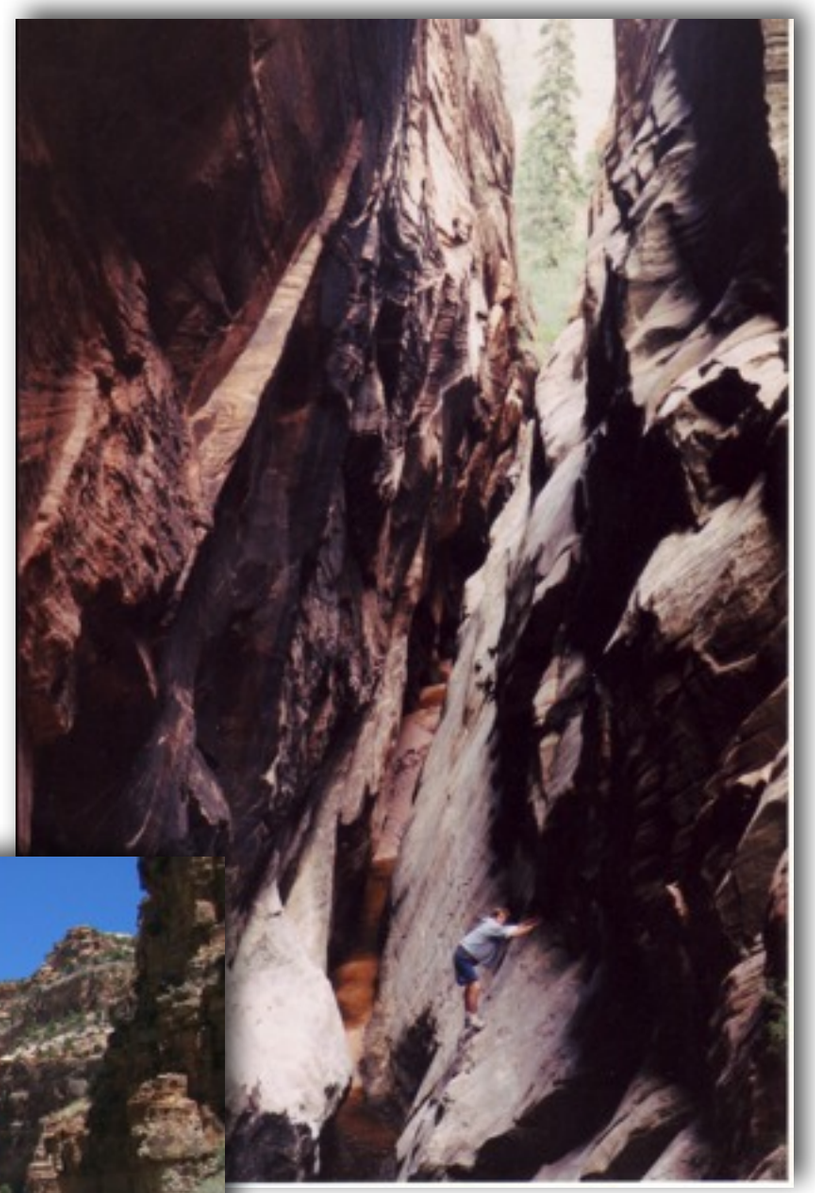
Wind Erosion

Enjoying Erosion



Hanging around
Grand Canyon

Canyoneering, Zion NP



Yampa River, Utah