

A spiral-bound notebook with a light brown, textured cover. The spiral binding is on the left side. The text is centered on the cover.

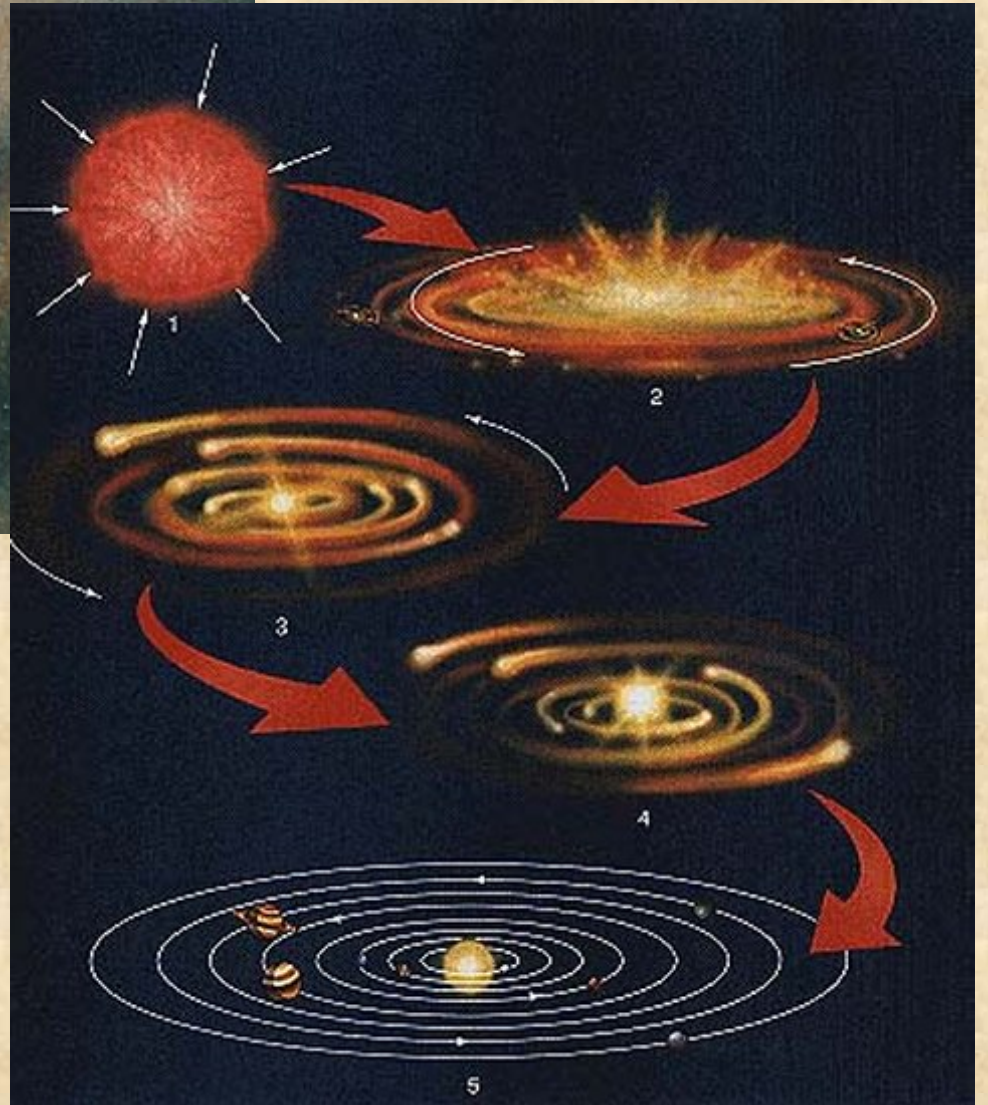
Geology 2000:

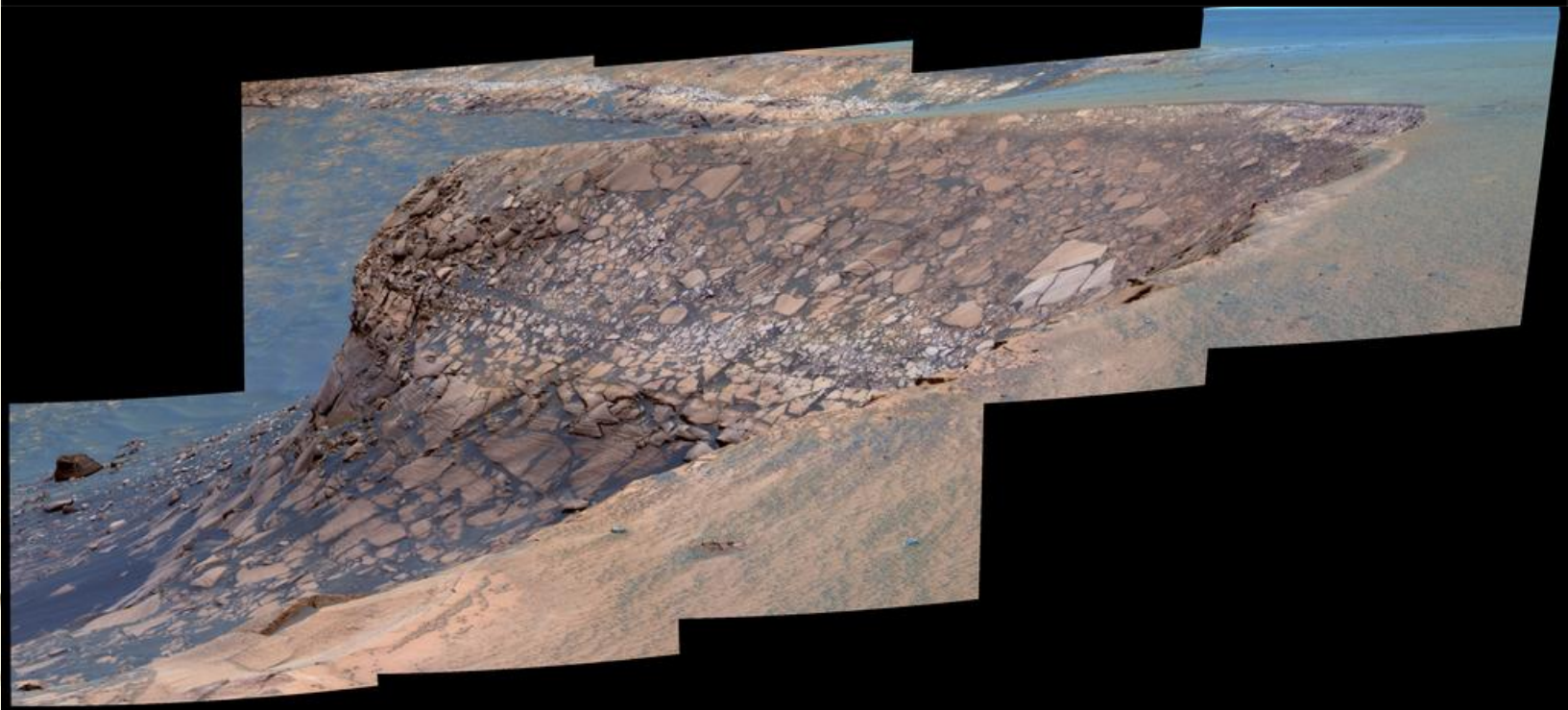
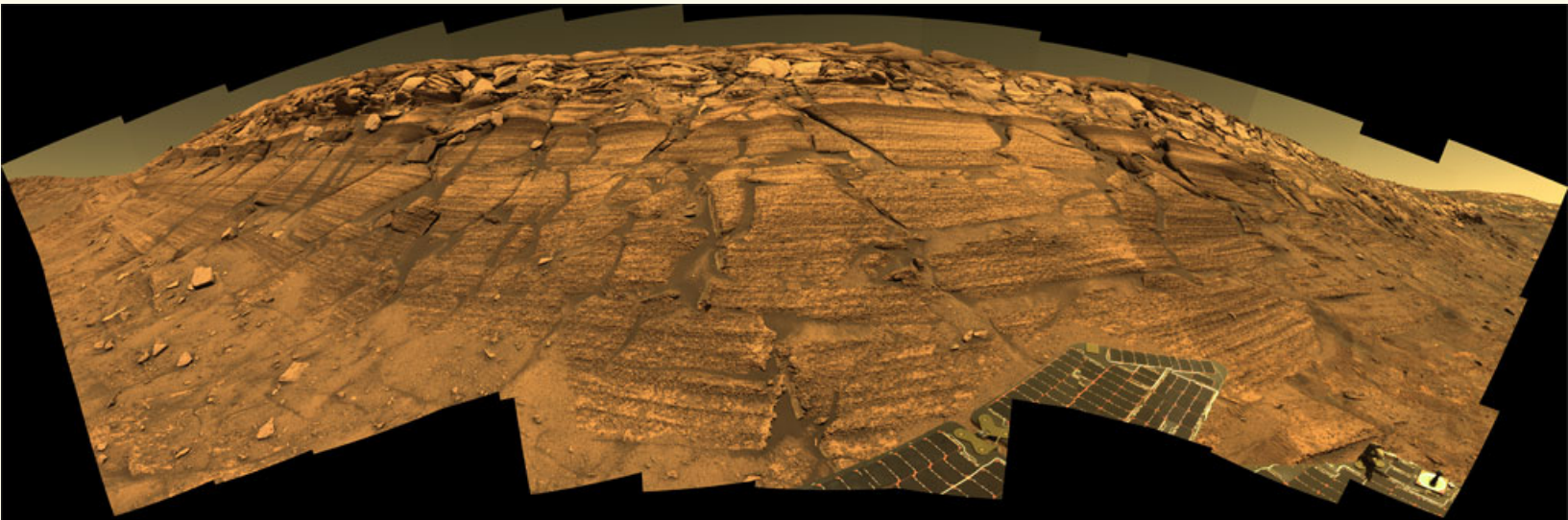
**Geochemical Cycles and the
Earth System**



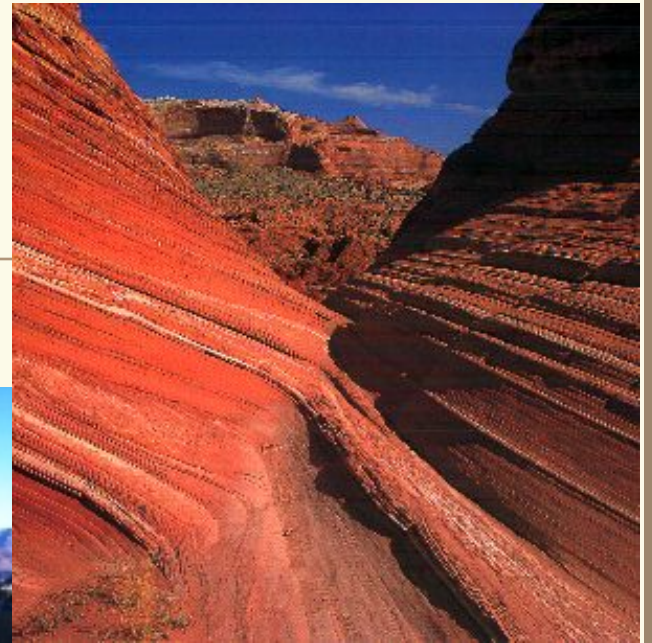
Used to do a LOT of climbing...



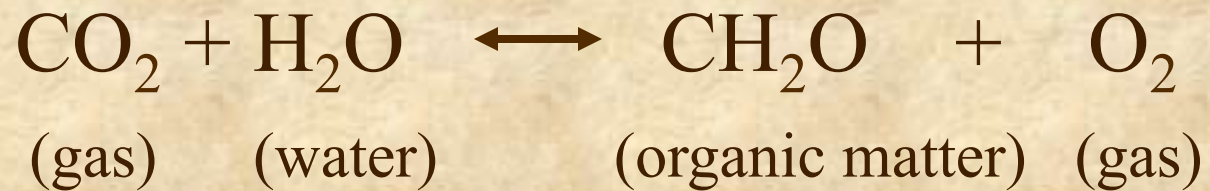




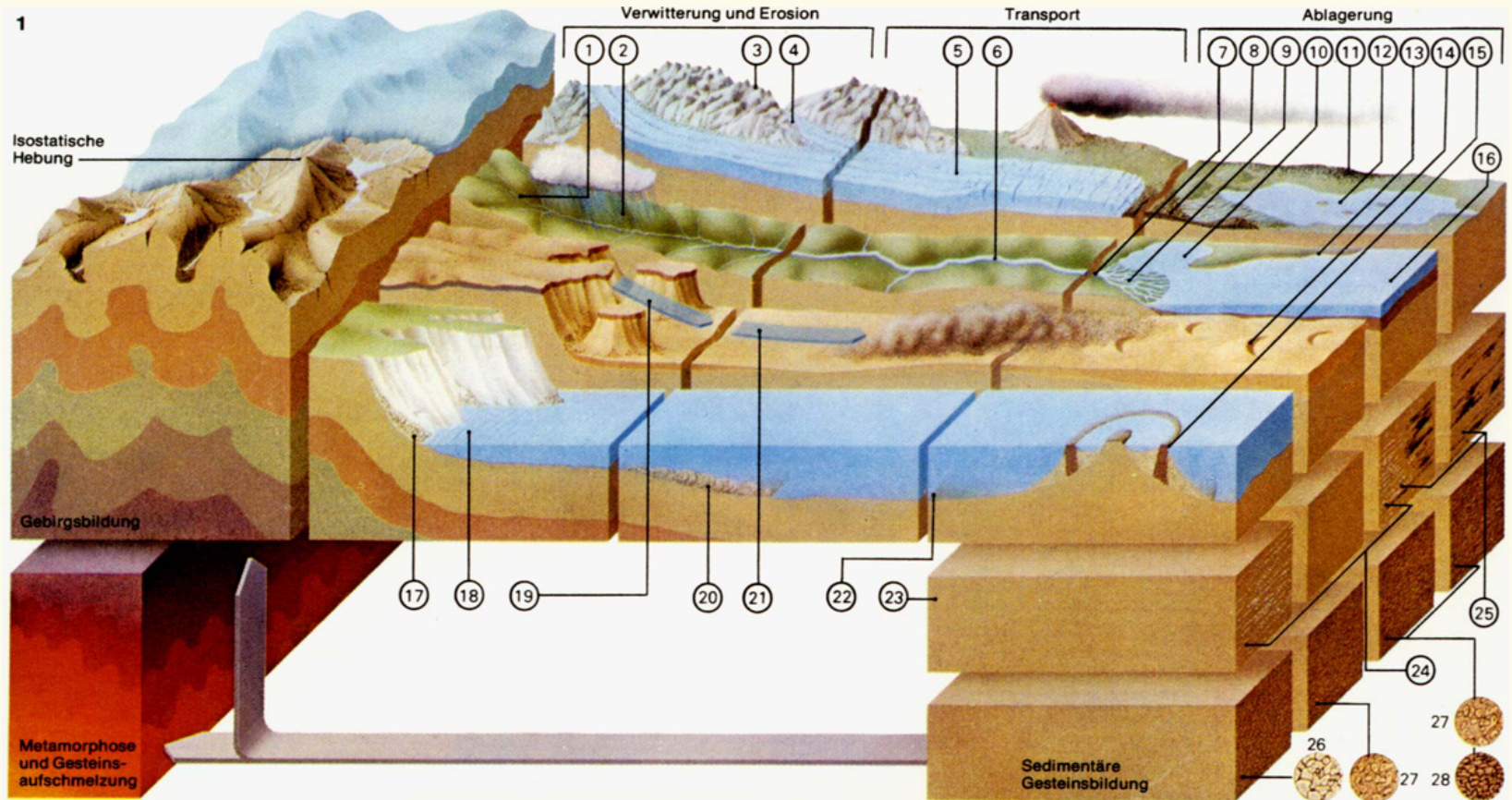


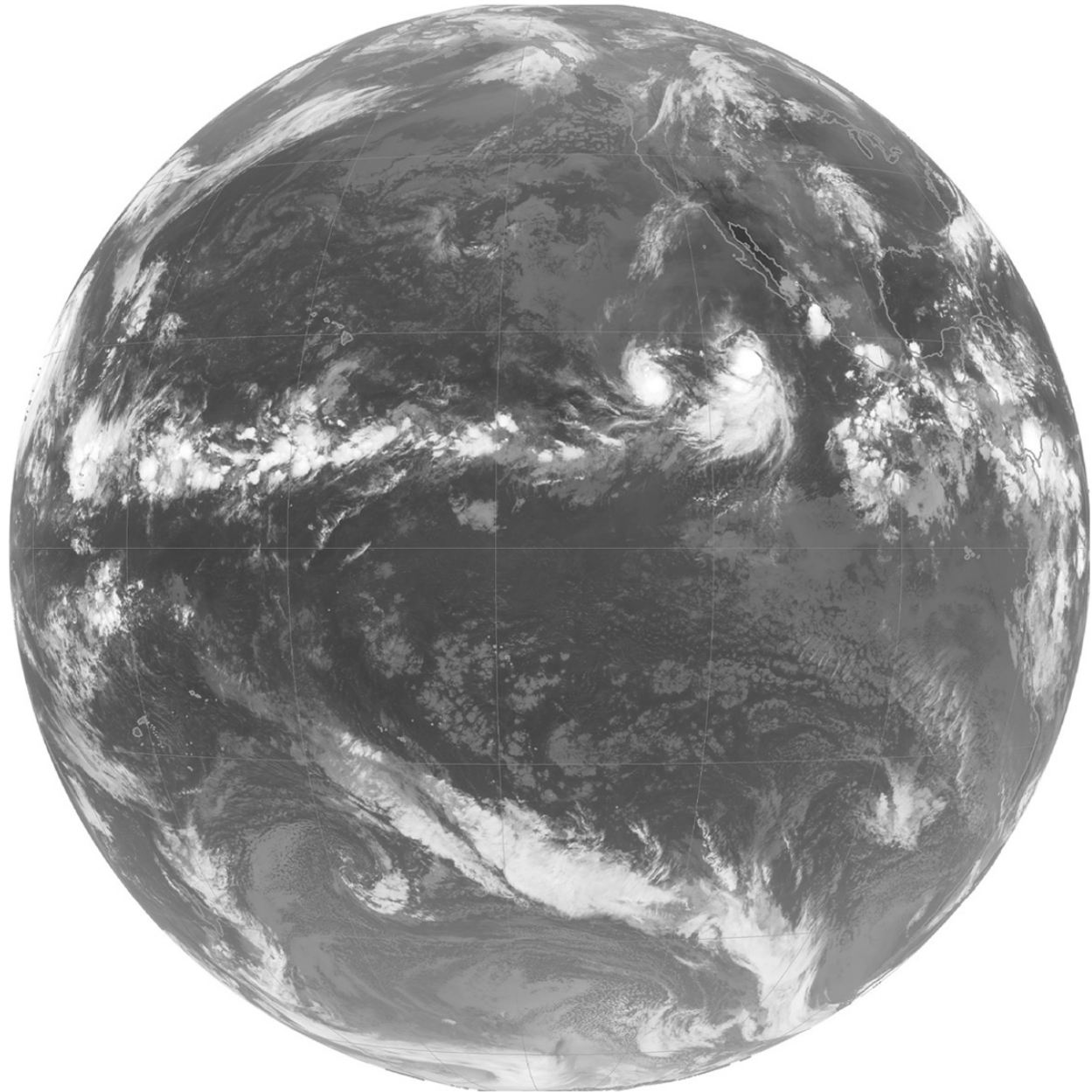


Photosynthesis, Respiration



Geological Cycling:



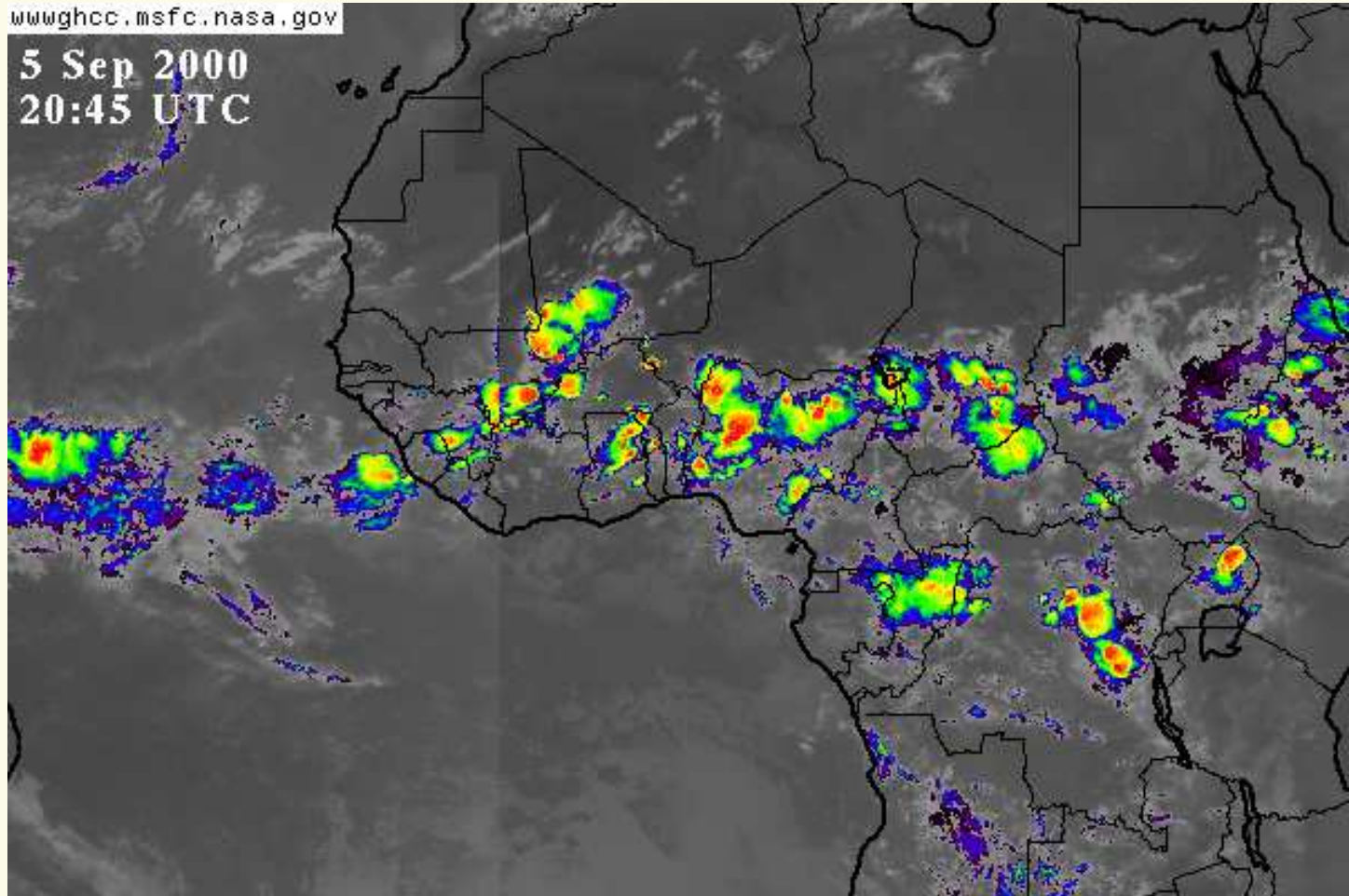


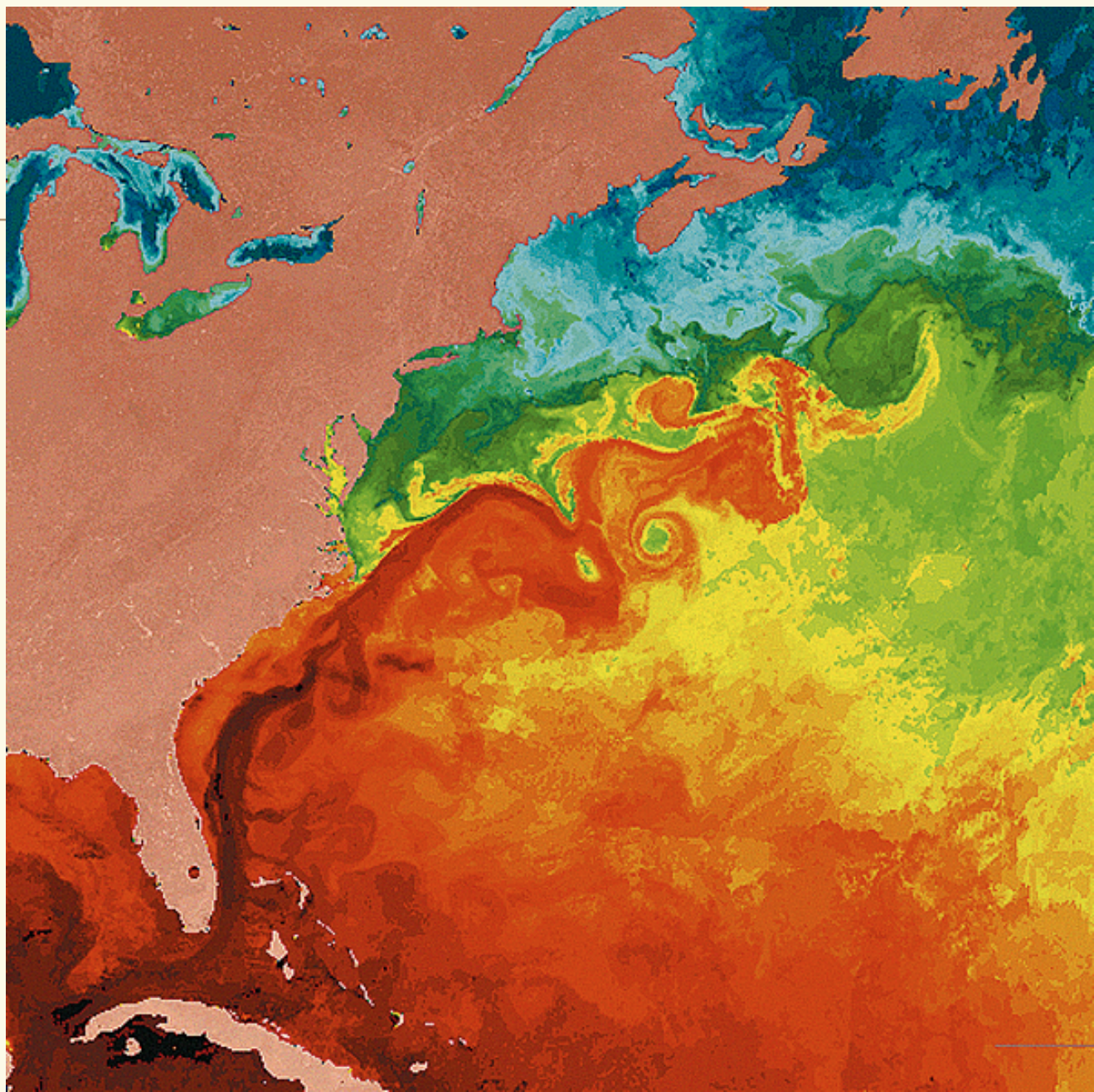
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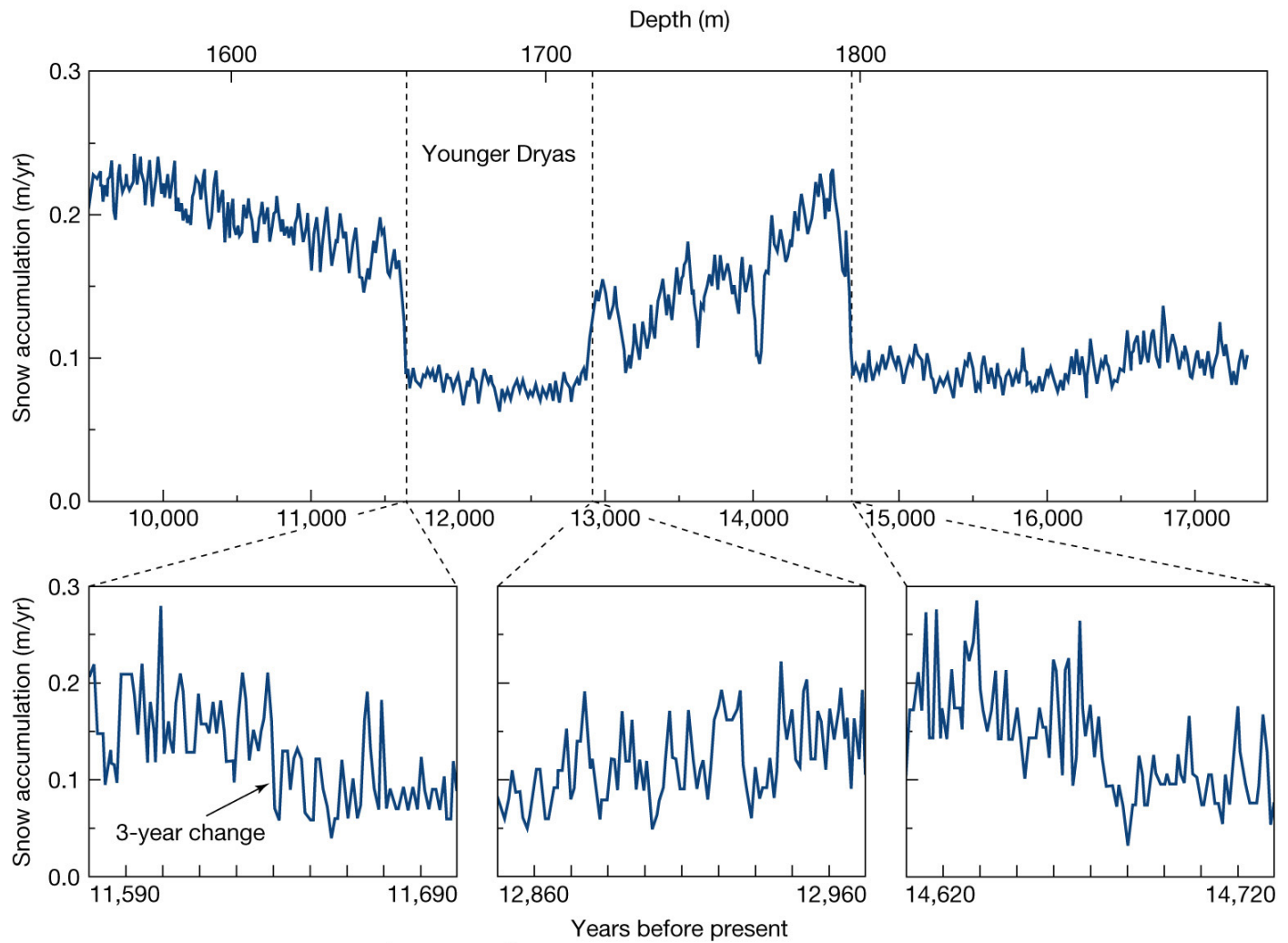
Intertropical convergence zone

www.ghcc.msfc.nasa.gov

5 Sep 2000
20:45 UTC



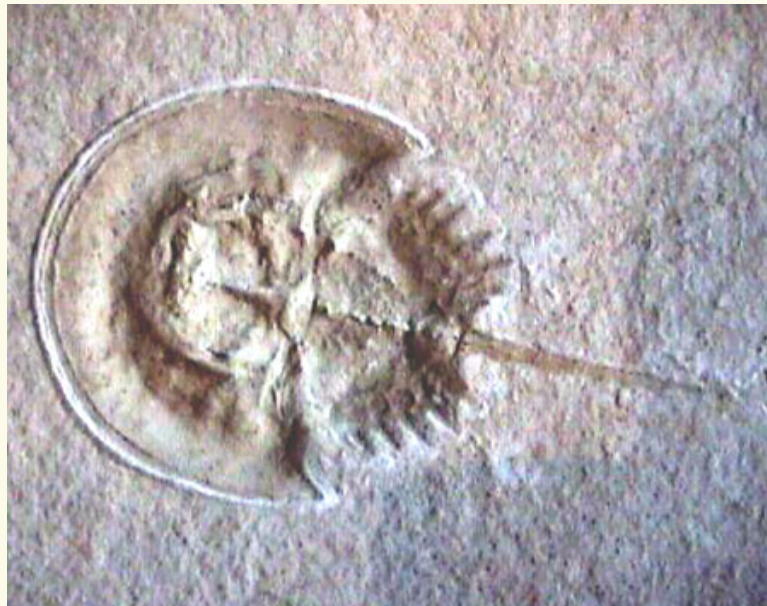




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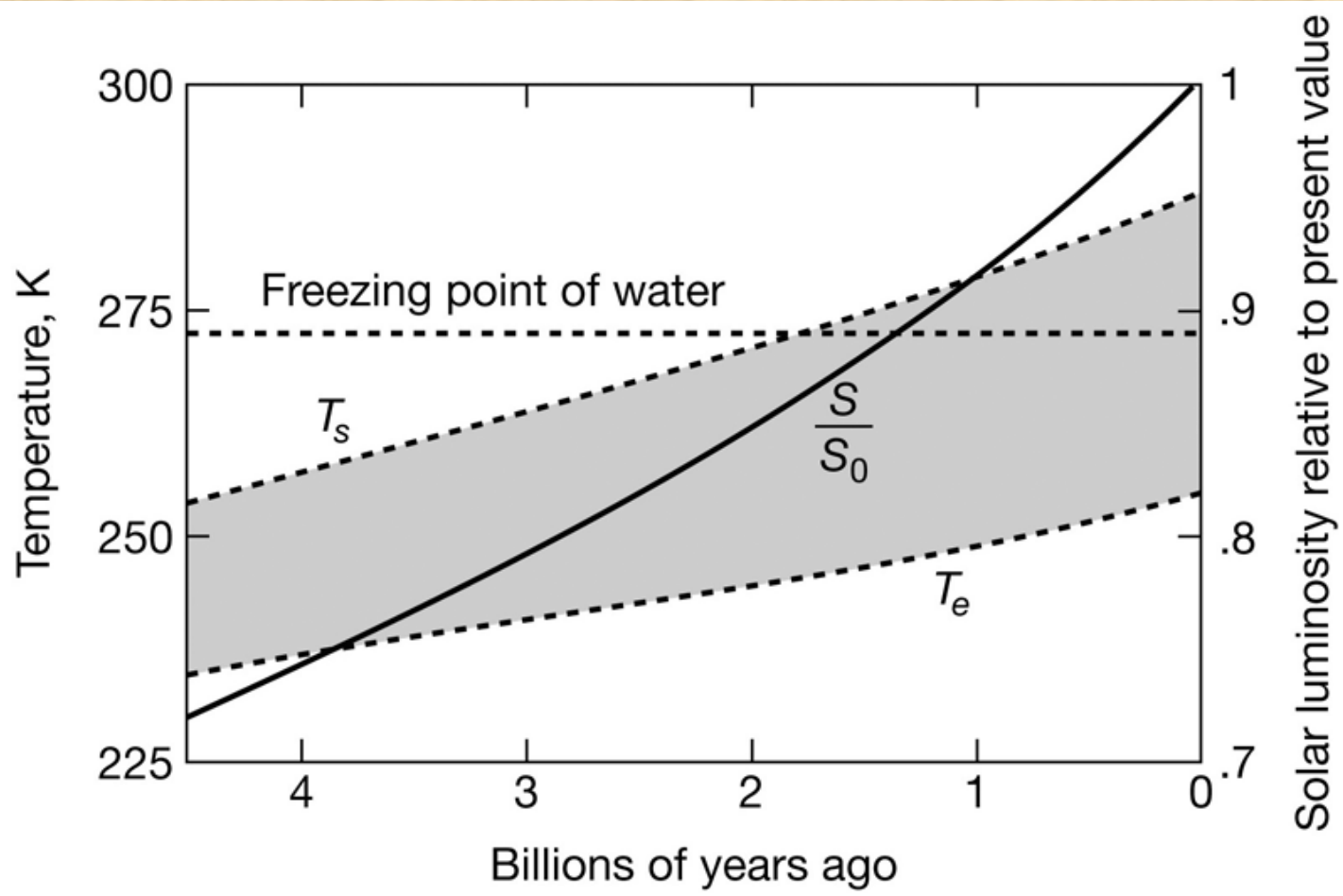
Paleontology: Ancient Life

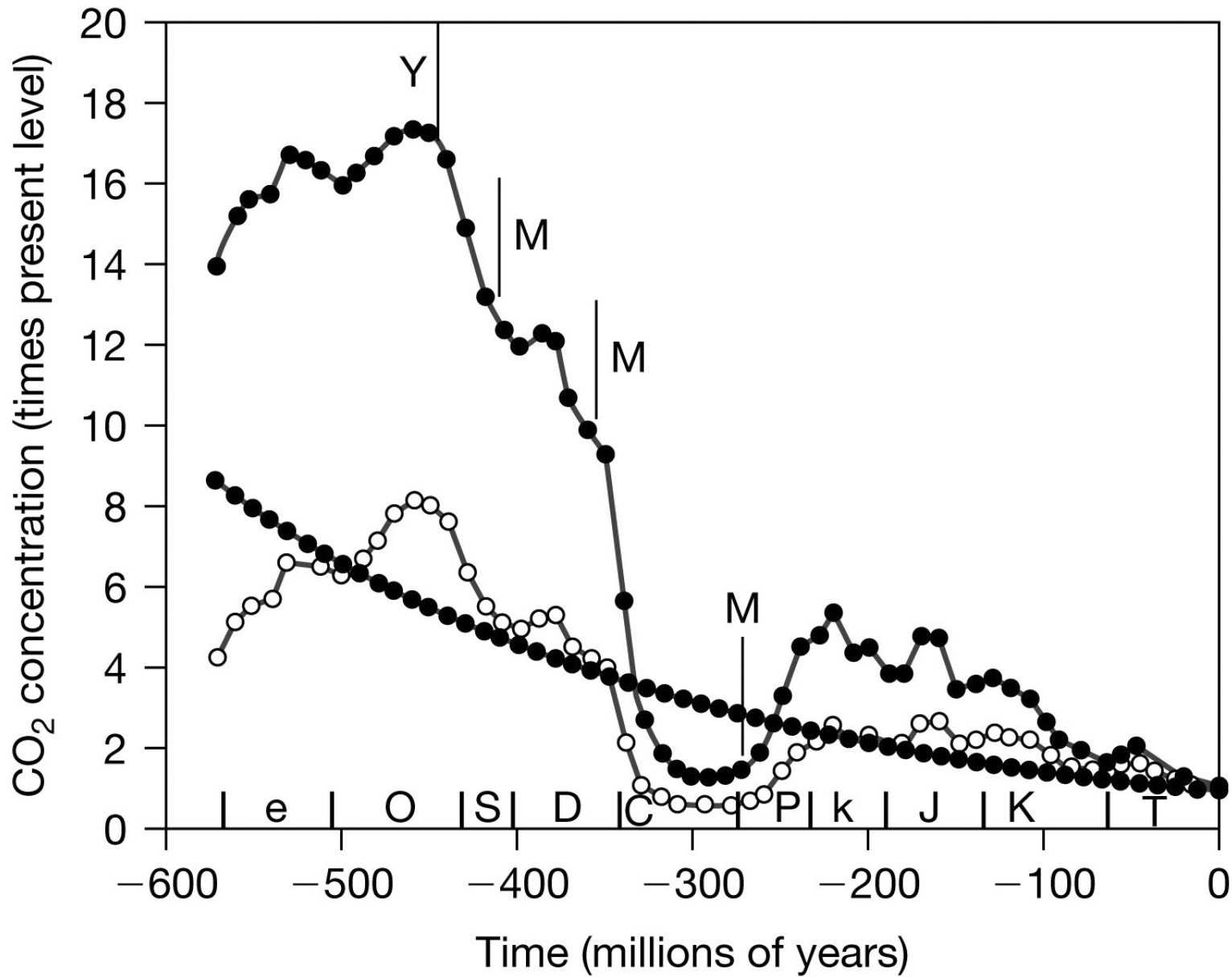
- ✓ Fossils tell us about conditions in the past
- ✓ The Earth has done “experiments” for us that we cannot do ourselves - the geologic record informs us about how life is affected by major changes in the Earth System.





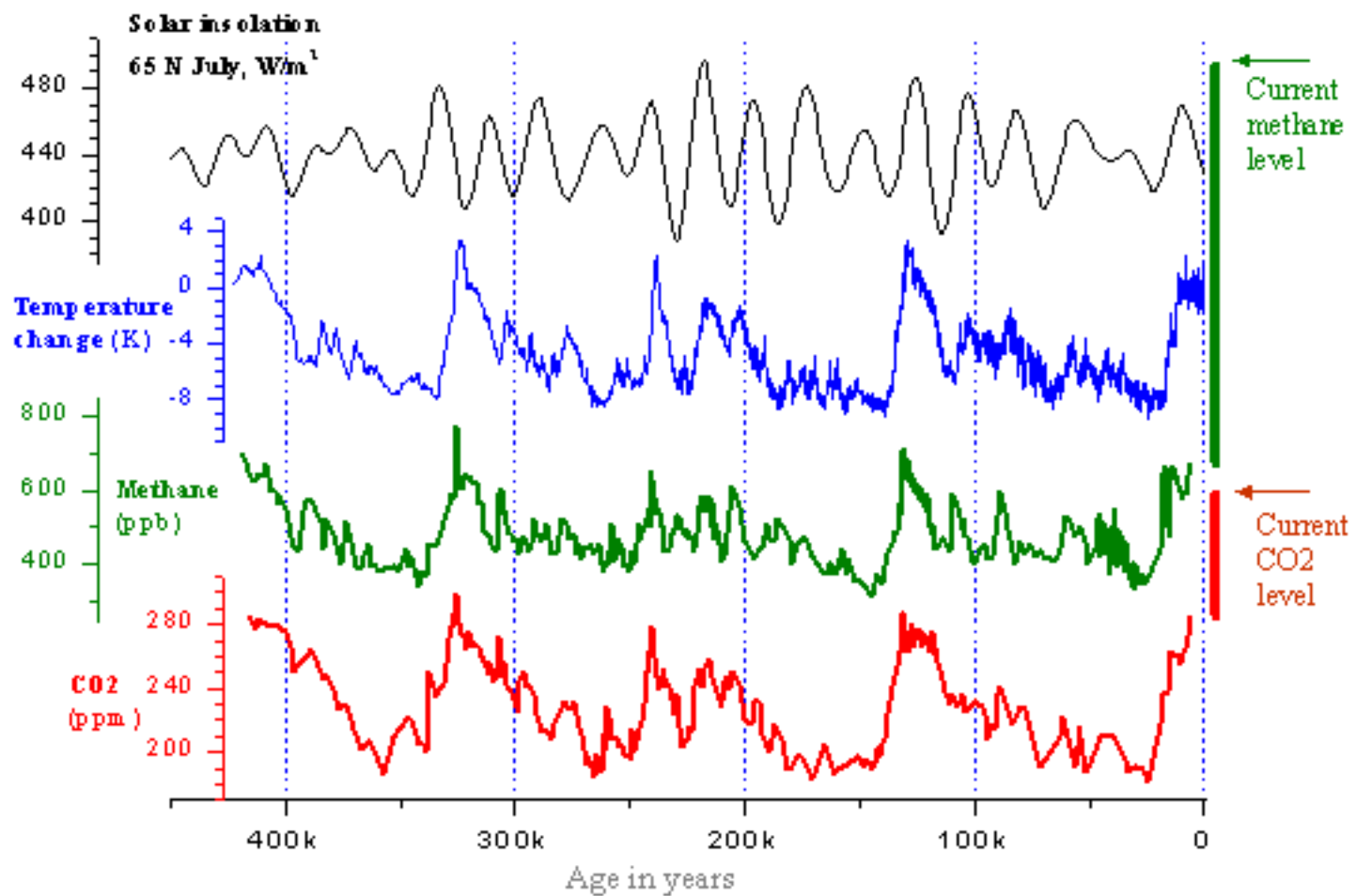
Faint Young Sun Paradox





The Vostok ice core record

Source: Petit et al, Nature, 1999.
Berger & Loutre, QSR, 1991







Die aus der Frühzeit der Fotografie stammende Aufnahme von Frédéric Martens um 1856 zeigt den Rhonegletscher mit seiner grössten Ausdehnung.

1900



2005



1934



2003



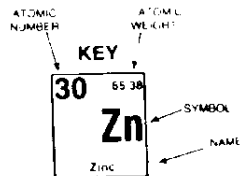




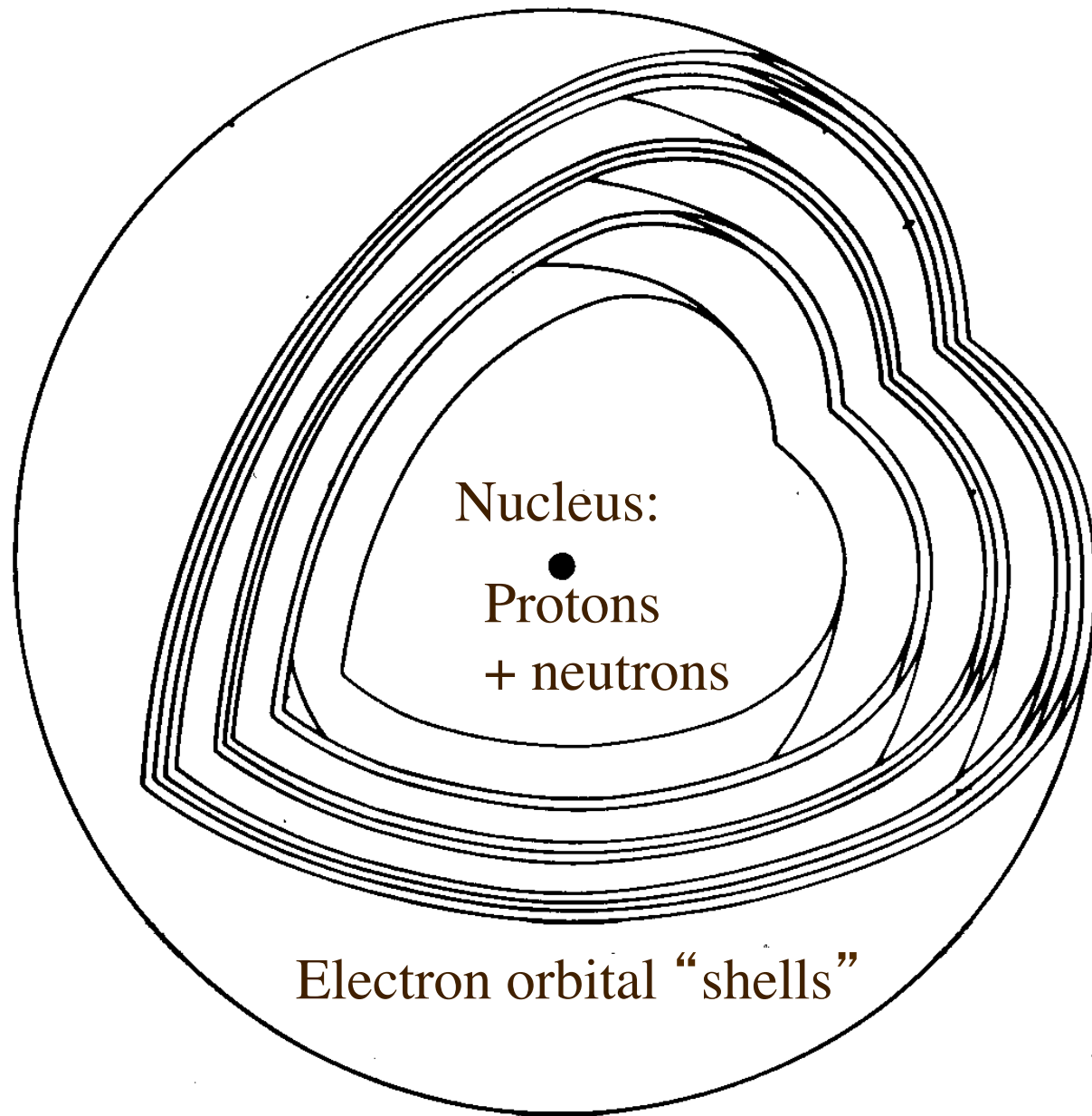
PERIODIC TABLE OF THE ELEMENTS

GROUP
IA

1 1.0079 H Hydrogen	IIA																2 4.00260 He Helium
3 6.941 Li Lithium	4 9.01218 Be Beryllium											5 10.81 B Boron	6 12.011 C Carbon	7 14.0067 N Nitrogen	8 15.9994 O Oxygen	9 18.998403 F Fluorine	10 20.179 Ne Neon
11 22.98977 Na Sodium	12 24.305 Mg Magnesium											13 26.9815 Al Aluminum	14 28.0855 Si Silicon	15 30.97376 P Phosphorus	16 32.06 S Sulfur	17 35.453 Cl Chlorine	18 39.948 Ar Argon
		IIIA	IVA	VA	VIA	VIIA	VIII			IB	IIB						
19 39.0983 K Potassium	20 40.08 Ca Calcium	21 44.9559 Sc Scandium	22 47.90 Ti Titanium	23 50.9415 V Vanadium	24 51.996 Cr Chromium	25 54.9380 Mn Manganese	26 55.847 Fe Iron	27 58.9332 Co Cobalt	28 58.70 Ni Nickel	29 63.546 Cu Copper	30 65.38 Zn Zinc	31 69.72 Ga Gallium	32 72.59 Ge Germanium	33 74.9216 As Arsenic	34 78.96 Se Selenium	35 79.904 Br Bromine	36 83.80 Kr Krypton
37 85.4678 Rb Rubidium	38 87.62 Sr Strontium	39 88.9059 Y Yttrium	40 91.22 Zr Zirconium	41 92.9064 Nb Niobium	42 95.94 Mo Molybdenum	43 98 Tc Technetium	44 101.07 Ru Ruthenium	45 102.9055 Rh Rhodium	46 106.4 Pd Palladium	47 107.868 Ag Silver	48 112.4 Cd Cadmium	49 114.82 In Indium	50 118.69 Sn Tin	51 121.75 Sb Antimony	52 127.60 Te Tellurium	53 126.9045 I Iodine	54 131.30 Xe Xenon
55 132.9054 Cs Cesium	56 137.33 Ba Barium	57 138.9055 La Lanthanum	72 178.49 Hf Hafnium	73 180.9479 Ta Tantalum	74 183.85 W Tungsten	75 186.207 Re Rhenium	76 190.2 Os Osmium	77 192.22 Ir Iridium	78 195.09 Pt Platinum	79 196.9665 Au Gold	80 200.59 Hg Mercury	81 204.37 Tl Thallium	82 207.2 Pb Lead	83 208.9804 Bi Bismuth	84 (209) Po Polonium	85 (210) At Astatine	86 (222) Rn Radon
87 (223) Fr Francium	88 226.0254 Ra Radium	89 227.0278 Ac Actinium															



* 58 140.12 Ce Cerium	59 140.9077 Pr Praseodymium	60 144.24 Nd Neodymium	61 (145) Pm Promethium	62 150 Sm Samarium	63 151.96 Eu Europium	64 157.25 Gd Gadolinium	65 158.9254 Tb Terbium	66 162.50 Dy Dysprosium	67 164.9304 Ho Holmium	68 167.26 Er Erbium	69 168.9342 Tm Thulium	70 173.04 Yb Ytterbium	71 174.967 Lu Lutetium
** 90 232.0375 Th Thorium	91 231.0369 Pa Protactinium	92 238.0289 U Uranium	93 237.0482 Np Neptunium	94 (244) Pu Plutonium	95 (243) Am Americium	96 (247) Cm Curium	97 (247) Bk Berkelium	98 (251) Cf Californium	99 (252) Es Einsteinium	100 (257) Fm Fermium	101 (258) Md Mendelevium	102 (259) No Nobelium	103 (260) Lr Lawrencium



Nucleus:

●
Protons
+ neutrons

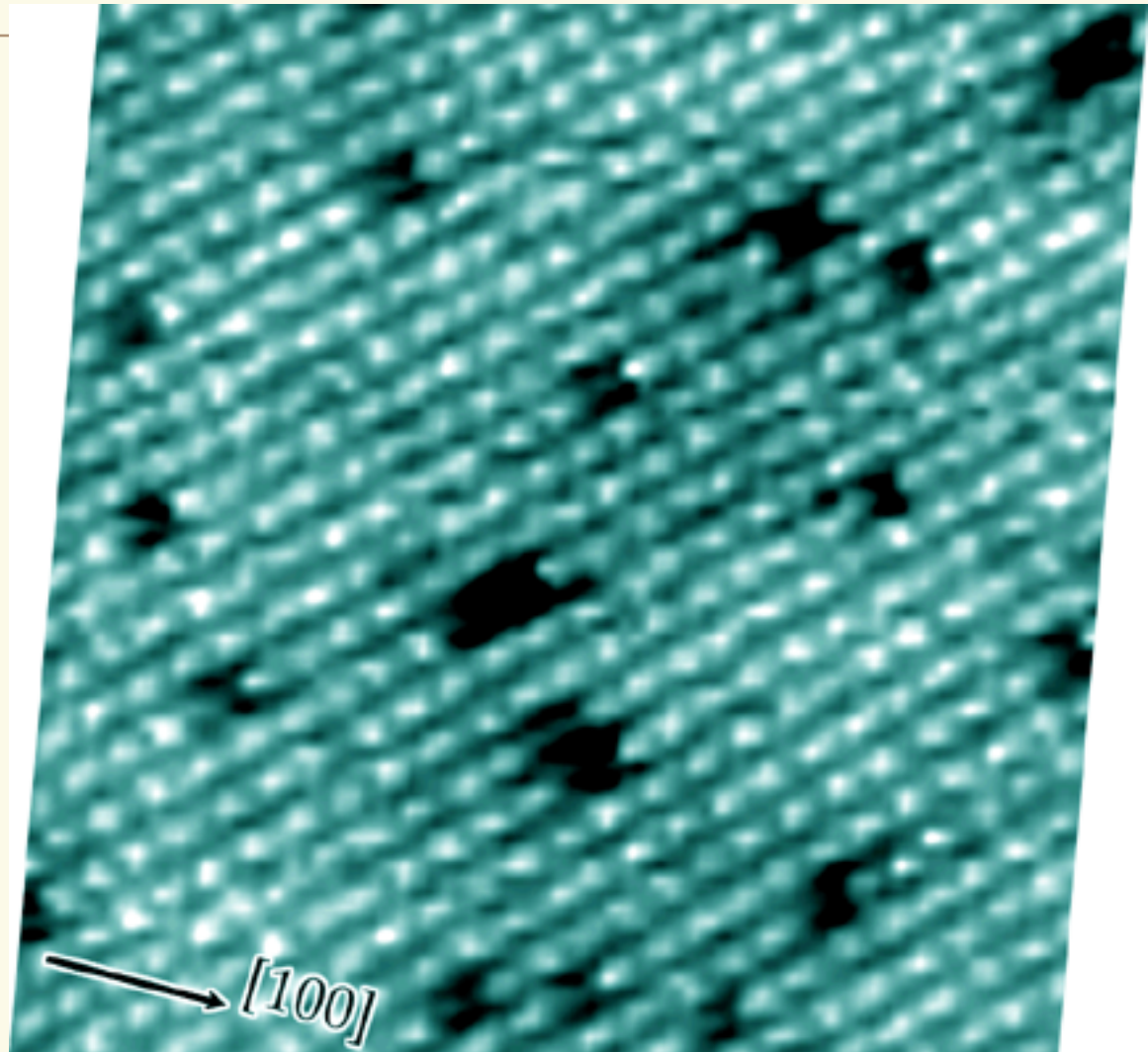
Electron orbital "shells"

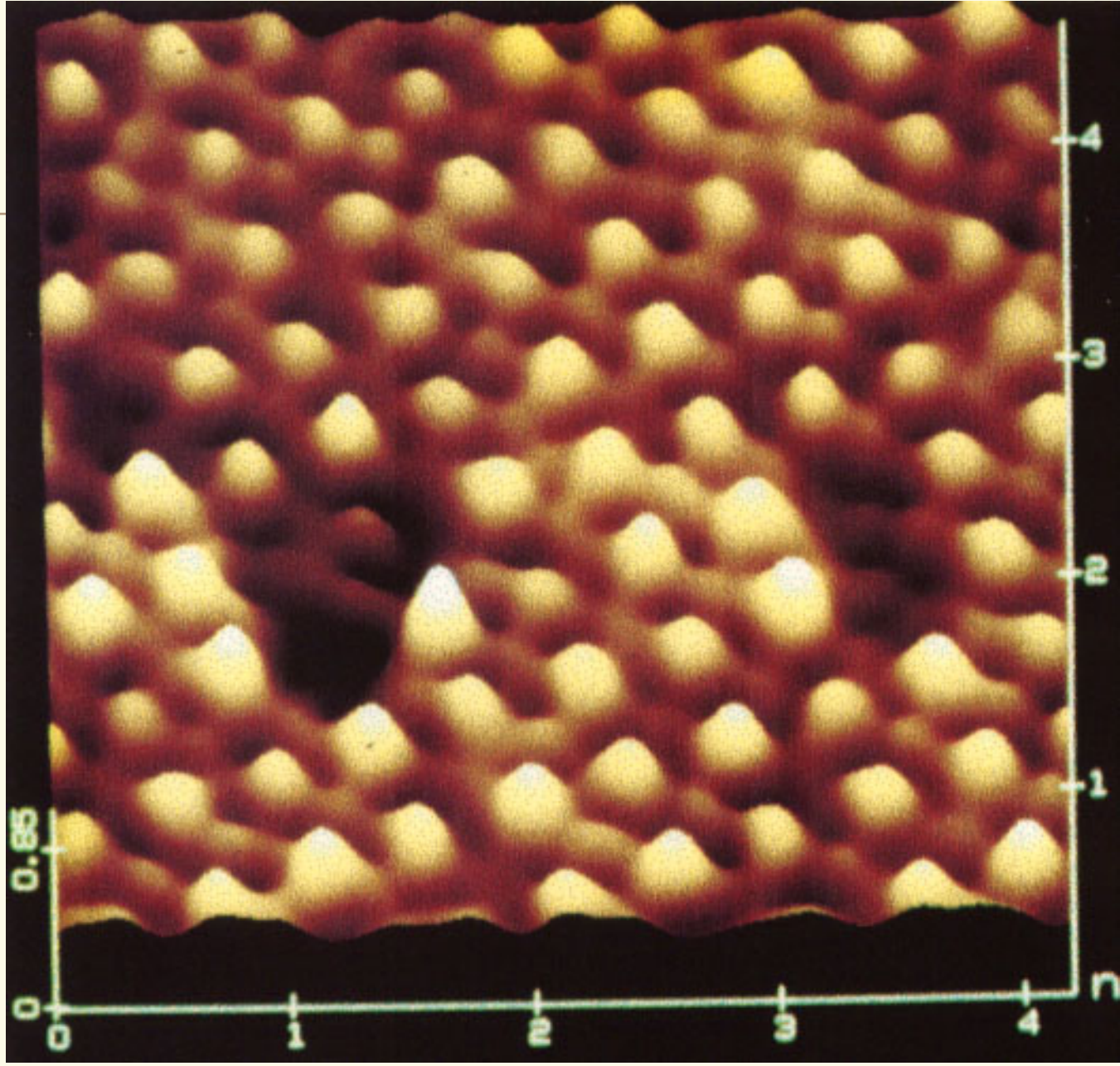
Atoms consist of:

- ✓ Nucleus, containing protons and neutrons, and thus most of the mass of the atom (proton mass = $1.6726231 \times 10^{-27}$ kg; neutron mass = $1.6749286 \times 10^{-27}$ kg)
- ✓ “Shells” consisting of electrons in “orbitals” around the nucleus, contributing the volume (electron mass = 0.910938×10^{-30} kg; this is $1/1836.1527$ of the proton mass)

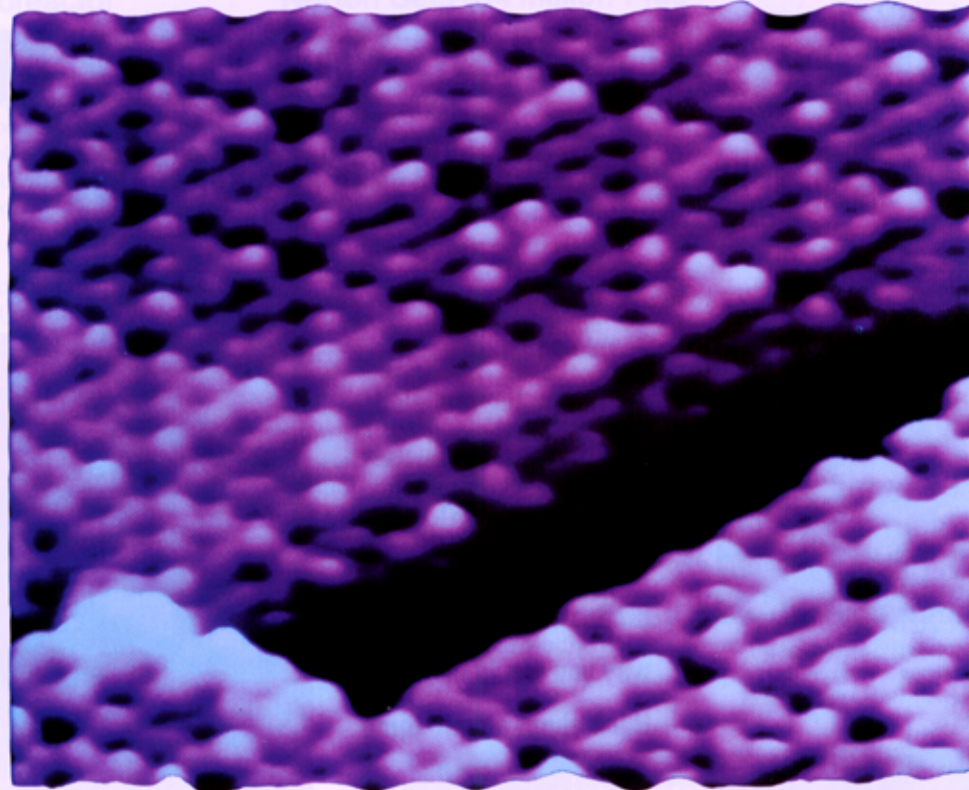


Galena (PbS)





The Silicon Surface



Things to remember about atoms:

- ✓ Atomic Number = # protons in nucleus
- ✓ The number of protons controls the chemical “identity” of an atom (that is, what element the atom is)...(why?)

Isotope:

- ✓ A selection of atoms, each with the same number of protons, may have different numbers of neutrons and thus different masses. These are **ISOTOPES** of the element; example: ^{12}C , ^{13}C , ^{14}C

Ions

- ✓ An electrically neutral atom has equal numbers of protons and electrons
- ✓ Atoms or molecules that have an electric charge are called **IONS**.

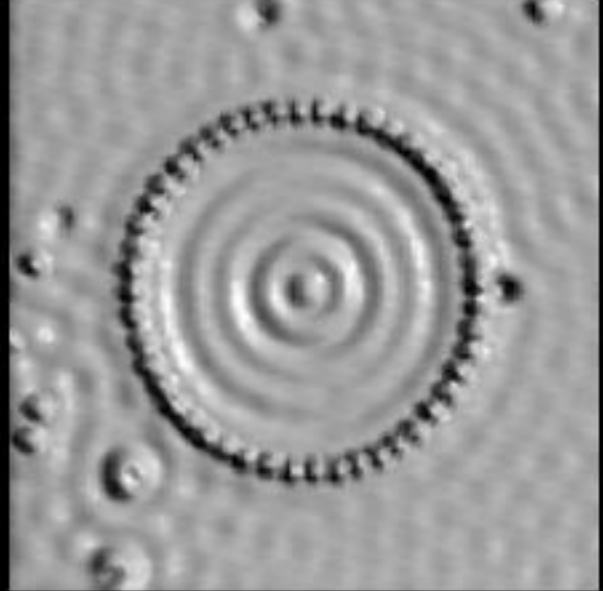
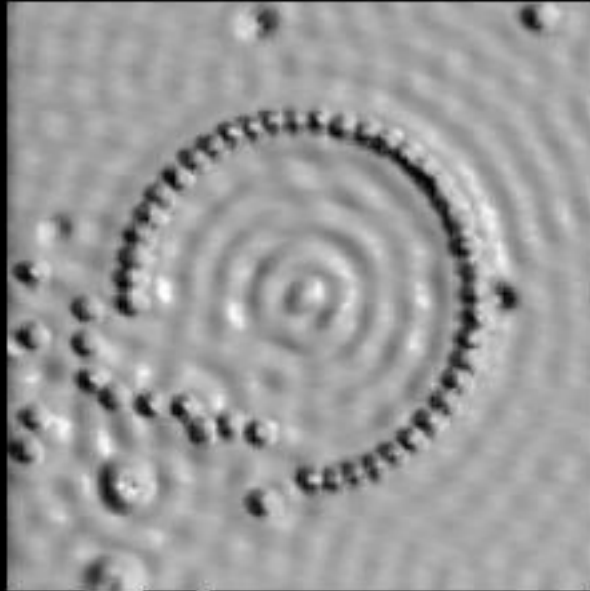
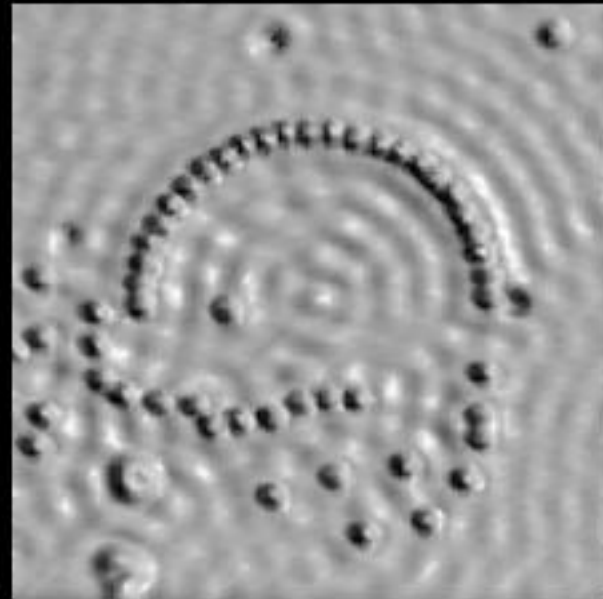
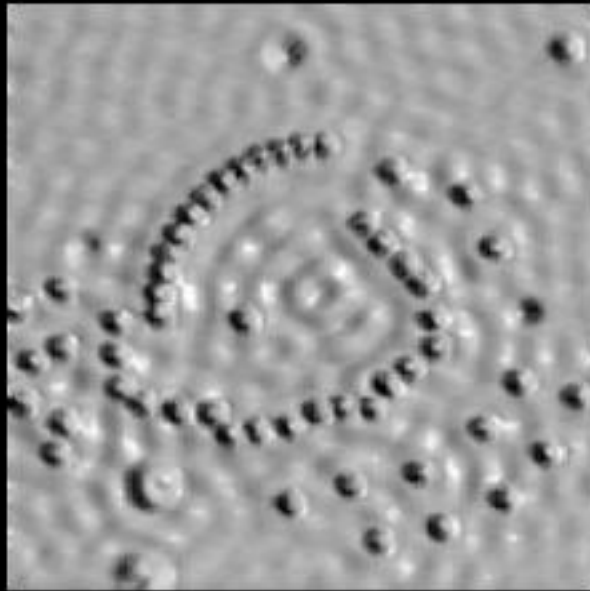


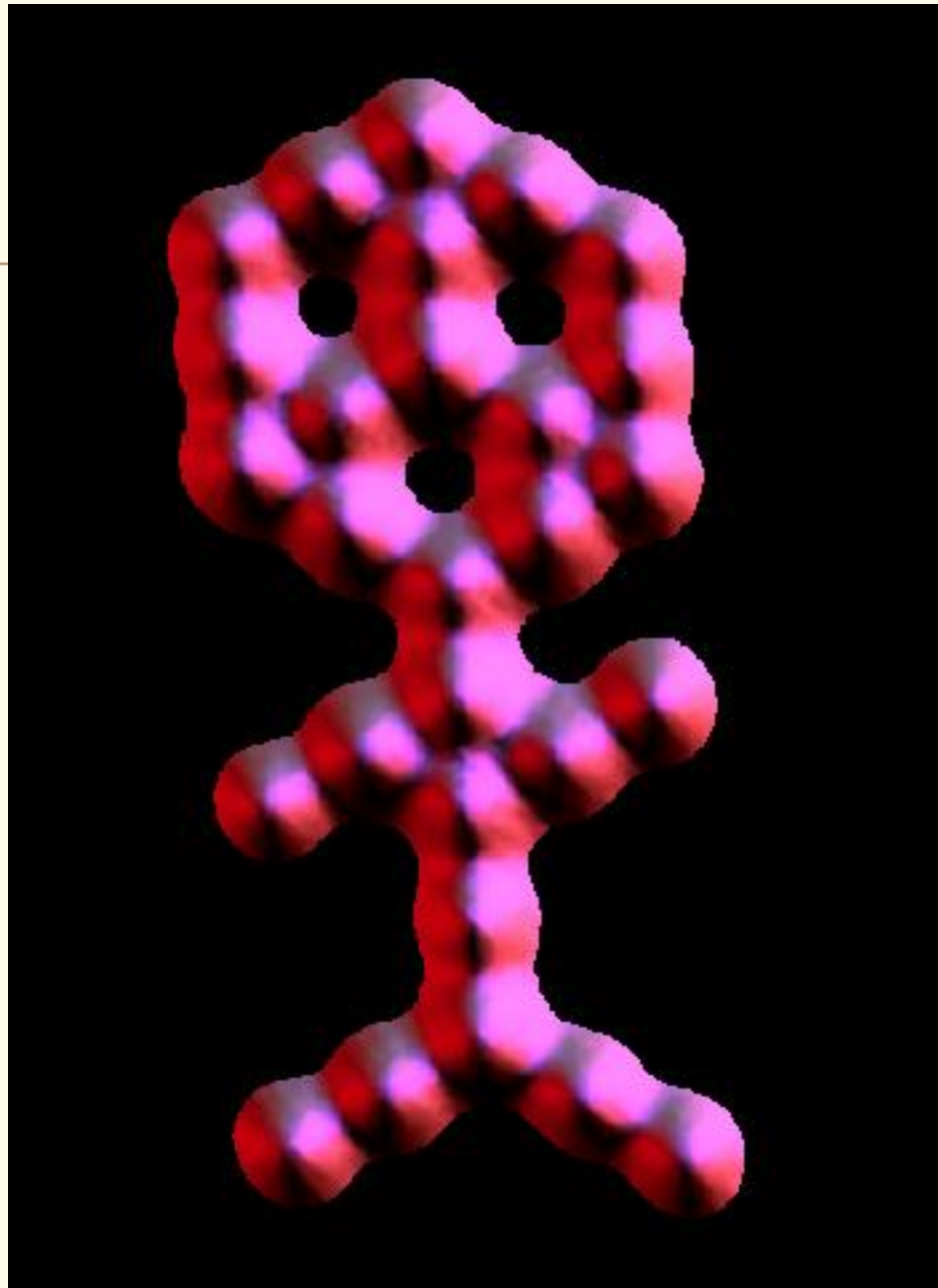
Positive ion = cation

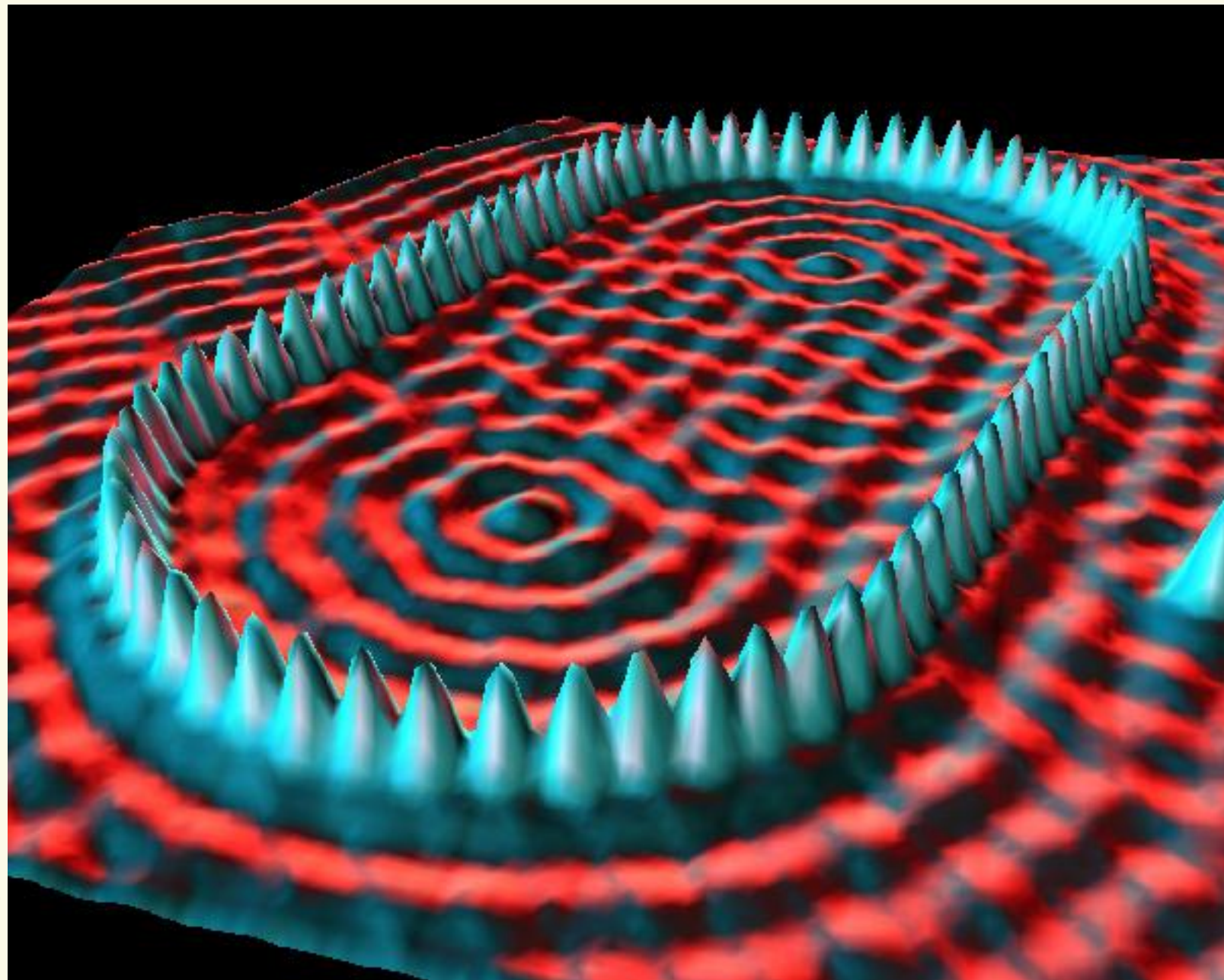
Negative ion = anion

Atomic weight:

- ✓ 1 dozen = 12 of something
- ✓ 1 mole = 6.0221367×10^{23} of something
(hopefully not donuts)
- ✓ The atomic weight, in the periodic table, is the weight in grams of one mole of that element.







Orbitals

- ✓ Standing waves
- ✓ Different ways of “fitting” waves around a nucleus

