## ES10 January 29 2001 Geologic Time Table

- How do we date things? Relative dating: stratigraphy. Law of superposition; Principle of Original Horizontality; Principle of Cross-Cutting Relationships
- Atomic number = number of protons in the nucleus. Mass number = protons + neutrons (=proton+electron) Isotopes: same number of protons, different number of neutrons Uranium has 92 protons. Three isotopes: Uranium-234 (mass of protons + neutrons = 234); Uranium-235; Uranium-238
- 3. Radioactivity. In some elements, the nuclei are unstable because forces binding protons and neutrons together are not strong enough. Nuclei break apart (radioactive decay).

Alpha particle (=2 protons + 2 neutrons) loss from nucleus: mass number - 4, atomic number - 2

Beta particle (electron) loss from nucleus. Mass number same, atomic number +1 (neutron  $\rightarrow$  proton).

Half-life: time required for  $\frac{1}{2}$  of the nuclei to decay.

Examples: parent  $\rightarrow$  daughter product (half-life)

Uranium-238 $\rightarrow$ lead-206	(4.5 billion years)
Uranium-235 $\rightarrow$ lead-207	(713 million years)
Thorium-232 $\rightarrow$ lead-208	(14.1 million years)
Rubidium-87 $\rightarrow$ Strontium-87	(47.0 billion years)
Potassium-40 $\rightarrow$ Argon-40	(1.3 billion years)

Cosmic ray + N-14 → Carbon-14 → C-12 (5730 years) [Libby, Nobel ~1960] Works for materials 70,000 YBP. Difficult for "young" materials.

4. Geologic Time

Major units during 1800's before radiometric dating. Each unit is characterized by changes in lifeforms Eons, Era, periods, epochs (Phanerozoic), (Paleozoic, Mesozoic, Cenozoic), (7, 3, 2 periods)

- 5. Evolution of life is dependent on the location of the continents (plate tectonics), atmospheric composition (e.g. O2), climate (related to CO2 abundance) ...
- Phanerozoic: 545 million years ago.
  1<sup>st</sup> era: Paleozoic, 1<sup>st</sup> period: Cambrian: fossilized, well-preserved, hard body parts. 2<sup>nd</sup> period: Silurian: plant life; 3<sup>rd</sup> period: Devonian: invertebrates, ...

Eon Phanerozoic	Era Cenozoic	Period Quaternary Tertiary	Epoch Holocene Pleistocene Pliocene Miocene	Millions of years ago		
				Today 0.01 1.6 5.3	(16,000 years ago)	
			Oligocene	23.7 36.6		
			Eocene Paleocene	57.8		
	Mesozoic	Cretaceous		65.0	िमान इ.स.	
		Jurassic		144 208		
		Triassic	Nontran Te	208		
	Paleozoic	Permian		245		
		Carboniferous	PS anniae	360		
		Devonian		408		
		Silurian	isecsel of	438		
		Ordovician	nd islouid	505		
		Cambrian		545 —		
Precambrian: •Proterozoic						
•Archean	-	Server Advertision to a	corres made	2500		

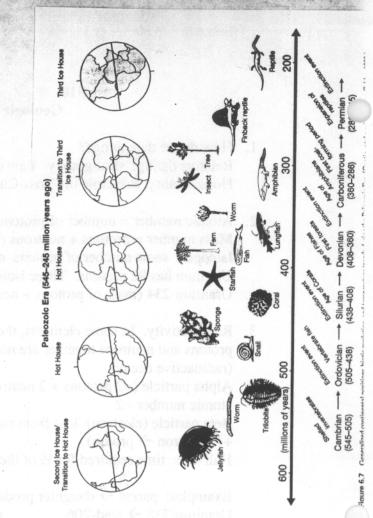


Figure 1.3 The geologic time scale. (After Skinner and Porter, 1995.)

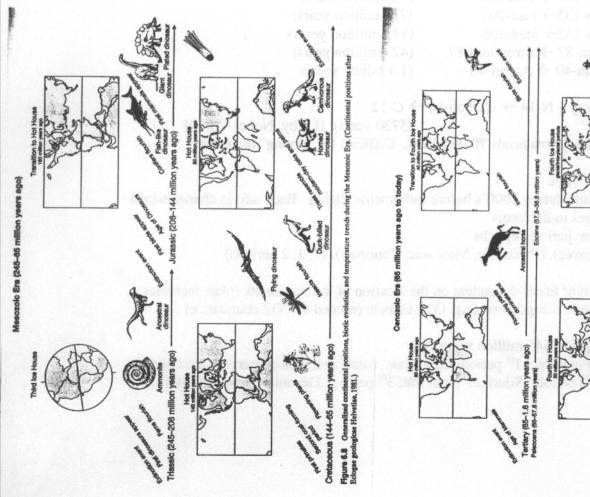


Figure 6.9 Generalized continental positions, biotic evolution, and temperature trends during the Cenozoic Era. (Continental positions after Eclogae geologicae Helveriae, 1981.)

Pleistocene (1.6 million to 10,000 )

(5.3-1.6 million years)

Miocene \_\_\_\_\_\_(23.7-6.3 million years)

Offgocene (36.6-23.7 million years)