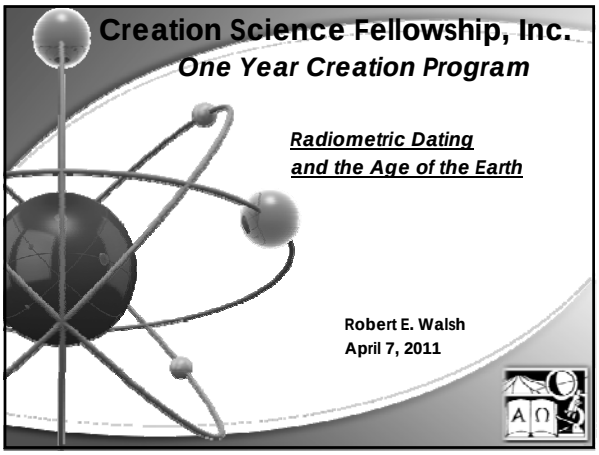
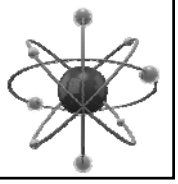


Agenda

1. INTRODUCTORY CONCEPTS
2. DECAY OF A FREE NEUTRON AND TYPES OF NUCLEAR DECAY
3. RADIOACTIVE DECAY PROCESSES
4. THE RADIOACTIVE DECAY LAW
5. THE CREATION MODEL OF RADIOMETRIC DATING
6. ? QUESTIONS ?



INTRODUCTORY CONCEPTS

What's an Atom?

"ατομος

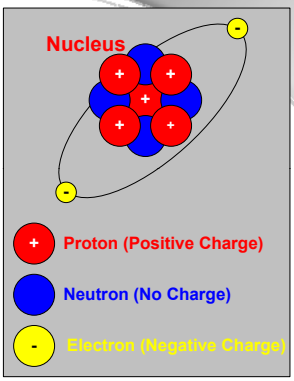
From the Greek Word τεμνω, meaning "to cut"

...and the Greek Negation "α" meaning "NOT"

Thus, meaning "<u>not</u> to cut" or "INDIVISBLE" => "can not be cut smaller"

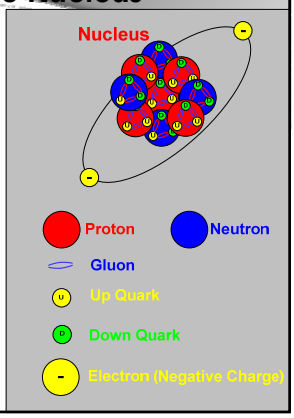
The Atomic Structure (High Level)

- The Atom is made up of a nucleus (comprised of neutrons and protons) and a set of orbiting electrons
- The number of protons determine the element
- The number of neutrons determine the "isotope"
- The chemistry of the atom takes place at the electrons irrespective of the isotope



A Closer Look Into the Nucleus

- The Nucleus is made up of Nucleons (Protons and Neutrons)
- The Nucleons are made up of Quarks and Gluons
- A Proton is made up of 2 "Up" Quarks and 1 "Down" Quark
- A Neutron is made up of 1 "Up" Quark and 2 "Down" Quarks
- Thus, Electrons, Quarks, and Gluons are the ELEMENTARY PARTICLES (ατομος)



Nuclear Nomenclature

A "happy" Nitrogen atom has:

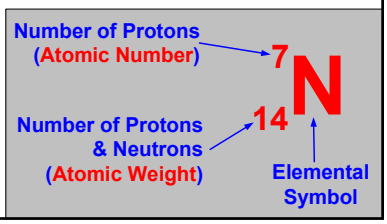
Seven (7) Protons, thus an Atomic Number of Seven (7)

Seven (7) Neutrons

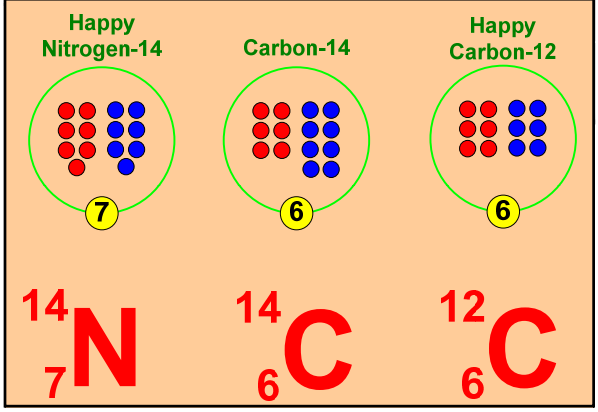
An Atomic Mass of Fourteen (14 = 7P + 7N)

Number of Neutrons do <u>not</u> always match the number of Protons

Seven (7) Electrons to match the Seven (7) Protons



Understanding Isotopes



THE DECAY OF A <u>FREE</u> NEUTRON AND TYPES OF NUCLEAR DECAY

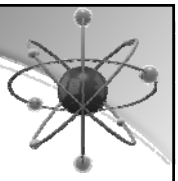
The Decay of a Free Neutron

A Free Neutron decays into:

- Proton (+ charge)
- Electron (- charge)
- Anti-Neutrino

n -> p + e + ~v

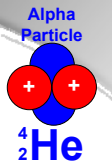
Types of Nuclear Decay

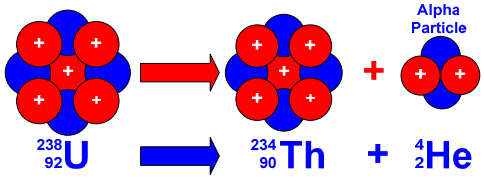


1. **Alpha Decay**
2. **Beta Decay**
3. **Gamma Decay**
4. **Electron Capture**
   - Lower shell electron captured by nucleus (proton)
5. **Proton Decay**
   - Proton is ejected out of nucleus
6. **Positron Decay**
   - A positron (anti-electron) is ejected out of nucleus
7. **Neutron Decay**
   - A neutron is ejected out of nucleus
8. **Cluster Decay**
   - A small nucleus is ejected (larger than an alpha particle)

Alpha Decay

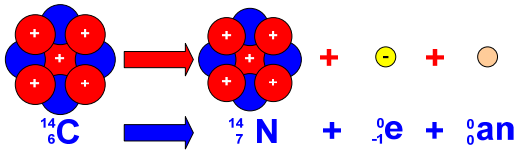
- When a nucleus ejects an "alpha particle" (Helium Nucleus) – no electrons in shells
- Uranium 238 (First Step in Series)





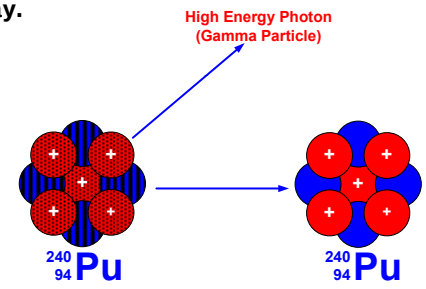
Beta Decay

- When a neutron in the nucleus ejects a "beta particle" (beta particle is an "electron") along with an "anti-neutrino"
- The neutron turns into a proton
- Iodine 131 beta decays – used in Thyroid therapy
- Carbon-14 is an example of Beta Decay



Gamma Decay

- When a high energy photon (Gamma Particle) is given off out of an "excited" nucleus
- Plutonium 240 is a good example of Gamma Decay.



RADIOACTIVE DECAY PROCESSES

Radioactive Elements

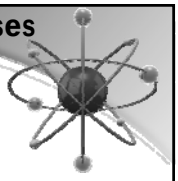
An unstable atom will "decay" until it reaches a stable state

The initial atom is called the "Parent"

It's next "form" is called the "Daughter"

The "decay process" follows the famous exponential decay curve (discussed later)

Types of Radioactive Processes

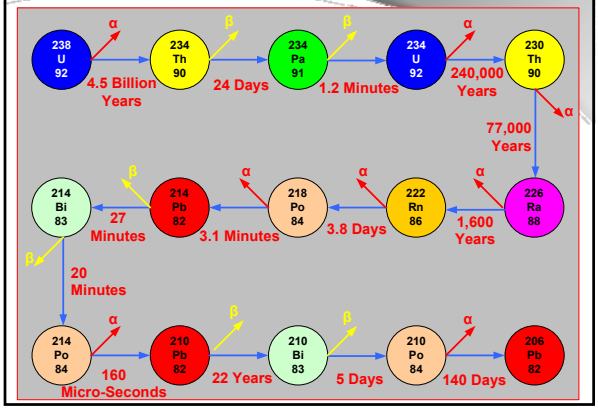


1. Uranium (U) – Lead (Pb)
2. Carbon (C)-14
3. Potassium (K) – Argon (Ar)
   - 1.3 Billion Years, Electron Capture
4. Rubidium (Rb) – Strontium (Sr)
   - 47 Billion Years, Beta Decay
5. Samarium (Sm) – Neodymium (Nd)
   - 106 Billion Years, Alpha Decay
6. Lutetium (Lu) – Hafnium (Hf)
   - 220 Billion Years, Beta Decay
7. Rhenium (Re) – Osmium (Os)
   - 40 Billion Years, Alpha Decay

Uranium (U) – Lead (Pb) Process

- Used to date old age rocks
- Not used for organic Carbon-based fossils
- Using present-day process rates, it is used to show ages on the order of 4.6 Billion Years
- Complex decay sequence from initial Unstable Parent to Stable Daughter Element

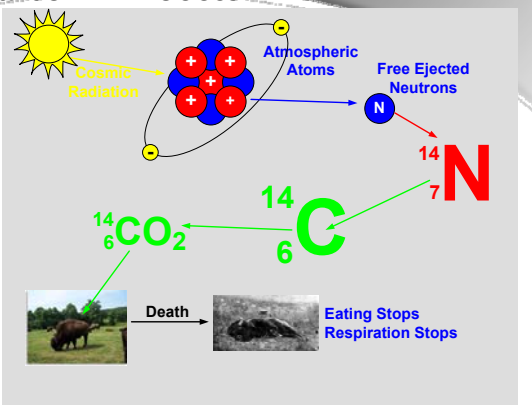
Uranium (U) – Lead (Pb) Process



Carbon-14 Process

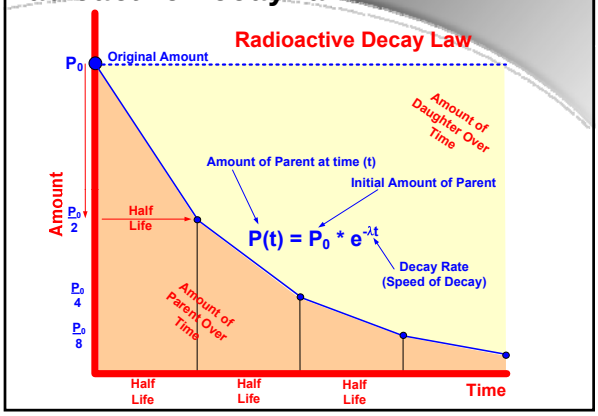
- Used to date organic material (e.g., bones, tissue, etc)
- Half life of 5730 years
- Complex Life Cycle
- Created in upper atmosphere through cosmic radiation and Nitrogen
- Maximum dates up to 62,000 years (assuming uniformity)

Carbon 14 Process

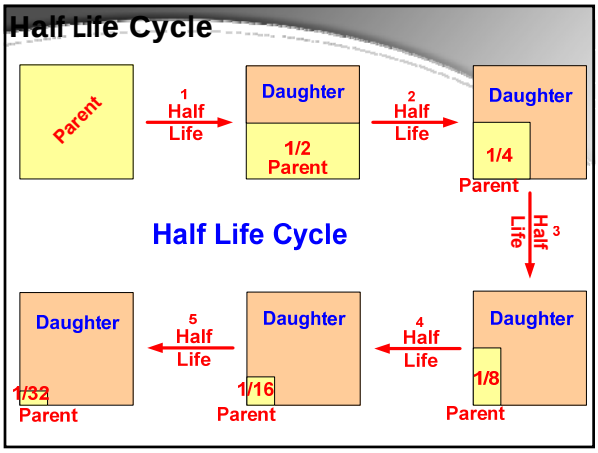


THE RADIOACTIVE DECAY LAW

Radioactive Decay Law

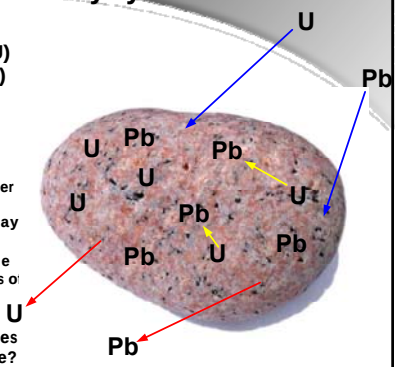


Half Life Cycle



The Radioactive Decay System

- A "specimen" contains Parent (U) and Daughter (Pb) elements.
  - Has the system been closed over time?
    - Is all the Daughter a result of radioactive decay of the Parent?
    - Can we know the original amounts of Parent and Daughter?
  - Are the decay rates constant over time?

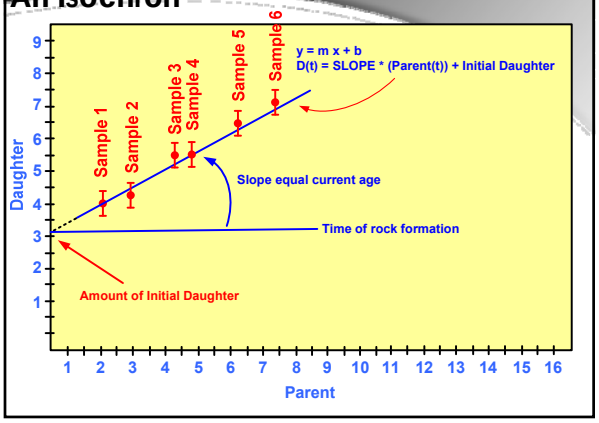


Determining the Age of the Specimen

$$t = \frac{1}{\lambda} * ln\left[\left(\frac{D(t) - D0}{P(t)}\right) + 1\right]$$

- Assumptions in the above equation:
  1. Decay rate (λ) is constant over time
  2. Initial amount of Daughter Element (D0) is known
  3. The system has been closed over time

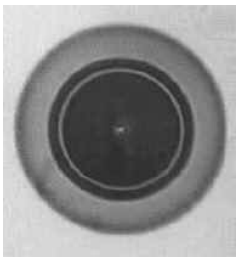
An Isochron

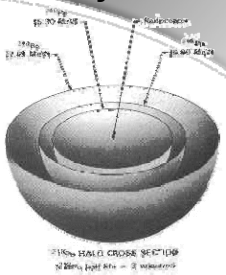


Discordances of Isochrons

- Discordant Potassium-Argon Model and Isochron "Ages" for Cardenas Basalt (Middle Proterozoic) and Associated Diabase of Eastern Grand Canyon, Arizona, 1998 ICC, Steven Austin
- Whole-Rock K-Ar Model and Isochron, and Rb-Sr, Sm-Nd, and Pb-Pb Isochron, "Dating" of the Somerset Dam Layered Mafic Intrusion, Australia, 2003 ICC, Andrew Snelling
- Austin, S.A. (Ed.), *Grand Canyon: Monument to Catastrophe*, Institute for Creation Research, Santee, California, 1994.
- Snelling, A.A., Isochron discordances and the role of inheritance and mixing of radioisotopes in the mantle and crust; in Vardiman, L., Snelling, A.A., and Chaffin, E.F. (Eds.), *Radioisotopes and the Age of the Earth: Results of a Young-Earth Creationist Research Initiative*, Institute for Creation Research, El Cajon, California, and Creation Research Society, Chino Valley, Arizona, pp. 393–524, 2005.

Polonium Haloes and Decay Rates





Polonium 218 Halo

1. Inclusion had to exist BEFORE material became solid
2. Halos can only form when material is SOLID (e.g., crystal lattice exists)
3. Po Half-Lives are (Po218-3.05s, Po214-164microsecs, Po210-138.4days)

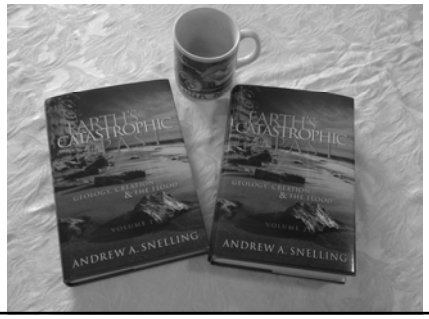
THE CREATION MODEL OF RADIOMETRIC DATING

International Conferences on Creationism

- Since 1986 key research has been peer-reviewed, published, and presented at the International Conferences on Creationism (1986, 1990, 1994, 1998, 2003, 2008)

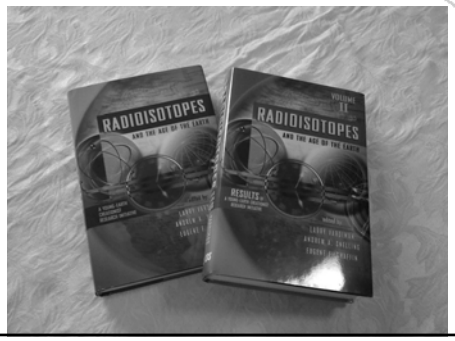
Earth's Catastrophic Past

- Considered to be the updating of the Genesis Flood (Whitcomb and Morris, 1961), Andrew Snelling has authored what many consider to be the current geological understanding of the creation model of origins.



RATE Group

- The development of a creation model of Radiometric Dating RATE - *R*adiometric *A*ge of *t*he *E*arth



? QUESTIONS ?

References

1. Austin, Steven, Grand Canyon: Monument to Catastrophe, Institute for Creation Research, Santee CA, 1994
2. Coffin, Harold, Origin by Design, Review and Harald Publishing, Haegerstown, MD, 1983
3. Dalrymple, G. Brent, The Age of the Earth, Stanford University Press, Stanford, CA, 1991
4. Dillow, Joseph, The Waters Above, Moody Press, Chicago, IL, 1981
5. Morris and Whitcomb, The Genesis Flood, Baker Book House, Grand Rapids, MI, 1961
6. Poole, Lynn and Gray, Carbon-14, McGraw Hill, New York, NY, 1961
7. **Snelling, Andrew, Earth's Catastrophic Past: Geology, Creation, and the Flood, ICR, Dallas, TX, 2009**
8. Slusher, Harold, Critique of Radiometric Dating, Institute for Creation Research, San Diego, CA, 1973
9. **Vardiman, Snelling, Chaffin, et al, Radioisotopes and the Age of the Earth, ICR, Santee, CA, Vol. 1 & 2, 2000 & 2005 respectively**

Papers from the International Conferences on Creationism

1. Wise, Kurt P., **The Way Geologists Date**, 1986, Vol. 1
2. Cook, Melvin, **Nonequilibrium Dating Substantiated**, 1986, Vol. 2
3. Snelling, Andrew, **U-Th-Pb: An Example of False Isochrons**, 1994
4. Austin & Snelling, **Discordant K-Ar Model and Isochron Ages for Cardenas Basalt and Associated Diabase of Eastern Grand Canyon, AZ**, 1998