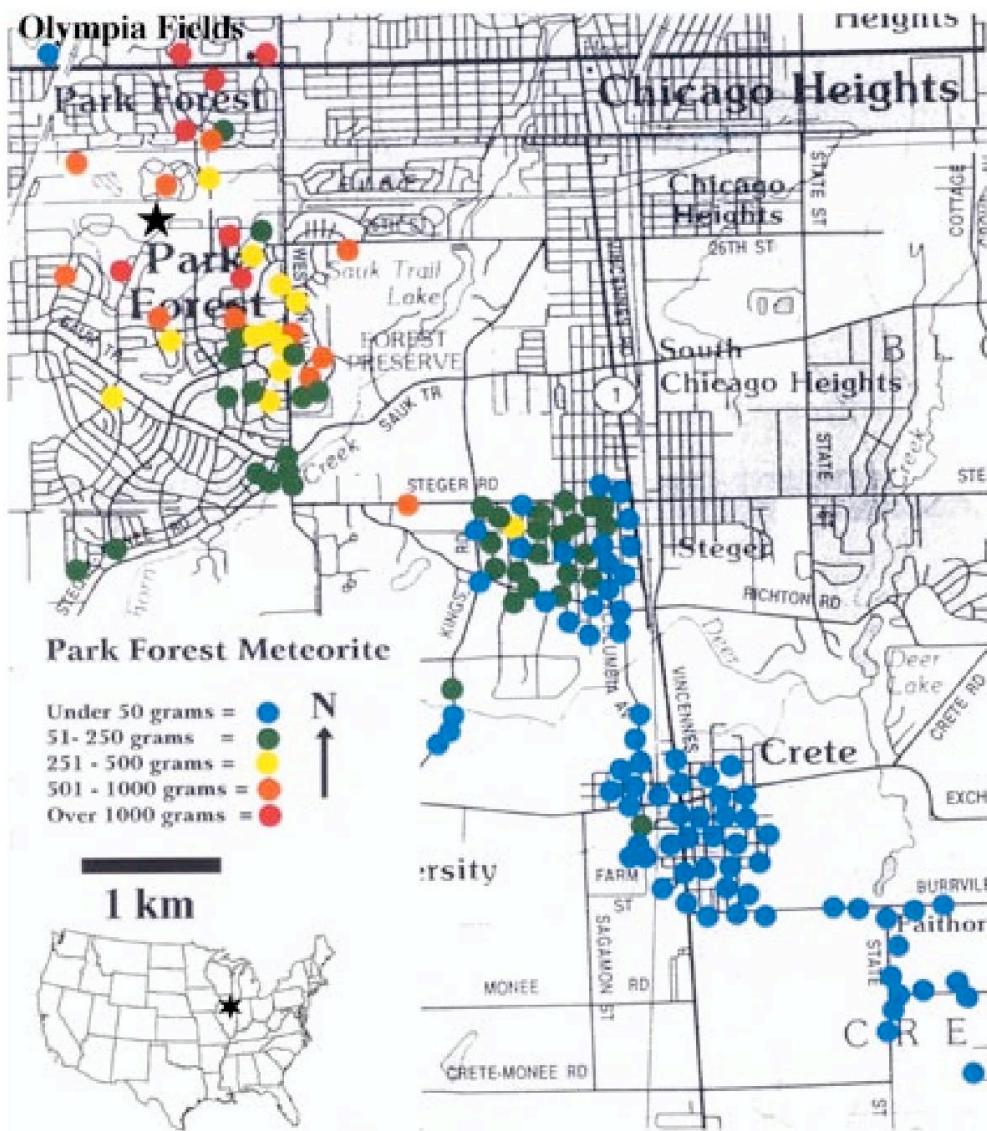


The Age of Things: Sticks, Stones and the Universe

Meteorites and the Age of the Solar System

<http://cfcp.uchicago.edu/~mmhedman/compton1.html>

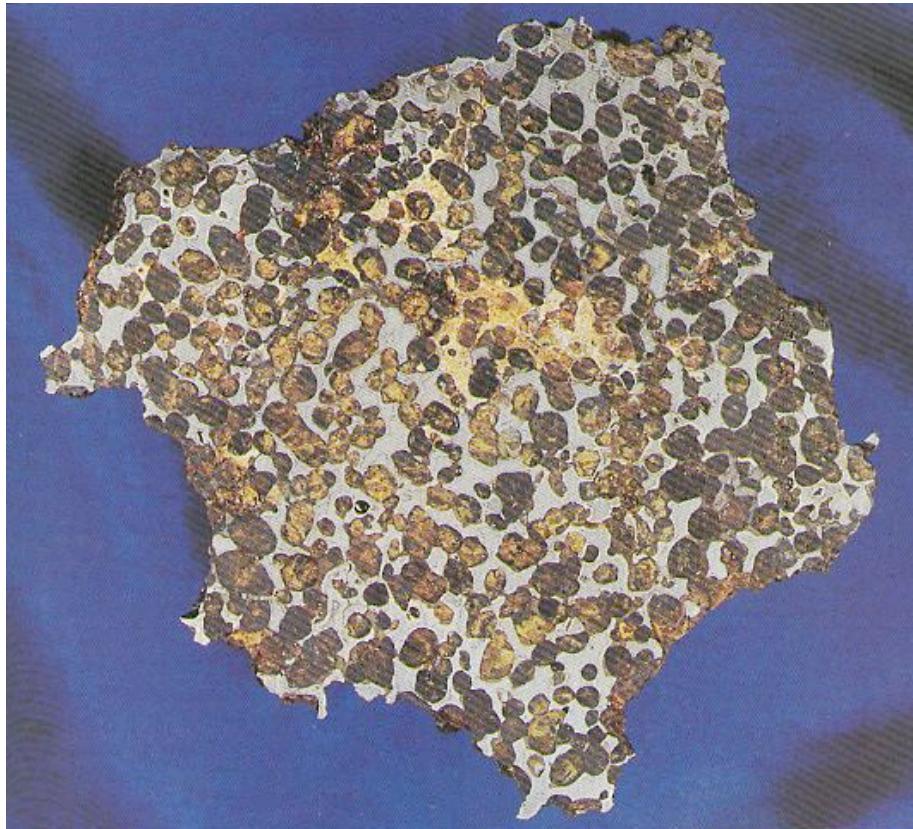
March 26, 2003 The Park Forest Meteorite



Images from Simon et al *Meteoritics and Planetary Science* Vol 39 (2004)

Different Types of Meteorites

Iron

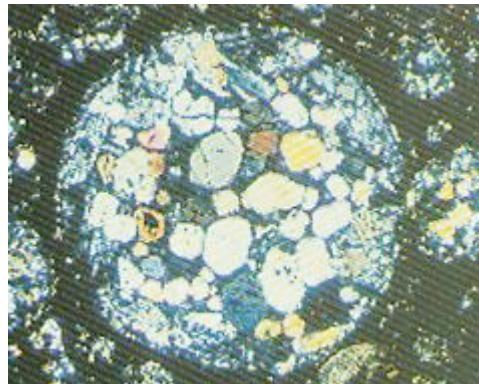


Stony

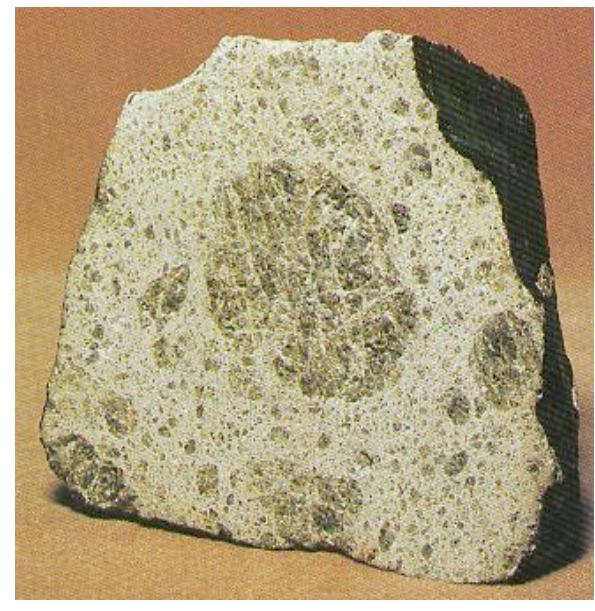
Different Types of Stony Meteorites



Chondrite



Achondrite

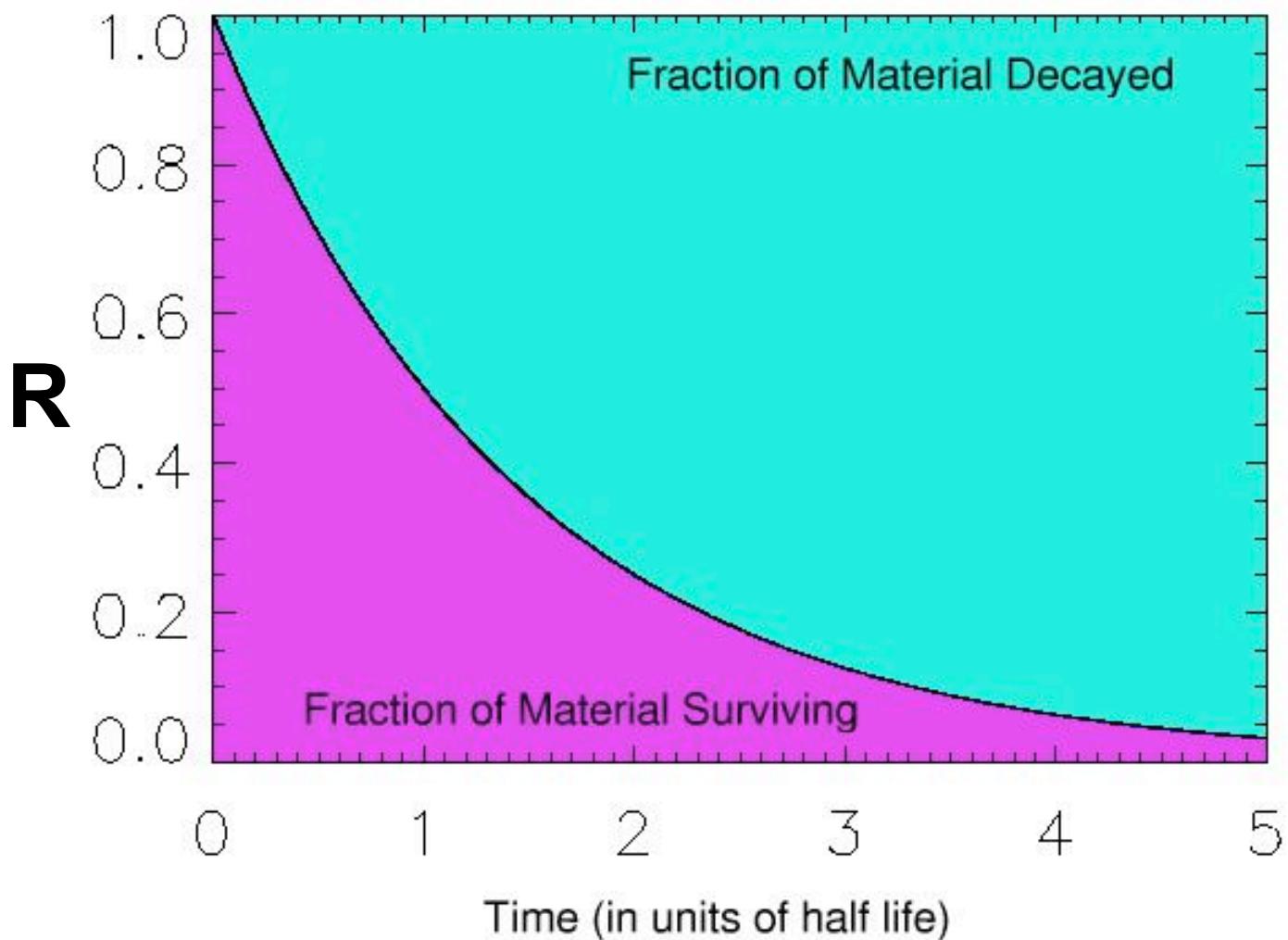




WARNING!

**Astrophysicist
talking
about Meteorites!**

$$R = \frac{\text{Current amount of Radioactive Nuclei}}{\text{Original amount of Radioactive Nuclei}}$$

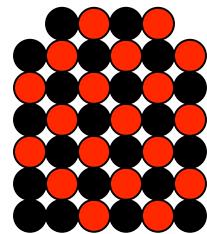


Potassium-Argon System

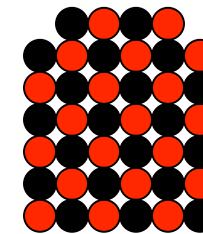
● Proton ● Neutron

Potassium 40

90%



Calcium 40

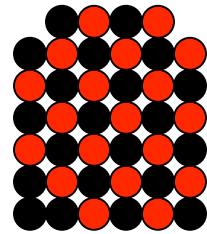


electron

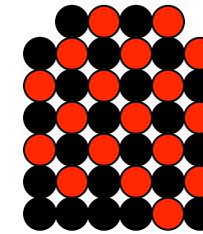
neutrino

Potassium 40

10%



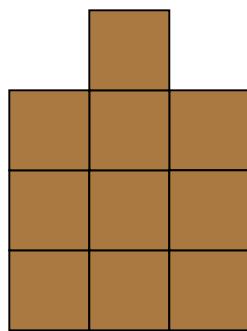
Argon 40



electron

neutrino

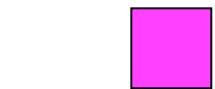
The Rock Today



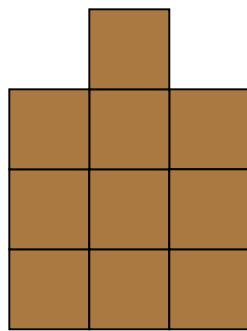
Potassium-40



Calcium-40



Argon-40



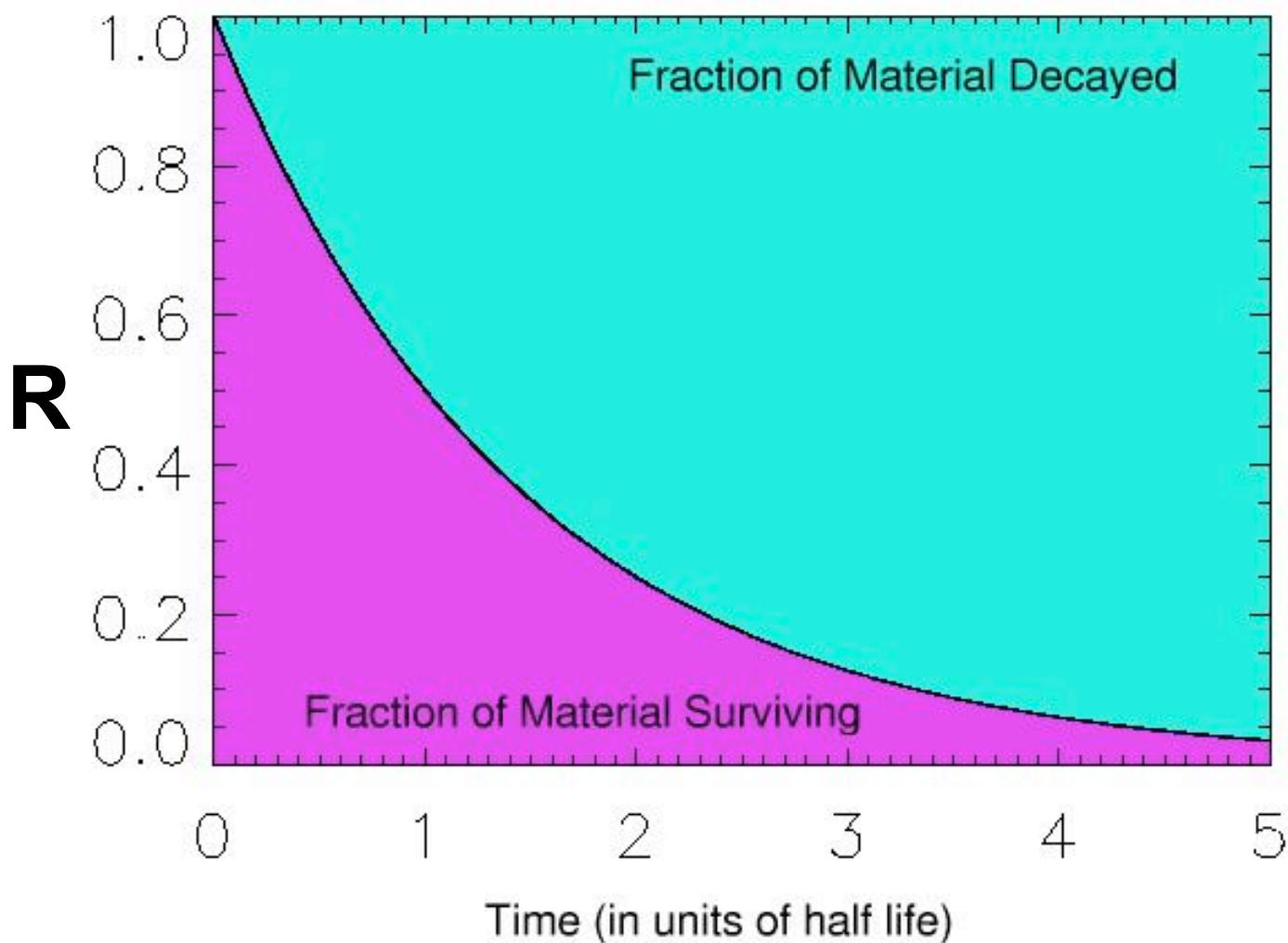
Potassium 40



Calcium-40

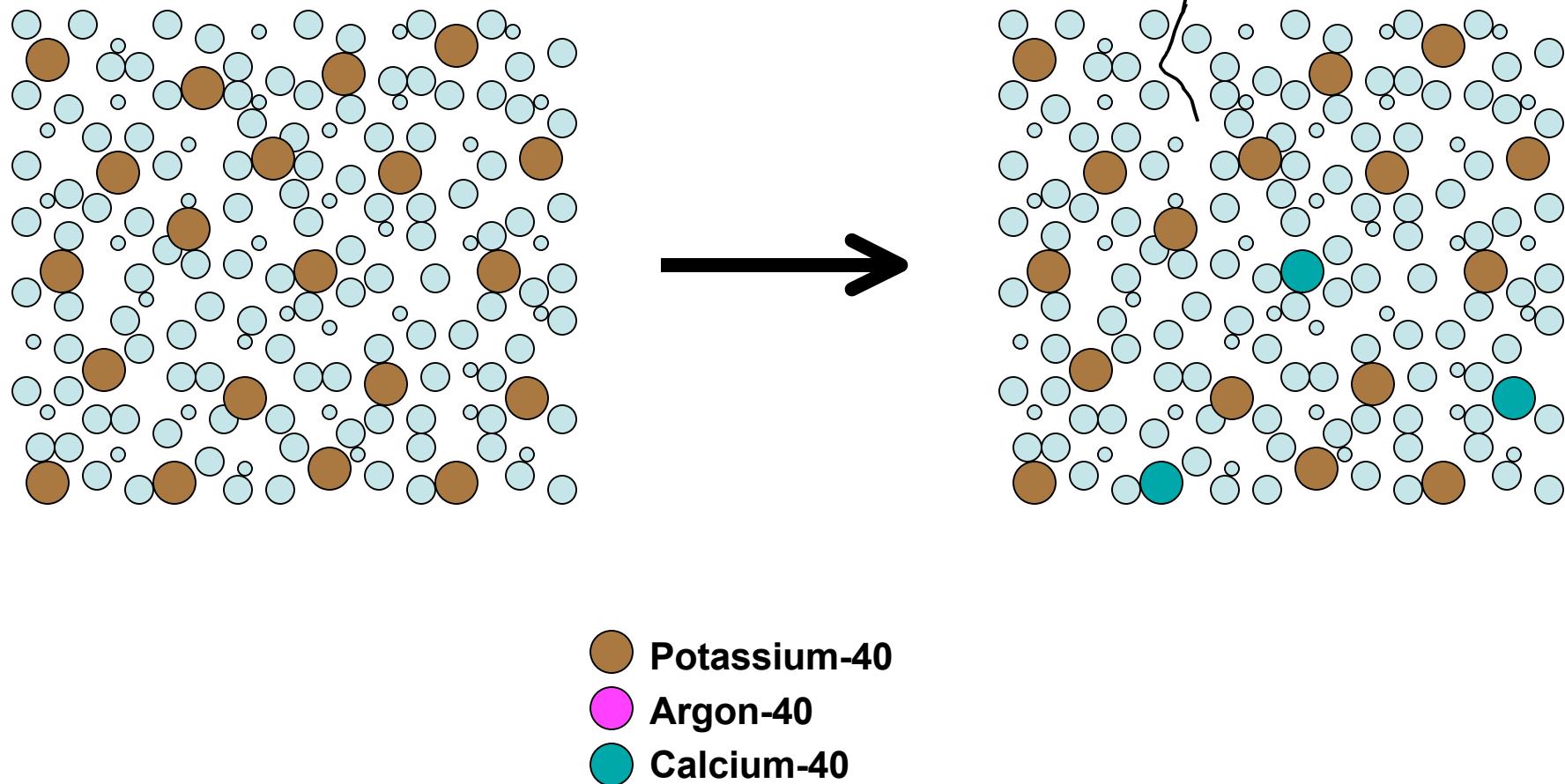
The Original Rock

$$R = \frac{\text{Current amount of Potassium-40}}{\text{Original amount of Potassium-40}}$$

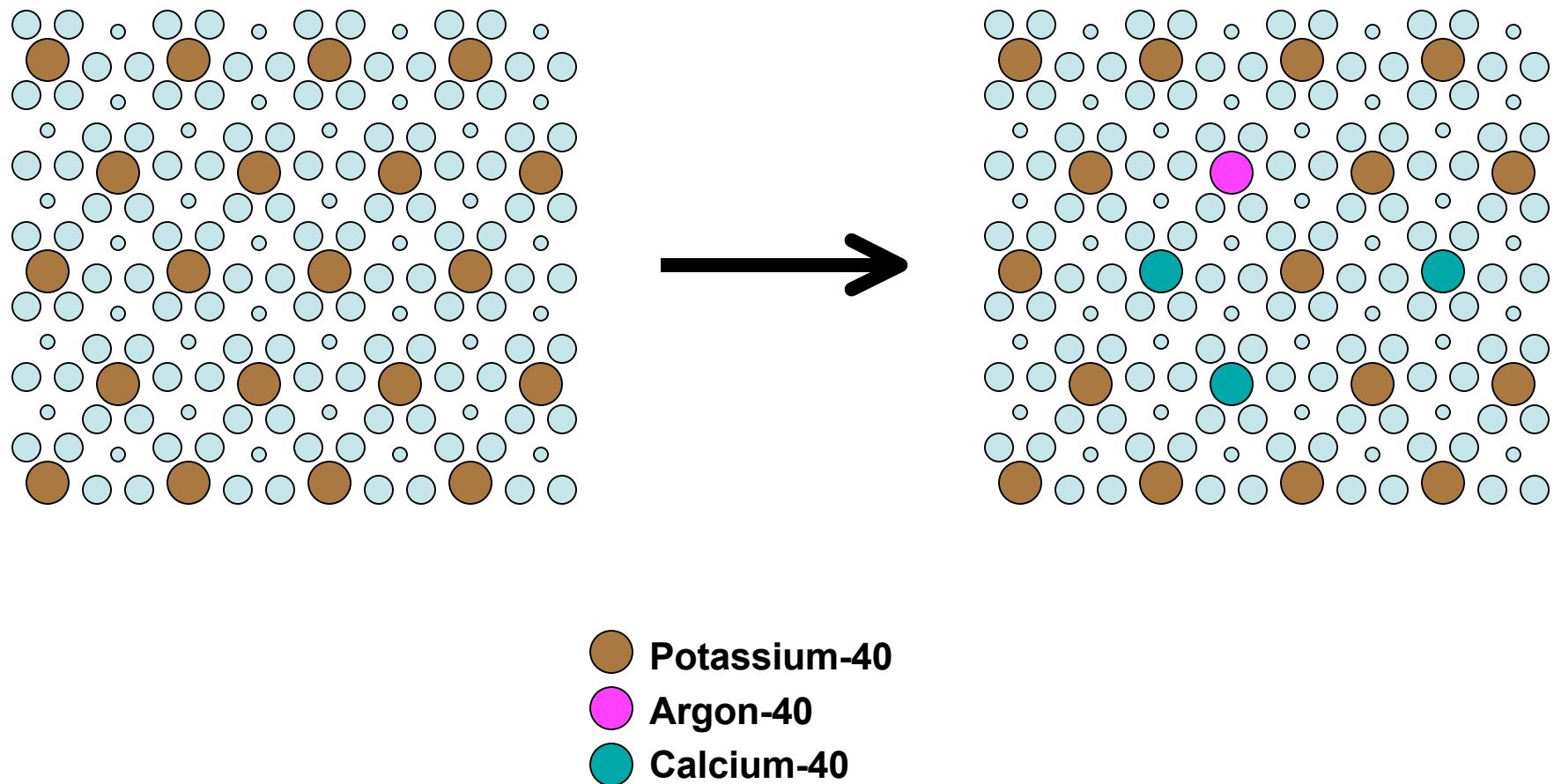


Half-Life of Potassium-40 is 1.25 billion years

Potassium-40 decay in molten rock



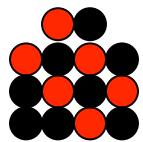
Potassium-40 decay in solid rock



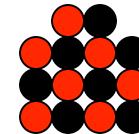
Rubidium-Strontium System

● Proton ● Neutron

Carbon 14



Nitrogen 14

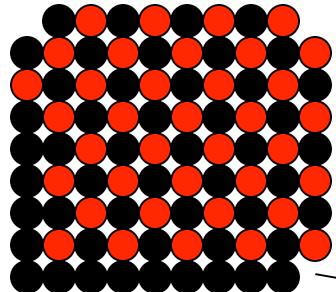


electron

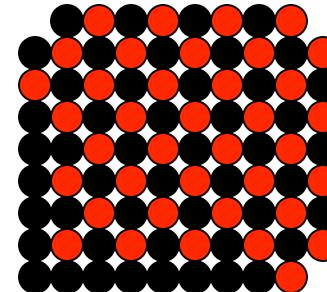
neutrino

Half-Life = 5700 Years

Rubidium-87



Strontium-87



electron

neutrino

Half-life = 49 Billion Years

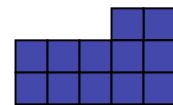
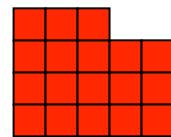
Rubidium-Strontium Dating

Rubidium-87

Strontium-87

Today

Mineral 1



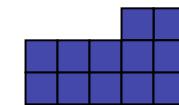
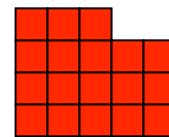
Rubidium-Strontium Dating

Rubidium-87

Strontium-87

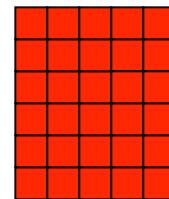
Today

Mineral 1



Originally

Mineral 1



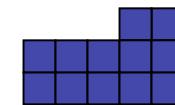
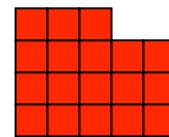
Rubidium-Strontium Dating

Rubidium-87

Strontium-87

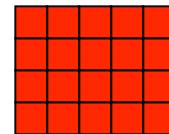
Today

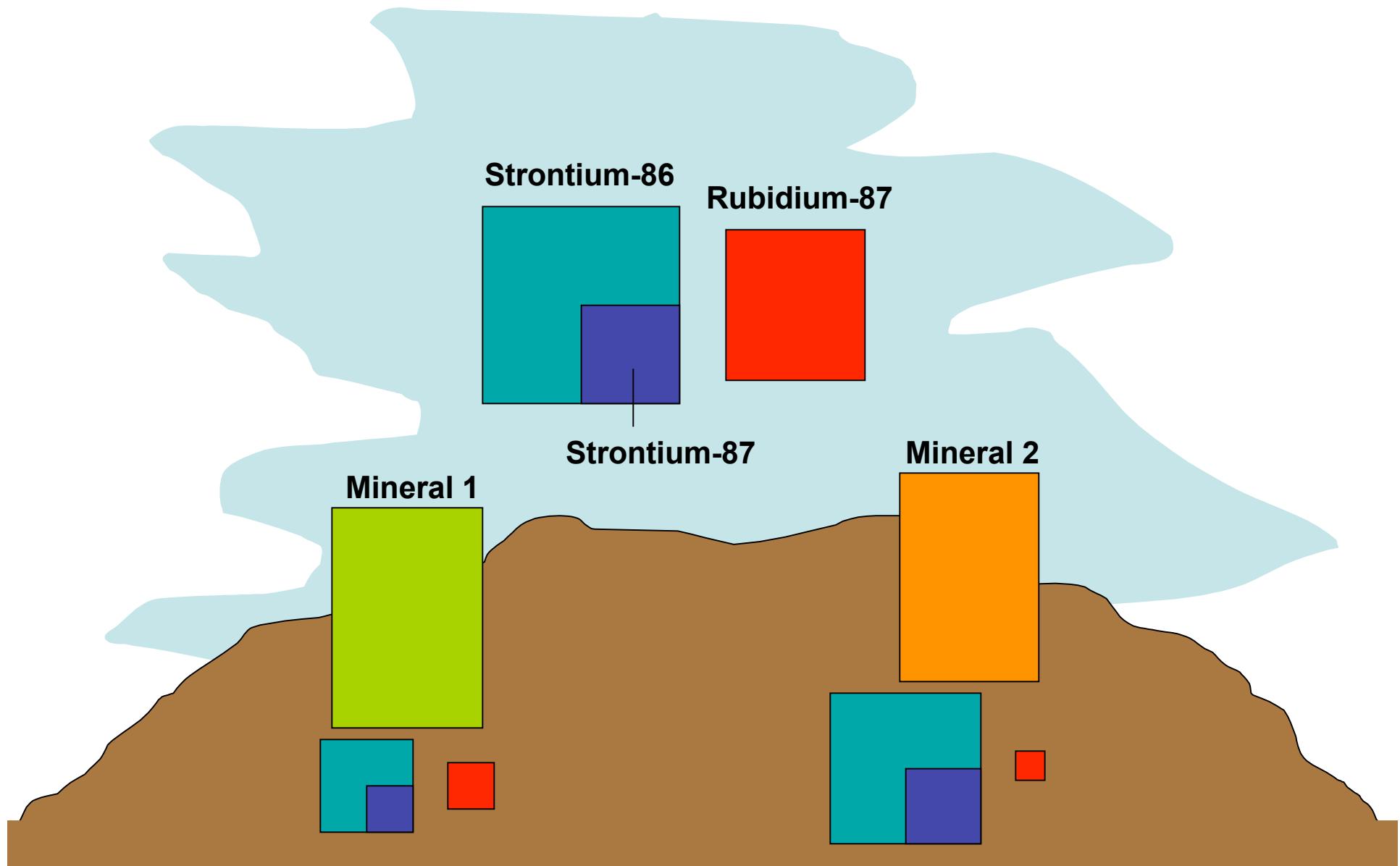
Mineral 1



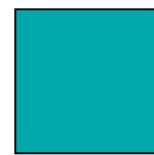
Originally

Mineral 1

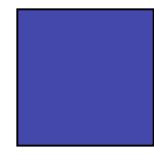




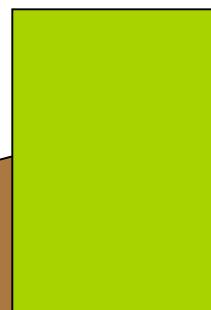
Strontium-86



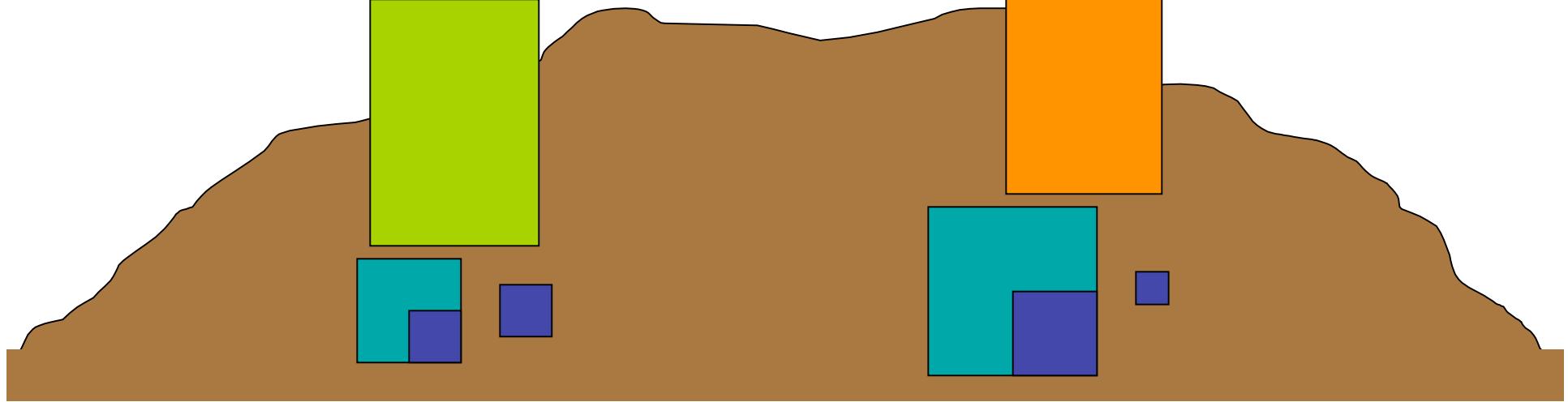
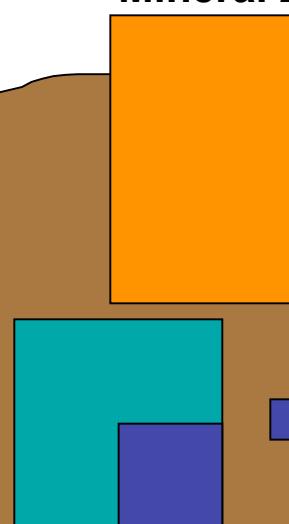
Strontium-87



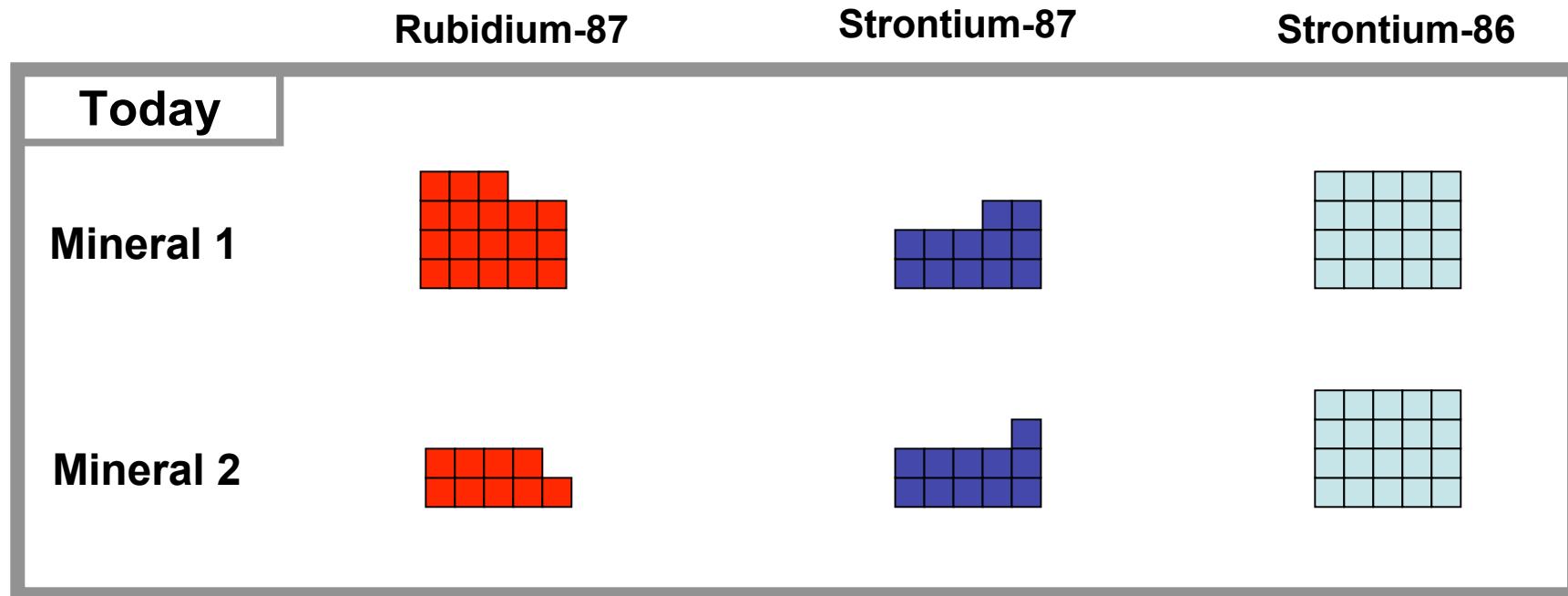
Mineral 1



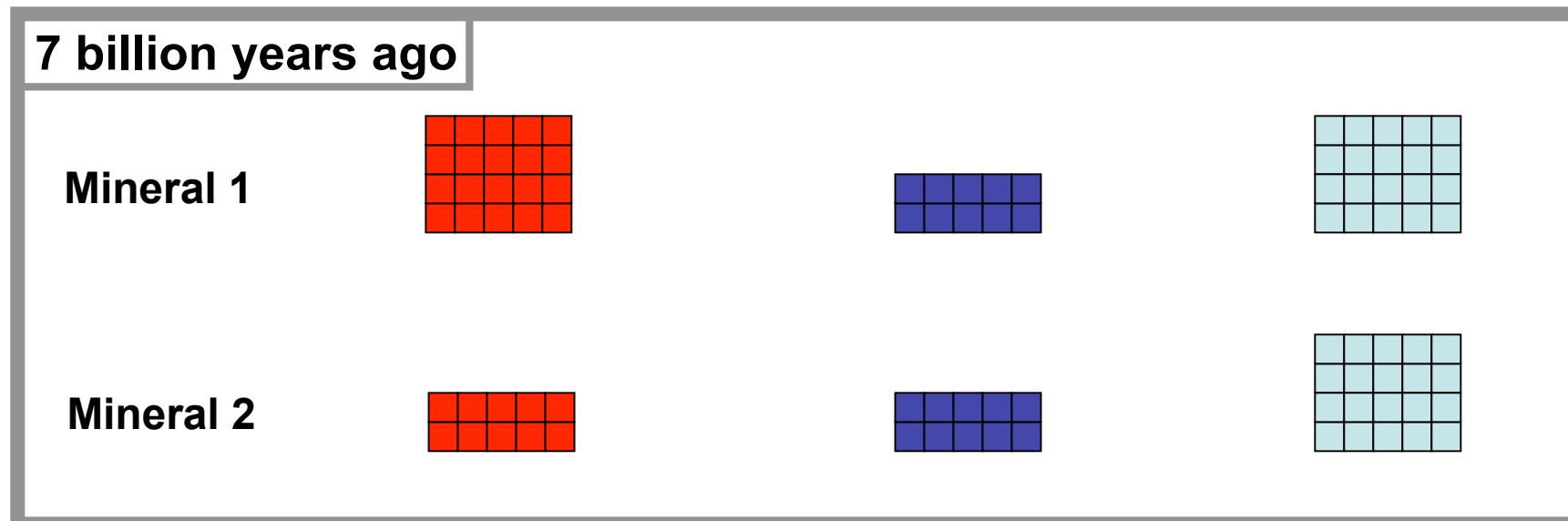
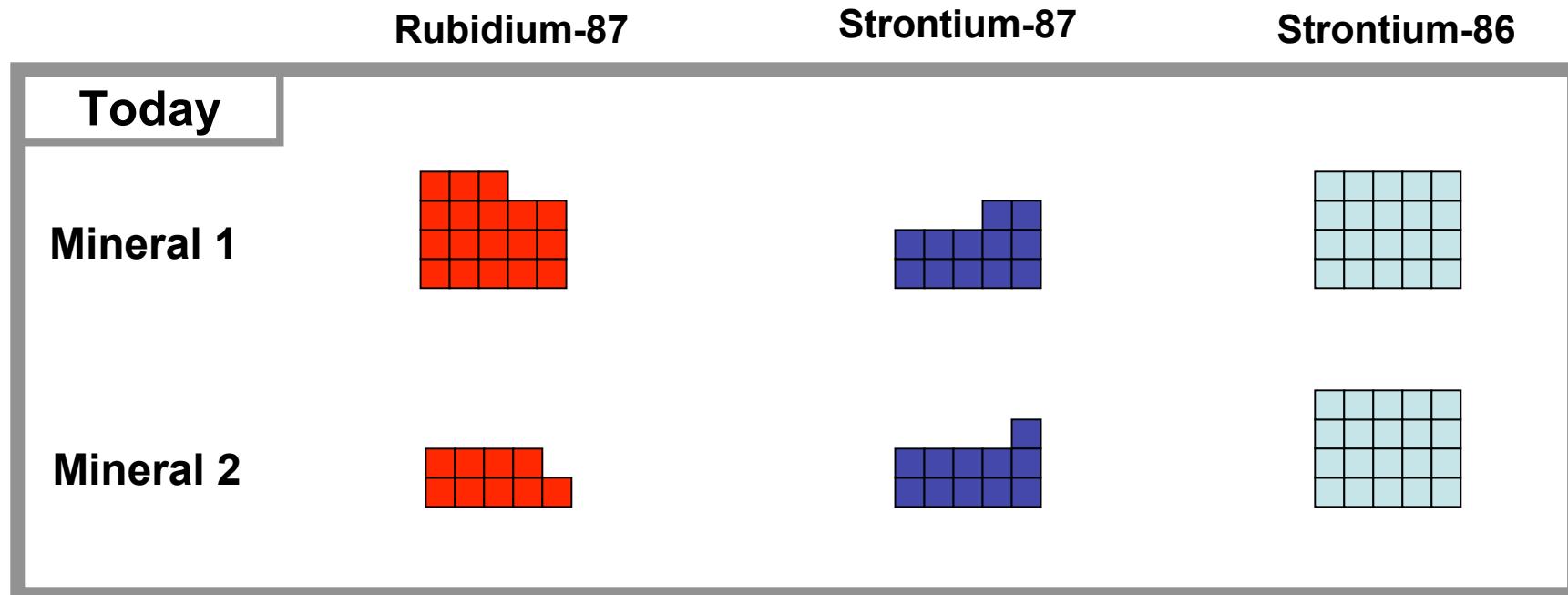
Mineral 2



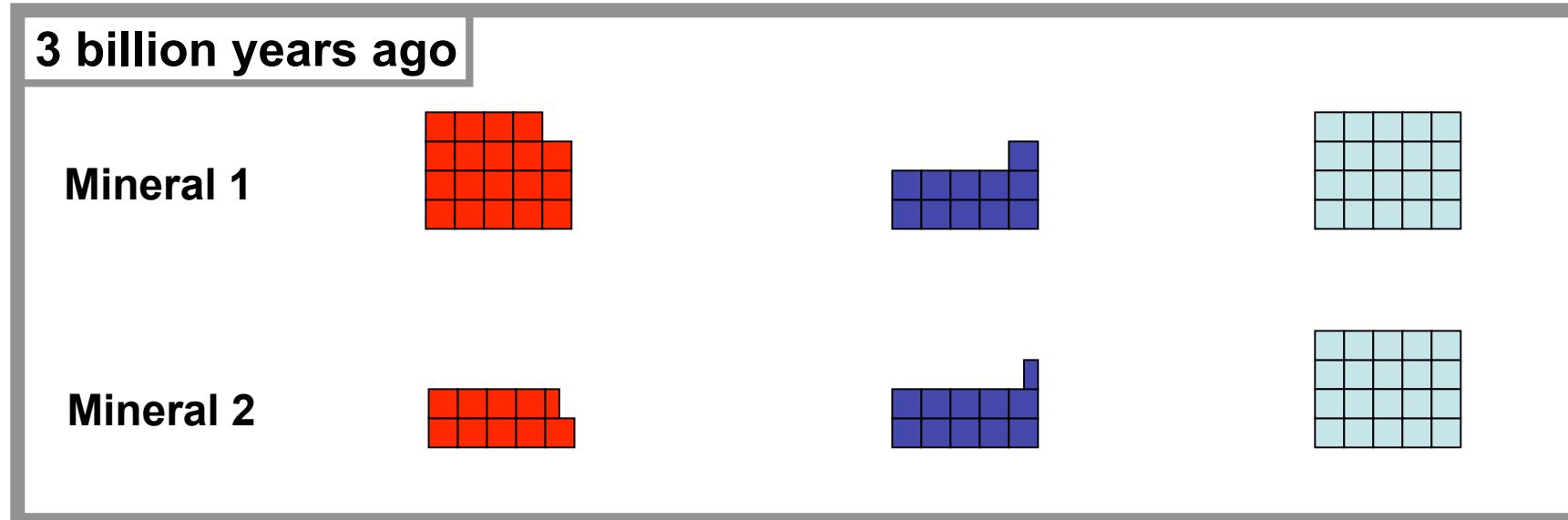
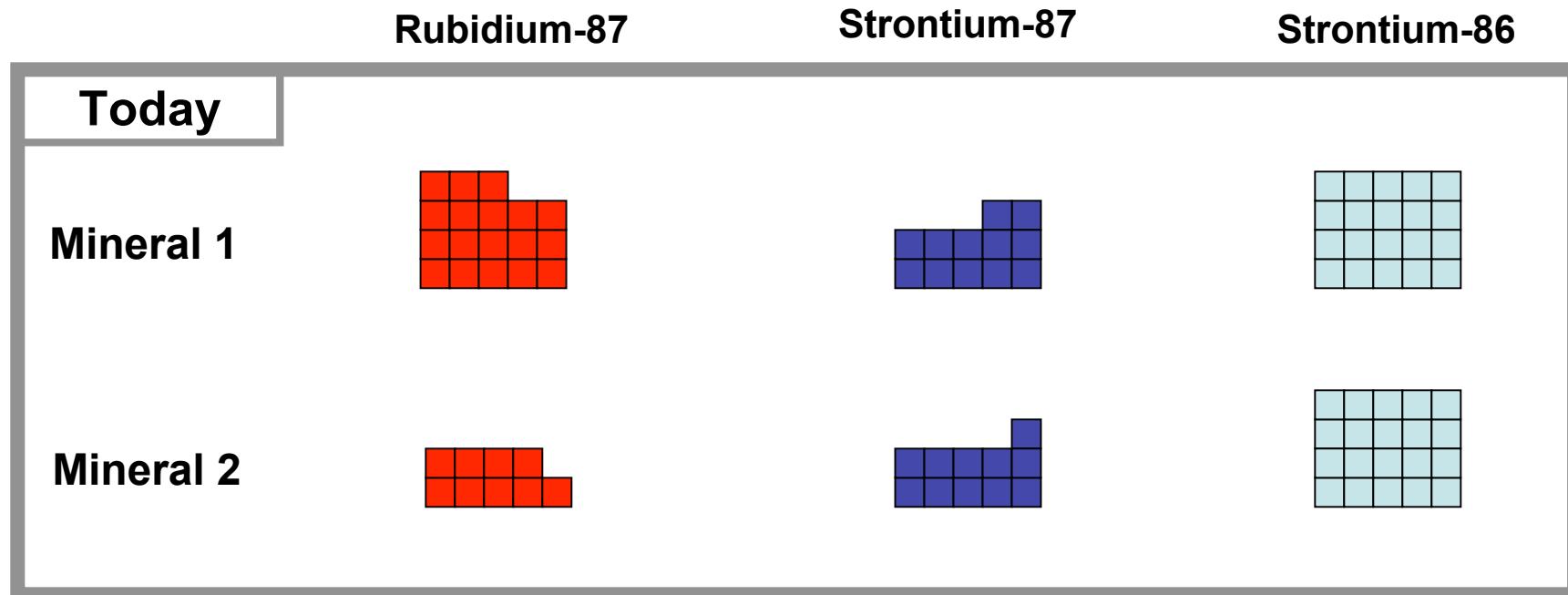
Rubidium-Strontium Dating



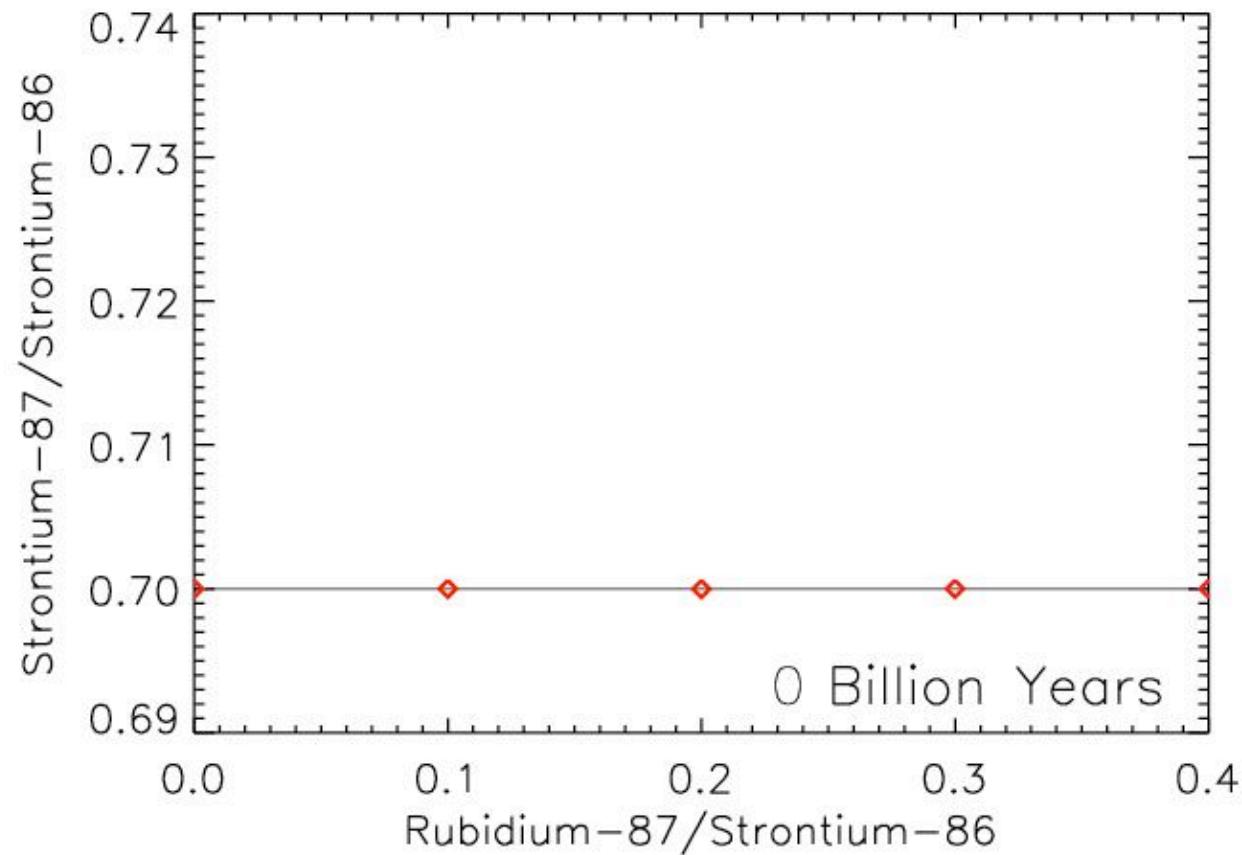
Rubidium-Strontium Dating



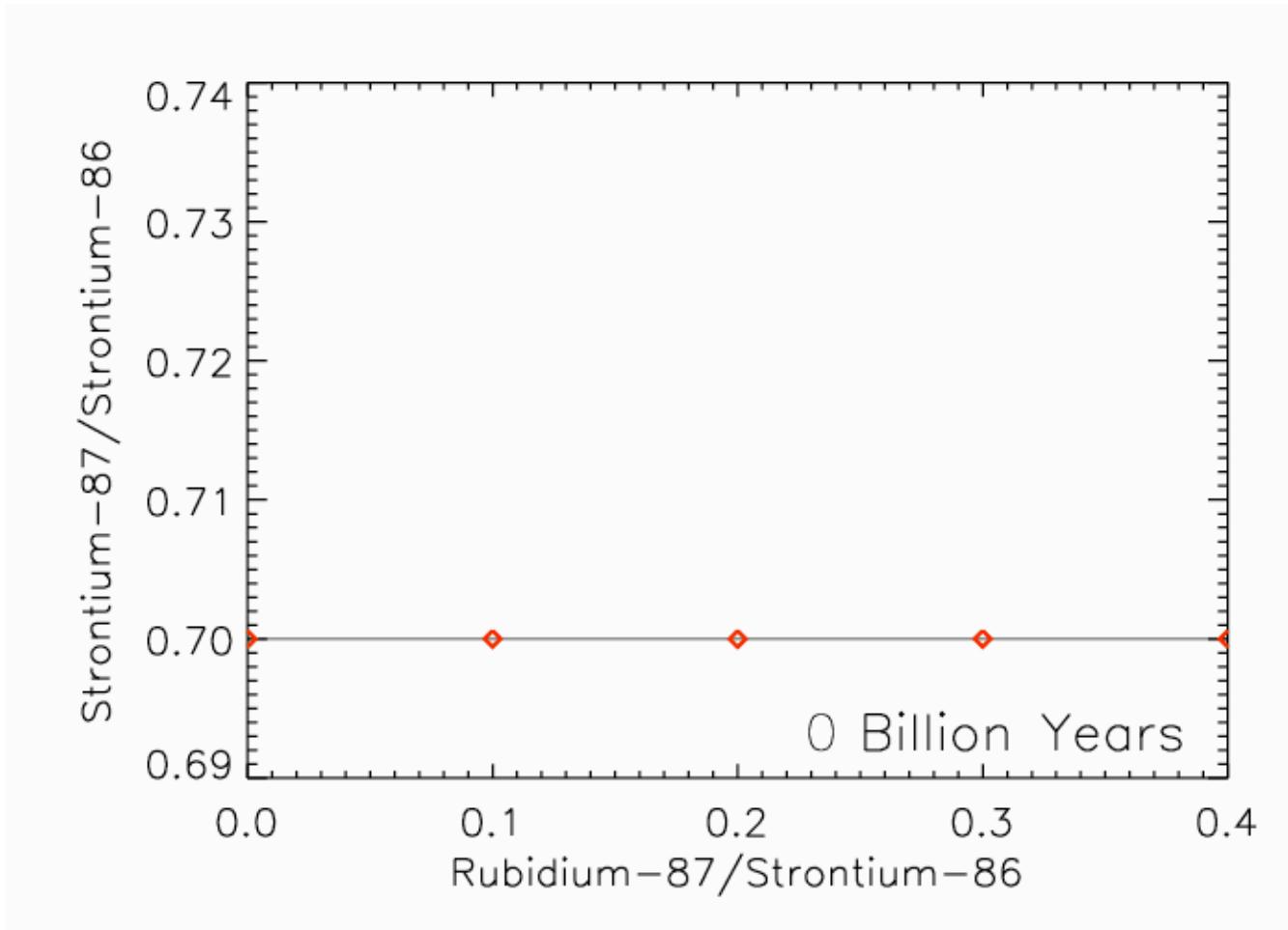
Rubidium-Strontium Dating



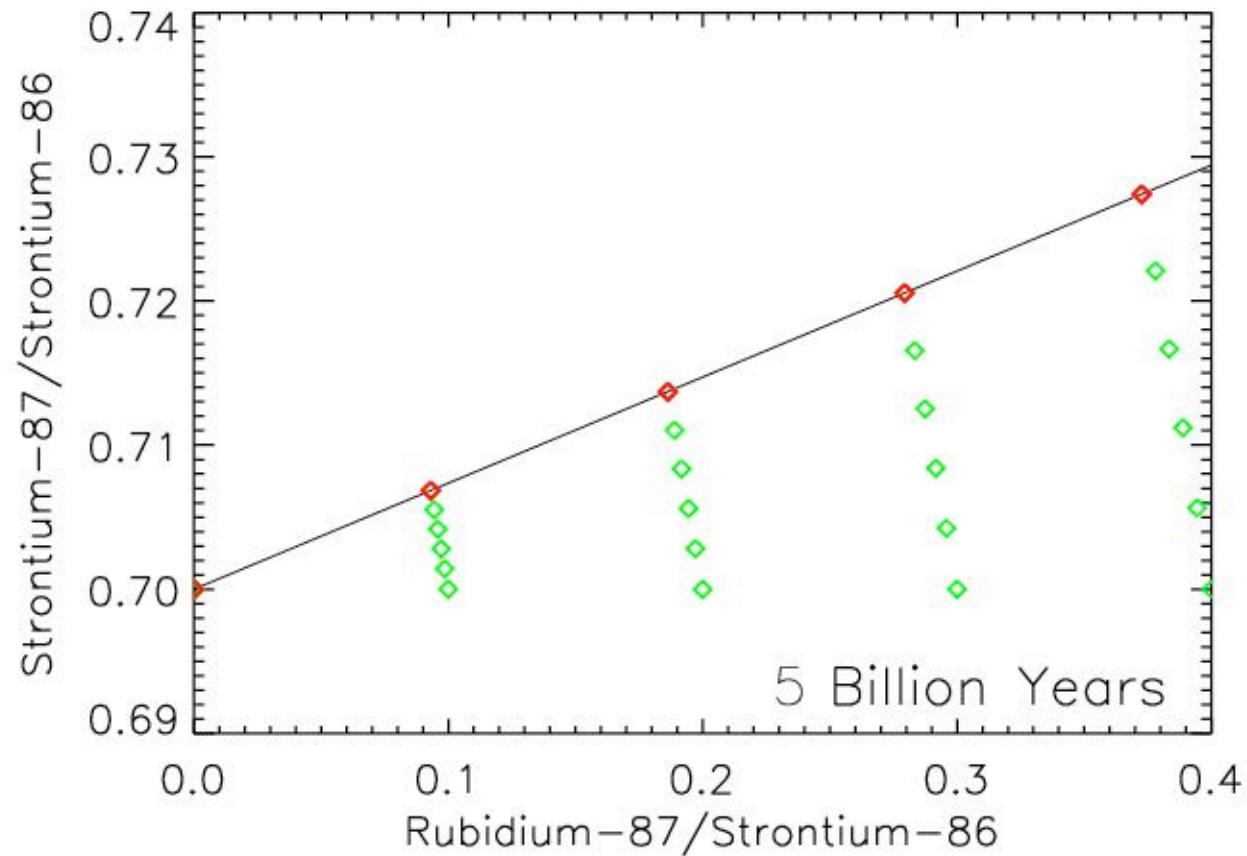
Rubidium-Strontium Isochron Plots



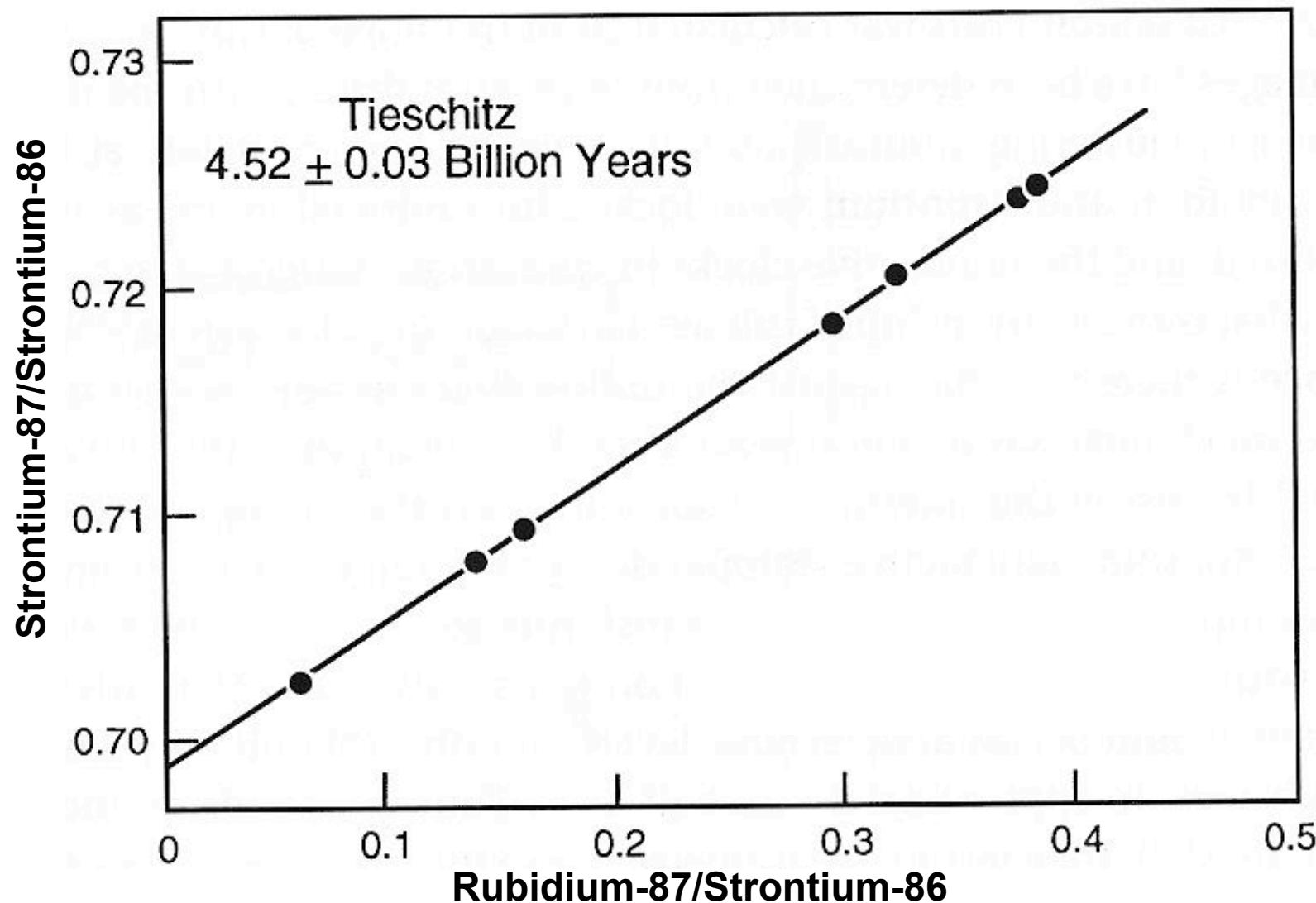
Rubidium-Strontium Isochron Plots



Rubidium-Strontium Isochron Plots



Rubidium-Strontium Ages

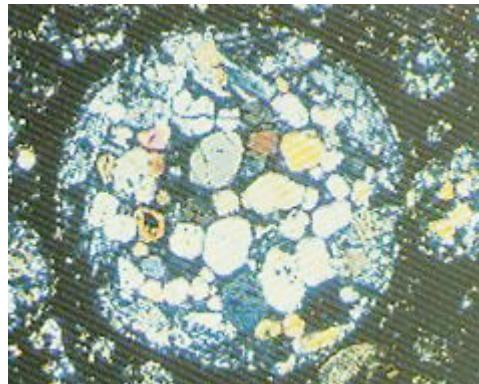


From McSween 2000 *Meteorites and Their Parent Planets*

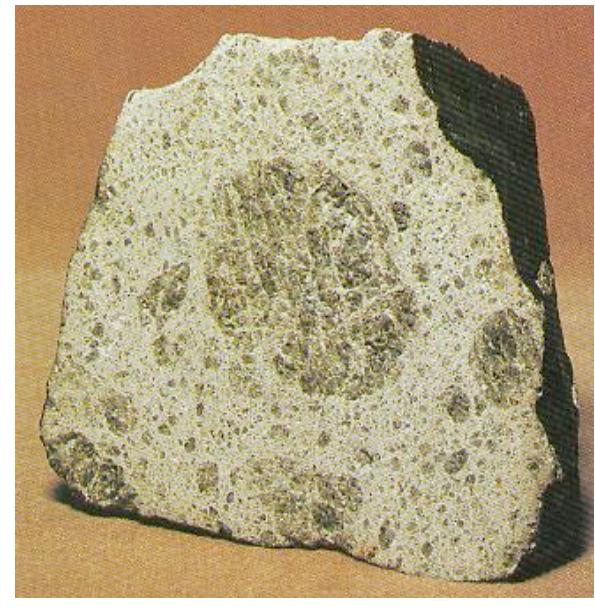
Different Types of Stony Meteorites

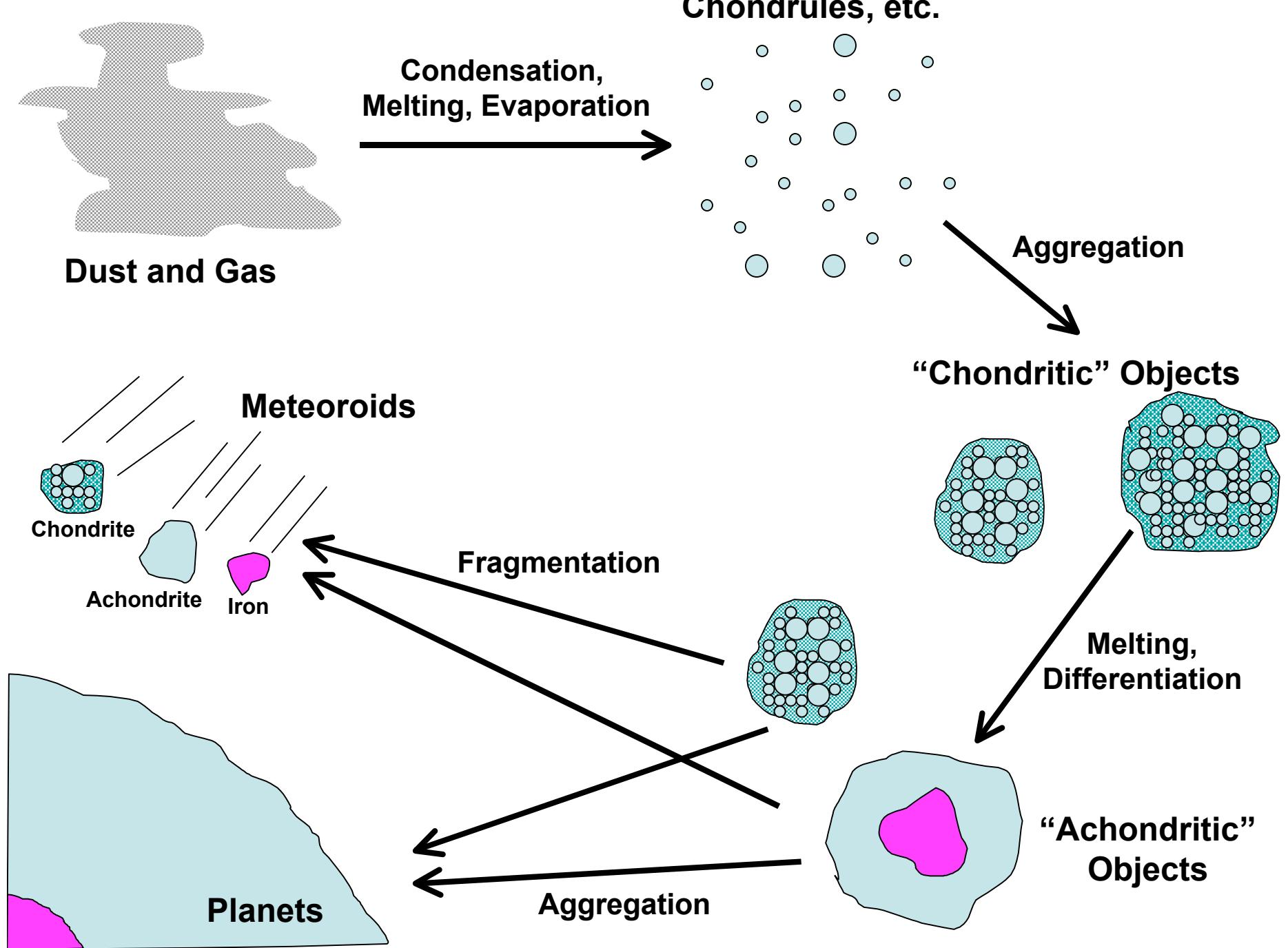


Chondrite



Achondrite

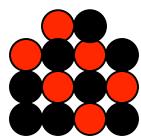




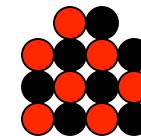
Aluminum-26 System

● Proton ● Neutron

Carbon 14



Nitrogen 14

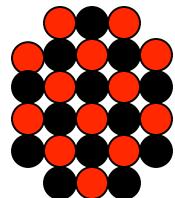


• electron

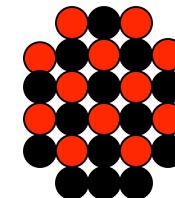
• neutrino

Half-Life = 5700 Years

Aluminum-26



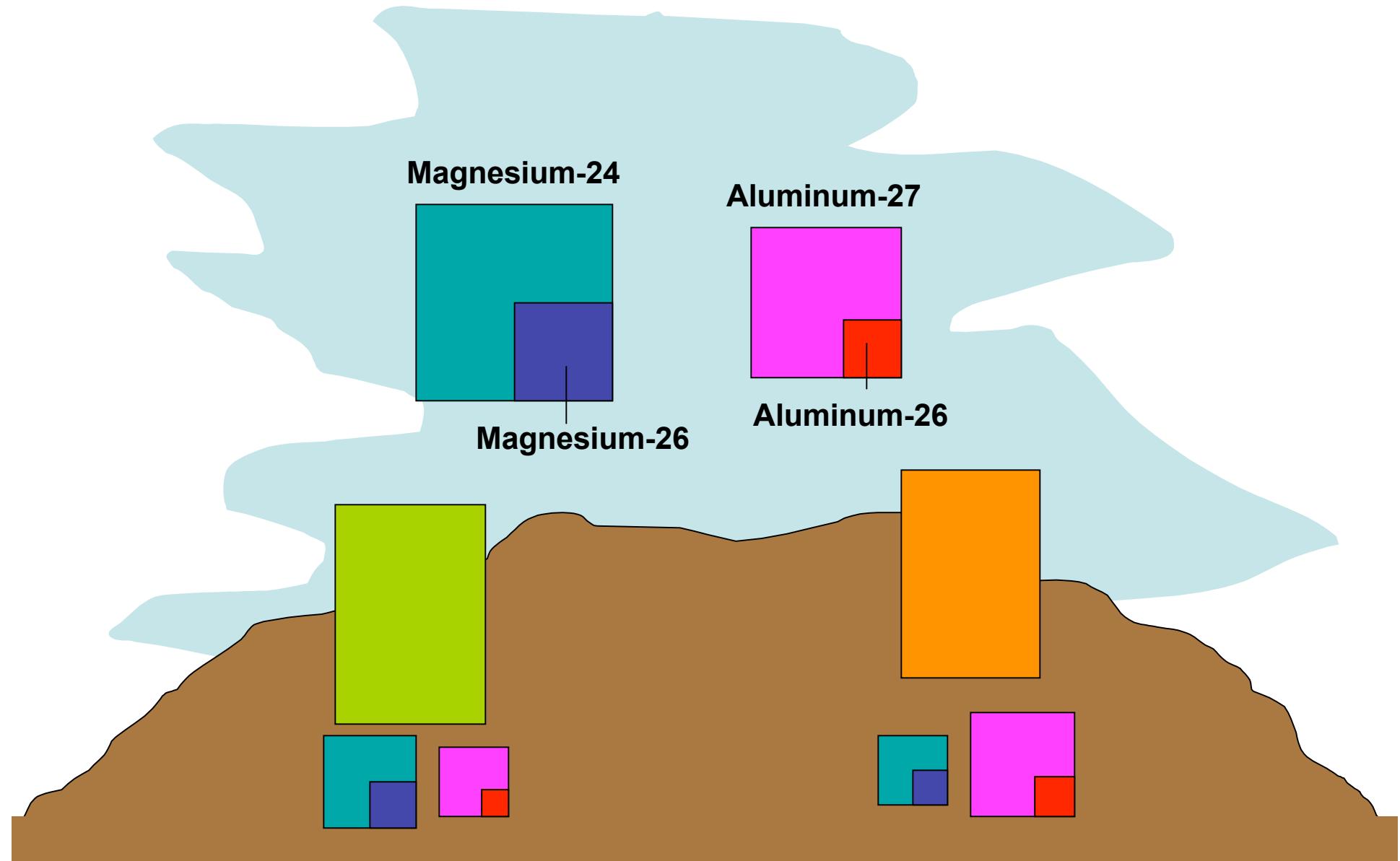
Magnesium-26

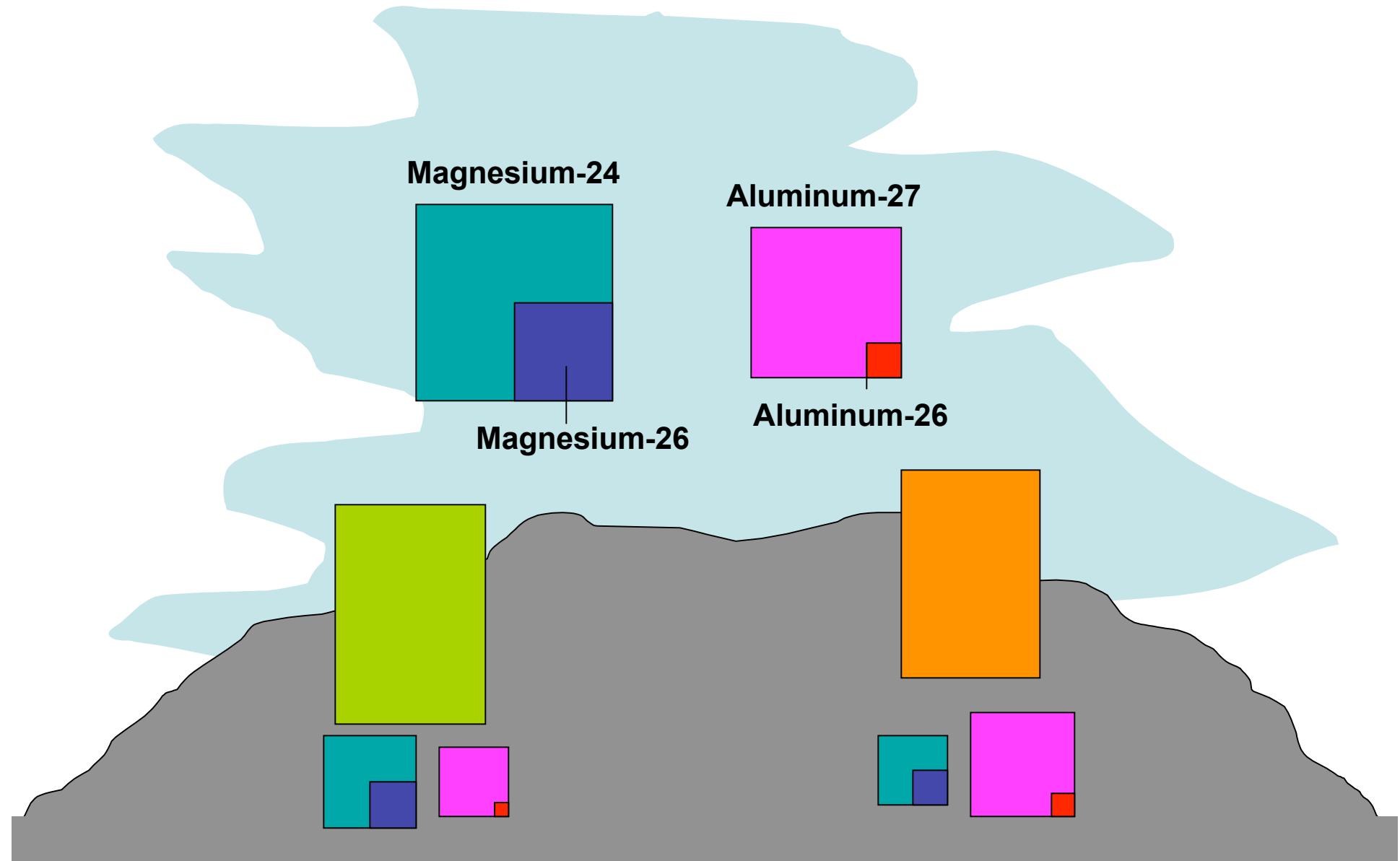


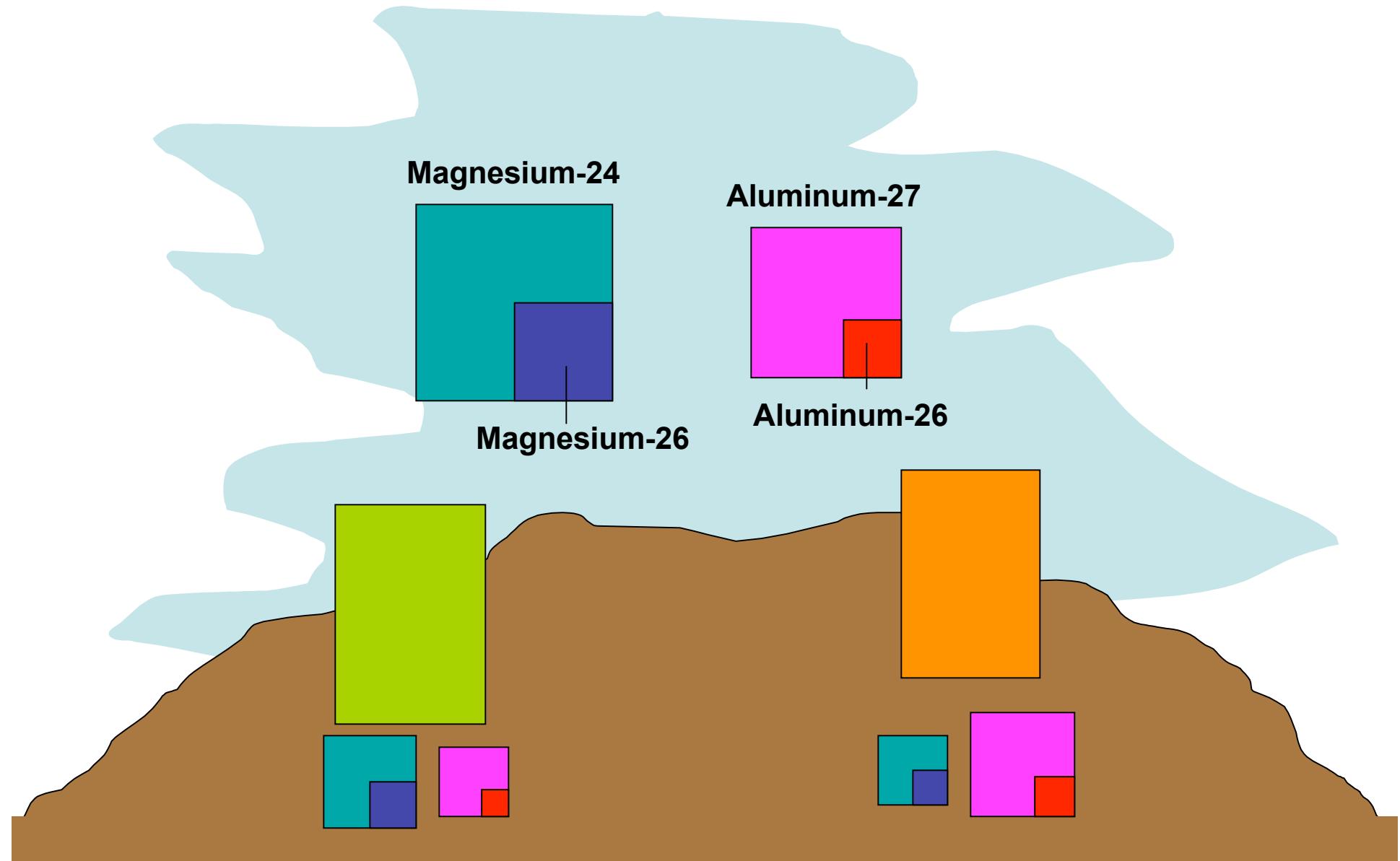
• positron

• neutrino

Half-Life = 700,000 Years







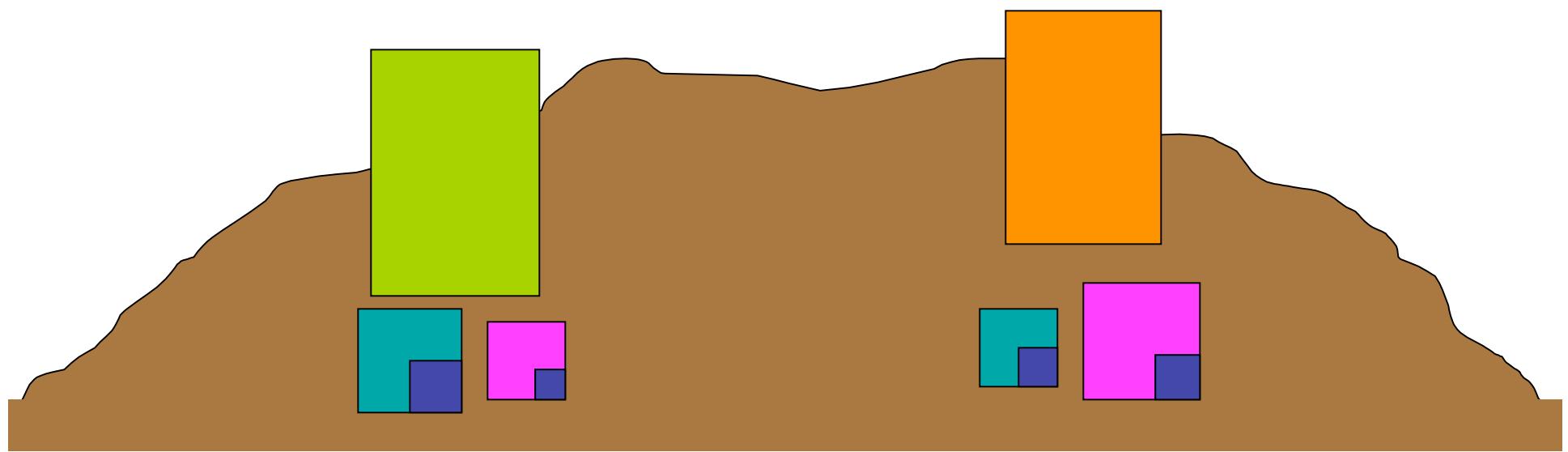
Magnesium-24



Magnesium-26



Aluminum-27



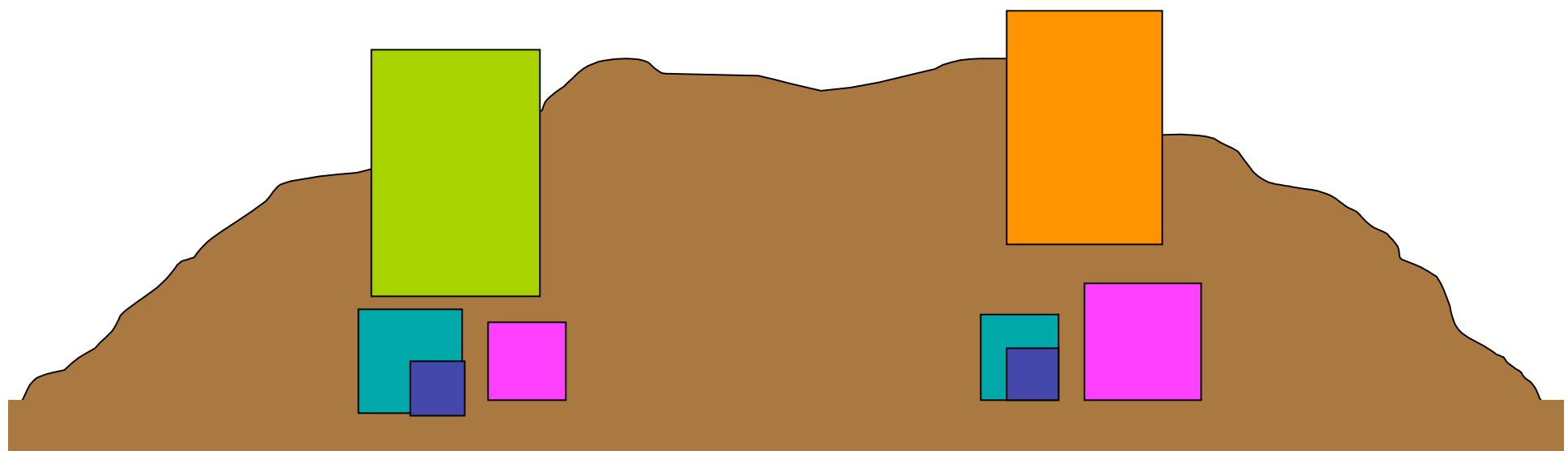
Magnesium-24



Magnesium-26

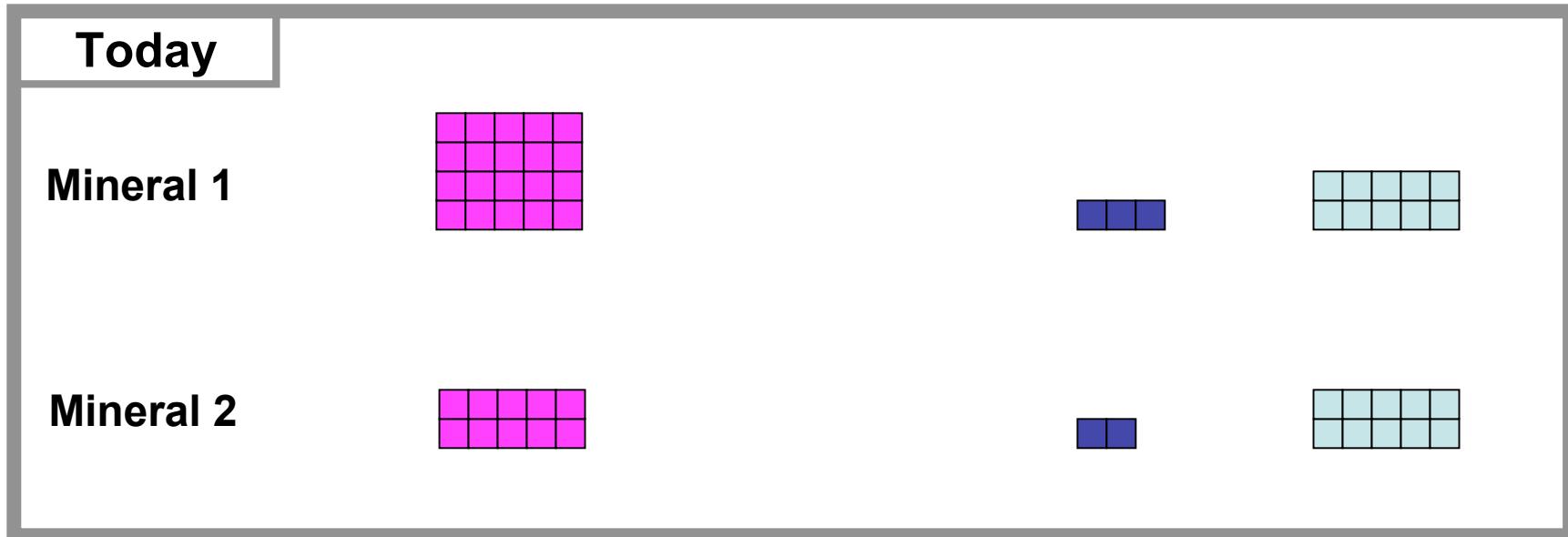


Aluminum-27



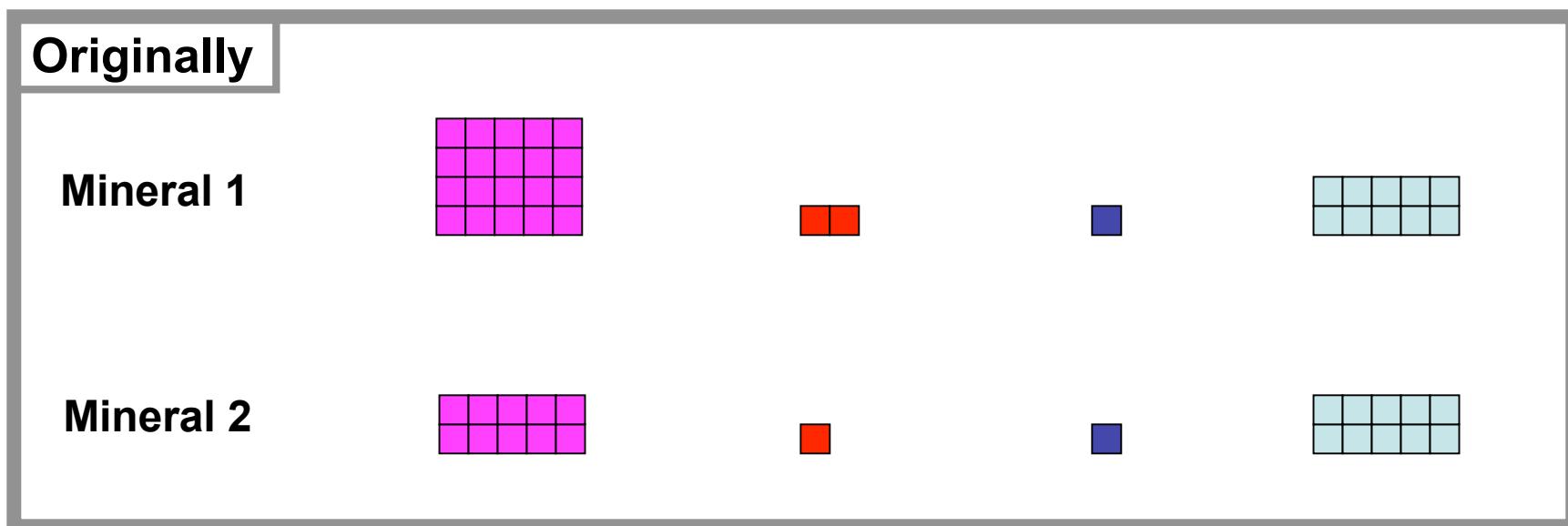
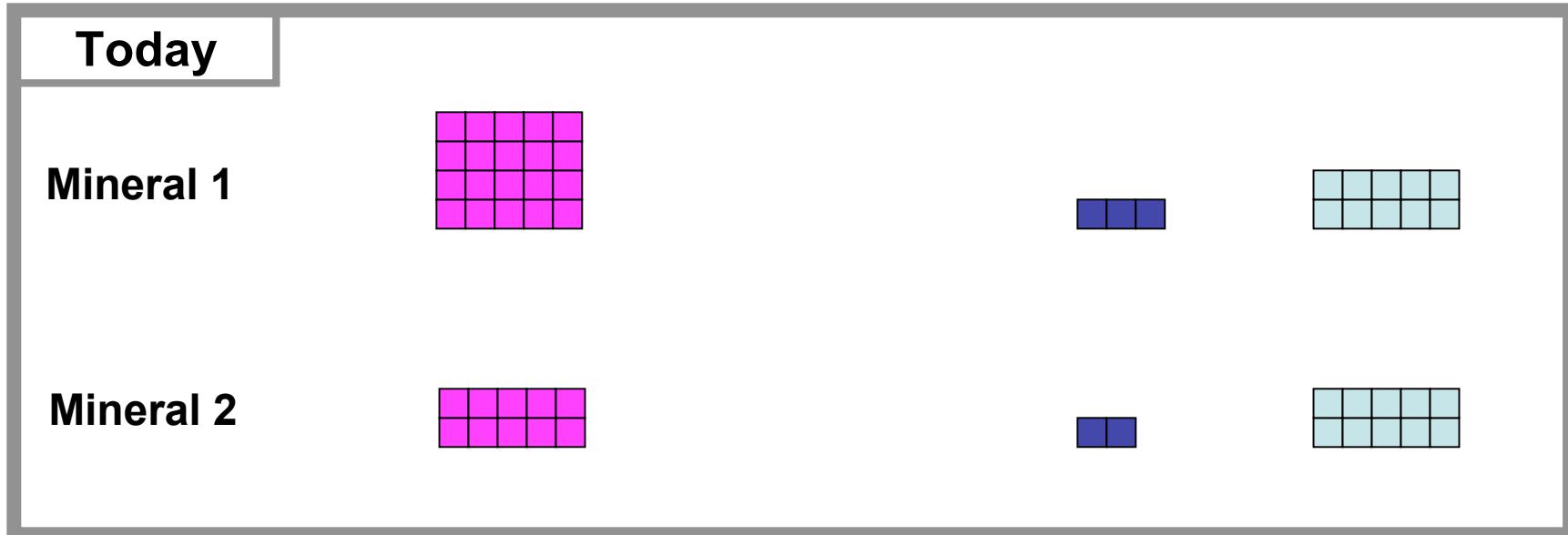
Aluminum-26 Dating

Aluminum-27 Aluminum-26 Magnesium-26 Magnesium-24

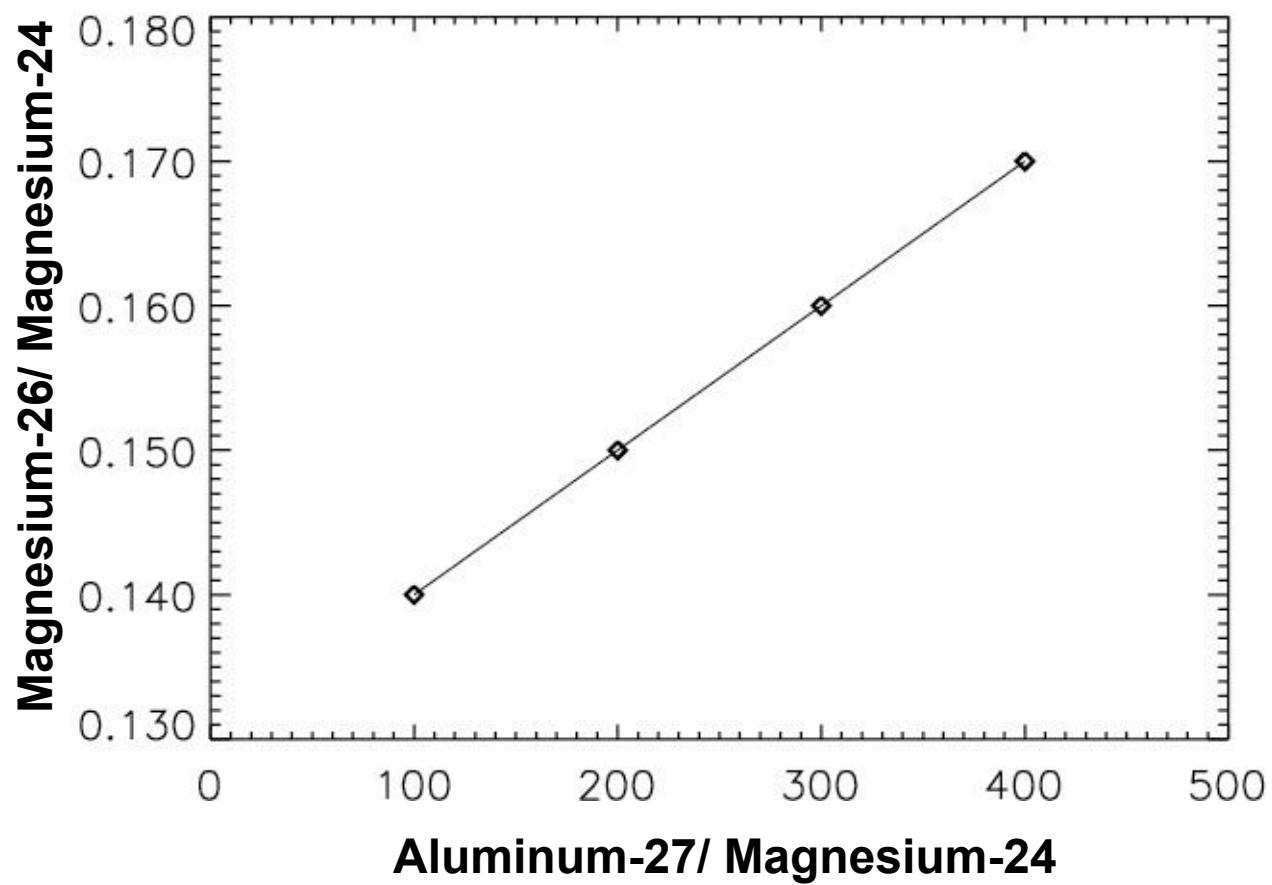


Aluminum-26 Dating

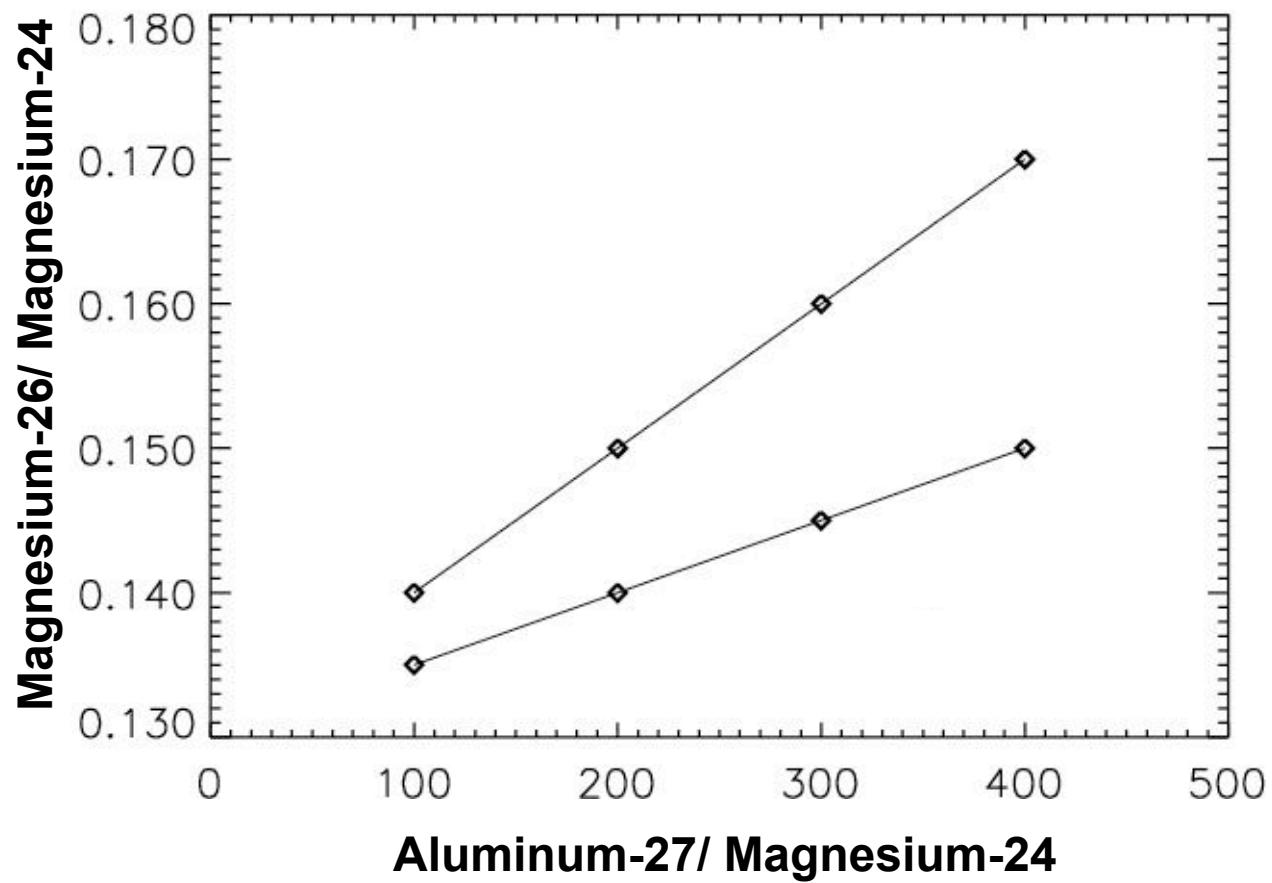
Aluminum-27 Aluminum-26 Magnesium-26 Magnesium-24



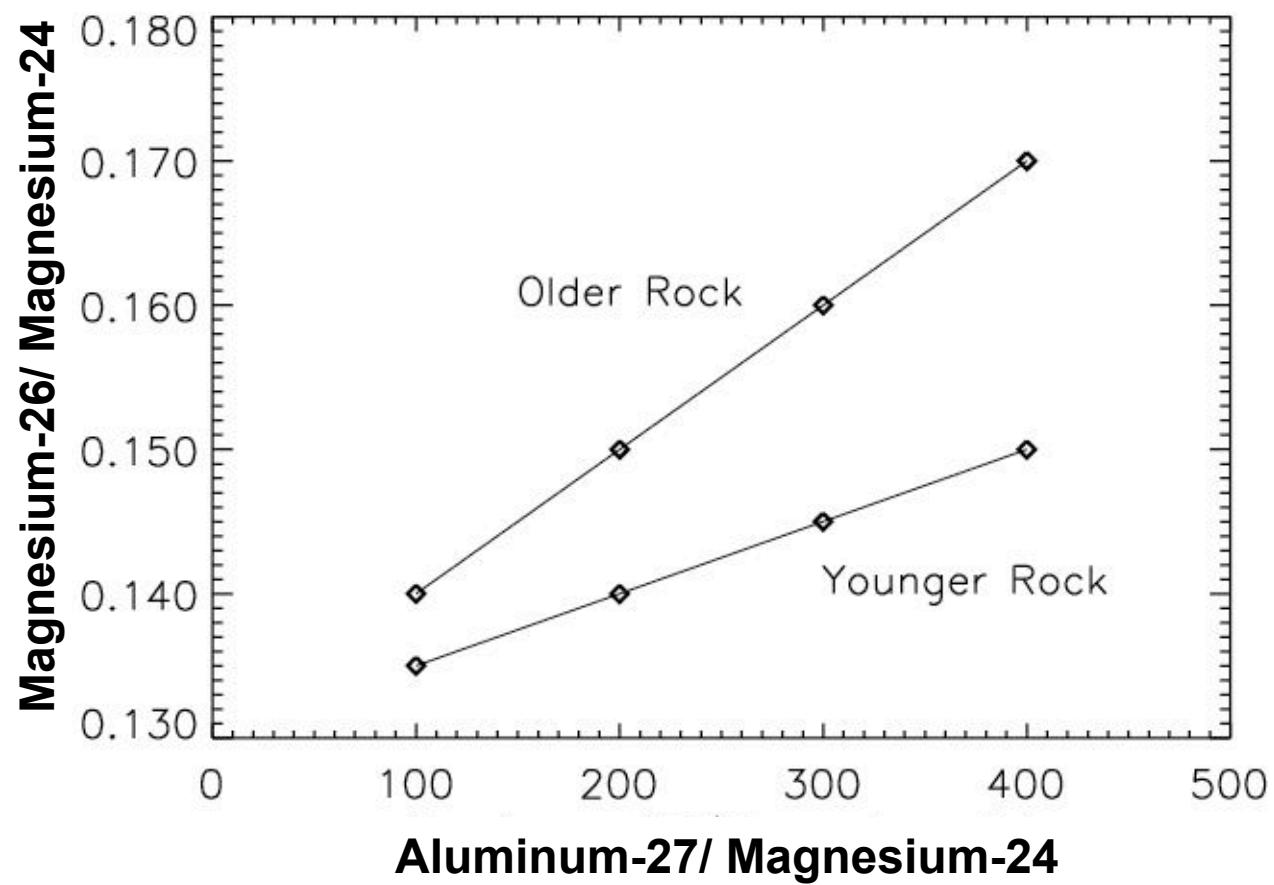
Aluminum-26 Isochron Plot



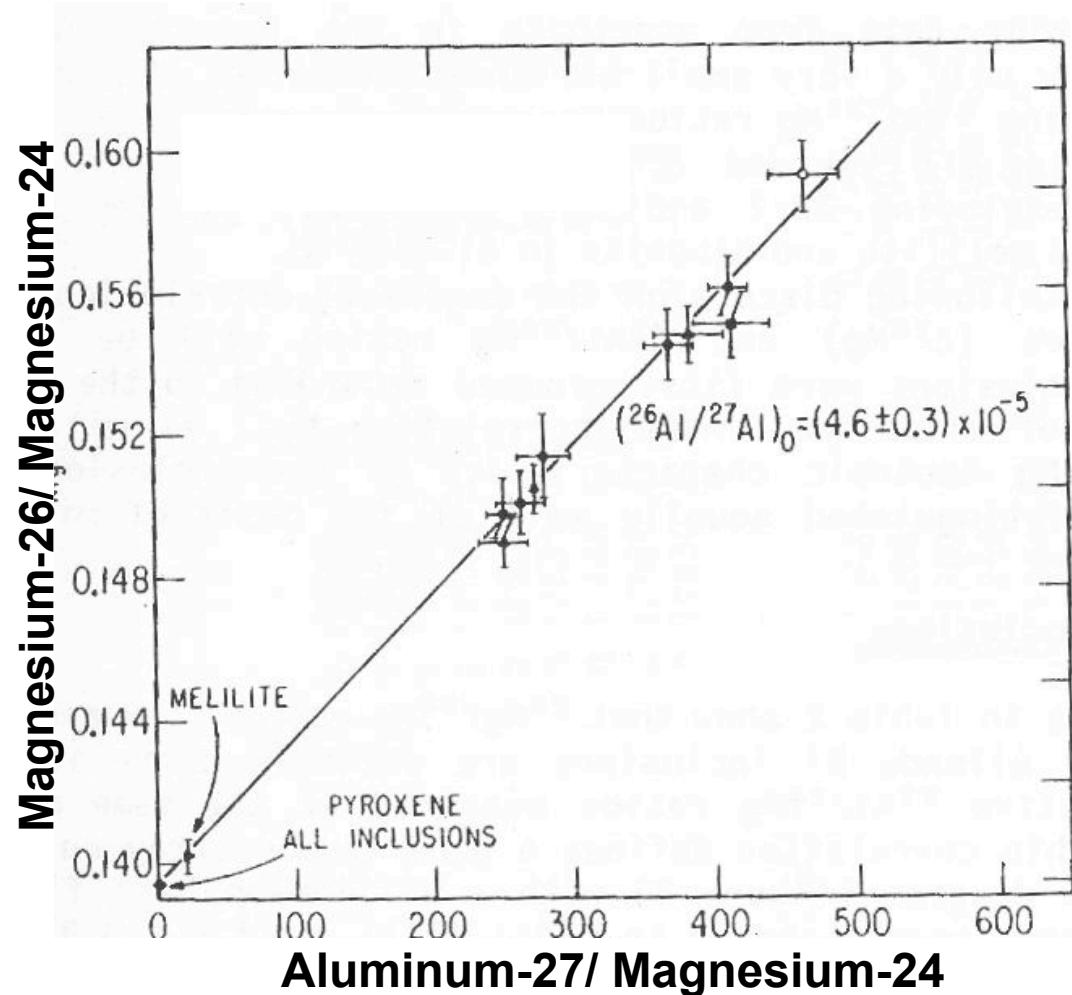
Aluminum-26 Isochron Plot



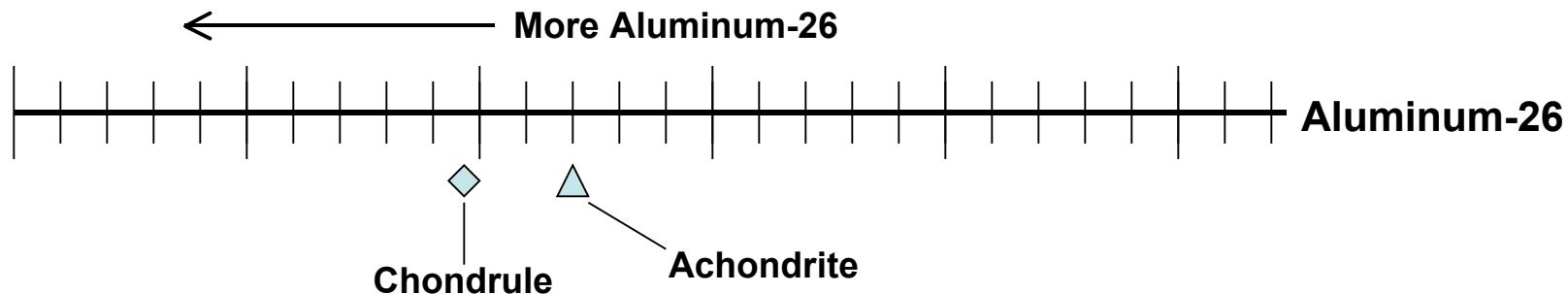
Aluminum-26 Isochron Plot



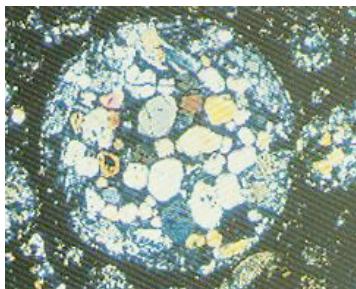
Relative Dating from Aluminum-26



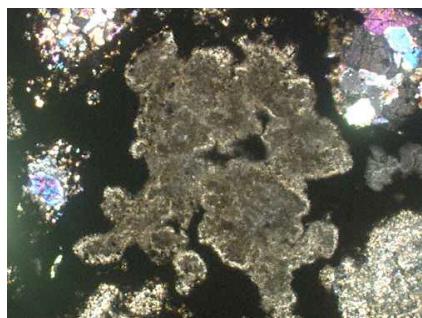
From Hutcheon 1982 in *Nuclear and Chemical Dating Techniques*



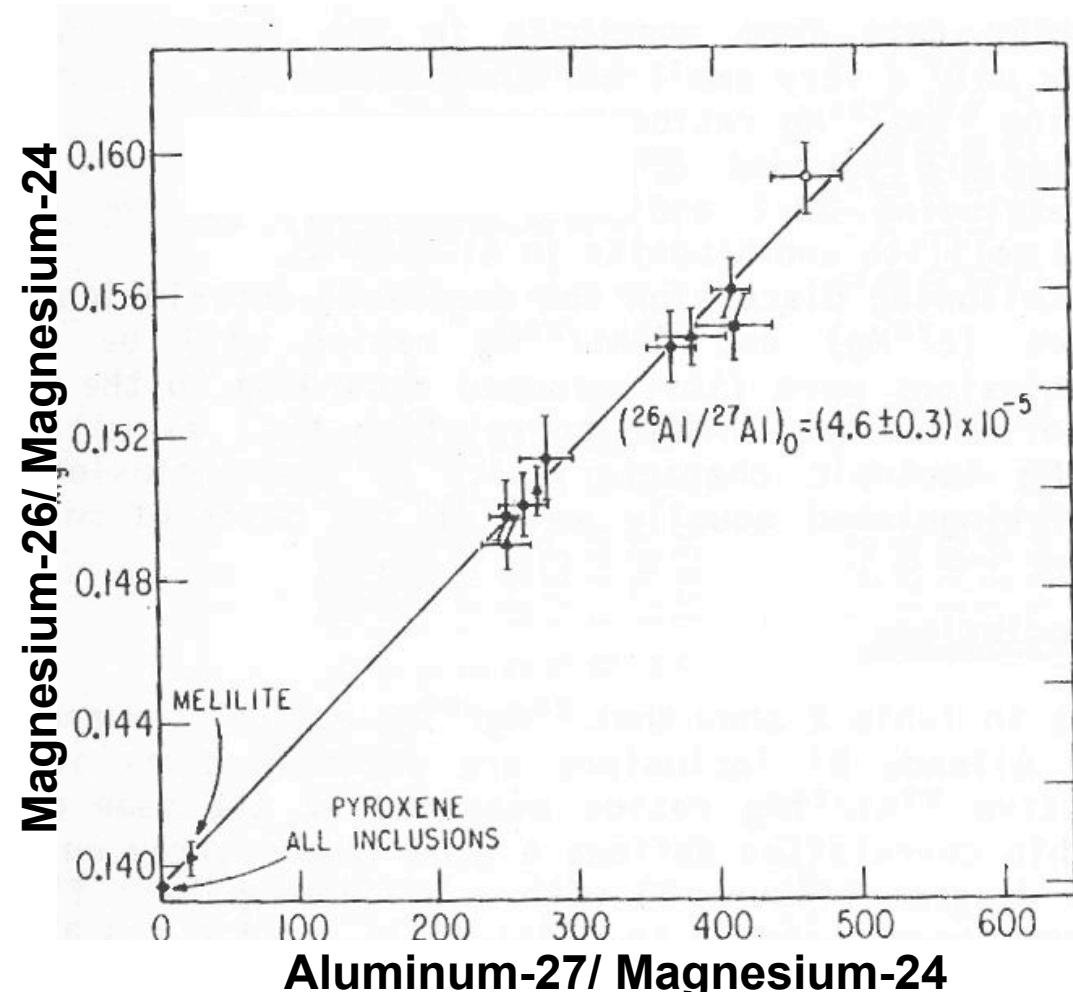
Relative Dating from Aluminum-26



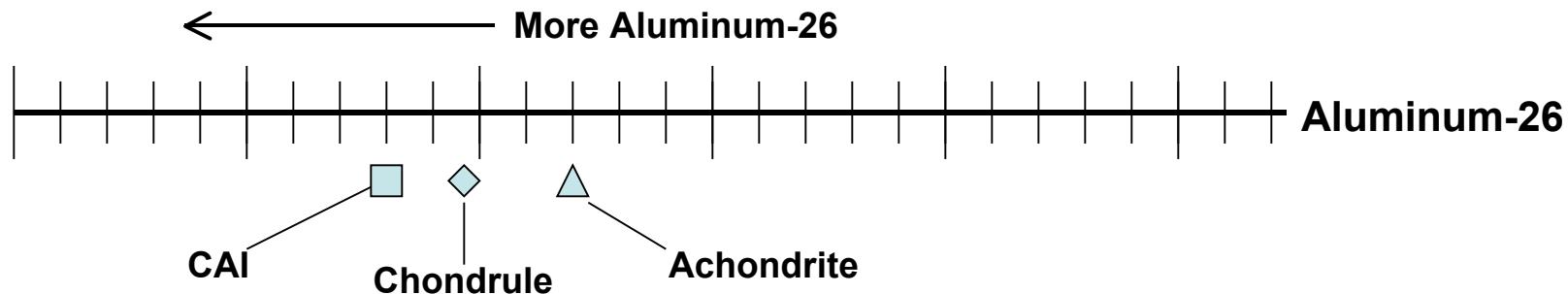
Chondrule



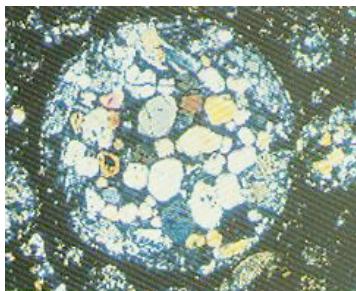
Calcium-Aluminum-Rich Inclusion



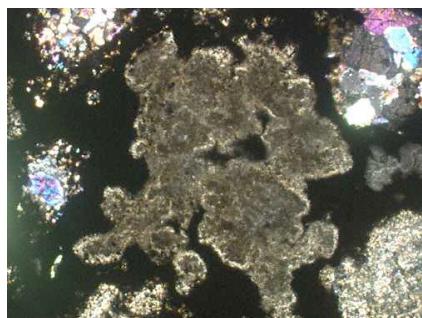
From Hutcheon 1982 in *Nuclear and Chemical Dating Techniques*



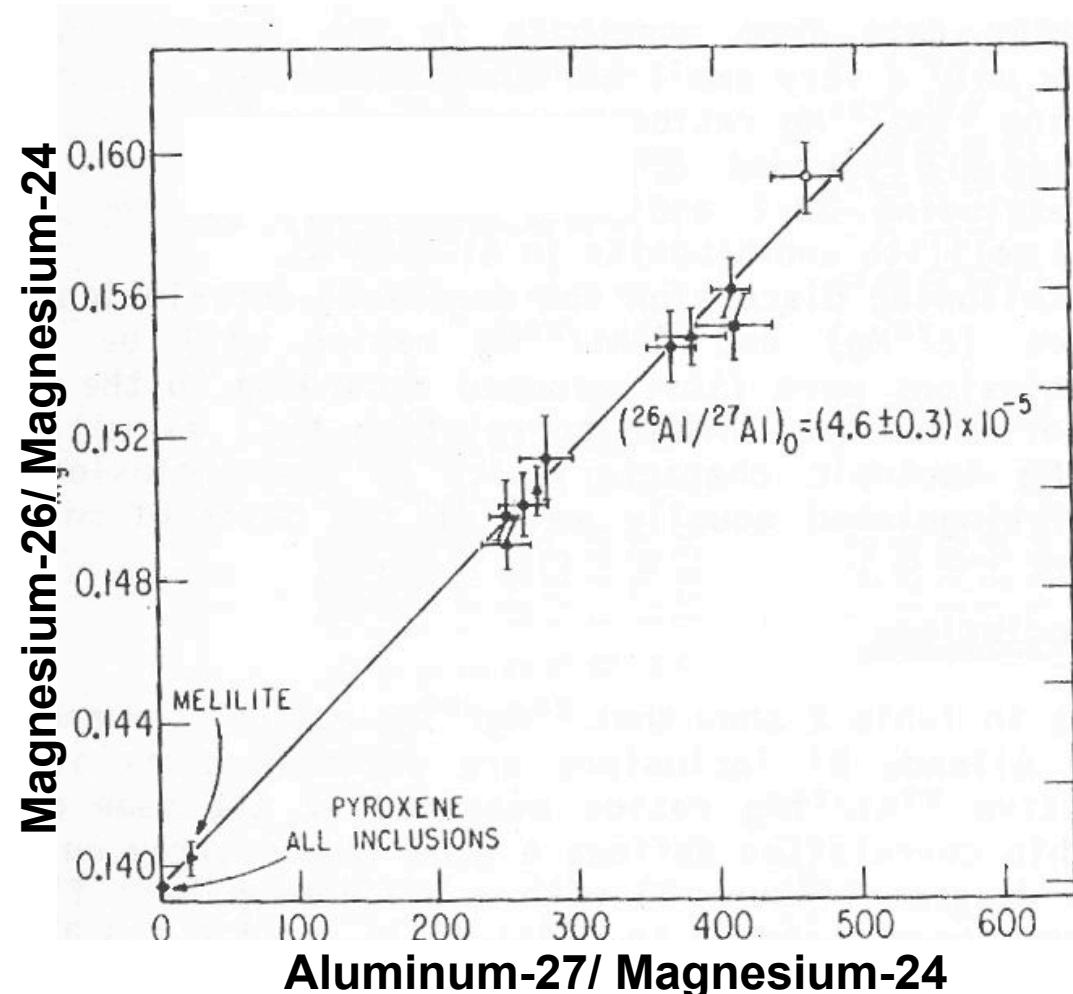
Relative Dating from Aluminum-26



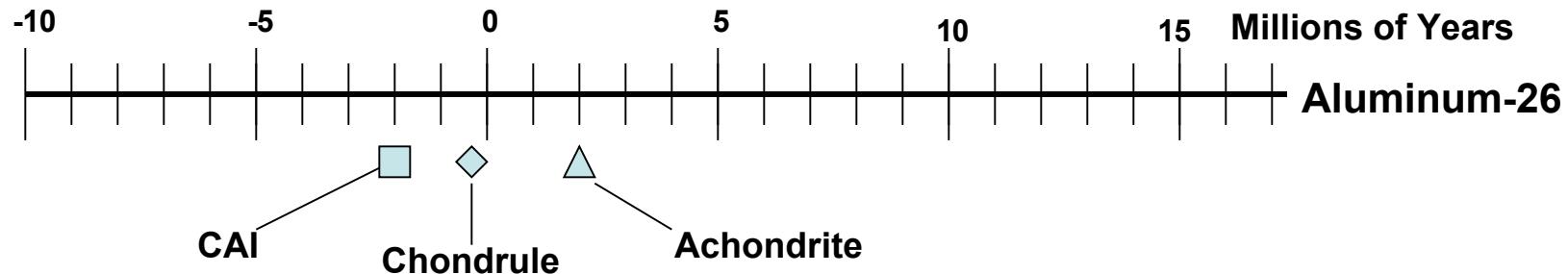
Chondrule



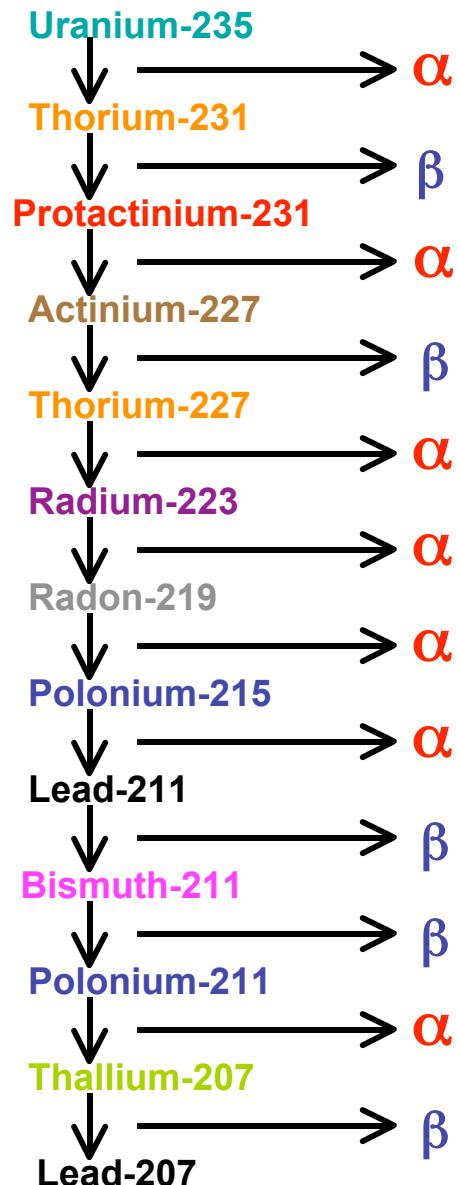
Calcium-Aluminum-Rich Inclusion



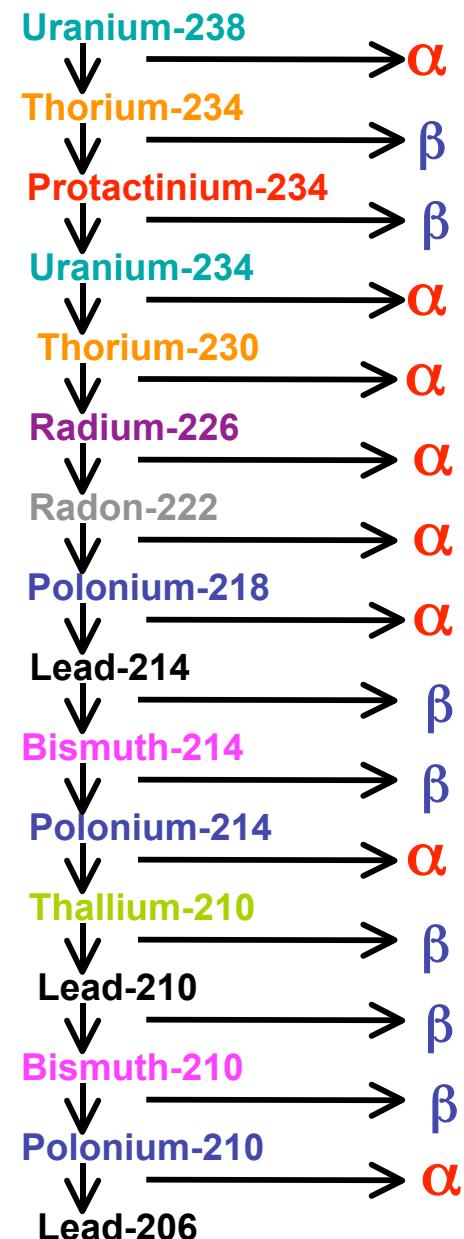
From Hutcheon 1982 in *Nuclear and Chemical Dating Techniques*



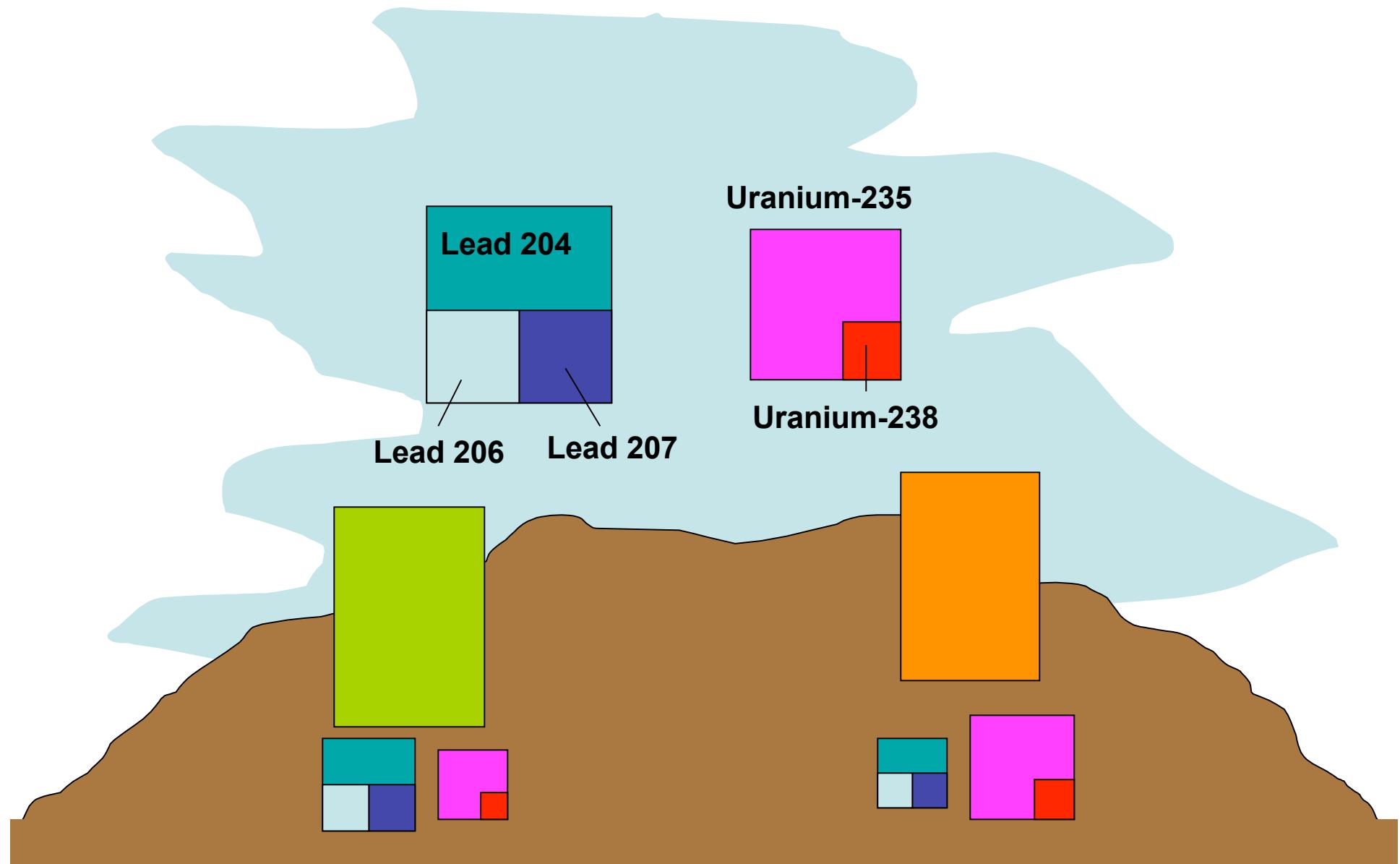
Uranium-Lead System



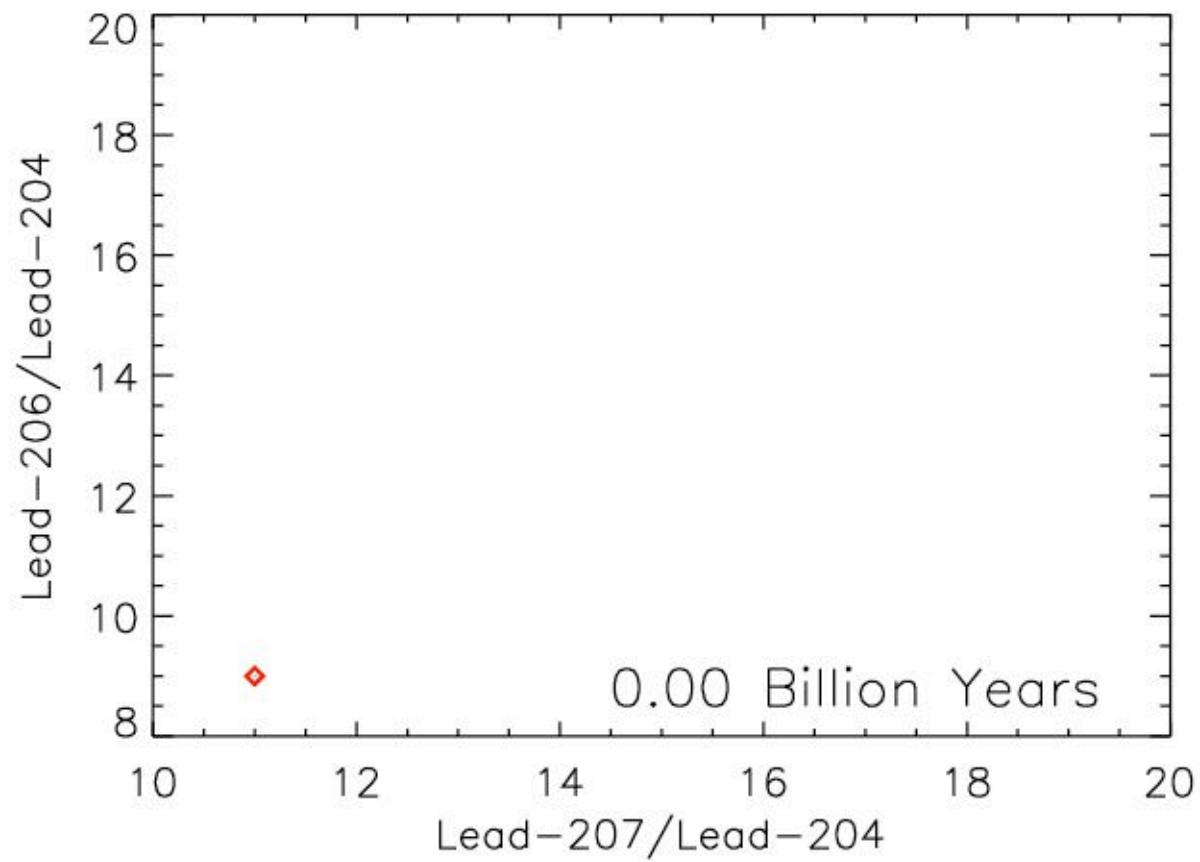
Half-Life = 700 Million Years



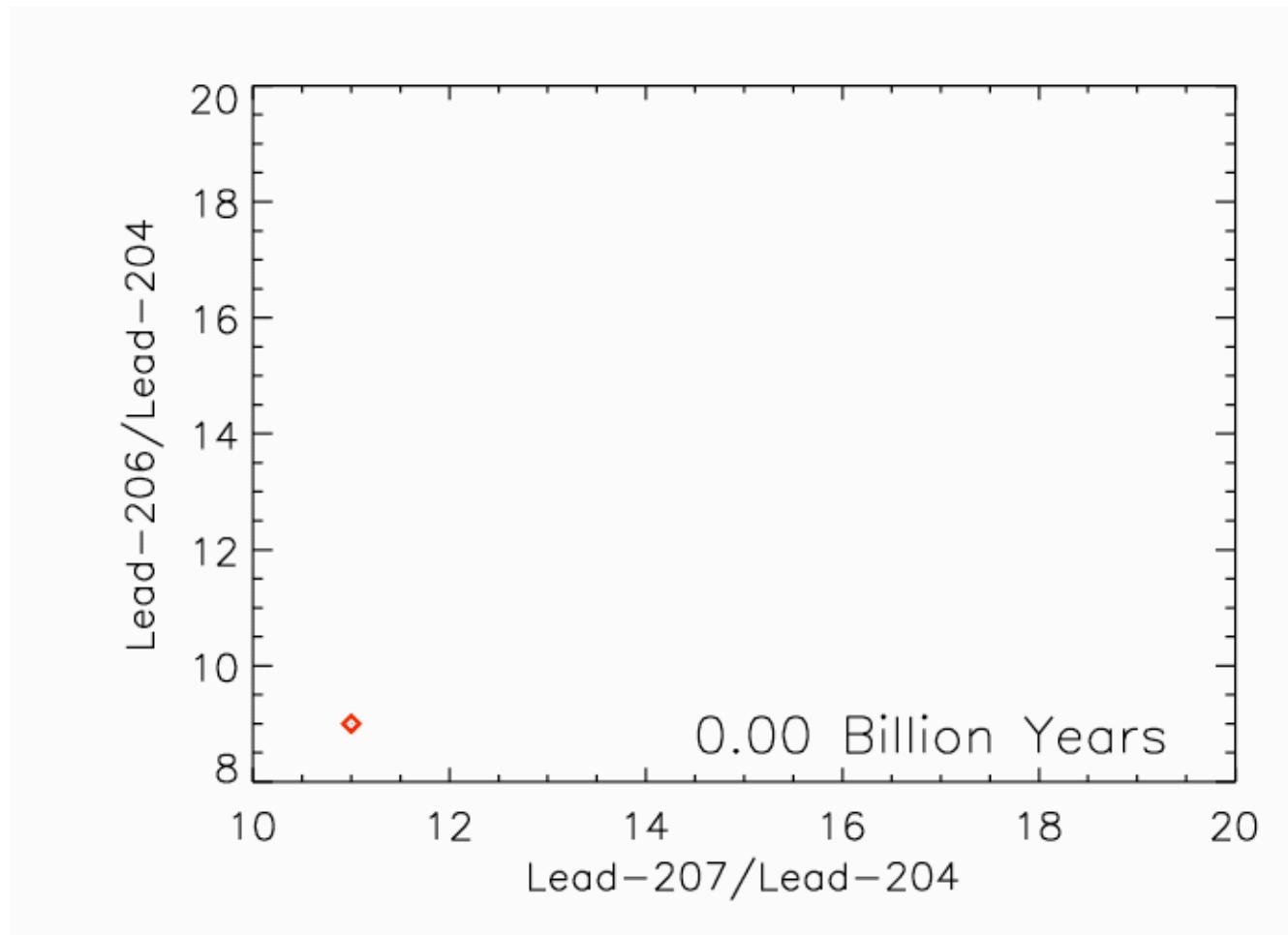
Half-Life = 4.5 Billion Years



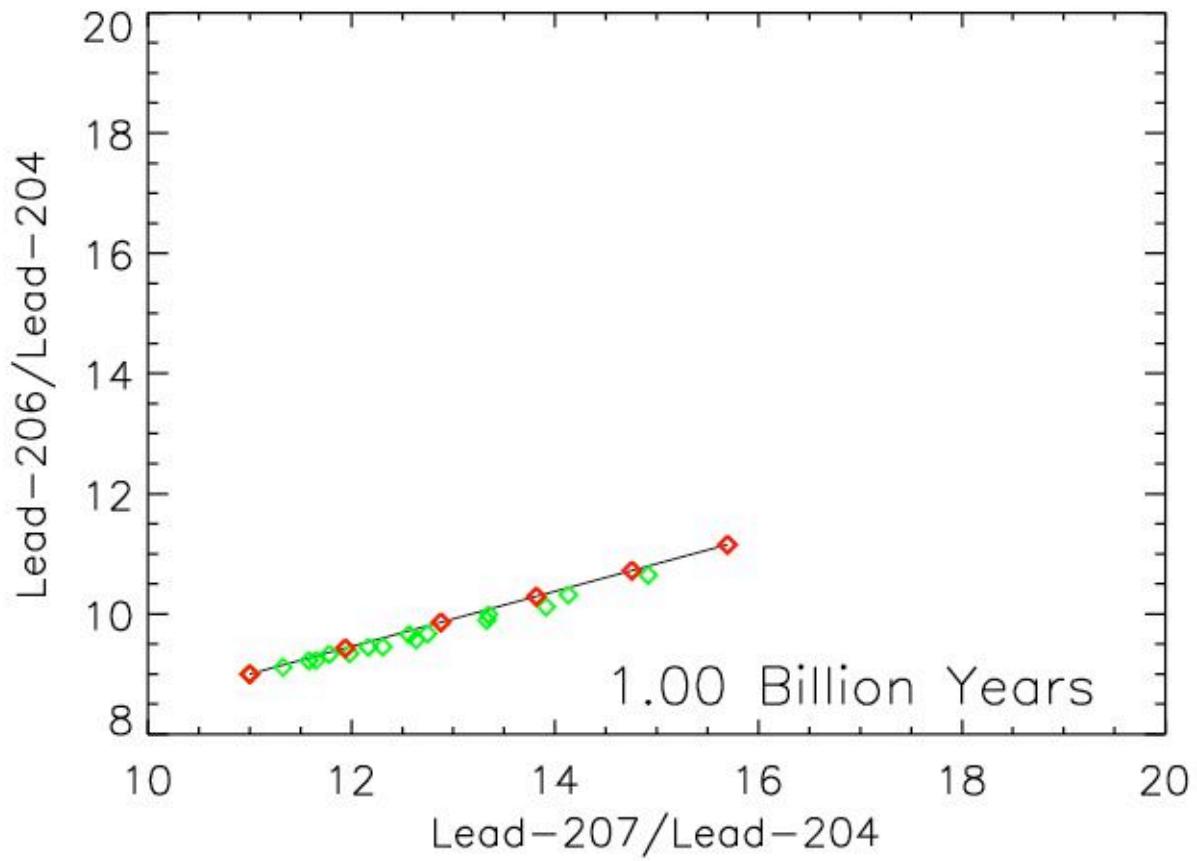
Lead-Lead Isochron Plot



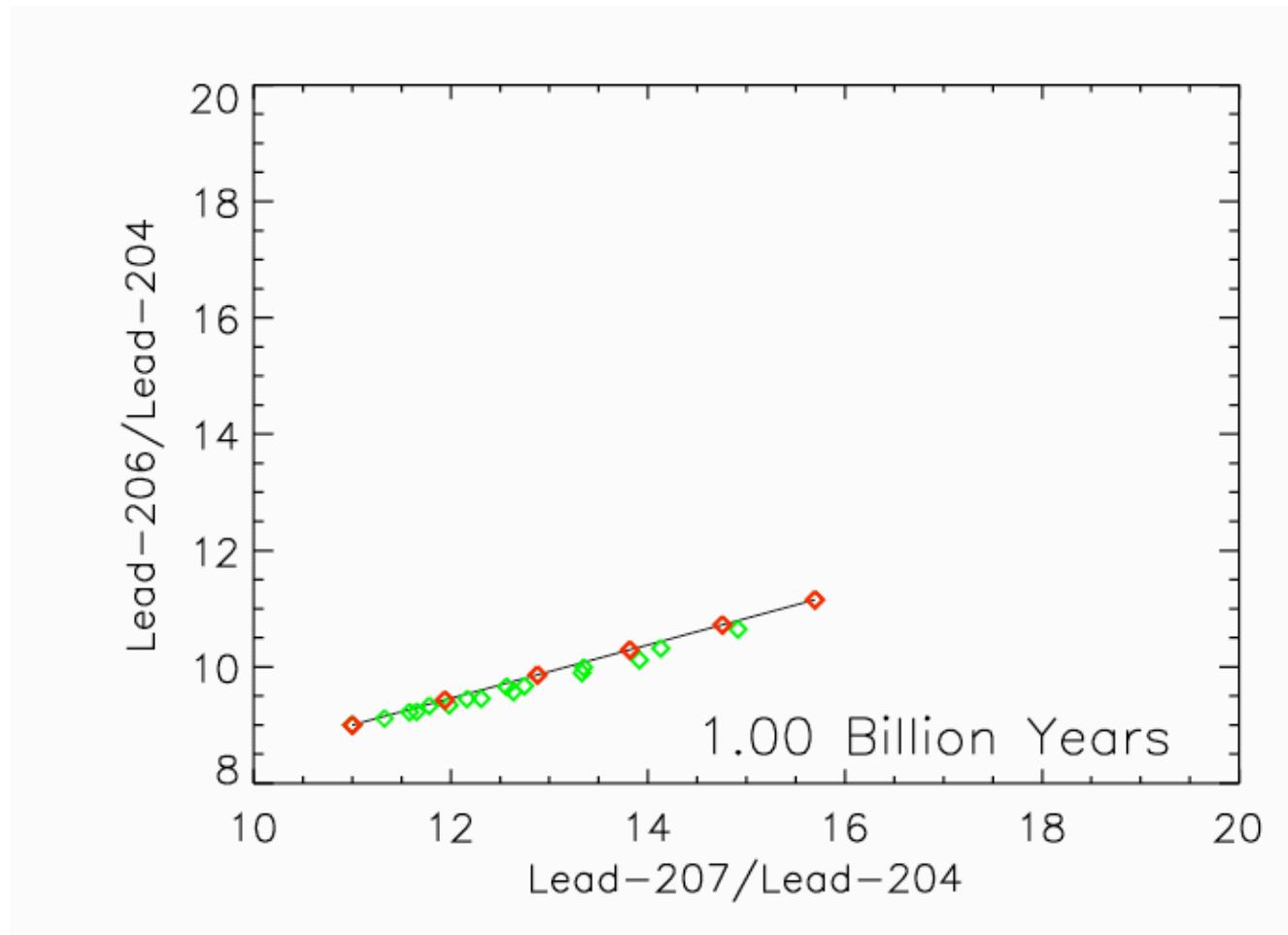
Lead-Lead Isochron Plot



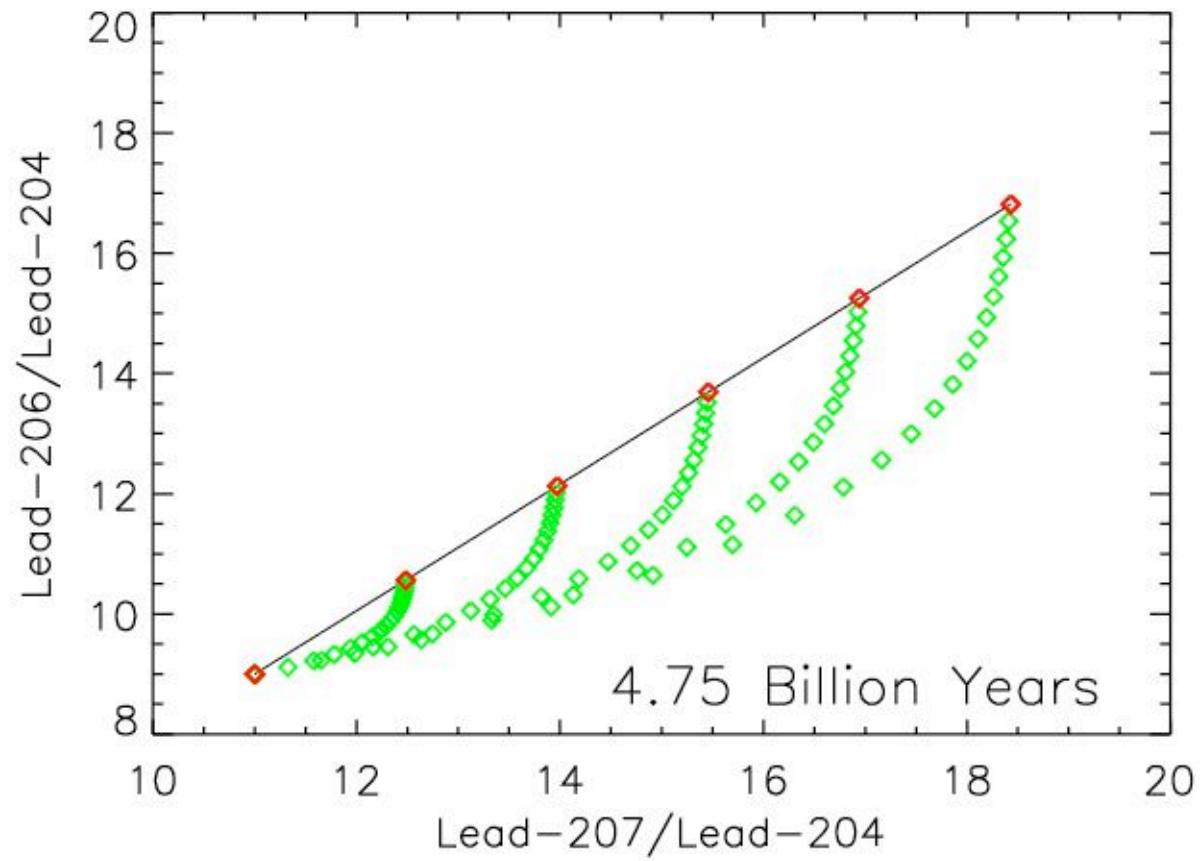
Lead-Lead Isochron Plot



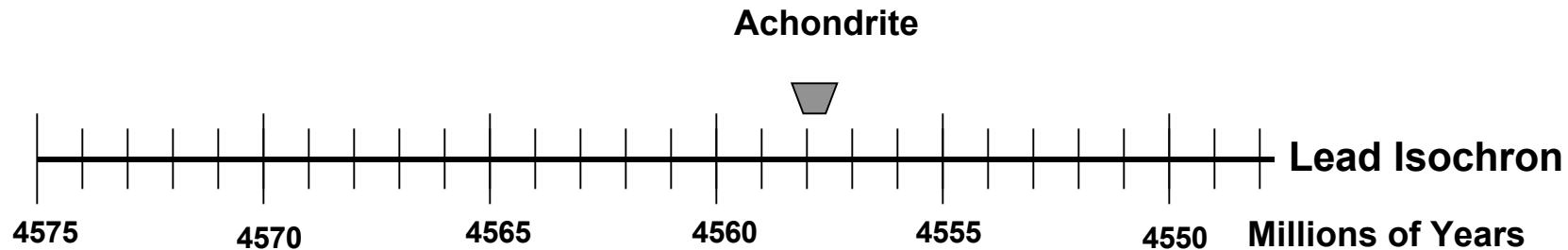
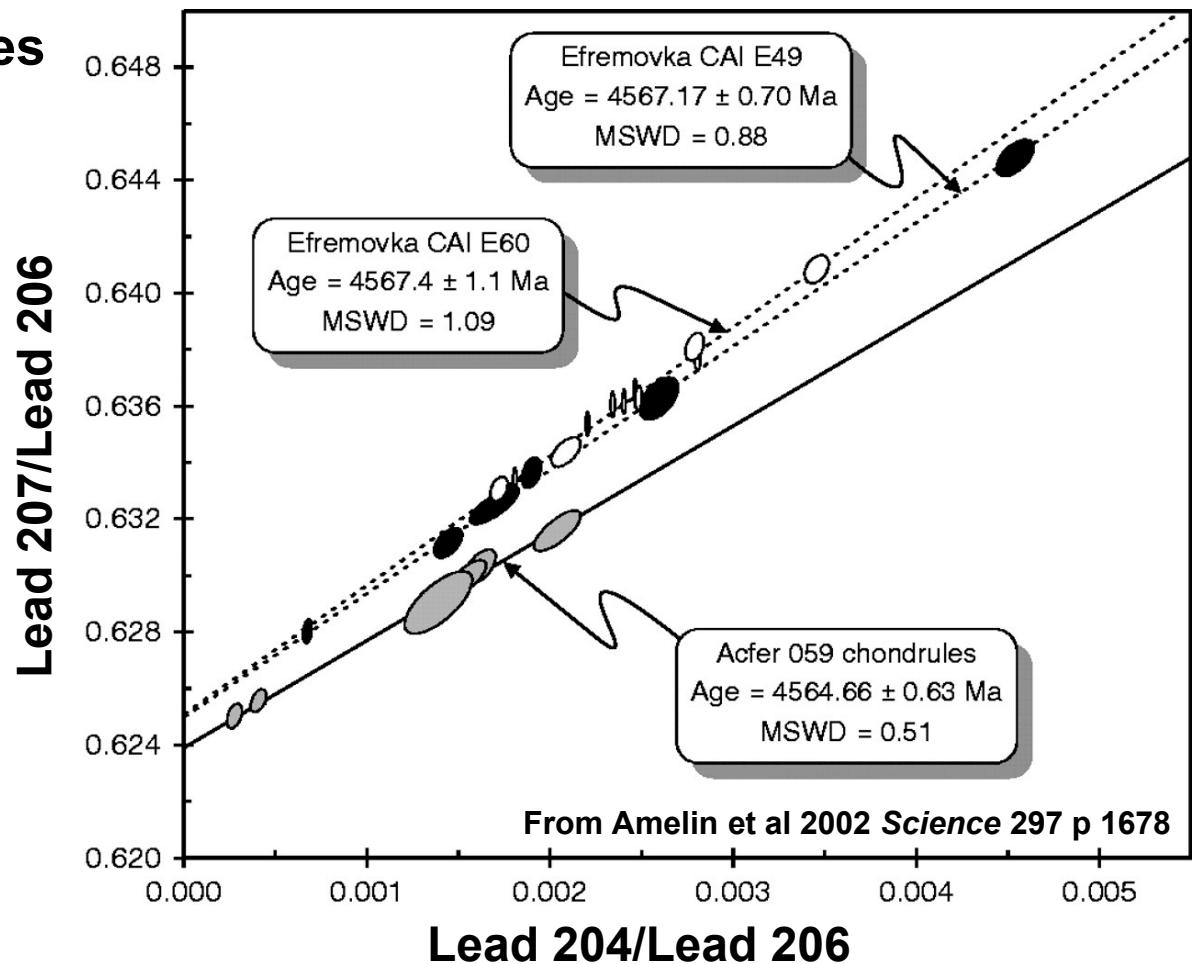
Lead-Lead Isochron Plot



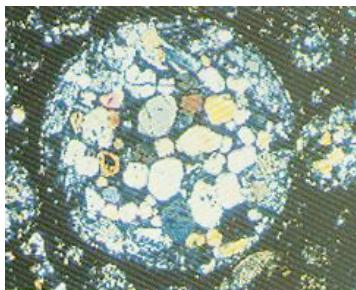
Lead-Lead Isochron Plot



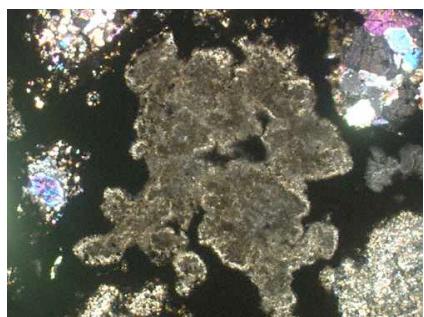
Lead-Lead Isochron Dates



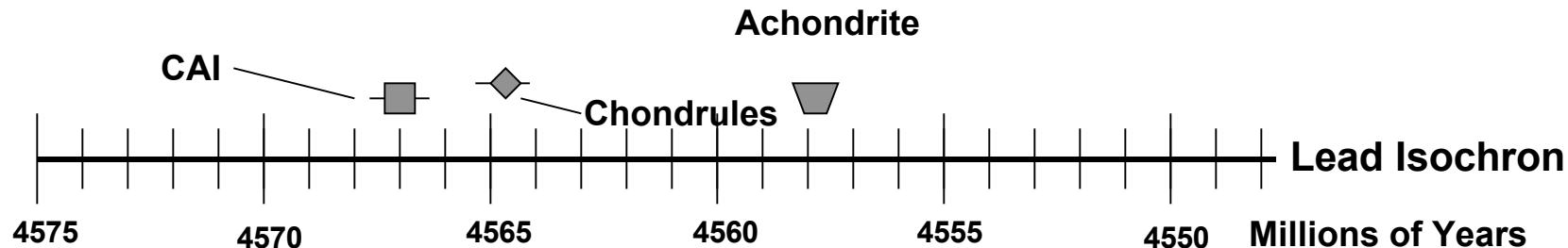
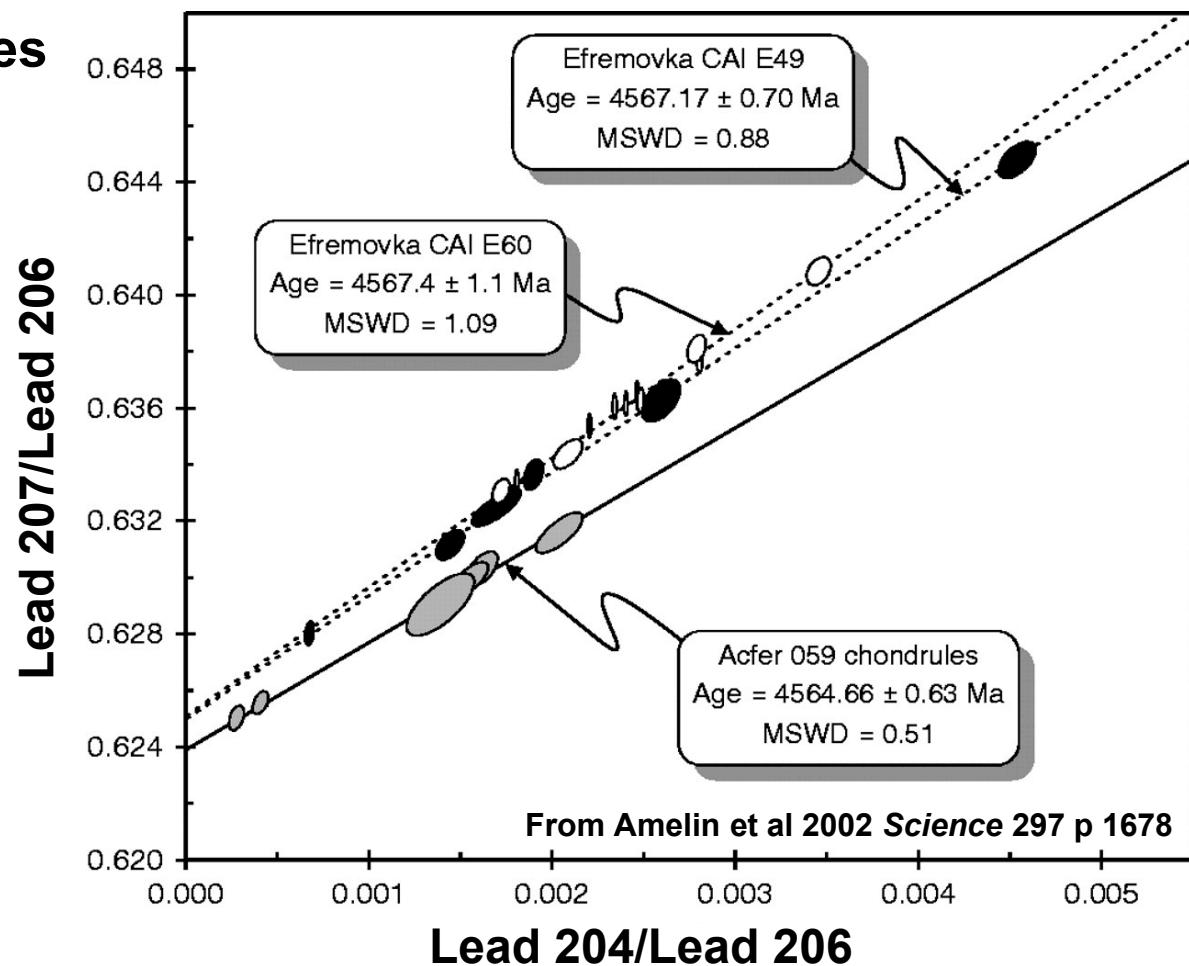
Lead-Lead Isochron Dates



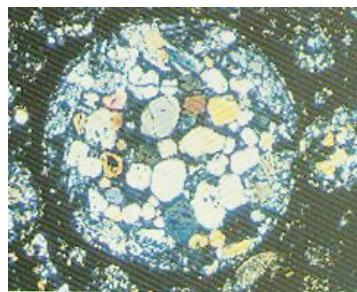
Chondrule



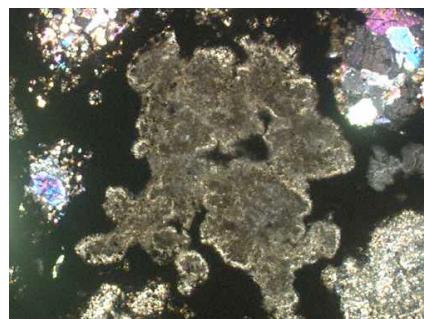
Calcium-Aluminum-Rich Inclusion



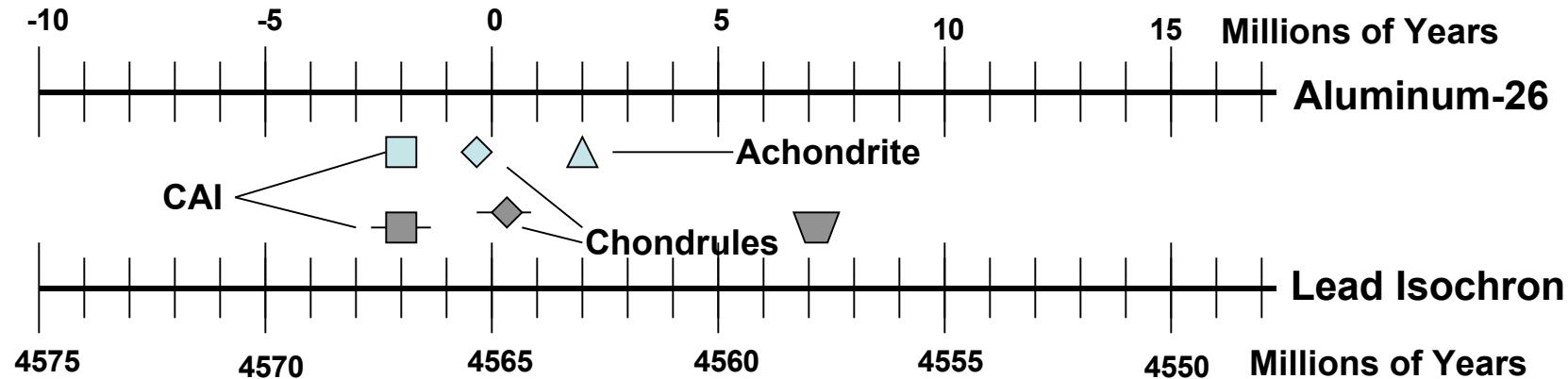
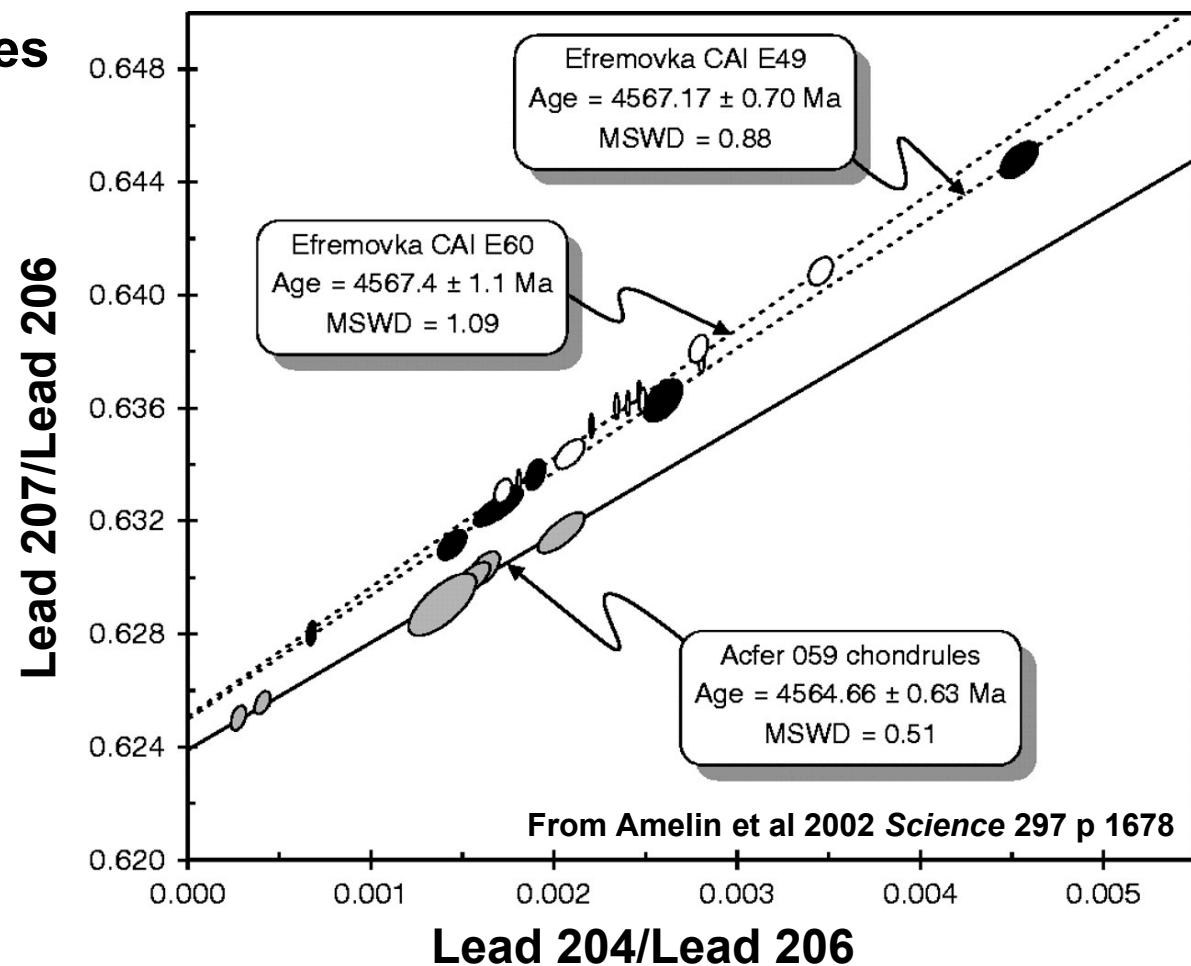
Lead-Lead Isochron Dates



Chondrule



Calcium-Aluminum-Rich Inclusion





Next time:

Colors, Brightness and the Age of Stars