

Welcome to Class 5: Geology & Life

Earth has very unique geological characteristics allowing it to support life.



Fern growing out of recent (50 yr old) lava flow.

How can one measure a half life of millions or even billions of years for an element?

Which of the days learning objects seem most complicated to learn?

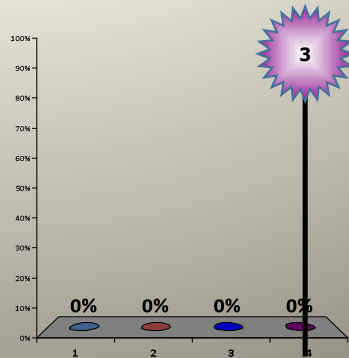
1. Three Geologic Aspects of Earth important to life.
2. Three rock types, how they form and fossils.
3. What is Half-life & Radioactivity. What goes into deriving radiometric ages.



Make sure your channel is set right: Ch 80 Ch

Why did life form here and not on the other Terrestrial planets?

1. Because we have active volcanoes
2. Because we have plate tectonics
3. Because we have a magnetic field
4. All of the above



Why did life form here and not on the other Terrestrial planets?

There are three (almost) geologically unique characteristics of Earth not shared by the other terrestrial planets:

Volcanism: released gases to form our atmosphere and oceans, and was a source of heat for early life.

Plate Tectonics: the renewal of surface material and recycling in the ocean floor leads to a stabilization of surface temperature.

Earth's Magnetic Field: a true 'energy field' which protects surface life and retains the atmosphere against the Solar Wind.

Bottom line: GEOLOGY is really important to life!

Everyone draw:

1. A large Triangle.
2. Label the three corners with the three types of rock.
3. Draw arrows going clock wise around labeling the transitions between types.
4. Draw arrows going around COUNTER clockwise, labeling the transitions between the types.

Let's review the three rock types and cycle

Which rock type goes with these definition?

1. Made from gradual compression of sediments

Sedimentary

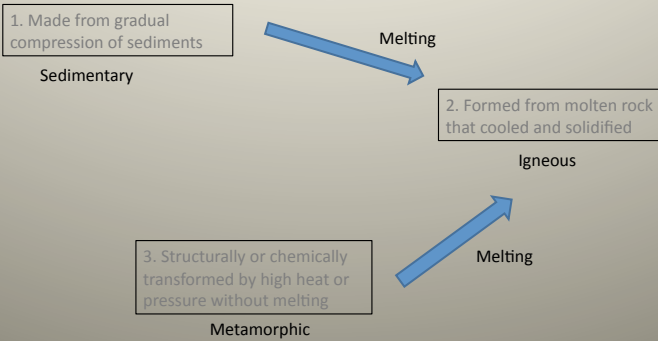
2. Formed from molten rock that cooled and solidified

Igneous

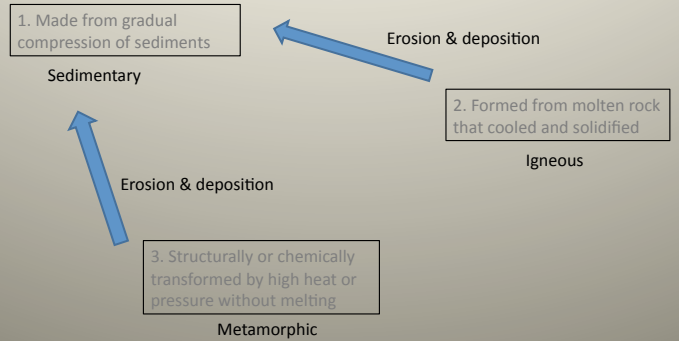
3. Structurally or chemically transformed by high heat or pressure without melting

Metamorphic

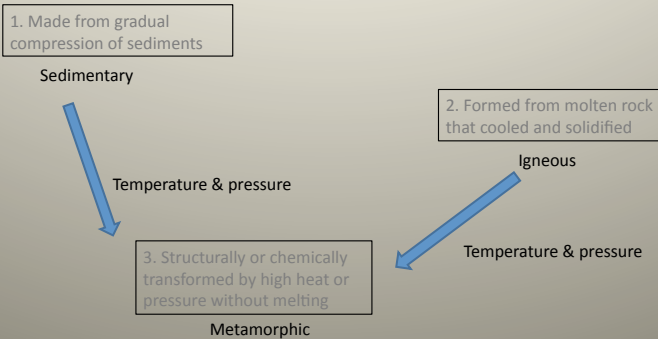
How do you convert Sedimentary and Metamorphic rock to Igneous?



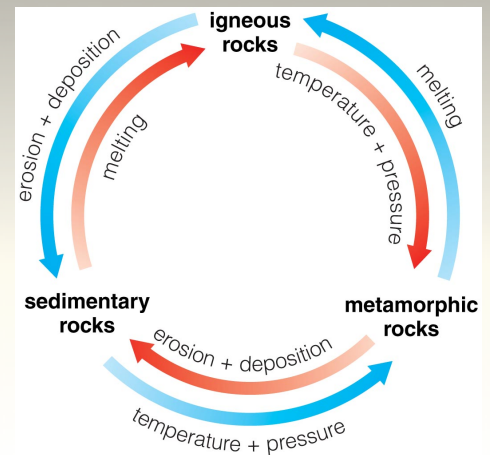
How do you convert Igneous and Metamorphic rock to Sedimentary?



How do you convert Igneous and Sedimentary rock to Metamorphic?

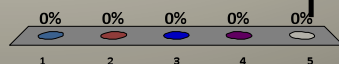




Your diagram should look like this:



The rock type (igneous, sedimentary metamorphic) tells us..

1. The age
2. Its composition
3. About the color
4. How it was made
5. How dense it is



True  or False  ?

1. Fossils can be found in metamorphic rock. TRUE
2. Isotopes have the same number of neutrons. FALSE
3. The nucleus after decay is the parent nucleus. FALSE
4. Decay rates are constant with time. TRUE
5. An element is fully decayed after two half lives. FALSE
6. After 1 half-life, 1/2 of the parent is decayed away. TRUE
7. A stable nucleus is one that does not decay. TRUE

You were just hired in a geology lab. For your first assignment, you are to find a more accurate value for the half-life of Potassium-40.

You are given:

- 1) A 50 lb sample of Potassium-40
- 2) Current estimates give the half-life as ~1 billion years
- 3) You have one week to complete your study.

In your group, come up with a design for the experiment you will perform.



From your astronomy book you know:

- Potassium-40 decays to Argon-40.
- Argon-40 is a noble (doesn't react) gas.

You got fired because your half-life value was clearly wrong

The 50 lbs was not pure Potassium-40, but contained other nuclei. Would you OVER or UNDER predict the half-life?

You did not capture all of the daughter nucleus created, Argon-40. Would you OVER or UNDER predict the half-life?

Your 50 lbs of Potassium-40 already contained significant Argon-40. Would you OVER or UNDER predict the half-life?

Let's test your knowledge of the days learning objectives.

Please work ALONE.

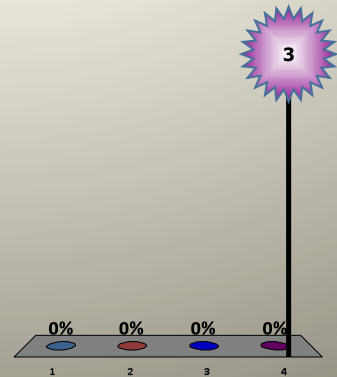
Please NEVER enter answers for another student.

You're Fired!



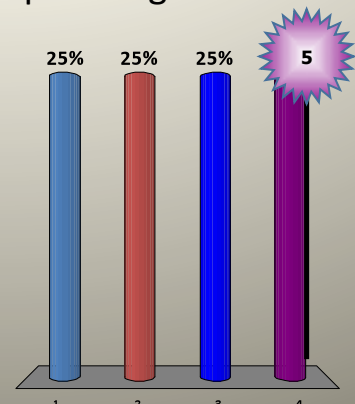
What assumptions are needed to derive rock ages from radiometric dating?

1. There were no daughter nuclei in the sample before it was formed.
2. The rock has not been altered by temperature or pressure.
3. All nuclei (parent and daughter) were retained in the sample over time.
4. All of the above.



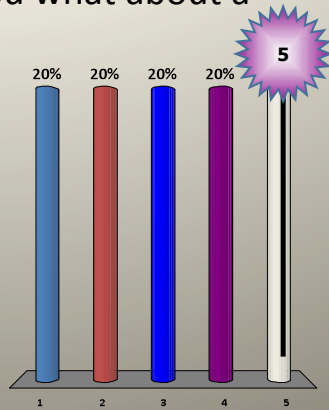
1. Which protects surface life and retains Earth's atmosphere against the Solar Wind?

1. Plate Tectonics.
2. Volcanism.
3. Ozone Layer.
4. Magnetic Field.



2. The rock type (igneous, sedimentary, metamorphic) tells you what about a rock?

1. Its internal chemistry.
2. Its location.
3. Minerals present.
4. Isotopic abundance.
5. None of the above.



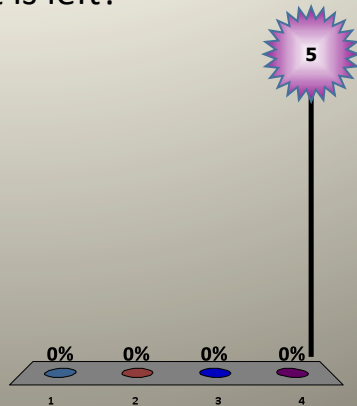
3. If you want to make metamorphic rock, you'll need

1. To melt it.
2. High Temperature and Pressure.
3. Erosion & Deposition.



4. After two half lives, how much of the parent element is left?

1. 75%
2. 50%
3. 25%
4. It will be all gone.



5. If some of the daughter nuclei leak out before you can measure it relative to the parent nuclei, how will this affect your measurement of the age of the rock?

1. You will underestimate the age.
2. You will overestimate the age.

