Radioactive Dice

Radiometric Dating

Name:_____

Date:_____

Uranium-Lead Dating

Zircon is a mineral with the chemical formula $ZrSiO_4$. As it grows in cooling magma, it allows ^{238}U into its crystal structure, but it will not allow any ^{206}Pb in, so a newly formed zircon crystal contains no lead. However, the ^{238}U trapped inside still decays into ^{206}Pb according to its half-life. When a geologist finds a zircon crystal that contains ^{206}Pb, they know that all of that lead came from the decay of uranium. By measuring the amounts of lead and uranium in the crystal, they can "work backwards" to figure out how much time has passed since the crystal formed. This technique is called **uranium-lead dating** - a type of radiometric dating.

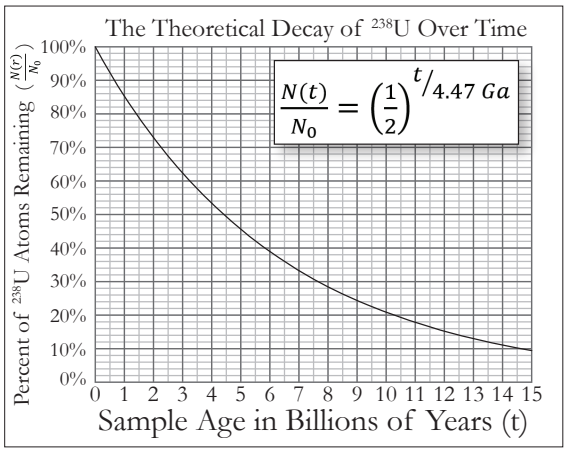
Zircon crystals selected for uranium-lead dating in Dr. Drew Coleman's Geochemistry Lab at UNC Chapel Hill. The horizontal field of view of this photomicrograph is half a millimeter!

Let's Do It!

Someone has given you a rock and asked you to figure out how old it is. You see that the rock contains the mineral **zircon**, so you decide to use **uranium-lead dating**.

You analyze a zircon crystal and discover that it has **6 trillion atoms of ^{238}U** and **3 trillion atoms of ^{206}Pb** trapped in its crystal structure.

You know that the half-life of ^{238}U is 4.47 Ga, and that since this rock formend, the original ^{238}U in the zircon has been decaying exponentially according to the equation on the graph to the right.



Using the information on this page, **answer these questions** to figure out the age of the rock:

1-a. How many **^{206}Pb** atoms were there in the zircon crystal right after it formed?		**3-a.** This (right) is the ^{238}U Exponential Decay Function. **N(t)** is the number of ^{238}U atoms remaining after **t** billion years. **N_0** is the number of ^{238}U atoms at t = 0. **4.47 Ga** is the half-life of ^{238}U and thus $^{t}/_{4.47\ Ga}$ is the number of half-lives that have elapsed since t = 0. **Solve this equation for t.** Use the back of this sheet if necessary.	$\frac{N(t)}{N_0} = \left(\frac{1}{2}\right)^{t/4.47\ Ga}$
1-b. How many **^{238}U** atoms were there in the zircon crystal right after it formed?			
1-c. What portion of the original **^{238}U** atoms are left? Write your answer as a fraction, percentage, or decimal.			
2. Estimate the age of the sample by identifying the point on the graph that corresponds to your answer for 1-c. Plot that point and write your answer here.		**3-b. Calculate** the age of the sample by plugging the correct values into the equation you have just made.	