GEOSCIENCE REPORTS

FALL 1996
NO. 21

RADIOISOTOPE AGE, PART II

GENESIS AND TIME:

WHAT RADIOMETRIC DATING TELLS US*

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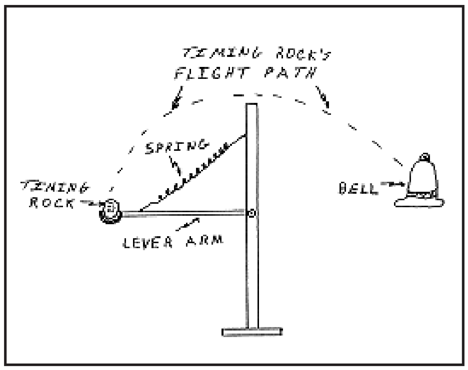
On hearing the estimates of Earth's age that range from 6,000 to more than four billion years, you may have wondered, "What difference does it make what I believe about Earth's age? Does it really matter how long life has been here?" Simply stated, your beliefs about these matters reflect your perception of the Bible's reliability. They also make an important difference in how you interpret the hypotheses offered by science and the information presented in the Bible.

As Bible-believing Christians, we accept as fact that God created the earth. As intelligent beings, we strive to understand God's creation using the analytic tools offered by human science. Radiometric dating is among the more widely used methods of calculating the age of our planet. It is based on the analysis of radioactivity in matter. What can radiometric dating tell us about the age of the Earth and our Solar System? What are the implications for our interpretation of the scriptural account of creation?

Earth from space. Photo courtesy JSC/NASA.



Rube Goldberg Rock Clock (you set the bell alarm by choosing a proper half-life of the timing rock).

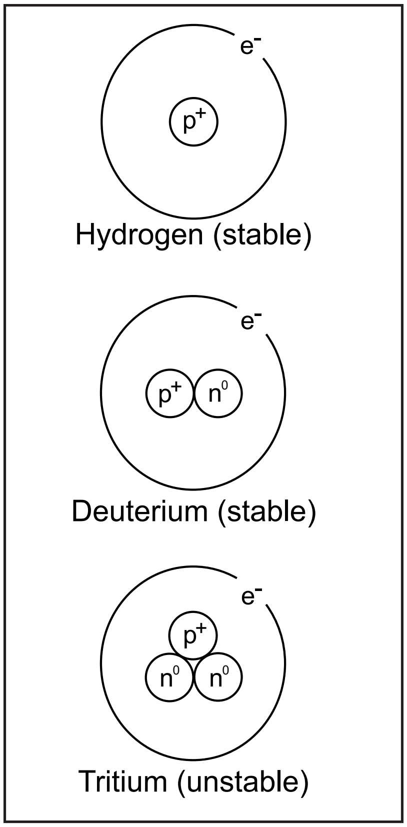
A Brief History

The study of radioactive decay (the natural and spontaneous decomposition of atoms) is about a century old. In 1896, French physicist Henri Becquerel reported to the Academy of Sciences in Paris radioactive decay in uranium. As early as 1904, Lord Ernest Rutherford recognized the potential of using radioactive decay to determine the passage of time. Two years later, Rutherford and Soddy calculated the age of a uranium sample found in the state of Connecticut, USA, to be 550 million years.

Radiometric dating was not fully exploited until after World War II. W.J. Libby's famous book *Radiocarbon Dating* was published a little over 30 years ago. Therefore, as a relatively new area of science, radiometric dating still poses many unanswered questions.

Definition

In order for us to discuss the questions posed at the beginning of this article, it is necessary for our readers to be at least superficially acquainted with the process of radioactive decay. Briefly, radiometric dating seeks to establish the age of matter based on the ratios of parent to daughter isotopes and the constant rate of decay of the radioactive isotopes present. Isotopes of an element are atoms whose nuclei have the same number of protons but a different number of neutrons (see diagram). The atomic nuclei of radioactive isotopes are unstable. As they move to a more stable configuration, the nuclei rid themselves of subatomic particles and excess energy. This process is known as decay. As radioactive decay proceeds, the radioactive "parent"



Hydrogen isotopes

material (e.g., uranium) is transformed into offspring or "daughter" products (e.g., thorium, etc.). This process continues until a stable daughter product is achieved (in the case of uranium, this is lead).

The length of time required for half of the original parent material to decay is known as the "half-life" of the isotope. These half-lives range from those less than 0.000000001 seconds to those extremely long (more than one billion years). For a given radioactive isotope, infinite age is often assumed after the passing of 7 to 10 half-lives, because after this point it is statistically impossible to accurately detect the presence of the parent isotope. An object that is infinitely old with respect to all isotopes would exhibit no radioactivity, for the radioactive isotopes would have decayed completely to their stable daughter products. Although radiometric dating is widely used and accepted, it is far from problem-free.

Uranium roll-front deposit, Turkey Creek. Photo courtesy of Jim Gibson.

Different Techniques

A variety of radiometric techniques are used (e.g., potassium-argon, rubidium-strontium, etc.) to measure the parent:daughter ratios of different elements found in a sample. This variety of techniques allows scientists to interpret the approximate age at which a specimen experienced major events such as its elemental formation (nucleogenesis), solidification, heating, remelting, shock, mixing with other minerals, exposure to water or to high-energy radiation.

Scientists performing more than one measurement of radiometric age on a given sample are not surprised when the resulting ages disagree. This disagreement implies that the sample being studied may have experienced more than one age-altering event. These events affected different isotopes in the sample in different ways. Discordance may provide useful insight into the chronology of events that the sample has experienced.

In many cases chemically and physically independent radiometric dating techniques agree. These concordant dates cannot be easily explained away and often point to physically significant events. The observed concordance between the numerous radiometric-age determinations for the theoretical consolidation of our Solar System is one such event. However, before we can establish the age of our Solar System, it is crucial to note that concordance of radiometric dates does not automatically imply direct correspondence between the radiometric age and real time.

Resetting the Clocks

It is important for us to realize that the academic climate in which radiometric dating techniques were developed was one which assumed long ages for the development of life forms through evolution. This assumption promoted the search for such supporting ages.

This current of thought also produced a questionable assumption: that radiometric "clocks" in matter are set or reset to zero when the matter is moved due to igneous activity (e.g., lava flows) rather than their retaining all or part of their "age information" during their transport.

Human concepts of time. Photo courtesy of C.L. Webster.

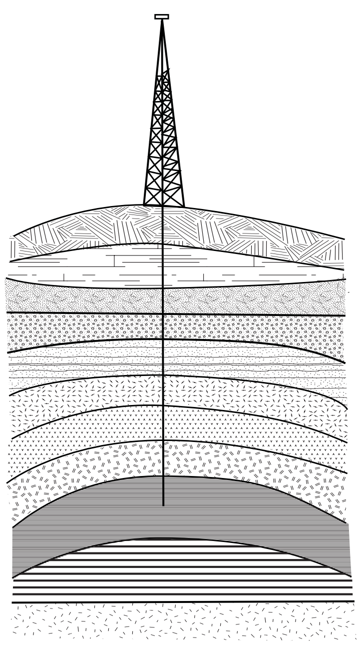
In the process of fossilization (when the material of an organic form, such as a plant, is replaced by mineral material) the zero-set hypothesis suggests that the radiometric age of the mineral material in the fossil is also the minimum real-time age of the fossil. Unqualified support of such an application of the zero-set hypothesis can be described as supporting a "graveyard hoax." It is similar to a person's attempting to

Fossil "graveyard" at Dinosaur National Monument. Photo courtesy of Jim Gibson.

calculate the age of a buried corpse by checking the age of a layer of soil both above and below the casket instead of reading the headstone. We must not characterize any individual who uses the zero-set hypothesis as supporting this "graveyard hoax" but rather look at such examples as emphasizing an important concept that may be overlooked. Simply stated, the radiometric ages for the mineral components of the earth in a cemetery plot are not necessarily expected to date the ages of that plot's occupants!

While ample evidence supports the zero-set hypothesis of various radiometric chronometer systems during the igneous formation or metamorphosis of minerals, scientific literature also authenticates the inheritance of previously established radiometric age characteristics during metamorphic and igneous transport processes. In some situations age characteristics, measured independently, have survived volcanic events. The survival of such age characteristics may be anywhere between total and nonexistent. (Examples of this were given in Part I of this series, *Geoscience Reports* No. 20, Spring 1996.)

The impact of sedimentary processes on radiometric age determinations has also been documented. An oil well in southwestern Louisiana (USA) that was drilled into formations that have a conventional geologic age in the 5-25 million year range (Miocene) produced drill cuttings from shale at the 5190 foot level that has a K-Ar age of 254 million years. When the shale cuttings were ground and screened into component particle size, the average K-Ar age was found to be 164 million years for particles less than one-half micron in diameter, 312 million years for particles in the ½-2 micron diameter range, and 358 million years for particles greater than 10 microns in diameter.[1] It is evident that the larger ratio of surface to volume for the smaller particles favors diffusion loss of the argon-40 that was inherited from the source of this shale. (The argon loss resulted in younger ages.) The radiometric age characteristics of the sediments into which this well was drilled reflect the radiometric age characteristics of the source areas drained by the Missouri and Ohio river systems, not the time of sediment emplacement.



Oil wells can be considered spyglasses to Earth's interior.

Radiometric ages greater than within the expected range are attributed to various factors: an incomplete resetting of the radiometric clock at mineral formation, a partial removal of the parent isotope, or an infusion of the daughter isotope after mineral formation. On the other hand, radiometric ages less than the expected range are attributed to the partial removal of the daughter isotope after mineral formation, or an infusion of the parent isotope.

When dealing principally with sedimentary materials, and fossils in particular, it appears highly probable that radiometric dates more reasonably represent the initial characteristics of the source material in which organisms were buried rather than the time of their burial.

Now that we have determined that fossils do not necessarily share the same radiometric age as the surrounding rock, we face the remaining challenge of determining the significance of the radiometric characteristics. Keep in mind that these characteristics not only represent the initial radiometric characteristics of the matter analyzed but also any changes that were produced by heat, water, etc., during the relocation process.

According to Genesis 1, 7, and 8, our planet has experienced three major modifications that should be expected to have altered the characteristics of many mineral formations in the planetary crust. These modifications are the appearance of continents and ocean basins on the third day of Creation week, the subsequent weathering of the continental crust and reduction of topographic relief until the planet was again completely covered with water (the Noachian Flood), and the reappearance of continents and ocean basins after the Flood. Each of these

Sedimentary sandstone. Photo by Jim Gibson.

modifications, and particularly the combined effects of all three, introduce severe complications into the scientific interpretation of the radiometric information for many of the mineral specimens available for our study.

Strategies for Accommodating Data

This discussion has been limited to radiometric age data for inorganic minerals, especially those associated with fossils. Three strategies can be considered to accommodate these data to the chronologic data presented in the Scriptures.[2]

1. Ignore any data provided by radiometric techniques.
2. Assume that Earth, its Moon, and stars are only thousands of years old and that the radiometric data observed today are the result of processes that are not completely understood. (Some suggest the Earth was created with apparent age.)
3. Assume that the activities of a recent Creation week (thousands, not millions of years ago) involved large amounts of elementary inorganic matter that was previously created some 4.56 billion years ago.

Science and Faith

If science indicates a particular hypothesis and Scripture allows it, it seems reasonable to accept such a position. While this approach minimizes conflicts between scientific and biblical interpretations, not all questions are answered. Areas requiring more than a small measure of faith remain.

We must realize that there is no way to proceed directly from radiometric data to a fiat creation for living matter within the past 10,000 years and a worldwide flood some 5,000 years ago. These are concepts that are accepted on the basis of faith in the same manner as is salvation.

Through a proper blending of this faith viewpoint and science it is possible to obtain a more complete understanding of God, our Creator and Sustainer. In seeking to harmonize God's character as it is revealed in the Scriptures and in nature, we must seek a model that is consistent with both sources of information. The third approach mentioned above begins to meet these requirements. Where we do not find such consistency, we need to search for a better understanding of both sources of revelation (nature and Scripture), asking for the Holy Spirit's guidance during our research.

Radiometric dating is an interpretive science. The complex chemical and physical processes taking place within Earth's mantle and crust are neither completely known nor understood. This is especially true when the radioactive isotope parameters are considered. Couple these uncertainties with the fact that there are numerous times where radiometric ages are not in agreement, it would seem logical — almost compelling — to seriously consider other sources of data for determining the time of Creation. For the Christian who is a scientist, such a primary source is the Holy Scripture.

ENDNOTES

1. Perry EA. 1974. Diagenesis and K-Ar dating of shales and clay minerals. Geological Society of America Bulletin 85:827-830.
2. These concepts were originally proposed by Robert H. Brown, retired director of Geoscience Research Institute.

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*Reprinted by permission from the article "Genesis and Time: What Radiometric Dating Tells Us," *Dialogue* 5:1 (1993) with slight modification.

Editor's Note: Pagination of the original article was from p 1-6.

Radiometric Age and Real Time

Radiometric age and chronological age may be assumed to be equivalent only if the following criteria are fulfilled:

1. Initial conditions are specified with a high degree of precision. In other words, if there were any radioactive parent or daughter products present initially, these must be known very accurately.
2. The radioactive decay constants under study have remained unchanged during the lifetime of the mineral assemblage.
3. The sample has remained a closed sample. In other words, the sample has been chemically and physically isolated since its emplacement.