Isotope Dating

Review of basic principles
and problems

then

Revolutionary new research
with
astounding new results !

First of all, lets review some basic facts:

All of the atoms of a particular chemical element has the same number of protons in it nucleus. That is why they all have the same electron structure that controls their chemical properties. But even though they have the same chemical properties some of them can have a different number of neutrons in their nucleus and that gives them different nuclear properties. These atoms with the same number of protons and same chemical properties but a different number of neutrons and different nuclear properties are called ***isotopes***.

Some isotopes are unstable in the sense that during each time interval know as the half life, half of the atoms of the isotope will spontaneously change into another chemical element with a smaller nucleus. The spontaneous change is called ***decay***. When an atom's nucleus decays it ejects a small piece of the nucleus, either an electron or the tiny nucleus of a helium atom, often called an alpha particle. Isotopes that spontaneously decay are said to be radioactive.

The length of time required for one-half of the atoms of a particular isotope to decay is called the ***half life***.

The half life of different isotopes covers a very broad range of values. The half life for some isotopes is mere seconds while for others it is days, months, years, millions or billions of years. Since we can measure the present half life we can calculate the age of a sample of an isotope if we also know how much of each isotope was there at the beginning of the process, and that nothing changed during the process that we did not know about. Since we cannot observe the beginning amounts that existed in the distant past, we have to make some assumptions in order to make dating calculations.

Uranium 238 is one of the more important isotopes for dating rocks because it has a quite long half life. The Uranium 238 decay chain is illustrated on the next slide.

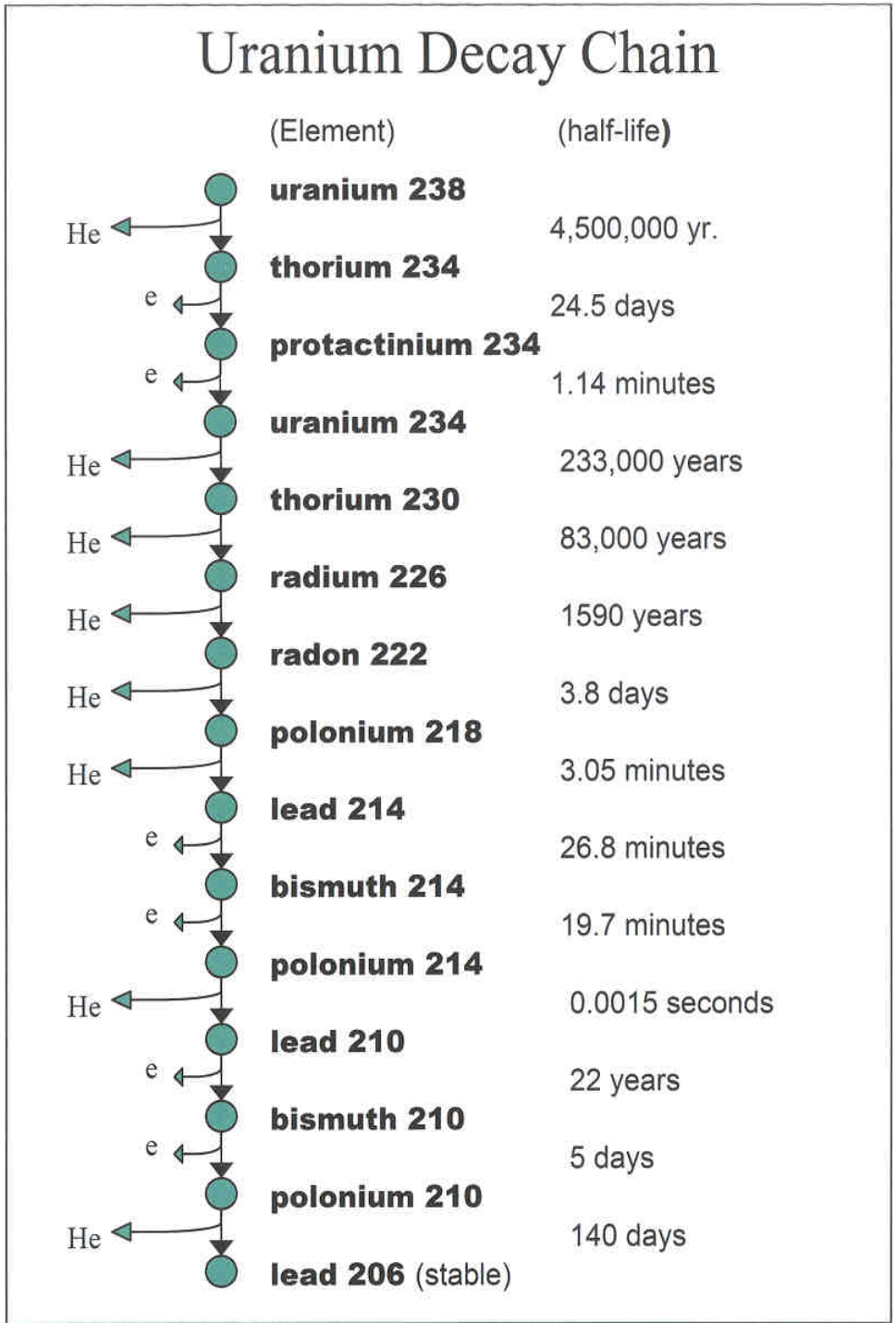
Radioactive Decay :

By alpha particle (helium nuclei, He) emission and beta particle (electron, e) emission, unstable radioactive atoms slowly decay into smaller and smaller atoms and finally into a stable atom like common lead.

At today's rates the average time for ½ of ^{238}U to decay to ^{206}Pb is 4.5 billion years

Half of ^{235}U decays to ^{207}Pb in 0.7 billion yr.

Half of ^{232}Th decays to ^{208}Pb in 14.1 billion yr.



Radioisotope Dating:

Rocks contain radioactive atoms that slowly ‘decay’ into smaller atoms as time goes by. As this decay proceeds the ratio between the ‘parent’ isotope and the ‘daughter’ isotope slowly changes (like sand falling through an hour glass). So if we can measure how fast the isotopes decay and how much of each is in the rock now, then we might calculate how long the decay has been going on – that is how old the rock has become since it solidified.

Parent isotope

Slowly decays into

Daughter isotope

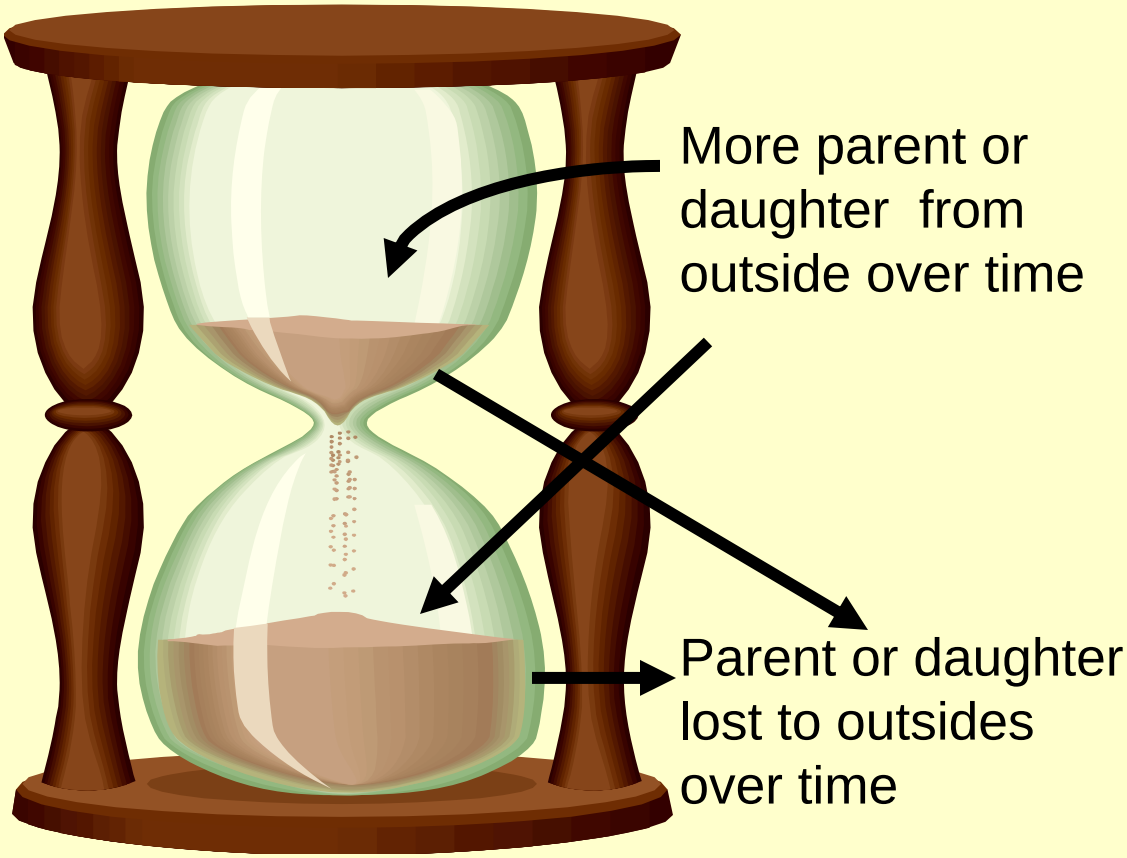
Radioisotope Dating Hidden Assumptions:

There are seven unknown variables involved in radioisotope dating. Before a date calculation can be made these variables must be given assumed values according to one's preconceptions about the past history of the Earth and of that particular rock sample.

Parent isotope
(Starting amount unknown)

Slowly decays into
(rate may change with time)

Daughter isotope
(Starting amount unknown)



One way to test the assumptions behind isotope dating is to isotope date the igneous rocks erupted from volcanoes in recent times. These ages are known as fact by direct observation. The isotope dates should agree or at least give a consistent error that can be calibrated out. But this is often not the case.

Geologist Dr. Andrew Snelling provides data on Mt. Ngauruhoe in New Zealand which has often erupted in recent decades. This rock has been dated by several different isotope methods. These yielded a great variety of dates ranging from 270,000 to 3.9 billion years! If the assumptions behind isotope dating were reliable we would expect all of these dates to be both much smaller and consistent with one another.

But that is often not what is found. (For more details see Dr. Snelling's articles in the *Proceeding of the Forth International Conference on Creationism* and in the *Fifth I.C.C.*)

In the 2007 edition of *The Young Earth,* geological engineer Dr. John Morris gives a sampling of the dating done on several volcanoes that have erupted in the recent past.

Note that there is not much connection between the know ages and the isotope "measured" ages.

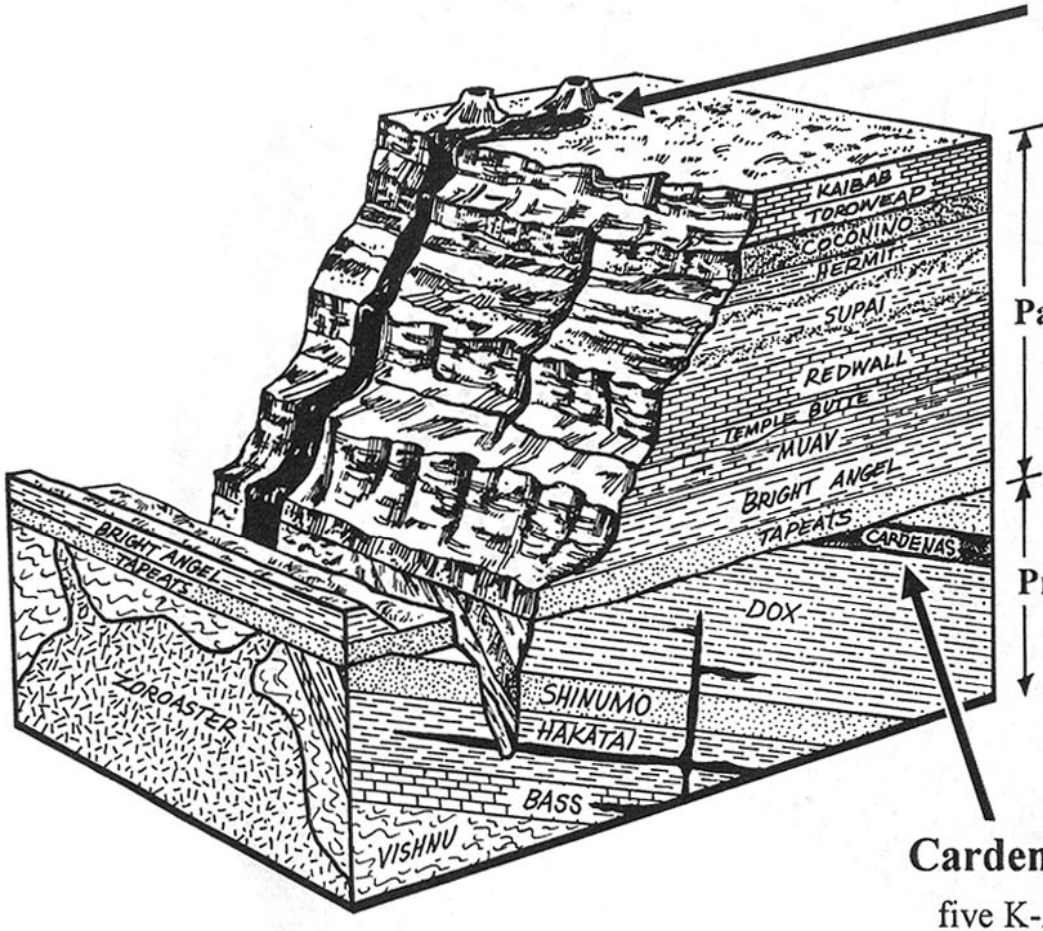
All of this indicates that the assumptions behind isotope dating are not very reliable. The processes that influence the assumed factors can be more important than the slow gradual decay process.

Volcano Location	Known age	Isotope age
Hualalai	200 years	1.6 million
Hualalai	200	22.8 million
Mt. Etna	2100	250,000
Mt. Etna	37	700,000
Mt. Etna	29	350,000
Mt. Lassen	85	100,000
Sunset Crater	950	270,000
Kilauea	<1000	43 million
Kilauea	<1000	30 million
Kilauea	<200	21 million
Kilauea	37	700,000
Mt. Stromboli	38	2.4 million
Rangitoto	<800	150,000
Mt. Erebus	17	640,000
Medicine Lake	<500	12.6 million

Next lets look at an example of a geologic formation that makes it very clear that the processes behind the hidden assumptions are active in very important ways. In fact the assumptions, which are usually swept under the rug, can be more important in isotope dating than the decay process that the researcher intends to be measuring.

One of the best examples is found at the Grand Canyon. On the north rim of the canyon there is a system of volcanoes called Vulcan's Throne. The erupted lavas have flowed down into the mature canyon and partly dammed up the canyon several times. The river soon overtopped the lava dam and cut back down to its channel but has not cut a lot lower. Thus, we know these lavas are younger than all but the deepest part of the canyon. So, these lavas are clearly much less than a million years old.

The basalt lavas from nearby volcanoes flowed down into the Grand Canyon and dammed it up for a time. These lavas are substantially younger than the mature canyon so they must necessarily be much less than a million years old. But most radioisotope dates of this lava are vastly older than that, like these below.



Basaltic rocks of Uinkaret Plateau

six K-Ar model ages .....0.01 to 17 million years
five Rb-Sr model ages.....1270 to 1390 million years
one Rb-Sr isochron age.....1340 million years
one Pb-Pb isochron age.....2600 million years

Paleozoic

Precambrain

Clearly the above dates are very wrong! Since we can't trust the lava isotope dates above, then how can we trust all of the others like those below?

Cardenas Basalt (Precambrian)

five K-Ar model ages.....791 to 853 million years
six Rb-Sr model ages.....980 to 1100 million years
one K-Ar isochron age.....715 million years
one Rb-Sr isochron age.....1070 million years

From Morris, *The Young Earth*

For many years scientists who are creationists have observed that there are many problems with isotope dating. A few of these are illustrated above. Note that in the last slide that both the older ‘model’ ages and the newer ‘isochron’ dates are equally bad.

The uniformitarian science establishment tends to keep these problems swept under the rug so they will not have to face all of the facts. They have found it a lot more comfortable to focus only on the data that might indicate long ages of slow and gradual geologic processes.

In the mid 1990’s a group of creation scientists banned together to attack the isotope dating problem and find a theory that accounts for all of the data in the true spirit of the scientific method. They formally organized a joint research project that came to be known as RATE.

The RATE Project

In 1997 the Institute for Creation Research and the Creation Research Society jointly started a long term research project named RATE for Radioisotopes and the Age of the Earth. The project was staffed by three physicist, Dr. Russell Humphreys, Dr. Eugene Chaffin, and Dr. Don De Young, two geologists, Dr. Steve Austin and Dr. Andrew Snelling, a geophysicist, Dr. John Baumgardner, and an atmospheric scientist, Dr. Larry Vardiman. Their goal was to answer as many of the questions raised by conflicts among isotope data as possible.

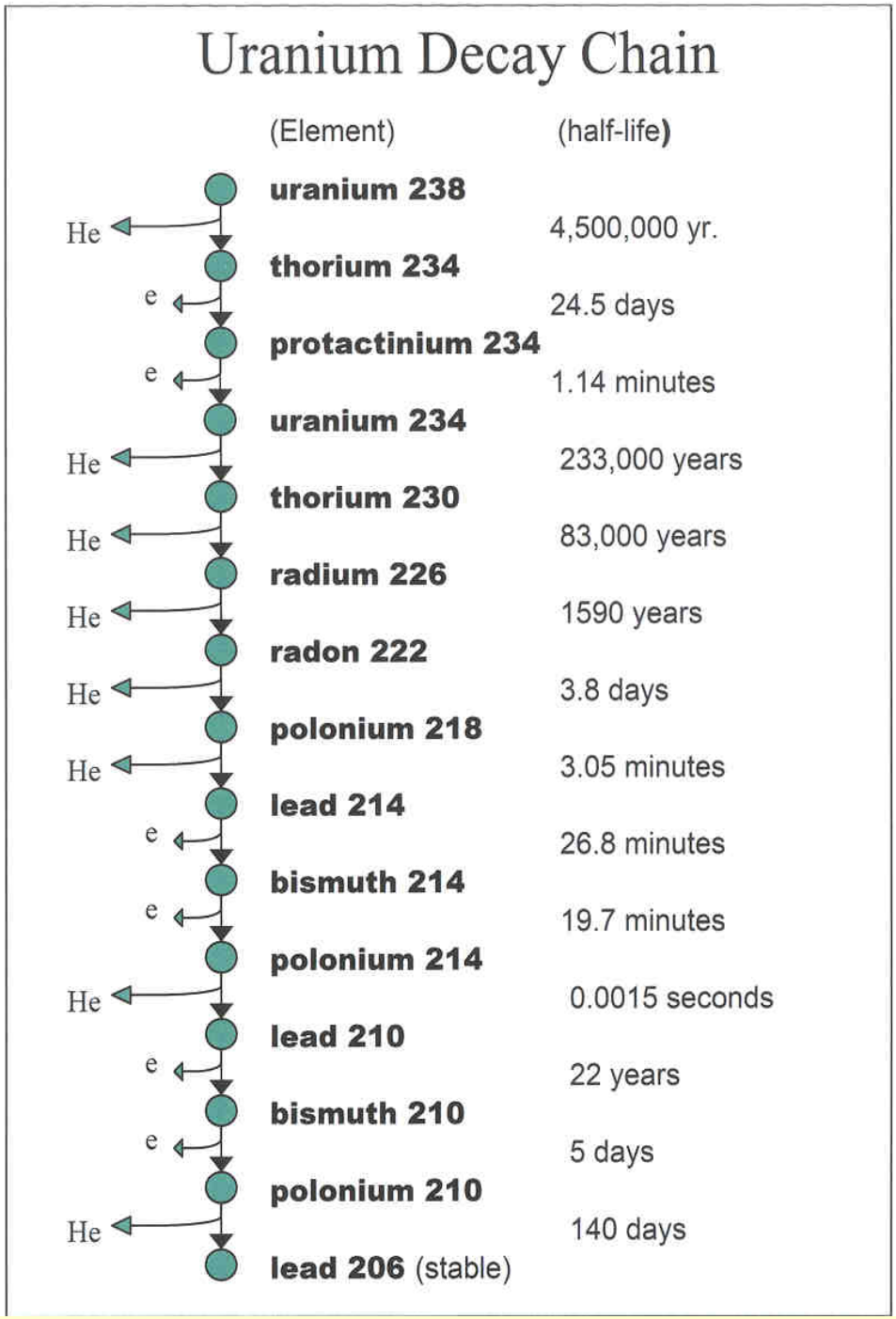
In 2000 the RATE project published research project plan in the form of a 600 page book defining the questions to be addressed, the technical background behind them, the research activities needed, and the funds and resources necessary. The RATE book provides a wealth of technical details and bibliographies about the issues.

In November of 2005 the RATE team published an 800 page technical book for scientists and a 180 page book for educated laymen giving the astounding results to that date. A summery of some major findings follows.

Helium from Isotope decay:

Note that there are eight helium nuclei (alpha particles) produced in the ^{238}U decay chain. Each of these helium nuclei picks up a couple of free electrons to becomes a helium atom, He, somewhere between the atoms in the rock's crystal lattice. These very small and inert helium atoms will rapidly diffuse through the rock and, over time, eventually end up in the atmosphere. This should produce vastly more atmospheric helium than is observed there today.

The RATE team set out to study this process in greater detail.

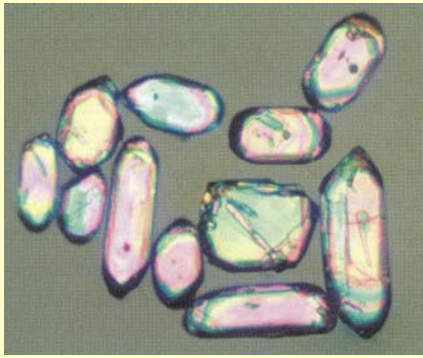


In 1974 Los Alamos labs drilled 4.3 km into the Precambrian basement granite in the Jemez Mountains in New Mexico taking rock samples for their geothermal research. The RATE team acquired some of these samples for their work.

wikipedia.org/wiki/Image:Granite_Yosemite_P1160483

Radioisotopes and the Age of the Earth, Vol. II, p28, Fig.3b

When granite solidifies the tiny zircon crystals form first and they capture most of the ^{238}U.

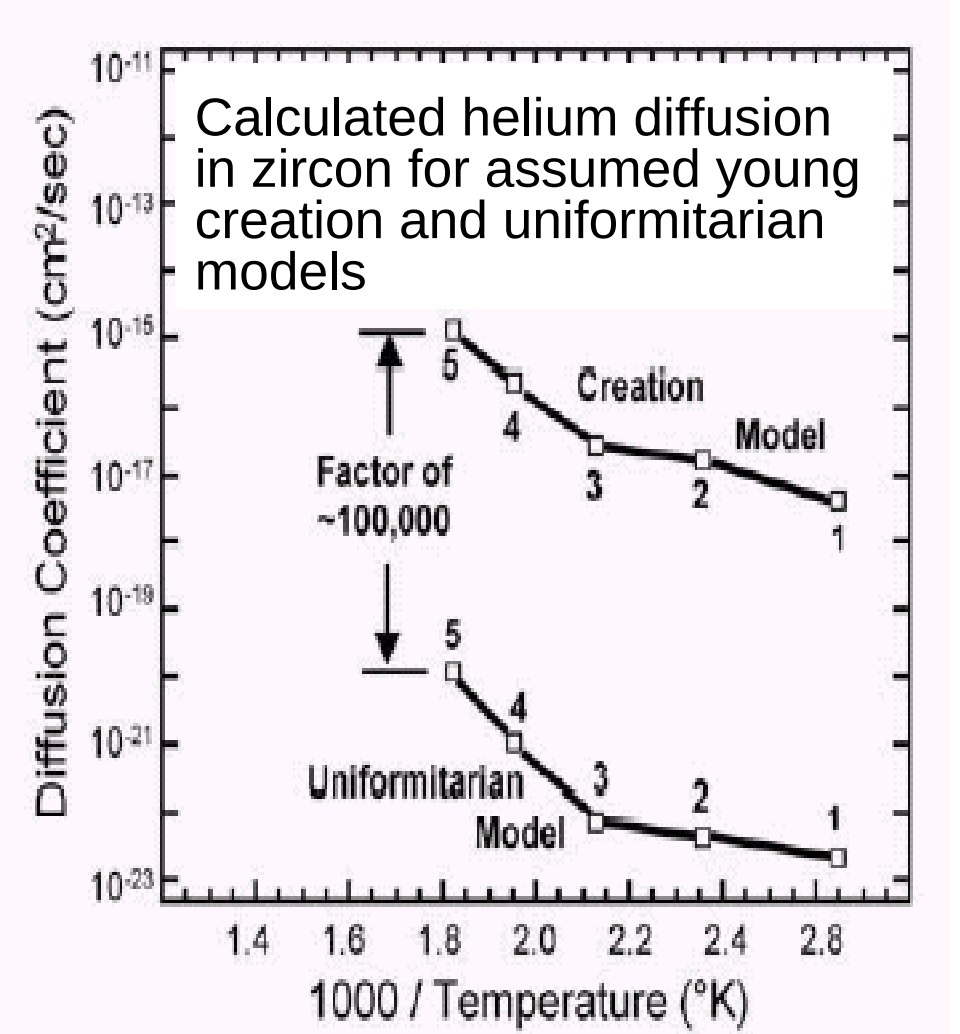


RATE Vol. II, p26.

Measurements show that much of the helium from the radioactive decay, up to 58%, is still in these zircon crystals. Because helium can be expected to diffuse out quickly this helium content is a big problem for uniformitarians.

The diffusion of helium had never been measured in zircon. But the standard equations for diffusion tell us what diffusion coefficient to expect for various situations.

With so much helium still in the zircon after many millions of years, the diffusion coefficient would have to be very small to retain the measured amounts of helium in a uniformitarian model (bottom line).



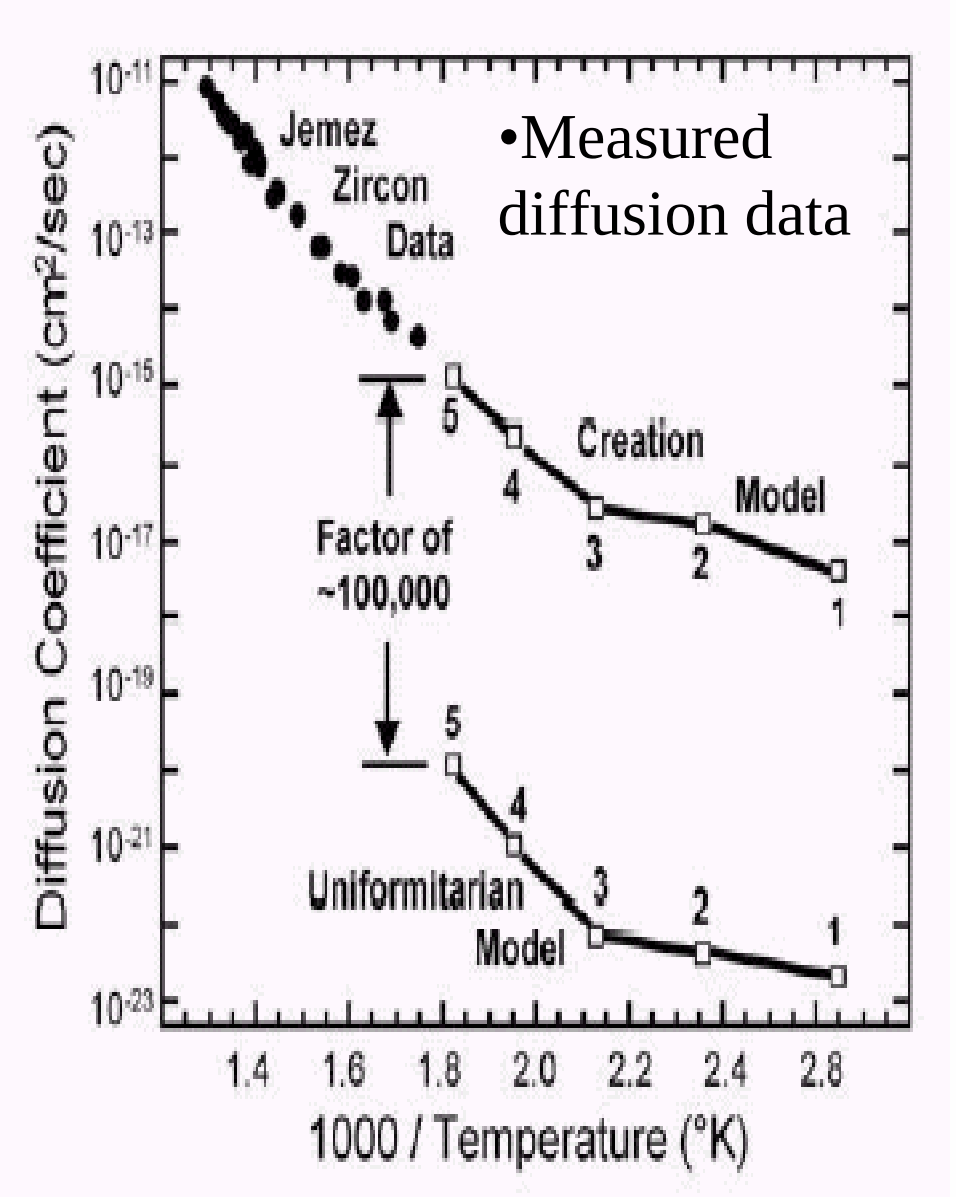
Adapted from Radioisotopes and the Age of the Earth, Proceedings of Fifth ICC, p337

But, if the rock were only a few thousand years old the diffusion coefficients would be expected to be much larger as shown in the Creation Model (top line).

The RATE project commissioned a university researcher, well known as an expert in diffusion, to measure the diffusion coefficients in some of the Jemez zircon.

As you can see the measured Jemez zircon diffusion data matches the creation model quite well. The data does not match the uniformitarian model at all.

But it would be better to have more data at lower temperatures where values were calculated from the diffusion equation. So, the RATE team commissioned these more difficult low temperature measurements as well.

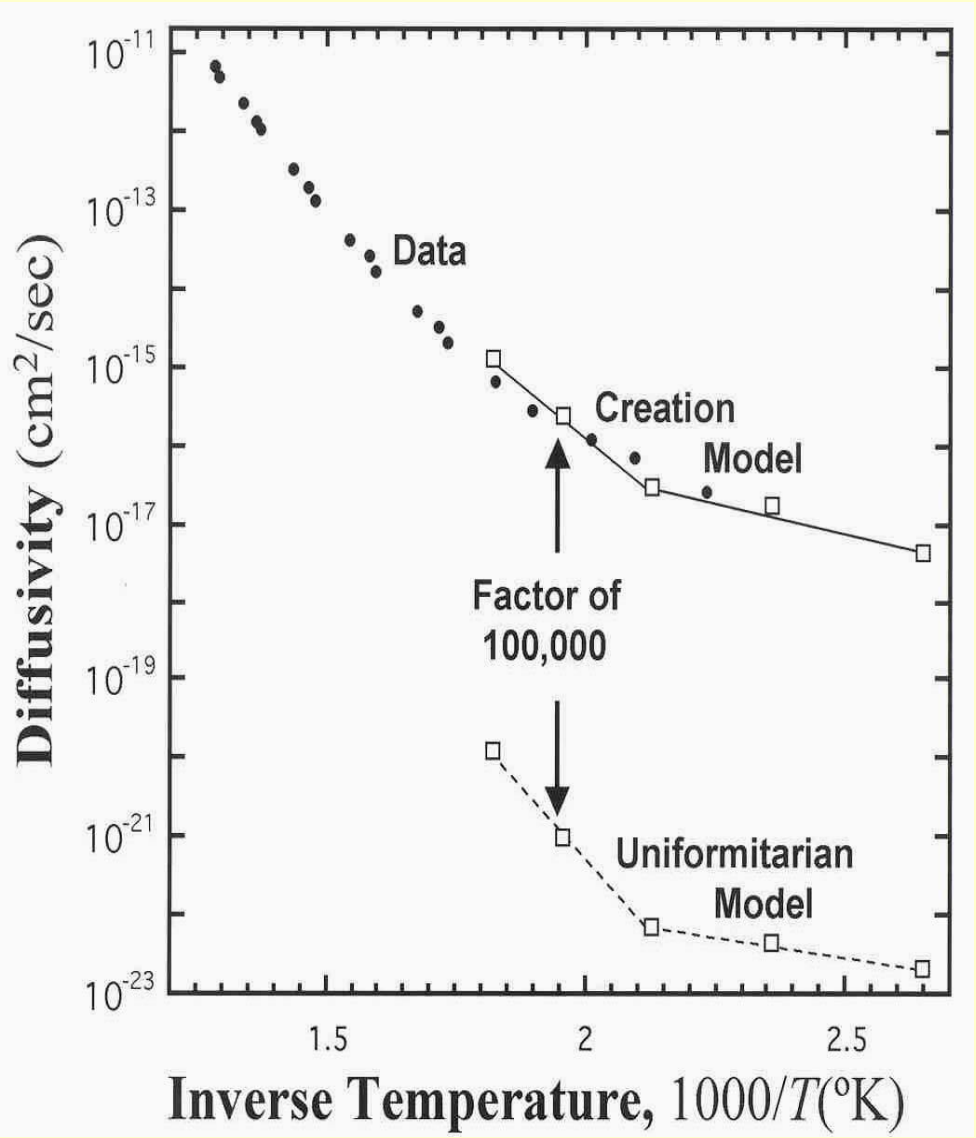


Radioisotopes and the Age of the Earth, Proceedings of Fifth ICC, p337

Here, the new data is plotted with the old data in the graph to the right.

All of this data fits the predicted creation model very well indeed. Again the data indicates that the diffusion has been going on for only a few thousand years.

All of this data also confirms that the uniformitarian old earth model is mistaken by a factor of about 100,000! (Or equivalently, about ten million percent!)



Thus, the scientific method applied to helium generation and diffusion in zircon demands a young earth conclusion.

He Diffusion Critics

Since the RATE project published it's results on He production and diffusion in zircons, several problems have been proposed by other scientists and these have been carefully answered by the RATE team scientists in the books and other publications recommended at the end of this presentation.

Some other critics have published long lists of supposed problems with the diffusion research. Most of these are rather minor and answers have been published for those that might be significant.

The one thing that critics have not done in any way is show that there is anything that can make a significant difference compared to factor of 100,000 difference between the measured data and the uniformitarian model.

In contrast the measured He diffusion data matches the creation diffusion model very well indeed.

What about

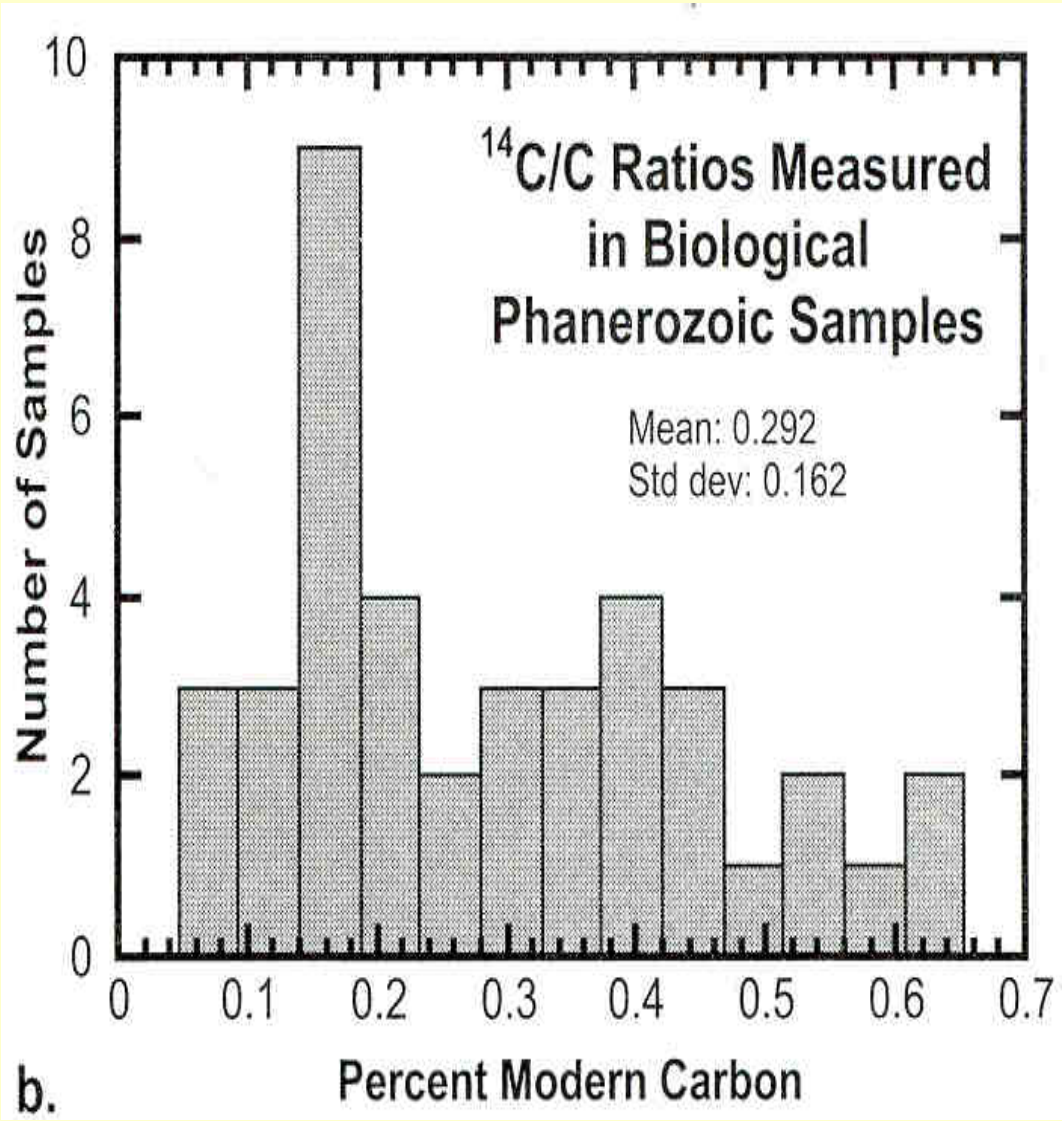
radiocarbon, ^{14}C ?

Radiocarbon ^{14}C decays very much faster than the elements like uranium. The half-life is only 5730 years. So material older than 250,000 years should not have one single atom of ^{14}C left. All of the ^{14}C would have long since decayed away.

Yet substantial amounts of ^{14}C is found in apparently all coal, oil, and fossil wood throughout the fossil bearing strata, called the phanerozoic. The RATE researchers report the following data in the Proceedings of the Fifth International Conference on Creationism which was held in 2003.

Radiocarbon ^{14}C is found in all parts of the fossil bearing rock layers. The conventional uniformitarian geologists assign ages from about one million to more than 500 million years for these various rock layers.

But anything older than 250 *thousand* years should not contain even one atom of ^{14}C left in it! All the ^{14}C would decay away before that.



Baumgardner, J., et al, *Measurable14C …,* Proceedings of Fifth ICC, p131, Fig. 2b

Next, lets look at coal samples from rock layers between 30 million and 320 million years old by conventional dating assumptions.

Table 2. Results of AMS ^{14}C analysis of 10 RATE coal samples.

Sample	Coal Seam Name	State	County	Geological Interval	$^{14}C/C$ (pmc)
DECS-1	Bottom	Texas	Freestone	Eocene	0.30±0.03
DECS-11	Beulah	North Dakota	Mercer	Eocene	0.20±0.02
DECS-25	Pust	Montana	Richland	Eocene	0.27±0.02
DECS-15	Lower Sunnyside	Utah	Carbon	Cretaceous	0.35±0.03
DECS-16	Blind Canyon	Utah	Emery	Cretaceous	0.10±0.03
DECS-28	Green	Arizona	Navajo	Cretaceous	0.18±0.02
DECS-18	Kentucky #9	Kentucky	Union	Pennsylvanian	0.46±0.03
DECS-21	Lykens Valley #2	Pennsylvania	Columbia	Pennsylvanian	0.13±0.02
DECS-23	Pittsburgh	Pennsylvania	Washington	Pennsylvanian	0.19±0.02
DECS-24	Illinois #6	Illinois	Macoupin	Pennsylvanian	0.29±0.03

Baumgardner, J., et al, *Measurable14C …*, Proceedings of Fifth ICC, p134, Table 2

The average of these coal samples, 0.247 pmc, implies they are 50,000 years old given the standard uniformitarian assumptions about the past.

But if there was a world wide flood and very much more vegetation before that, then 0.247 pmc cold easily mean less than ten thousand years.

What about diamonds?

The carbon atoms in diamond are so tightly bound together that it is the hardest substance known. Thus, it is virtually impossible to contaminate! Diamond is conventionally thought to have formed billions of years ago very deep in the Earth's crust.

A few diamond samples have been tested and a substantial amount of C14 was found in each case, but less than coal.

Country of Origin	Diamond Location	C-14/C-12 (pMC ±1σ)
Botswana, South-Central Africa	Orapa mine	0.06 ± 0.03
	Orapa mine	0.03 ± 0.03
	Lethakane mine	0.04 ± 0.03
	Lethakane mine	0.07 ± 0.02
South Africa	Kimberley mine	0.02 ± 0.03
Guinea, West Africa	Kankan placer	0.03 ± 0.03
Namibia, Southwest Africa	Placer deposits	0.31 ± 0.02
(Six diamond samples)		0.17 ± 0.02
		0.09 ± 0.02
		0.13 ± 0.03
		0.04 ± 0.02
		0.07 ± 0.02
Average percent modern carbon for the 12 diamonds is 0.09 ± 0.025		

From De Young, *Thousands…Not Billions,* p57.

This means that diamond is older than the above coal samples but vastly younger than the billions of years supposed by the conventional wisdom.

But *how* can all this be true ??

Some other evidences indicate that a very large amount of isotope decay has occurred, suggesting long ages!

Examples:

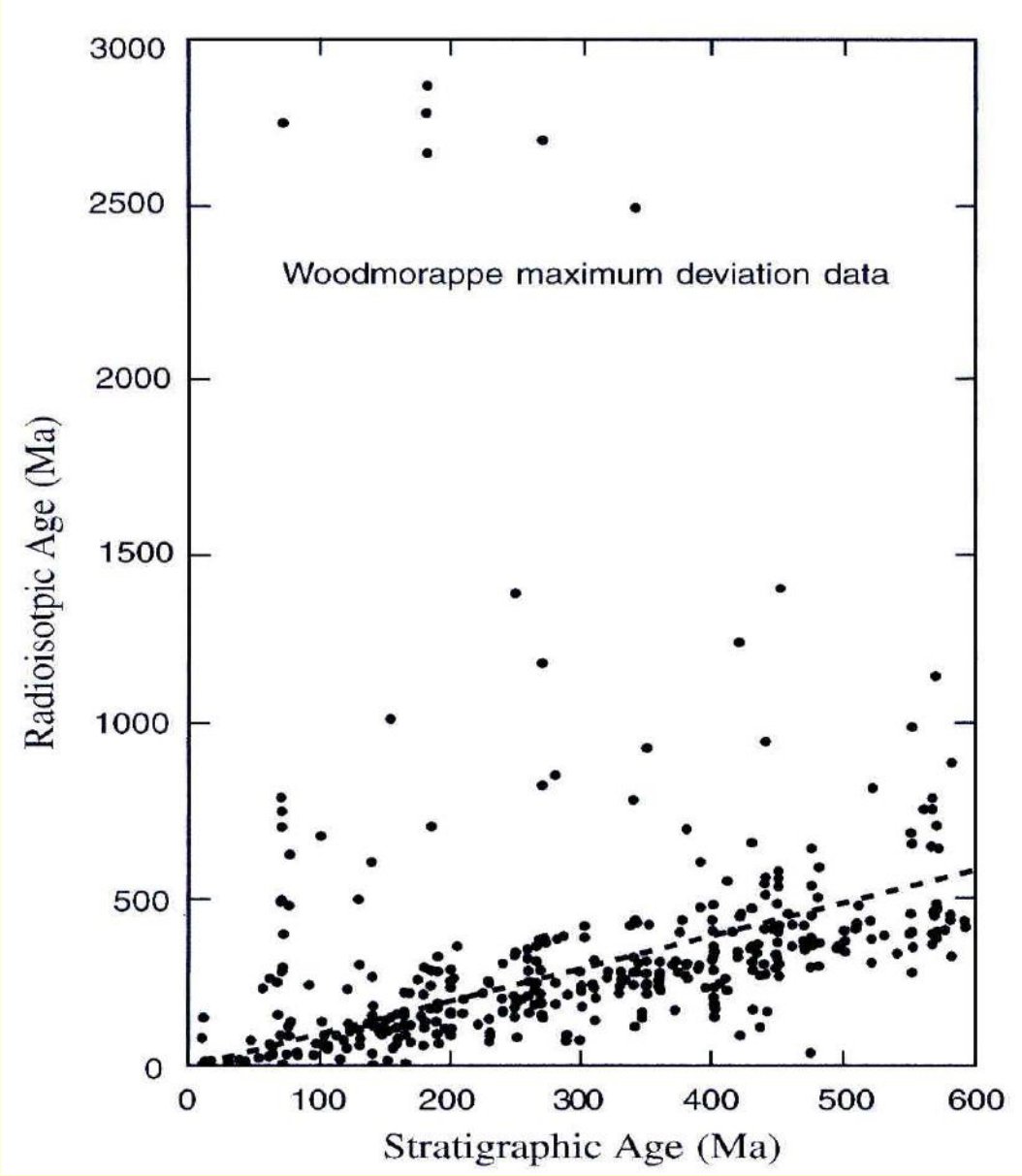
- The real age trend in the isotopes in the geologic column
- Fully formed ^{238}U radiohalos
- Fission Tracks

Lets look at each of these and then see what the RATE scientists propose as a solution to the apparent conflict of these issues with the data presented above indicating short ages.

Trend in Isotope Data Scatter

When plotted against geologic age as estimated by stratigraphic analysis, isotope ages show very much scatter but they also show a very real and distinct trend consistent with the long ages assumed by stratigraphic geology.

There could easily be an element of circular logic involved here, but a significant question remains.

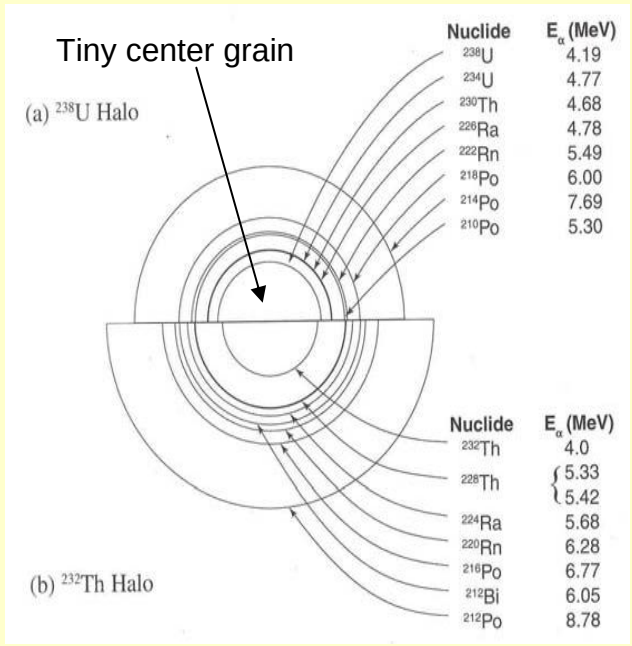


From Radioisotopes And The Age Of The Earth, 2000, p342.

Mature ^{238}U Radiohalos

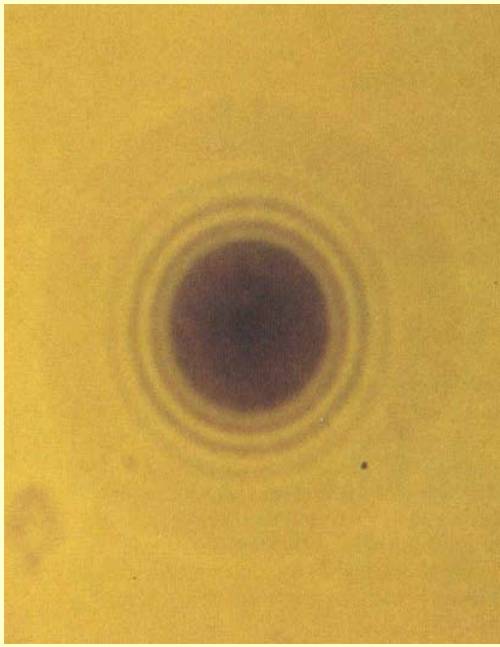
- Tiny 1um center grain contains a billion atoms in the decay chain
- Complete sets of rings imply that all isotopes are present
- Each ring requires tens of millions of alpha decays producing helium, He.
- The ^{238}U decay ring alone would require 100s of millions of years of decay at today's decay rates

Schematic drawing



Radioisotopes and the Age of the Earth, p386, Fig.3

Microscopic photograph

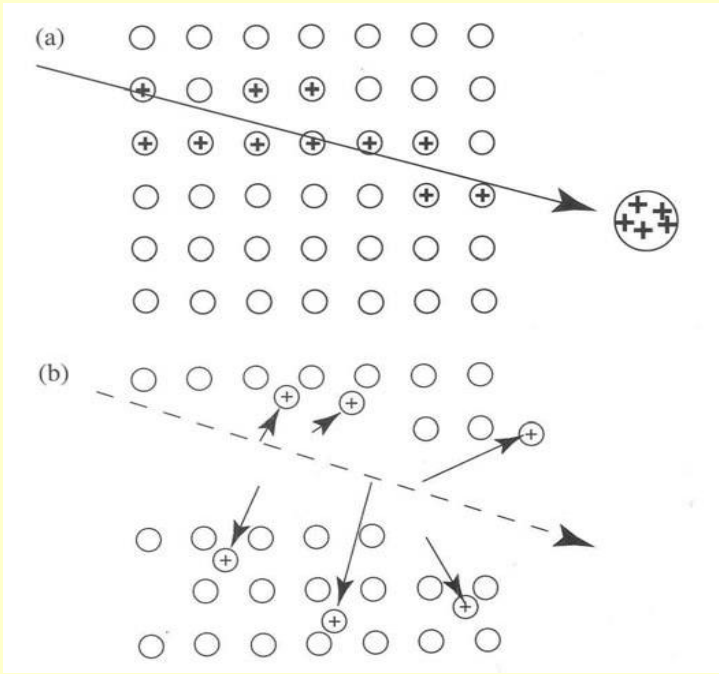


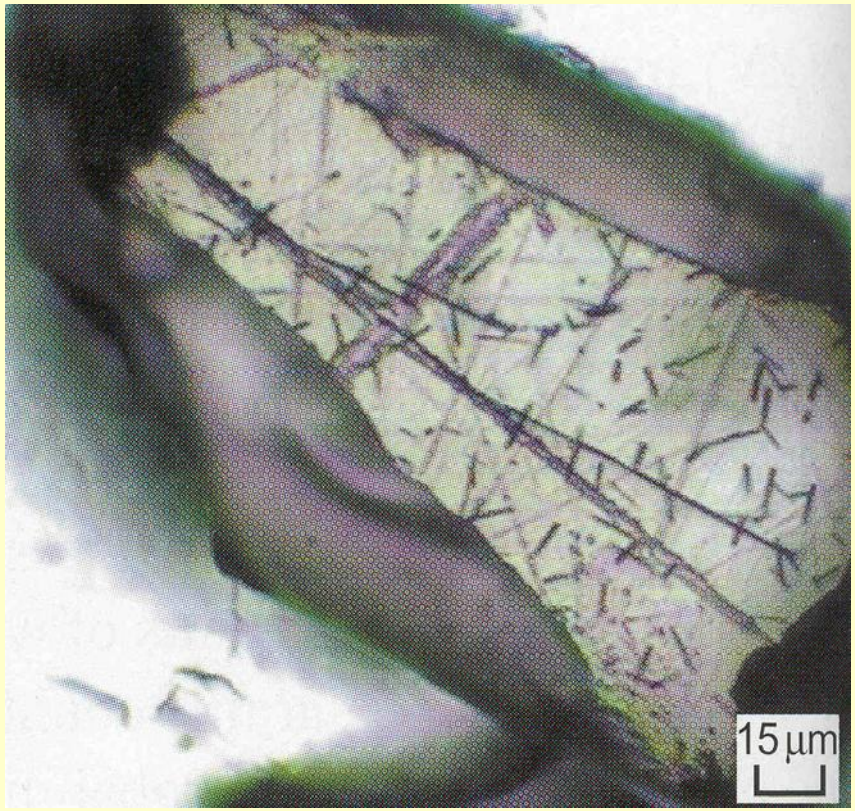
Creation's Tint Mystery, Plate 1(a).

Vardiman, L., et al *Radioisotopes and the Age of the Earth*, p314, Fig.1

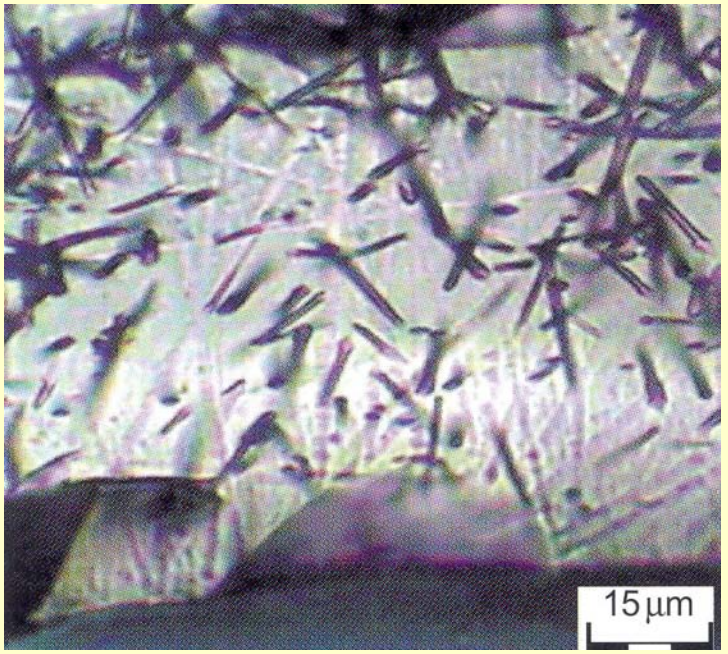
Fission Tracks

Often the density of tracks from nuclear fission is a thousand times that possible in a Biblical timeframe at today's decay rates





Vardiman, L., et al *Radioisotopes and the Age of the Earth*, p236



Accelerated Decay

Past periods of accelerated decay could be a solution resolving the conflict between two sets of evidence:

- the evidence that requires large amounts of decay:
  - Fully formed ^{238}U halos
  - Fission tracks abundance
  - Stratagraphic isotope trend

- the evidence that requires a short time scale:
  - Helium still in the zircon, very little in the atmosphere, even though He diffuses out of rocks quite fast
  - ^{14}C still in fossil carbon throughout the phanerozoic or fossil bearing strata even though ^{14}C decays away very fast.

Estimating time since accelerated decay:

If we assume a short period of rapid decay in the past followed by steady diffusion, one can calculate from the helium data how long ago the last period of rapid decay must have occurred.

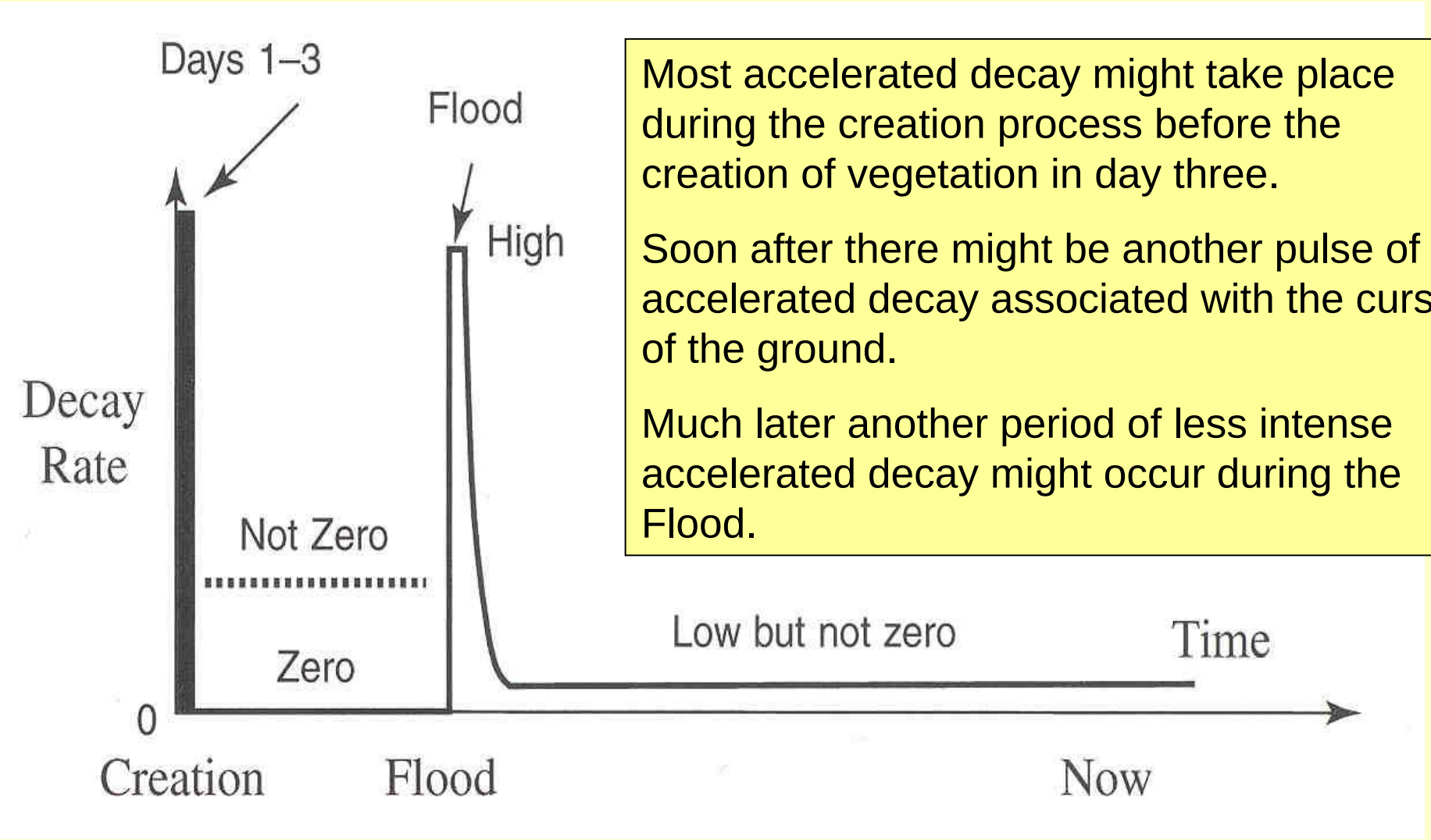
In their paper in the Proceedings of the 2003 ICC, Drs. Humphreys, Austin, Baumgardner, and Snelling give the following table for their data for helium diffusion in zircon (red emphasis added):

Table 4. Time For Diffusion

	x	D/b^2 (sec^{-1})	Time t (years)	Error (years)	
3	4.0982×10^{-3}	1.2672×10^{-15}	10389	+ 4050	- 2490
4	3.3250×10^{-2}	1.6738×10^{-14}	6392	+ 2110	- 1150
5	1.8190×10^{-1}	1.2311×10^{-13}	4747	—	—

So the time since the proposed last accelerated decay event is approximately consistent with the Biblical creation and flood events.

Possible periods of accelerated decay:



Most accelerated decay might take place during the creation process before the creation of vegetation in day three.

Soon after there might be another pulse of accelerated decay associated with the curse of the ground.

Much later another period of less intense accelerated decay might occur during the Flood.

From Radioisotopes And The Age Of The Earth, 2000, p341

Summary:

- We have seen that there is evidence of big problems with conventional isotope dating which goes down to the foundational assumptions.

- Helium generation and diffusion in granite zircons demands young ages

- ^{14}C throughout the fossil rock layers demands that all are young

- Periods of accelerated isotopic decay might reconcile evidence conflicts
  - He and ^{14}C evidence demanding young ages
  - Evidences indicating large amounts of isotopic decay

- The uniformitarian assumption of historical geology is apparently incorrect

Concluding Comment

The above results of the RATE project are very important and may well lead to some paradigm shifts in science. We creationists still have a large amount of work to do to produce a comprehensive theory of the past. The work of the RATE project is continuing. In addition to RATE there are ongoing research projects in several areas of geology, tectonics, astronomy, cosmology, biology and genetics.

As new research results come in, the creationist community expects to build a much more comprehensive theory of past that recognizes both the observable and repeatable data and the action of the supernatural Creator as described in the Bible. Clearly this approach to science requires some fundamental assumptions that are different from the conventional historical sciences which generally demand the materialistic assumption that there is no God or anything else supernatural involved.

We challenge all to keep up with developments in creation science as well as secular science. Some helpful creation publications follow.

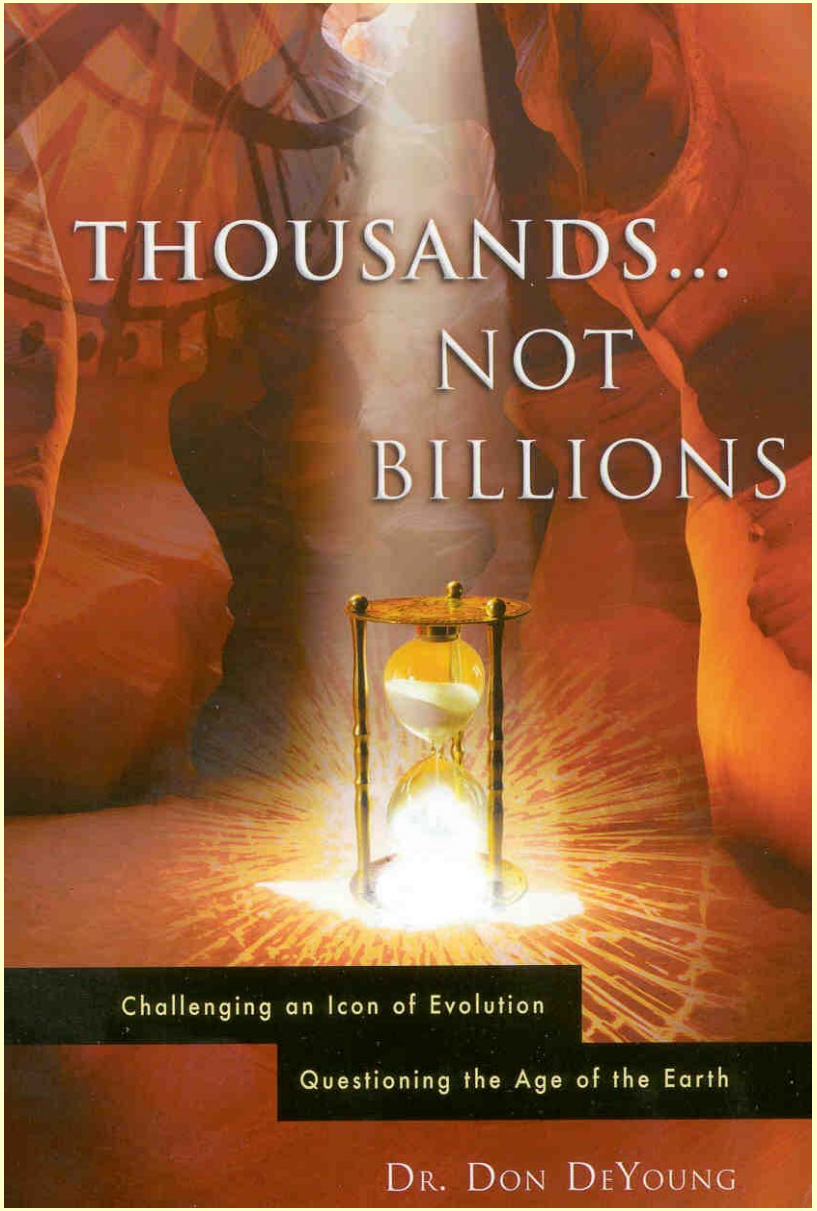
RATE project overview:

Thousands … Not Billions

An excellent overview very well written for educated laymen

by physics professor Dr. Don DeYoung

Available at www.icr.org, www.creationresearch.org or at Amazon.

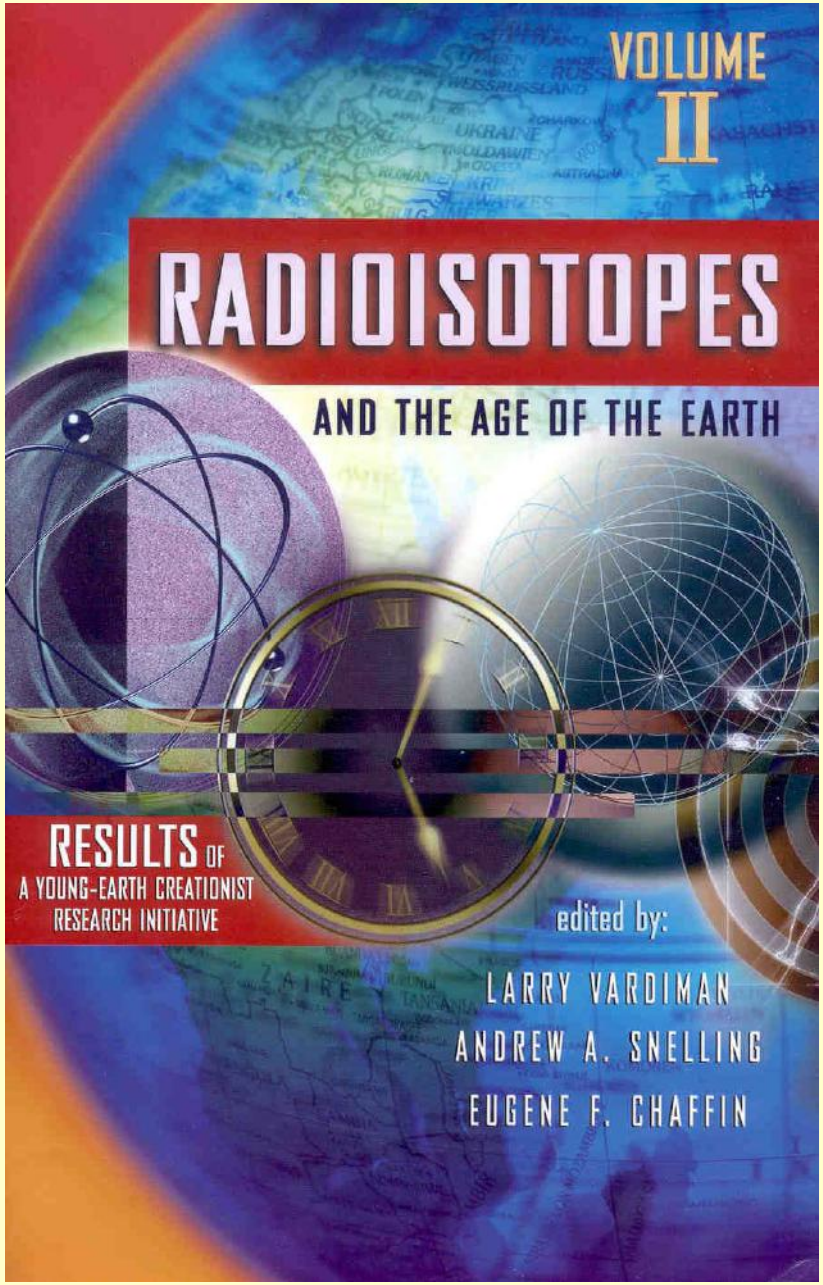


Technical details:

800 pages of
research procedures,
calculations, measurement
data, and analysis from
nuclear physics to geology.

By the RATE team
member scientists

Available at www.icr.org,
www.creationresearch.org
or at Amazon.



Creation periodicals:

I hope that I have peaked your interest in the research that is being done by scientists that are creationist. I want to challenge the reader to watch the ongoing creation science publications for new developments as RATE and other research projects proceed in the future. Some excellent resources include:

- The in-depth technical publication, *Journal of Creation*, from Creation Ministries International, http://www.creationontheweb.com.
- The *Proceedings* of the International Conference on Creationism http://www.csfpittsburgh.org/icc.htm.
- The *Creation Research Society Quarterly*.
- The Creation Research Society web site, www.creationresearch.org.
- The Institute for Creation Research web site, www.icr.org.
- The *free* Institute for Creation Research newsletter, *Acts and Facts*.