

# The Age of the Earth

by G. Brent Dalrymple  
Stanford University Press, 1991, 1994

Reviewed by Andrew A. Snelling

Dr G. Brent Dalrymple has been a highly respected research geologist with the United States Geological Survey for many years, only very recently resigning because of morale-sapping political machinations in Washington. His speciality has been geochronology, being acknowledged worldwide as one of the leading practitioners. So it's hardly surprising that he is the author of this book on the use of radioactive isotopes to establish the age of the earth.

He tells the story of how he came to write the book. It all started with a phone call he received in December 1980 asking him to appear as an expert witness for the State of California, to testify for the defence in a civil suit brought by Kelly Segraves because evolution was being taught to his children as fact in the science classrooms of the public schools. Needless to say Dalrymple prepared notes for his testimony, but the trial fizzled. At the suggestion of the other leading scientists who had also been assembled to testify, he subsequently turned his notes into a lengthy manuscript that was planned for inclusion in a proposed anti-creationist book. Within months he was called to testify for the American Civil Liberties Union (ACLU) in the December 1981 Arkansas trial against the teaching of creation science in that state's public schools. He took the witness stand along with other scientists under a blaze of media coverage. The Louisiana lawsuit followed, but never came to trial. In the meantime he received numerous invitations to speak, and write articles, on creation science and the age of the earth. In the course of all this activity he discovered that there was no current book that explained, in a simple,

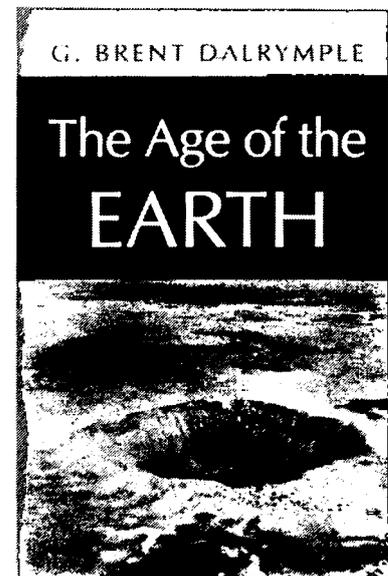
straightforward and thorough way, the current evidence for the age of the earth (within a uniformitarian/evolutionary interpretative framework, of course). So he set to and wrote this one.

Dalrymple's stated purpose is that the book is for people with some modest background in science, but written at a level that will allow the material to be useful and informative to those without a deep knowledge of geology or physics. He says:

*'... even skilled scientists need a simpler level of communication than is usually to be found in the traditional scientific literature. For the average scientist who is not an expert in what is known about the age of the Earth, the voluminous literature dealing with the topic is difficult both to find and to digest. I hope I have succeeded in providing a simple, satisfying, and enjoyable account for anyone who is curious about how the age of the Earth has been determined.'*  
(Preface, pp. x-xi)

Yes, he has succeeded, and therefore I can recommend this book to anyone (creationists included) who wants to be well-informed on this topic, albeit from an evolutionary, millions-of-years perspective.

What then of the book's contents? Chapter 1 is introduction and contains a brief history of the universe 'as science knows it', to provide readers with the framework sufficient to allow the details of succeeding chapters to be kept in evolutionary perspective. Chapter 2 follows with an account of some of the historical attempts, made before 'modern' radiometric methods were available, to determine the age of the Earth. Then in chapter 3 he provides



the background necessary for understanding the remainder of the book. The claimed quantitative evidence for the Earth's age is based on measurements involving what are today long-lived, naturally occurring radioactive isotopes, so Dalrymple next explains how these radiometric methods work and how they can thus be used to date events in what he believes is the very distant past.

Upon this foundation, chapter 4 is a discussion of what are regarded as the earth's oldest rocks. According to Dalrymple and his colleagues the first 700 million years or so of the earth's history has been effectively erased, and the oldest rocks found on the earth are thus not nearly as old as the earth itself. This chapter also includes considerable interesting discussion of the geology of these oldest rocks, because the radiometric results are difficult to understand without knowing how these important rocks (supposedly) formed, and how they are related geometrically and temporally to other rocks.

Some of the key evidence for the age of the Earth, Dalrymple says, comes from bodies in the solar system that are not 'so highly evolved' as the earth. These bodies, the moon and meteorites, are believed to provide a record of the time of some of the earliest events in the solar system. Because the earth

supposedly formed as an integral part of the solar system, the ‘ages’ of the oldest meteorites and lunar samples, which are the subjects of chapters 5 and 6, thus are presumed to provide estimates of the age of the earth. As in chapter 4, these two chapters contain sufficient information about the geology of the moon and of meteorites that is very interesting in itself, as well as according to the ‘age’ data their meaning.

Chapter 7 explains what Dalrymple and his colleagues regard as *their pièce de resistance* — the ‘simple and elegant method that provides us with a reasonably accurate figure for the age of the earth’! This method involves a *model for the evolution of lead isotopes in the solar system*, and employs measurements on meteorites, lunar samples, and earth rocks.

Chapter 8 concerns the evidence for the ages of the Milky Way Galaxy and the universe, as well as some indirect evidence from radioactive nuclides that supposedly indicates that the solar system is billions of years old. This evidence does not lead to any specific figure for the earth’s age, but it does reinforce the evolutionary/uniformitarian conclusion that the earth and the universe of which it appears physically to be a tiny part are ‘incredibly old’ compared to the span of the human lifetime.

The concluding chapter (chapter 9) offers a synopsis of the information in the book, as well as some suggestions about the most fruitful directions that research on the age of the earth might take in the future, within the evolutionary/uniformitarian interpretative framework, of course. Dalrymple confidently asserts that it is highly unlikely that future findings will change the current estimate of the earth’s age, and wistfully suggests it would be nice to tie up what few loose ends remain.

So is Dalrymple’s case for a 4.5 Ga (billion-year-old) earth convincing? Let’s be honest, the answer has to be a qualified ‘yes’! Does that mean his case is watertight? Definitely not! Dalrymple condescendingly dismisses the young-earth creationist case in the

preface to the book in just a few lines, conveniently ignoring, for example, his own testimony during the Arkansas trial that Dr Robert Gentry’s polonium radiohalos are ‘a very tiny mystery’, and at the same time brushing aside Dr Paul Damon’s conclusion that if correct that tiny mystery ‘would call into question the entire science of geochronology’. Nevertheless, the major challenge of radiometric dating has yet to be resoundingly conquered by young-earth creationists, but the day of reckoning is coming.

Quite correctly, Dalrymple says that the use of different decay schemes on the same rock is an excellent way to check the accuracy of age results (p. 124). Yet when it comes to the ‘crunch’ with practical examples, Dalrymple comes ‘unstuck’ with debatable arbitrary explanations as to why there are glaring discrepancies between whole rock and mineral ‘ages’ using different radiometric methods on the same ‘ancient’ rocks in Greenland (pp. 150-151). U-Pb discordia data from zircons and whole-rock Rb-Sr, Lu-Hf and Pb-Pb data all for the Amitsoq gneiss all consistently give a presumed emplacement ‘age’ of 3.7 Ga or more and a (probable) ‘age’ of initial metamorphism of about 3.60-3.65 Ga, *but* individual K-Ar and <sup>40</sup>Ar/<sup>39</sup>Ar ‘ages’ on the minerals biotite, hornblende and muscovite within the *same* Amitsoq gneiss are inconsistent, ranging from 1.67 Ga to 4.85 Ga (older than the earth!), while U-Th-Pb and Rb-Sr measurements on a variety of separated minerals also show ‘a confusing pattern’, rather than the straightforward isochron relationships of the whole-rock data.

So how does Dalrymple ‘wriggle’ out of this, when according to his own statement the accuracy of these ‘age’ results and the methods used to obtain them must be questioned? He says that a ‘logical answer’ is that when the rocks were heated during metamorphism, the isotopes moved, but not very far, so that the isotopes were homogenised only within the surrounding small portions of the rock, not throughout the entire rock body. Thus, for example, during heating

a <sup>87</sup>Sr atom will move out of a Rb-bearing mineral where it was generated by radioactive decay, but in whose crystal structure it does not fit comfortably, only to be captured by an adjacent calcium mineral (for example, plagioclase) where it can substitute easily for that element. Rock samples that contain many thousands of individual mineral grains therefore remain systems essentially closed to <sup>87</sup>Sr even though the individual mineral grains do not. The same argument, says Dalrymple, can be applied to the other isotopes used in dating these rocks, and

*‘this explanation, or some similar mechanism, must be correct for there can be little doubt that the whole-rock isochrons represent the age of the gneisses’* because the data *‘are far too consistent to be explained as mere coincidence’*.

To the contrary, the data in his published table are only consistent because he *chose* to leave out the inconsistent (inconvenient) 1.67-4.85 Ga K-Ar and <sup>40</sup>Ar/<sup>39</sup>Ar ‘ages’ and confusing U-Th-Pb and Rb-Sr measurements. So much for *‘there can be little doubt’* and the explanation given *‘must be correct’*! If the <sup>87</sup>Sr atoms migrate out of minerals then the minerals are not closed systems. Where is the ‘proof’ of how far the <sup>87</sup>Sr atoms migrate and whether whole-rock data represent homogenisation in those rock portions sampled and analysed? By his own admission the same argument can be applied to the other isotopes used in dating rocks. This is arbitrary ‘fiddling of the books’, which is *never* justified even if the end result *looks right* (that is, is consistent with expectations). Yet he repeats the same sort of ‘explanations’ in several other places in the book (pp. 157-163, 170, 187) when disparities occur between different isotopic ‘dates’ on the same rock. Creationists’ criticisms of radiometric dating are therefore still justified, Dalrymple’s fine treatise notwithstanding.

There are also a lot of critical assumptions that, like glue, hold Dalrymple’s seemingly impregnable radiometric dating ‘fortress’ together. Not the least of these is Dalrymple’s

*pièce de resistance*, which after all need not be the only model for the occurrence of lead isotopes in the solar system. While growth curves are legitimate inferences if, and only if, radioactive decay of U and Th to Pb has been constant, which has definitely *not* been proven, it is arguable whether the lead isotopic compositions of 'ancient' lead ores can be 'massaged' to yield a 'primeval' lead composition, given that assumptions are first made about the 'ages' of the lead ores and about the derivation of their lead isotopic compositions. Absolutely critical is what constitutes 'primordial' lead, and whether this is represented by the lead isotopic compositions of iron meteorites such as the Canyon Diablo. The key assumption is that meteorites, as mostly fragments of asteroids, represent materials that formed at the same time as the earth and the other planets from the sun, billions of years after the 'big bang', all of which is totally at odds with the order and timeframe given in the Creator's eyewitness testimony in Genesis.

From these assumptions regarding the primordial or initial lead isotopic composition flow the 'date' interpretations of U-Th-Pb isotopic data of rocks. It is fascinating, therefore, to read Dalrymple's comment (p. 250) that the U-Pb method has proven of minimal value in determining the ages of individual lunar rocks, because most U-Pb isotopic data for lunar rocks, when plotted on the conventional  $^{206}\text{Pb}/^{238}\text{U}$  versus  $^{207}\text{Pb}/^{235}\text{U}$  concordia diagram, are highly discordant and do not fall on concordia. The few that do typically give concordant U-Pb 'ages' of 4.4-4.5 Ga are unacceptable, because these ages are greater than the rocks' (true?) ages as determined by other radiometric methods. The reason (or is it an excuse?), says Dalrymple, for the high frequency and degree of discordance is that '*most lunar samples contain initial lead*'. To make any acceptable sense out of the lunar rock U-Pb isotopic data, therefore, requires 'correction' for primordial lead, so if the conclusion (assumption?) that the lunar samples contain initial lead, and/or the

primordial lead composition chosen (based on biblically-incorrect assumptions) to 'correct' the U-Pb dates is incorrect, then the U-Pb 'ages' of lunar rocks will remain unacceptable and therefore useless (though they still must have meaning within a creationist framework).

Back to earth again, Dalrymple says (p. 119) that the result of the addition of Pb to a sample is 'unpredictable' because it depends (understandably) on the isotopic composition of the added lead, and so by inference (he doesn't spell it out) this means the U-Pb concordia method is thus useless for 'age' dating in such circumstances. Furthermore, this method can only be used on minerals that contain either no initial lead, or initial lead in such small quantities that a correction for its presence can be accurately made. Indeed, but how does one recognise which lead is initial lead without the meteorite primordial lead or local background lead assumptions? This is what I meant earlier about critical assumptions holding Dalrymple's radiometric 'fortress' together — if the glue is weak (which it is), then the 'fortress' is not impregnable.

And the ultimate method, as far as the topic of his book is concerned, is the Pb-Pb isochron method, which he says '*is the basis for what is thought to be the most precise value for the age of the meteorites and the earth*' (p. 120).

It is '*self-checking*' because '*unreliable data are indicated by scatter*'. The 'age' is determined by the slope of the isochron and the method can be used when either the composition or the amount of initial Pb remains unknown. But the initial and primordial lead assumptions cannot be so easily ignored, nor the fact that the isotopic composition of the primeval lead standard used (p. 323) already contains the radiogenic  $^{206}\text{Pb}$  and  $^{207}\text{Pb}$  isotopes as well as nonradiogenic  $^{204}\text{Pb}$ . The amount and composition of whatever initial and/or primordial lead there is in any samples will always be a part of the isotopic analyses that are then plotted on a Pb-Pb isochron diagram, only assumptions

about primordial lead making it possible to distinguish it. As for self-checking, how is that accomplished in cases like that in the Koongarra area, Northern Territory, Australia, where Pb isotopic analyses of 113 soil samples are highly correlated ( $r = 0.99986$ )<sup>1</sup> and yield an isochron 'age' of  $1428 \pm 33$  Ma with an MSWD of only 964, or if two apparent outliers are removed an isochron 'age' of  $1420 \pm 18$  Ma with an MSWD of a mere 190?<sup>2</sup> The scatter is very minimal, so this is a good isochron and therefore, according to Dalrymple, the resultant 'age' is acceptable. However, in this instance it is a geologically meaningless result that cannot even be explained by mixing from different sources.

The possibility that 'isochrons' may in fact result from mixing of isotopic ratios from different sources is not even touched upon by Dalrymple, even though this concept has repeatedly been raised in the conventional scientific literature over the past three decades to explain 'anomalous' data sets. Dr Robert Brown of the Geoscience Research Institute (USA) also pointed out this inadequacy in his review of Dalrymple's book,<sup>3</sup> and discussed the mixing and isochron concepts in a little detail.

We could take issue with Dalrymple on many other aspects of radiometric dating, but space doesn't permit it. For example, why does  $^{87}\text{Sr}/^{86}\text{Sr}$  have to be identical in all minerals in a rock simply because crystallisation supposedly doesn't fractionate isotopes (p. 106)? Or why is it that  $^{86}\text{Sr}$  is a constant when it is non-radiogenic? Dalrymple tells us (p. 111) that the constant J is determined for calculating the  $^{40}\text{Ar}/^{39}\text{Ar}$  'age' of a sample by irradiating a sample of 'known age' as a monitor with the sample, but this merely 'begs the question' as to how that 'known age' is first known! And the Ar diffusion model (p. 115) — how can heating steps be progressively releasing Ar from further and further inside mineral grains if they are the product of the rock and its constituent mineral grains having first been crushed in the preparation process?

So by all means young-earth creationists should read this book to be

fully informed by an acclaimed specialist on the case for an old earth and universe. His account is certainly lucid and persuasive. However, while we can negatively challenge the assumptions and discrepancies all we like, the way forward must surely be to positively produce a better explanation/model for what the isotopic ratios and 'ages', and the patterns of progressive 'ages' through the geologic record, actually mean. Rather than viewing

isotopic 'dating' as an 'enemy', we must accept the isotopic analyses (not the dates) as valid and seek to make them our 'friend'. Dalrymple, therefore, has done us all a service in making the 'art' of geochronology more understandable to informed laypersons, so that the technical mystique is removed and the enormous challenge ahead of us can be appreciated. So if you are brave enough read this book, but only borrow it from a library!

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## The Desert's Past: A Natural Prehistory of the Great Basin

by Donald K. Grayson

Reviewed by Michael J. Oard

## THE DESERT'S PAST

A NATURAL PREHISTORY  
OF THE GREAT BASIN

DONALD K. GRAYSON



Examining below the veneer of recent sediments, scientists often come across biological and climatic evidence for major differences from presently operating processes. The '*present is the key to the past*' is sometimes challenged by the first spadeful of dirt. The *Desert's Past* is a book that documents the unique history of the recent past for one particular area — the Great Basin of the United States.

The Great Basin is essentially that part of the southwestern United States centred in Nevada that possesses no external drainage. The time corresponds to the late Pleistocene and Holocene periods of geological time, which would be post-Flood time within the creation-Flood model. The author summarizes many of the mysteries in his preface:

*'During the late Ice Age, there were camels living near what is now Pyramid Lake in northwestern [sic] Nevada; there were massive glaciers in the high mountains of eastern Nevada; there were substantial lakes in settings as far flung as Death Valley and the Great Salt Lake Desert; there were trees in the valleys of the Mojave Desert of southern Nevada.'*

(p. xvi)

These findings contrast sharply to the near desert climate of today.

The camel is one of 32 large mammals, including mammoths and mastodons, that became extinct in North America by the early Holocene. Other large mammals, such as the bison, survived. Scientists have been trying for over 200 years to understand this preferential extinction mystery.

Distinct shorelines from recently dried up lakes are etched on many hills and mountains in the Great Basin. Dried up Lake Manly with a maximum depth of 600 feet (183 m) once occupied Death Valley, now one of the hottest places on earth! Creationists have no trouble filling up Great Basin depressions as the worldwide Flood waters drained. However, evidence that the pluvial lakes are more than a remnant of the Flood is provided by etched shorelines on end moraines at two locations in the Great Basin. The climate was truly much wetter after the Flood.

The late Pleistocene lake depth chronology has been developed for pluvial Lake Bonneville, the much expanded Great Salt Lake of the ice age.

The details of this chronology have varied over the years. The book now claims that the Younger Dryas cold phase about 11,000 years ago in geological time shows up by a slight rise in lake level. Given all the recent attention to the Younger Dryas event, this claim provides evidence that shoreline chronologies are mostly based on preconceived ideas of Pleistocene history.

Besides pluvial lakes and mountain glaciers, pollen and macrofossils from packrat middens indicate the late Pleistocene summers in the Great Basin were around 11° to 21°F (-12° to -6° C) cooler! There is some evidence that winters were warmer. Precipitation estimates ranged up to four times current amounts. The vertical vegetation zones in the high relief of the Great Basin were shifted downward about 3,000 feet (900 m), 4,600 feet (1,400 m) in some