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Radiometric Dating: An Unconvincing Art

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RADIOMETRIC DATING --
AN UNCONVINCING ART

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Radiometric dating techniques have always been an important element in the modern Creation-evolution controversy. From the time that radioactive decay rates were first suggested as a means of measuring the age of rocks, creation-model scientists and other critical thinkers were quick to point out that because the original compositions of the rock could not be established, the "age" as measured was actual conjecture, and without compelling scientific value. Nothing has happened to change that. However, a very clever mathematical trick called "isochrons" has more recently been used by geochronologists to delude themselves into thinking that they are able to find rigorous proofs for old-age in rocks through radioactivity data.

This mathematical method is indeed rigorous, and at first glance appears very compelling evidence for ancient ages. However, careful analysis discloses that there is at least one other equally valid mechanism for the source of the data, and no cogent proof that can be offered that any significant amount of any radiogenic daughter element has ever been the result of decay from the parent over long ages.

To determine the age of a rock by means of the radioactive decay of a "parent" isotope, one must first determine the present concentration of the "parent" and the "daughter" isotope. It must also be assumed that the rate of radioactive decay of the "parent" isotope is correctly known, and that this rate has been constant over the period of time being studied. There seems to be no reason to dispute these measurements, or assumptions. However, unwarranted assumptions are made by geochronologists. Some of these basic assumptions are:

1. That a change in the isotopic ratios has indeed taken place since the rock crystallized.

2. That the rock was changed from the original conditions to the present conditions by radioactive decay of the parent isotope - and that some process other than simple radioactive decay could not have contributed to the alleged change.

3. That one can know or estimate the original concentration of the "parent" and the "daughter" isotopes in the rock.

If any of these critical assumptions are challengeable, radiometric dating is not a valid proof of the age of a rock or of the earth.

ANOMALOUS RESULTS

The contradictory estimates of time which are calculated make it reasonable to challenge one or more of the basic assumptions used in these studies. The geochronological literature includes vocabulary such as discordance and anomalies which indicates that contradictory dates indeed do exist. John Woodmorappe's historic paper found in Creation Research Society Quarterly(1) documented and discussed the discordant dates obtained by using radioisotopes.

OPEN SYSTEMS

There are a host of arguments used to explain why the reported ages are not consistent with each other and with other evolutionary predictions. They focus on one or another of the basic assumptions being invalid in the particular case. The most common explanation is that the systems have been "open" such that the samples have lost or gained some of the critical isotopes during the time in question, thus violating the requirement that the alleged change is not solely due to radioactive decay. Often a bad date is claimed to be the result of an imperfect estimate of the original concentration of the "parent" or "daughter" isotopes.

A CREATIONIST'S VIEW OF THE RADIOMETRIC DATA

Creation theorists can well challenge one or all of the basic assumptions of geochronology because the calculated ages are inconsistent with predicted values. Geochronologists must carefully qualify each reported date. Creationists point out that the dates which are derived from different radiometric systems differ. The consistency demanded by scientific theory, or by good scholarship, is not obtained. This fact alone should disqualify the use of radiometric dating as a proof of immense ages.**

Geochronologists have chosen to measure the isotopic ratios of only "parent" isotopes which have half-lives in the range of the expected age of the earth, thus the random dates cluster near the expected values. If geochronologists chose to study the decay of an isotope with a half-life in the range of thousands of years, the reported age would be some multiple of a few thousand years.

Values which are too "high" or too "low" are argued to be the result of contamination or leaching. The unexpected dates are explained without admitting that a problem exists with the basic assumptions of radiometric dating.

ISOCHRONS

The Rb-Sr isochrons which were first used in 1958 seemed to solve the evolutionary dilemma as this procedure appeared to validate all of the assumptions used in the technique.

By plotting the ratio of the daughter element to a non-radiogenic isotope vs. the ratio of the parent to the same isotope, a straight line often results. Fig. 1 illustrates such a plot. An example is a plot of $^{87}Sr/^{86}Sr$ vs. $^{87}Rb/^{86}Sr$. ^{87}Rb decays to ^{87}Sr by beta decay, with a half-life of 48.8 billion years. Such plots are called "Isochrons".**(2,3)

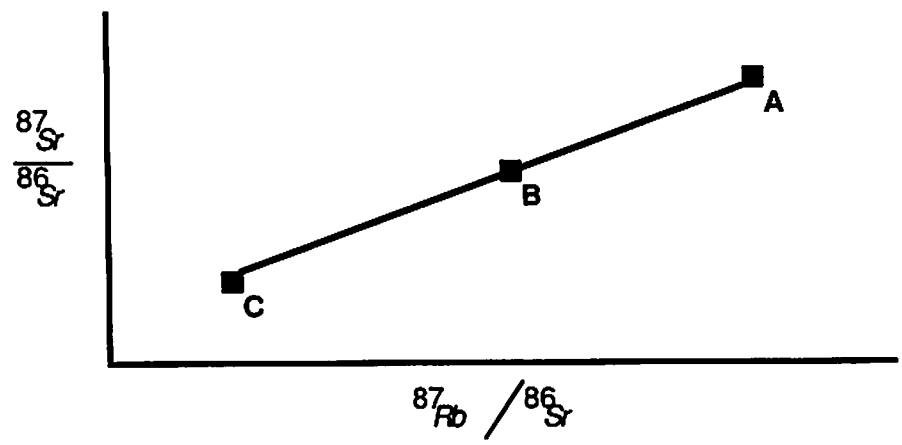

Figure 1

Typical Configuration of a Rb-Sr Isochron

Scientific experience tells us that when data fit on a mathematically-defined curve, especially on a straight line, there is a fundamental relationship between the data points, and that this relationship can be discovered. In this case evolutionary geochronologists presume that the relationship is the decay over time of the parent into the daughter. It follows that there is no problem in determining the original composition of daughter isotopes -- it is given by the zero intercept of the straight line. The slope of the isochron defines the age of the sample. There is furthermore no question as to whether the sample has been a "closed system" over time. If it were not, the data would not fit a straight line.

** Wherever this symbol appears in this paper, see Overn, W. M. "The Truth About Radioactive Dating" in Volume 1 of this Conference for an expansion of this point.

The isochron method is elegant, because it eliminates so many problems of calibration and possible error. It is essentially self-checking, because of the requirement that the data points lie on a straight line.

The isochron interpretation of isotopic data indeed seems to answer many questions for evolutionary geochronologists. A belief in immense ages seems to be required by these data.

The authors estimate that a few thousand isochrons each comprised of three to twelve linear data points have been published. If the data displayed as an isochron did not have a reasonable short-time interpretation, it would certainly pose a legitimate challenge to biblical chronology.

PROBLEMS WITH ISOCHRONS

The isochrons appear to be mathematically rigorous and logically unarguable. However, many dates which have been obtained from isochrons are deemed to be faulty even by evolutionary theorists. Woodmorappe(1) reports that many dates obtained by use of isochrons are ignored if the values do not agree with evolutionary theory. He even reported that two isochrons which appeared to be concordant were ignored, because they were inconsistent with fossil dates. This fact alone should indicate that evolutionists do not trust the use of isochrons.

In addition to discordant dates obtained by the use of isochrons, negative isochrons have been recorded. Clearly this fact indicates that these procedures are invalid. Even with the knowledge that evolutionists recognize that a few isochrons are erroneous, it is important to establish that an alternate short-time span mechanism for the origin of isochrons exists.

In 1981, Arndts, Overn and Kramer (4,5,6) published a series of papers which discussed the modern methods of radiometric dating. They pointed out that another equally well-known mechanism, mixing of parts from other initial rocks, can give the same results. If mixing is the mechanism, the data have no time significance -- the rock could have formed yesterday.**

THE MIXING MODEL

The mixing model is an alternate explanation for the data often displayed as an isochron. It should be made clear that the authors are not attempting to prove that isochrons are the result of mixing. Even if one could prove that a particular isochron is the result of mixing, it would not prove that the rock was formed recently. The mixing event could have taken place a billion years ago as well as yesterday. This paper is an attempt to show that the short-term mixing model is a reasonable alternate to the immense-age, radioactive-decay interpretation of the isochrons.

The data points of an isochron are connected by a straight line. If a small portion of the material used to form points A and C were mixed in equal portions, analysis of the isotopic ratios of the mixture would place it on a line half-way between points A and C. A mixture made from any amounts of the material in points A, B, or C would result in a new mixture which would fit on a straight line somewhere between points A and C.

Mixing or contamination is quite often used as a mechanism to explain an isochron whose data is not consistent with evolutionary theory. Geochronological texts discuss this possibility. Molten lava melts and dissolves country rocks and mixes their elements into the molten phase. The viscosity of the melted rock is such that the resulting mixture does not become homogenized. The resulting solid phase exhibits variable Rb/Sr and Sr-87/Sr-86 ratios. When the resulting isochron is positive and when its slope is consistent with the expected age, the isochron is reported as proof of this time. If the slope indicates an age which is not consistent with evolutionary expectations, the isochron is deemed to be the result of mixing, leaching, or contamination.

It becomes apparent that the validation of radiometric dating is based on the premise that the earth is billions of years old. Radiometric dating can in no way constitute proof of ancient age, since any individual measurement could be due to mixing rather than decay.

MINERAL VS WHOLE-ROCK ISOCHRONS

A valid isochron interpretation requires a plausible mechanism for the data of the straight line. There must primarily be a valid mechanism for having parts of the rock with differing initial quantities of parent isotopes, so that a plot could be made, rather than a single point.**

The mineral isochron is an elegant scheme for obtaining the required heterogeneity. As the crystals of individual minerals form, they absorb varying trace amounts of Rb and Sr, depending upon their individual chemistry. This is affected by the concentration of the trace elements, however, so that heterogeneities due to partial mixing will also affect the process.

The elegance of the mineral isochron lies in the fact that the selectivity of crystals to the trace elements provides, in the form of a well-known mechanism, the required heterogeneity to make the plot.

The isochron process depends on heterogeneities in Rb at the beginning. The introduction of subsequent heterogeneity would simply destroy the process. The process also depends on homogeneity in the strontium ratio at the beginning. Any initial systematic heterogeneity in the Sr ratio from partial mixing, or from any other source, will yield a fictitious isochron or mixing line.

Rb-Sr isochrons are regularly published from data obtained from the whole rock, however. The crystallization process cannot be depended upon here to provide the heterogeneity that occurs. (The existence of the isochron attests to heterogeneity.) If the heterogeneity is of recent origin, the isochron is unreliable. If the heterogeneity was there at the beginning, then the melt was not homogeneous, and the Sr ratios were probably also heterogeneous, defining the isochron as a mixing line.**

The whole-rock isochron is justified on the basis that migration of the isotopes in a metamorphic event may be confined to distances of perhaps 1 cm. This is much larger than the average crystal size. Thus the original constituants of each crystal will lie nearby. By taking samples of 100-cm dimensions, one could assure that the entire content of the original crystals are well represented by the sample, with very small error. However, this matrix is the original melt that was theorized to be homogeneous. The ability to find differences in the rubidium content among the samples violates the assumption of original homogeneity. Original inhomogeneity is the only possible explanation: in other words, mixing.

Geochronologists do not generally propose the radiometric dates as proof for ancient age, even though many others accept them as such. Each isotopic system for every rock system is carefully studied before accepting it for dating. Ultimate acceptance depends on the degree of fit with a large body of accepted dates. The original accepted dates were derived from the fossil record and uniformitarian assumptions, and were available from the beginning of the radiometric technology. They played an important role in this acceptance. We can therefore make a general statement that the "radiometric clock" was "calibrated" to the fossil dates. Statements referring to the need for selection abound in the literature. A common term is whether the data are "stratigraphically" acceptable, referring to the fossil data.

The mineral isochrons are not accorded as much credibility as the whole-rock isochrons. The conclusion is that mineral crystals are not reliable closed systems. Whole-rock isochrons are systematically proferred (on a superficial literature survey, approximately 10:1) over the mineral, based on the above, but primarily prompted by the better fit with accepted data. Note, however, that the mixing model is the only simple straightforward explanation for the straight-line heterogeneties in the whole rock.

SUMMARY

Is the art of radiometric dating in any way convincing for acceptance of an ancient earth? We say NO!

1. Geochronologists don't accept it at face value, except in those cases where it agrees with the "stratigraphic" date.

2. It yields discordant results.**

3. There are other mechanisms to explain the results, primarily mixing.

4. There is no mechanism to validate the preferred whole-rock method, outside of mixing, which has no time significance.

It appears that the reasons that immense ages seem so reasonable from the radiometric data is primarily due to the long half-lives of the isotopes commonly chosen for the practice of the art.

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DISCUSSION

In response to the five points in the summary:

1. *A considerable amount of radiometric data doesn't have anything to do with "stratigraphic" information, for example the isochron plot of the solar system showing that it formed 4.5 billion years ago.*

2. *Now that geochronology has developed into a very sophisticated science with stringent "honest" requirements on samples to be dated, there is a very small percentage of results which give discordant ages.*

3. *Mixing can only explain a few of the isochron plots and can certainly not explain why the overwhelming majority of all isochron plots from the continental crust give positive slopes with old ages. Also, mixing is not a possible mechanism for the isochron plot of the solar system.*

4. *This point is too technical to answer in one sentence.*

5. *Choosing isotopes with long half-lives does not preferentially result in data giving old ages. With these isotopes the percentage uncertainty in the measurements is smallest for the old ages, but young ages are equally possible.*

William Wharton, Ph.D.
Wheaton, Illinois

Any theoretical explanation for the straight lines on an "isochron" diagram must account not only for the lines but also the values of the data points. Many isochrons include points with $\frac{^{87}Sr}{^{86}Sr}$ *values ranging between about 0.7 and 0.8 - 0.9. If mixing explains the isochron for an igneous rock then one of the components must have had a ratio of 0.8 - 0.9. But no magma has ever been measured with a* $\frac{^{87}Sr}{^{86}Sr}$ *much greater than 0.71, certainly nowhere around 0.91 If the mixing model is valid then proponents must show that magmas with very high Sr ratios are common. Current evidence indicates they don't exist.*

Solid rocks with high Sr ratios do exist. But a magma mixed with lots of solid xenoliths would show abundant field evidence of widespread contamination. Many of the igneous rocks for which isochrons have been obtained show neither physical field evidence nor major element nor trace element chemical evidence of substantial contamination.

Davis A. Young
Grand Rapids, Michigan

CLOSURE

We wish to thank Dr. Wharton for taking the time to review our paper. We appreciate the chance to enter into a helpful exchange.

In his first point he said that stratigraphic information does not have anything to do with an isochron plot of the solar system. Our point was simply that when fossils can be used and when they yield a date inconsistent with a radiometric date, geochronologists simply assume that that particular isochron is a mixing line. The geochronological literature lists other mechanisms to explain dates which do not fit prevailing theory. Mixing is simply one of these mechanisms.

In the second statement, it is asserted that there are only a few discordant dates in geochronology. One example that seems to dispute that claim is the fact that uranium-lead dating (discordia curves) is a method designed to make use of data where each uranium-lead

date is discordant with the other uranium-lead date. Discordia curves dominate uranium-lead dating.

The third point is that most isochrons yield positive ages, even though negative isochrons are reported. In the case of where a negative isochron is reported it is conceded to be a mixing line. The claim is made that most of the reported isochrons have positive slopes. There are at least two responses to this claim.

The explanation for a preponderance of positive isochrons may be that there would be little if any motivation to publish an isochron with a negative slope, because geochronologists would assume it to be a mixing line and of little interest.

If indeed all data is reported and there is a preponderance of positive isochrons, then one could speculate that the composition of most of the pre-existent mixing materials just happen to have the composition that we observed. Those who claim that isochrons are proof of immense ages must be able to disprove this possibility.

The fifth point that was made concerned the half-lives of the parent isotopes used in geochronology. It would be impossible to measure immense time spans using isotopes with half-lives of a few thousand years. It seems that this point is self evident.

We also appreciate the fact that Davis A. Young was kind enough to give of his time to help evaluate our work.

His comments seemed to deny the likelihood of the existence of end members with a high 87 Sr/86 Sr ratio. The formation being studied has at least one place with an excess of 87 Sr. That place is the one represented by the point on the extreme right of an isochron. Thus, to speculate that the earth cannot contain other places with that same composition would seem to be unwise.

We allege that the isochrons may be evidence of mixing just as evolutionists allege that the isochrons are evidence for immense ages. The evolutionists must accept the burden of proof that the isochrons are not the result of mixing, if they wish to claim that they have evidence for immense ages.

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William M. Overn, Ph.D.