THE WAY GEOLOGISTS DATE!

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ABSTRACT

Geologists commonly use only three dating methods. Creationists commonly claim each of these techniques is invalid. Carefully considered, each technique has difficulties, but none of them can be considered faulty enough to be invalid. Suggestions are made to increase the validity of each of the methods, and creationists are encouraged to use them to their advantage.

INTRODUCTION

Sherlock Holmes invariably solved his cases from many a clue. A worn area on a chair, the position of a table, a lack of dust on a hearth, a faded memory--all were used by this most famous detective. Each piece of evidence considered alone was usually nigh to worthless. It was often a fuzzy memory of uncertain validity, a comment made without substantiation, or evidence pointing to many a suspect. But it was the collection of these facts in concert which betrayed the guilty one. Together these ambiguous clues would convict the guilty party beyond any reasonable doubt. What is most amazing is that though Holmes did not himself witness the crime, he was able to reconstruct it successfully from evidences remaining. Scientists often appeal to the same techniques in discovering truths about the past. Historical geologists, for example, have not witnessed the earth's history, yet undertake to reconstruct it by considering all the artifacts preserved from its past.

One of the questions historical geologists wish to answer about an event of the past is "When did it happen?" Several dating techniques are used by geologists, but creationists seem to love to criticize them all. Erroneous radiometric dates are listed and hailed as evidence that radiometry is unreliable and unusable for dating. Paleontologists are accused of circular reasoning when they date rocks with fossils and then date fossils by the rock. Stratigraphers are accused of covering up evidences which indicate an incorrect order in the geologic record. This paper's purpose is to familiarize the reader with the most common dating techniques used by geologists. Thus equipped, the reader can himself properly critique any published age.

A geologist has three major dating methods available to him when dating a rock: superpositional stratigraphy, biostratigraphy, and radiometry. Superpositional stratigraphy involves studying the rocks surrounding the one of concern. It is assumed that those rocks which underlie the rock of concern are in fact older. Those rocks which overlie it are younger. If the age is known for a rock below and for another above, the rock of unknown age is somewhere between the two. Biostratigraphy involves studying all the fossils and/or artifacts which are found in the rock of concern. If one or more of those fossils have known age ranges based on information from another area, then the rock of concern has an age which is held in common among the dated fossils. Radiometry involves taking part of the rock and measuring the amount of radioactive element and product present in it. From this data an absolute age can be assigned to the rock. Each of these techniques has its own difficulties, but it is the use of all three techniques in concert which makes a date reasonable. This paper will review each of the techniques, then give an example where the three techniques have been used on a fossil of concern to creationism.

SUPERPOSITIONAL STRATIGRAPHY

Years before Darwin published the Origin of Species, geologists had constructed a geologic column very similar to that used today. As early as the late eighteenth century it began to be recognized that fossils found below others in one area would be found beneath the same ones in another area. By the late 1820's Georges Cuvier had convinced most of the scientific world that there was a certain inviolable order to the fossils of the world.

Although the types of rock did not always occur in the same order, the fossils contained within them always would. It became common to give names to suites of fossils which were always found together. Thus arose the names Cambrian, Ordovician, Silurian, etc., that are found on the current geologic column.

When the theory of evolution was introduced, the order of the geologic column was not affected appreciably. Since it is not possible to predict the path of evolution, no change in the column should have occurred with the acceptance of evolution--and no change did occur. The column also preceded by at least a century any means of affixing absolute ages. The only methods of "dating" available in the nineteenth century were those of superpositional stratigraphy and biostratigraphy. Each of these methods yielded only relative ages--that is, younger, older, or the same age as some reference rock or fossil. When radiometry was introduced a method of assigning absolute ages had finally arrived. With it, any defects in the column should have been quickly recognized. No significant contradictions occurred between the column and radiometry. Although this may be due to wholesale dishonesty in the interpretation of radiometric dates, no systematic study has been done to establish this. As a result, the radiometric dates must be taken as strong evidence in support of the correctness of the geologic column.

Creationists often attack the geologic column by citing evidences of inverted sections--those areas where the order of the geologic column is reversed. Non-creationist geologists call these areas "overthrusts" because they are thought to be the result of faulting. The older rocks are thought to have been pushed over atop the younger units along a fault plane inclined at a very low angle to the horizontal. Since this type of fault involves the shortening of a unit of rocks, movement is due to compressional forces. As a result, these faults and their associated overthrust blocks should be found in areas of significant compression. There should also be other evidences of faulting in the section in the form of sheared rubble, slickensides, dragfolds, and metamorphism.

The most popular inverted section cited by creationists is the Lewis Overthrust in Northern Montana and Southern Alberta. Along a line about two hundred miles long, 70,000 feet of Precambrian sediments have been pushed over Cretaceous black shales for a distance of 40 miles. The Cretaceous shales are considered hundreds of millions of years younger than the sediments that overlie them. A close examination of the contact between the Cretaceous and Precambrian rocks leaves no doubt that the contact is a fault contact. Highly sheared rubble is found between the units in many places. The only reason the rubble is not found along the entire trace of the fault is because the fault plane deviates from being a perfect plane. In addition, slickensides are found in the Precambrian sediments. Slickensides are planes of shear in rocks. The Lewis Overthrust slickensides indicate direction of movement from the west to the east. Since the precambrian Rocks match those found to the west, this is taken as strong confirming evidence that thrustfaulting occurred in the area. Furthermore, the Cretaceous shales underlying the fault are highly folded, unlike the sediments both above and below them. Since shale is much more ductile than the other sediments under conditions of equal stress, the folding of the shale is taken as an indication of stress having taken place in the area in the past. The folds are also consistent with the overlying sediments having been pushed over them from the West to the East. Each of these bits of evidence may be debatable if found alone, but taken together they comprise a strong set of data. The existence of an inverted section in a thrust belt region with slickensides, dragfolds, and sheared rubble along the unconformity leaves no reasonable doubt that the Lewis Overthrust is in fact a result of overthrusting. It cannot be considered a contradiction to the geologic column.

All of the inverted sections should be carefully examined by geologists. Modern creationist theory predicts that there should be many inverted sections which are not at all associated with faults. Each of these sections must be examined to determine if faulting indicators are there. A search should be made along the entire fault trace for sheared rubble, slickensides, dragfolds, and metamorphism due to friction-produced heat. In the meantime, however, the geologic column must be considered unrefuted, and thus usable in dating rocks. A rock underlain by an Upper Cambrian rock and overlain by a Lower Silurian rock must then be considered as having an "age" between the Upper Cambrian and Lower Silurian inclusively.

BIOSTRATIGRAPHY

As a method of dating biostratigraphy is as old as superpositional stratigraphy. As soon as it was found that certain sets of fossils were always found associated, and that those sets could be assigned specific ages, a means had been found for finding the age of potentially any fossil or rock. A new fossil could be dated by means of the fossils with which it was associated. A previously unrecognized rock could be dated by means of the fossils found within it. Thus the geologic column, made up initially of a certain set of "key" or "index" fossils, has grown to include nearly every rock and fossil on earth.

Creationists commonly criticize the use of biostratigraphy as a method of dating. Most often this criticism involves the claim that biostratigraphy is circular reasoning. After all, fossils are used to date rocks and the rocks are used to date fossils. Put in those terms, biostratigraphy sounds like circular reasoning. If in fact a paleontologist dates a rock by a fossil and then dates that same fossil by the rock then this is circular reasoning. When dated properly, a rock is dated by means of a few index fossils, then this same age is given to the other fossils found in the rock. A general survey of biostratigraphy should be done to determine if circular reasoning is often used in geology. Until such a time as such a survey is done, accusations of circular reasoning without example are to be ignored. When properly used, biostratigraphy thus remains as a valid method of dating.

RADIOMETRY

Beginning in the early twentieth century the decay of radioactive elements was used as yet another means of dating rocks. Several species of atoms were found to be unstable, breaking down into other species of atoms. In large quantities these atoms were also found to decay at constant stochastic rates--different for each element, but identical for all atoms of a given element. It was then thought that if one could determine how much of the radioactive (parent) element had decayed an age could be determined. We could date a rock, for example, if we knew: (1) the ratio of parent to daughter element in the rock today, (2) the rate of decay throughout the rock's history, (3) the amount of parent and daughter added to or taken away from the rock throughout its history (other than through decay), and (4) the ratio of parent to daughter at the rock's origin.

The current ratio of parent to daughter is the only one of the four unknowns which is measurable in the lab. Creationists typically call the remainder of the points invalid assumptions. In most cases, though, they are not assumptions. Though they lack complete proof, they do not completely lack proof. Critics need to consider what proof there is before categorically rejecting the dating method.

Requirement number two is that we know the rate of decay throughout the rock's history. The decay rate is usually assumed to be constant and equal to the rate that we see today. Initially this was claimed on the basis of theory. There was no natural process or event which was thought capable of changing the rate of decay of a radioactive material. In the years since, there has been some attempt to test experimentally this claim. Although decay rates are not nearly as immutable as once thought, the initial theory has been more or less corroborated. Decay rates remain constant under most, if not all, natural conditions. If creationists are truly interested in invalidating this requirement, they should begin by finding events which, if they occurred, would alter decay rates. Then, independent means should be found for recognizing rocks which had experienced any of these events. Finally, an effort should be made to determine how widespread these events were, and exactly how radiometric ages should be altered. Barry Setterfield's work is an example of this kind of method. He thought that a change in the velocity of light would cause a change in all radiometric decay rates. He also cited evidence, outside of radiometry, for the change in the velocity of light. Having done this he then concluded that all radiometric dates must be revised down to just a few thousand years. He also concluded some interesting things about the antediluvian world assuming that the speed of light had undergone such a change. Other critiques of constant decay rates must be similarly comprehensive.

Requirement number three is that we know how much daughter and parent has been added to and/or taken away from the rock. In the radioactive elements this occurs primarily by either heating or dissolution. For the Potassium-Argon method, for example, the daughter element, argon, is a gas. If the rock was ever melted, then the argon would be released from the rock's crystalline matrix. Such a resetting of the radiometric clock would result in a K-Ar date smaller than the actual age of the rock. Heating of rocks is a common geologic phenomenon. Resetting of K-Ar clocks is common. However, heating a rock changes more than the amount of argon in the rock. Many minerals grow in the rock under such high temperature conditions. This and other indicators make it easy for a geologist to know when the age of a rock cannot be determined by the Potassium-Argon method. Most of the other radiometric systems are altered by dissolution. Uranium for example, is easily dissolved and transported out of one rock and into another. A loss of uranium will produce dates too large, and a gain of uranium will produce dates too young. Such an influx of water however is again recognized by other indicators. In sum, there is a battery of tests which can be done on a rock to determine if it is suitable for dating. If these tests have been done before the rock is dated then the resultant date must be accepted. Too often in geology these tests are not performed until there is found to be a problem with a date. Then the tests no longer become a good idea, but have an ad hoc quality. Although geologists are guilty of such negligence, creationists are not justified in rejecting dating methods merely because such problems exist. A list of the ways in which a date can be invalidated and

examples of ad hoc tests being performed is not enough to reject radiometry. Rather, creationists should suggest to the geological community a list of tests to which every rock should be subjected before it is dated. They should also survey the record and determine how often the processes of invalidation have actually occurred in the past and how this modifies all dates.

Requirement number four is that we know the initial ratio of parent and daughter element in a rock. If no parent or daughter has entered or left the rock since its origin (see above), then we need only know how much daughter element was present initially. Geologists who use radiometry are typically accused of merely guessing how much daughter was present at first. In reality the amount of daughter is determined by assuming that the present ratios of isotopos of the daughter also existed in the past. This is not an unreasonable assumption as no significant deviations occur in any recent rocks. Unless creationists can show any reason to believe that past isotope ratios were significantly different than at present, then this requirement must be considered reasonable.

Of the three dating techniques radiometric dating is that method most fraught with difficulty. Yet a simple list of errors is insufficient to reject the method. If creationism is true, radiometric dates are wrong, but the fact that they are wrong in the same direction (all too old) must be explained for a critique to be complete.

AN EXAMPLE

A recent item of controversy involves a human skeleton on the island of Guadeloupe. There was nearly complete unanimity among scientists of the last century-and-a-half that this specimen is in recent, post-Pleistocene, post-Flood sediment. Bill Cooper disagrees. He claims the fossil is buried in Flood deposits of Miocene age. When the above dating techniques are employed they very powerfully indicate that Cooper is wrong.

Stratigraphically, the sandstone in which the fossil was found overlies and thus is younger than the Pleistocene raised reefs of the island. Above it lies either sand or nothing at all. Stratigraphically then, the skeleton is Pleistocene or younger. All the associated fossils are of species currently living in the Caribbean. Since many of those species have not been found in Pleistocene rocks, this unit must be younger than the Pleistocene. The human artifacts are all those currently used on the islands. Indicative of the Indians of the Arawak language group, they also indicate the rock is younger than a few thousand years. Other artifacts hint of European manufacture, meaning the rock is less than a few hundred years old. Radiometrically, Carbon-14 dates range from A.D. 200 to A.D. 1500, depending on the position in the unit.

It must be remembered that each of these dating methods may be incorrect or tenuous in some way. But it's the combination of these methods in concert which allows for the most powerful conclusion. Superpositionally, biostratigraphically, and radiometrically this unit is post-Flood and post-Pleistocene.

SUMMARY

Creationists should not be so quick to reject dating methods. Many of these methods, properly understood, can be applied to questions of interest to creationism (e.g., Guadeloupan woman). It is insufficient to simply show that these techniques are fraught with difficulty. Each technique may be filled with potential error, but when several methods agree on the same date, simple criticism is ineffective. A wholesale reinterpretation of geochronology would be needed in order to create a good critique. Creationists, in their apprehension, can offer valuable criticism to geochronology. Geochronology in turn, properly understood may lead even creationists to a greater understanding of the past.