How Can Woodmorappe Sell Us a Bill of Goods if He Doesn't Know the Costs?

Dr. Kevin R. Henke

Young-Earth creationists (YECs) have repeatedly failed to undermine the reliability of radiometric dating by invoking radical "changes" in radiometric decay rates (Vardiman et al., 2000), unrealistic magma "mixing" (Arndts and Overn, 1981; Mandock, 1982; Plaisted, see The Radiometric Dating Game, fictional isotope fractionation processes (Woodmorappe, 2001; Plaisted: The Radiometric Dating Game, and other fantasies. YEC John Woodmorappe's (1999) approach to explain away radiometric dates is fairly unique, but is just as unreasonable as the other YEC attempts. Woodmorappe (1999, Figure 20, p. 51; p. 52, 87-92) claims that all radiometric dates may be nothing more than products of "chance," that is, random numbers. Woodmorappe (1999, p. 85) even endorses YEC Robert Witter's outrageous charge that geochronologists could obtain just as good radiometric results by throwing darts at a concordia diagram.

According to Woodmorappe (1999, p. 16, 21-22, 51-54, 82, 85, 95, etc.), geologists who submit samples for radiometric dating, unknowingly obtain random and meaningless results, and then usually publish only those results that can be rationally "explained away" or happen to correspond with their "preconceived expectations." Woodmorappe (1999, p. 21-22, 50-54, 82, 87, 92, 95, etc.) argues that the selective publication of meaningless random numbers can even explain away the large numbers of precise radiometric dates in the literature - thousands of dates that have been confirmed by two or more radiometric methods, as well as fossil data, astronomical evidence, and/or paleomagnetic results. At the same time, Woodmorappe (1999, p. 16) resists the idea of accusing geologists of being liars and just routinely filling journals with fabricated numbers.

Under Woodmorappe's scenario, geologists are presumably so wealthy that they can keep requesting dates until they get the results that they want. Depending on the amount of sample preparation, current prices (in US dollars from Geochron Laboratories and other Internet sources) are typically around \$300-\$1000 for just ONE K-Ar analysis. The price of EACH data point on a

Rb-Sr isochron graph varies from about $400 to $700. Because Rb-Sr isochrons should contain a minimum of three data points, an Rb-Sr isochron diagram would require a minimum of $1200 to construct. U-Pb radiometric dates on mineral separations cost about $400-$750 per analysis. One Sm-Nd analysis costs of about $400-$1200; again, depending on the amount of sample preparation. Even if the analyses are done "in-house," equipment maintenance, supplies, sample preparation, technician salaries and miscellaneous expenses will easily run into the hundreds of dollars per analysis.

By using log-linear and log-normal "quasi-Monte Carlo" methods, Woodmorappe (1999, p. 87-92) attempts to demonstrate that a significant number of "concordant dates" (within +/- 2.5% of each other) could be randomly generated. Using these methods, Woodmorappe (1999, p. 89) generated 11 data sets (labeled A-K), each of which consisted of 100 random numbers. Woodmorappe (1999, p. 90) then performed a "first try comparison" with the 11 data sets. The first-try method consisted of comparing each of the 100 values in a set with each one of their correspondingly ordered values in the other 10 sets. That is, the first value in set A was compared for concordance with the first value in set B, then the first A value was compared with the first value in set C, and continuing through set K. Next, the process was repeated by comparing the first value in set B with each of the first values in sets C-K, and so on. The second value in set A was then individually compared with each of the second values in sets B-K. The total process produced a total of 5500 cross pairings between the 11 sets. Using these comparisons, Woodmorappe (1999, Table 4, p. 91) found six (+/- 2.5%) concordant pairs between the 200 random values in sets E and H. The other 54 set comparisons had 0 to 5 concordant pairs. A total of 116 fortuitously concordant pairs were found among the 5500 possible pairings (2.1% of the total) (Woodmorappe, 1999, p. 91). Woodmorappe (1999, p. 90) argues that this "first try approach" simulates random concordant results involving two different dating methods (such as K-Ar and Rb-Sr) on a geologic sample.

Woodmorappe (1999, p. 91-92) is impressed that the number of randomly concordant pairs was as high as 2.1%. However, contrary to Woodmorappe's claims (1999, p. 16), no geologist in his/her right mind would throw money at any analytical method that produces inconsistent results 97.9% of the time. Under Woodmorappe's Lucky Draw, probability dictates that geochronologists would have to generate a long list of results for each sample and then they and geologists must wade through the obviously random numbers to find "desirable dates." Even if Woodmorappe's (1999, p. 10, 16, etc.) accusations were true that the geologists could always use their "imaginations" and "post-analysis rationalizations" to find a few more cooling and metamorphic "ages" among the long list of chaotic data, the vast majority of numbers on these lists would be worthless noise and a blatant waste of time and money. Also, doesn't it occur to Woodmorappe that geochronologists would become suspicious when they have to keep rerunning their quality control samples and standards dozens or even hundreds of times before they obtain even one reasonable result? What scientist would pay thousands of dollars to look through long lists of numbers for reasonable values and still not be intelligent enough to realize that the results are no better than lottery numbers? When financial and technical aspects are considered, Woodmorappe's crapshoot becomes utterly ridiculous.

If the numbers in Woodmorappe's Table 4 (1999, p. 91) are correct, a geologist would be lucky to get 6 pairs of "concordant dates" at +/- 2.5% from the "first try" analysis of two data sets with a total of 200 random numbers. If the geologist is only interested in concordant results, the other 188 or so numbers would be useless and thus discarded. So, if we assume a typical price of US$500 per radiometric analysis, it would cost a scientist $100,000 for 200 dates. What geologist would be rich and stupid enough to spend all that money just to throw away 188 dates worth $94,000? Indeed, according to Woodmorappe's Table 4 (1999, p. 91), the geologists would sometimes get no concordant pairs whatsoever for $100,000!! The probability of obtaining random concordant pairs becomes even more improbable as scientists strive to obtain concordances that vary by no more than +/-1%, such as with the dating of the Permian-Triassic (for example, Kerr, 1995) and Cretaceous-Tertiary boundaries (as examples, McWilliams, 1994; Swisher et al., 1993).

Many of the references in Woodmorappe (1999) contain numerous consistent radiometric dates using two or more methods (including: K-Ar, Ar-Ar, Rb-Sr, and/or U-Pb). A few examples include: Baadsgaard et al. (1988), Baadsgaard et al. (1993), Queen et al. (1996), Montanari et al. (1985), Foster et al. (1989), and Harland et al. (1990). Specifically, Baadsgaard et al. (1993) analyzed minerals (including: biotites, sanidines, plagioclases, and zircons) from the Snakebite bentonite (#1) of southwestern Saskatchewan with three different radiometric methods (Rb-Sr mineral isochron, U-Pb, and laser 40Ar/39Ar). Sanidines and biotites were analyzed by laser 40Ar/39Ar and yielded 20 dates that only ranged from 72.28 +/- 0.84 to 72.80 +/- 0.93 (1 sigma) million years (Baadsgaard et al., 1993, p. 774). Using the analyses of 14 biotites and feldspars, a Rb-Sr mineral isochron date of 72.54 +/- 0.18 (2 sigma) million years was obtained (Baadsgaard et al., 1993, p. 771, 772). The Rb-Sr isochron was highly linear with a mean square of weighted deviates (MSWD) value of only 0.70. Five groups of zircons were analyzed to yield 206Pb/238U and

207Pb/235U dates of 72.4 +/- 0.4 and 72.6 +/- 0.4 (2 sigma) million years, respectively (Baadsgaard et al., 1993, p. 769, 773). Additionally, all of the radiometric results were consistent with the presence of Cretaceous fossils in associated beds, including *Baculites reesidei*.

Not surprisingly, Woodmorappe (1999) never appropriately discusses the impressive radiometric dates in Baadsgaard et al. (1993) or any of the other references that he exploits. In Baadsgaard et al. (1993), the results from these three methods vary by no more than 0.7% (72.28 to 72.80 million years) with a maximum error of +/- 0.93 million years (1 sigma, no more than 1.3%).

As part of his Lotto Game, Woodmorappe (1999, p. 91) also calculated the number of random three-way "concordances" at +/- 2.5% from his 11 data sets using the "first try" approach. Of 16,500 trios from Woodmorappe's 1100 random numbers, he (1999, p. 91) only obtained 5 "fully concordant" trios (0.03% of the total), where each member of a trio had overlapping values at +/- 2.5% with the other two. However, Woodmorappe (1999, p. 87-92) does not claim that all 15 members of the five trios had overlapping "ages," which would be highly improbable. Even IF all of the dates were derived from laser Ar-Ar analyses, which might be run for only $20 a piece, see ^{40}Ar/^{39}Ar lab at Lehigh University, the total cost of the 1100 dates, which only produced 5 fully concordant trios (15 dates), would be $US 22,000. The probable cost and number of samples required for Woodmorappe's Lotto Game become even more outrageous when we consider that Baadsgaard et al. (1993) obtained 23 Ar-Ar, Rb-Sr, and U-Pb dates, ALL of which vary by no more than 0.7%!

Because the "creationist house" never wants to lose Woodmorappe Lotto, Woodmorappe can always argue that the "first try" approach really isn't relevant to the studies in Baadsgaard et al. (1993) and other articles. He could claim that the radiometric dates in Baadsgaard et al. (1993) and other references could be more realistically "modeled" by selecting desirable numbers from anywhere in a pool of random results (Woodmorappe, 1999, p. 91). Furthermore, if that doesn't work, YECs can always change their plastic rules, move their "goal posts" and then claim that radiometric dates aren't that random after all (e.g., Woodmorappe, 1999, p. 92), but they're still somehow invalid because the Bible supposedly says so.

Now, Woodmorappe has the full responsibility for either renouncing his accusations or demonstrating through appropriate economic and statistical evaluations of real examples from the literature (such as Baadsgaard et al., 1993) that his carnival game is both financially and scientifically feasible. Nevertheless, we'll perform a few more calculations to further evaluate his

Lottery Game. First of all, let's eliminate the "first try" restriction on Woodmorappe's carnival game and estimate the minimum number of analyses Baadsgaard et al. (1993) would probably have to run and how much money they would have to spend to just randomly obtain 20 laser Ar-Ar results of 72.0 to 72.9 million years. Of Woodmorrappe's four "quasi-Monte Carlo" distributions, the "short-running log-linear distribution" has a mean date of 50 million years, which most closely approaches the desired results of 72.0 - 72.9 million years. With a log-linear distribution, there are equal probabilities that a "date" will fall into one of the following ranges: 1 million to 10 million, 10 million to 100 million, 100 million to 1000 million and 1000 million to 10,000 million, etc. (Woodmorappe, 1999, p. 87). Woodmorappe (1999, p. 87) argues that most published radiometric dates fall between a few million years up to 2500 to 3000 million years. Considering these variations, Woodmorappe (1999, p. 87-89) developed two log-linear distributions, one with arbitrary "short range" limits of 1 to 2500 million (logs 6.00 to 9.40) years and the other with a longer range of 10 million to 3500 million (logs 7.00 to 9.54) years. According to Woodmorappe (1999, p. 87, 89), the "short-running" log distributions are more "applicable" to K-Ar "dates," whereas methods with longer half-lives (Rb-Sr, Sm-Nd, and U-Pb) are supposedly better represented by the "long range" log distributions.

Because of the similarities between Ar-Ar and K-Ar dating, the 20 Ar-Ar dates in Baadsgaard et al. (1993) were evaluated with Woodmorappe's "short-running" log-linear distribution. A Microsoft Excel™ spreadsheet was used to estimate the MINIMUM number of random analyses that would probably be required to produce 20 Ar-Ar "dates" between 72.0 and 73.0 million years. It is fully recognized that the random number generator in Excel™ may not be state of the art. Nevertheless, this study will give a reasonable idea of how much money Baadsgaard et al. (1993) had to spend if Woodmorrappe's Lotto Game is correct.

A total of 100 random number sets were generated. Each set contained 5000 "random dates" based on Woodmorappe's short running log-linear distribution. After reviewing the contents of the 100 sets, the MINIMUM number of random "analyses" that were required to produce 20 "dates" between 72.0 (log 7.857) and 73.0 (log 7.863) million years was 3,775. As mentioned above, a typical MINIMUM cost for ONE laser Ar-Ar analysis is US$20. If Woodmorappe's shell game is correct, Baadsgaard et al. (1993) had to spend AT LEAST $75,500 for just 20 Ar-Ar dates, which is ridiculously expensive and intolerably wasteful. Of course, YECs could always accuse Baadsgaard et al. (1993), Baadsgaard et al. (1988), Queen et al. (1996), Montanari et al. (1985), Foster et al. (1989), and others of just fabricating their excellent results. However, such accusations would be baseless and insolent attacks on the integrity of these reputable scientists.

Woodmorappe (1999, p. 91-92) further argues that the use of isochrons and the dating of individual grains and multiple lithologies allow for "many more opportunities" to obtain concordant results by chance. In reality, Woodmorappe's crapshoot becomes even more financially and scientifically ridiculous when isochrons and multiple samples are considered. For example, Woodmorappe (1999, p. 92) claims that U-Pb SHRIMP analyses on individual grains could generate countless radiometric dates that could be exploited by geologists. Like laser Ar-Ar dating, the recovery of numerous zircons and multiple grain analyses with SHRIMP are not fast and cheap. Numerous zircon analyses, such as those presented in Corfu and Stott (1998), also question the relevance of the hypothetical example in Woodmorappe's Figure 30 (1999, p. 82) and suggest that SHRIMP zircon dates are not nearly as diverse or "random" as Woodmorappe (1999, p. 82) imagines.

In isochron dating, geologists try to fit at least three and usually many more chemically diverse samples on a straight line, hopefully with an MSWD of no more than 2.5. In Baadsgaard et al. (1993), the single Rb-Sr isochron date was based on 14 mineral analyses with an MSWD of only 0.7. If the Woodmorappe-Witter dartboard game is correct, how many thousands of mineral analyses are required before 14 points randomly fall on a straight isochron line with a date of +72 million years and an MSWD of only 0.7? Recall that any random horizontal or vertical "isochrons," "isochrons" with negative slopes, or even positively sloped highly linear "isochrons" with dates much lower or greater than 72-73 million years would be useless in duplicating Baadsgaard et al.'s (1993) results. Also, how much money would be required to run all of these analyses? Remember that each point on a Rb-Sr isochron would cost about $400 to $700.

Using the random number generator in Microsoft Excel™, we can estimate the MINIMUM number of random values that are likely to be required to produce 14 points on a 87Sr/86Sr vs. 87Rb/86Sr isochron graph whose slope represents +72 to +73 million years. A y-intercept of 0.705 was selected, which is consistent with the results in Baadsgaard et al. (1993, p. 772) and with similar samples in the literature. The 14 biotites and feldspars on the Rb-Sr isochron plot in Baadsgaard et al. (1993, p. 771-772) have 87Sr/86Sr values (y-axis) of 0.70544 +/-9 to 0.79230 +/- 8. The 87Rb/86Sr ratios (x-axis) of the samples range from 0.006 to 84.1. Because the 87Rb/86Sr values extend over several orders of magnitude, Woodmorappe's (1999, p. 87-92) examples were followed and logs were used to equalize the probabilities. Otherwise, random 87Rb/86Sr values of 0.006 to 0.01 are unlikely to occur. Because the 87Sr/86Sr values extend over a short range, log conversions were not necessary.

The "first try" approach was used to simulate the production of a pair of random 87Sr/86Sr and 87Rb/86Sr results for an individual biotite or feldspar grain. A total of 100 random data sets were generated. Each set contained a series of random 87Sr/86Sr values between 0.70544 and 0.79230. Every random 87Sr/86Sr value had a corresponding random log-based 87Rb/86Sr value representing a measurement between 0.006 and 84.1. Using a y-intercept of 0.705, the slope of the line passing through the intercept and the random 87Sr/86Sr and 87Rb/86Sr point was calculated and converted into a date.

After generating 100 random data sets, a MINIMUM of 4,269 pairs of random 87Sr/86Sr and 87Rb/86Sr values had to be generated before 14 of them fell on a curve representing a radiometric date of 72.0 to 72.9 million years. At US$400 per Rb/Sr isochron data point, the 4,269 pairs would have an outrageous price of at least $1,707,600. It's absurd to believe that Baadsgaard et al. (1993) would have paid $1.7 million to obtain ONE Rb-Sr isochron date of 72.54 million years!

When each of the hundreds of references in Woodmorappe (1999) are further reviewed, individuals will quickly discover that if Woodmorappe's crapshoot is right, enormous numbers of samples would have to be routinely analyzed and thousands or even millions of dollars would have to be spent. Few geologists are wealthy and gullible enough to spend millions of dollars on a long list of radiometric numbers and then be satisfied with scanning through that list for a small fraction of useable results.

CONCLUSIONS

Woodmorappe's (1999, p. 91) carnival game makes no financial sense. His game is not only blatant pseudoscience, it's also voodoo economics. Woodmorappe's (1999, p. 95-96 and elsewhere) repeated cries that radiometric dating is based on "special pleading" and "rationalizations" are utterly false and are especially hypocritical when compared with the unrealistic pleadings, incredible luck and great liberties that are required to prop up his expensively prohibitive Lotto Game. That is, after seeing the special pleading that Woodmorappe (1999, p. 87-89) makes for his Bingo game, he has no grounds for criticizing radiometric dating methods (for example, his naive attacks on air abrasion techniques in 1999, p.85-86, 96).

Under Woodmorappe's crapshoot, geochronology laboratories would soon go out of business. If radiometric dating really produces the types of random numbers that we see in Woodmorappe's Table 3 (1999 p. 90), any geologist or geochronologist with half a brain would immediately abandon such methods. Although Woodmorappe (1999, p. 16) naively claims that useless radiometric dating methods would go undetected and not be abandoned, it is extremely obvious that science and economics dictate that any method would soon be discarded if it is expensive and fails to readily produce usable analyses and consistent results with standards and quality controls. Clearly, Woodmorappe has no rational choice but to abandon his accusations. Woodmorappe has to admit that radiometric dating is something MUCH MORE profound than the products of "chance" and selective publishing.

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