

## Forum

### Time: Measured Responses

I was dismayed by Raphael G. Kazmann's conclusion in his review of a symposium on 'Cosmochronology, geochronology, and the neutrino crisis' (Time: In Full Measure, Eos Trans. AGU, 60(2), pp. 21-22, January 1979) that essentially casts in doubt the entire science of geochronology, on the basis of an absurd interpretation of the origin of 'polonium' halos in minerals observed by Robert Gentry. I have no doubt that Gentry's halos exist, but to ascribe the halos to 'primordial'  $^{218}\text{Po}$  unsupported by  $^{222}\text{Rn}$  can be quickly reduced to an absurdity by the following argument: (1)  $^{218}\text{Po}$  has half-life of 3 minutes; (2) more than one  $^{218}\text{Po}$  atom would be required to produce a halo; (3) the probability of 1 atom of  $^{218}\text{Po}$  surviving after 490 minutes is 1 out of  $16.5 \times 10^{48}$  based upon the exponential decay law; (4)  $16.5 \times 10^{48}$  atoms of  $^{218}\text{Po}$  are equal to the mass of the earth. Therefore, in order to accept the assertion that Gentry's halos are caused by unsupported primordial  $^{218}\text{Po}$ , either the earth must be composed entirely of  $^{206}\text{Pb}$  (the stable isotope in the  $^{238}\text{U}$  chain following  $^{218}\text{Po}$ ) or the earth must have been less than 490 minutes (8.2 hours) old at the time the mineral was formed so that an amount of  $^{218}\text{Po}$  less than the mass the earth was originally present. Clearly the earth is not composed entirely of  $^{206}\text{Pb}$ . It is no less credible to suggest that the earth and its strata were formed and intruded by granitic magma that subsequently cooled the point where both the mineral and the halo were stable all in less than 8.2 hours. 'Curiouser and curiouser said Alice in Wonderland.

I can appreciate the frustration of my geochronological colleague Derek York when he pointed out to the audience that 'fewer observations would have to be explained in a scheme based on conventional interpretations than would be needed if Gentry's data on radiohalos were used as a basis for a new comprehensive theory...' In fact, virtually all of the internally consistent observations upon which modern physics, geology, and cosmology are based would have to be re-explained by this new comprehensive theory—a formidable task!

The history of science includes many examples of valid observations that have been given unacceptable interpretations. One need not doubt the validity of Gentry's observations of the existence of halos with certain characteristics in order to reject his interpretation as reported by Kazmann. However,

I certainly hope that Kazmann and his fellow engineers do not design structures such as nuclear reactor sites based upon the short time scale suggested by a misinterpretation of Gentry's apparently valid observations!

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I agree with Damon that if  $^{218}\text{Po}$  halos in granites originated with primordial polonium, this would essentially cast in doubt the science of modern geochronology. I also agree that primordial  $^{218}\text{Po}$  halos imply either that the earth is now solely  $^{206}\text{Pb}$ , which is demonstrably wrong, or that the pristine earth (i.e., no fossil-bearing strata) was synthesized within several hours at most. Understandably, Damon considers both alternatives equally absurd and concludes that any new theory which accounts for primordial  $^{218}\text{Po}$  halos must also re-explain virtually all the internally consistent data upon which modern physics, geology, and cosmology are based. But with all due respect to Damon, he was not here when the earth was formed, thus his belief that a rapid synthesis of the earth is incredible is not based on the kind of direct experimental evidence like that which shows that the earth is not just  $^{206}\text{Pb}$ . Moreover, I must take strong exception to his unqualified inclusion of the laws of physics in the same category as geology and cosmology. This association gives the impression that any evidence which would apparently falsify the current cosmological and geological framework can immediately be recognized as an absurdity because it would also invalidate contemporary laws of physics. But this is not necessarily true because, even though cosmology and geology both rely on data from contemporary physics, the ultimate reliability of these theories is hinged separately on the crucial unproven assumption that physical processes have remained unchanged with time.

In fact, when Damon argues that the concept of primordial  $^{218}\text{Po}$  halos is incredible because it contradicts the uniform action of physical laws, it seems he is arguing against a concept (nonuniformity) which is inherent in the very cosmology he defends. That is, does not the present cosmology assume that physical laws have operated uniformly only

since the Big Bang, whereas the Big Bang itself, if it occurred, is an example of a singularity that defies explanation on the basis of known physical laws? Let us then examine the other side of the coin. If the word incredible is to be used to describe the possibility that primordial  $^{218}\text{Po}$  halos exist and that they are evidence of a rapid synthesis of the earth, ought we not be fair enough to weigh that incredibility with the one which at one time necessitated all the matter of the universe to be compacted within an ultrasmall volume in space?

And as far as a new comprehensive theory is concerned, I would replace the one singularity of the Big Bang with two major cosmos-related singularities (in which I exclude any implications about extraterrestrial life-related phenomena) derived from the historic Judeo-Christian ethic, namely the events associated with (1) the galaxies (including the Milky Way) being created ex nihilo by Fiat nearly 6 millennia ago and (2) a later catastrophe which resulted in a solar system-wide disturbance that was manifested on earth primarily as a worldwide flood with subsequent crustal adjustments. True, this framework disagrees with current theories of star formation. But as the symposium revealed, astrophysical predictions differ from experimental values on the sun's neutrino flux and moreover diverge very sharply from the observations on Sirius over the past 2000 years. To me these discrepancies mean that the premises and deductions of current astrophysical theory have only limited reliability.

I propose that this new framework has a scientific basis because there are certain predictions which, in principle, can be confirmed and others which can be falsified by suitable counter examples. For example, primordial  $^{218}\text{Po}$  halos imply that Precambrian granites, pegmatitic micas, and other rocks which host such halos must be primordial rocks (and hence should constitute ideal rad waste containment sites). Therefore I regard the failure to resolve the long-standing controversy in geology which concerns the origin of the Precambrian granites to be because such rocks are primordial and hence not necessarily explainable on the basis of conventional principles. Even though I think they further qualify for that role in their association as basement rocks of the continents, nevertheless I would consider my thesis essentially falsified if and when geologists synthesize a hand-size specimen of a typical biotite-bearing granite and/or a similar size crystal of consider my thesis essentially falsified it and when geologists synthesize a hand-size specimen of a typical biotite-bearing granite and/or a similar size crystal of biotite.

I will likewise relinquish any claim for primordial  $^{218}\text{Po}$  halos when coercive evidence (not just plausibility arguments) is provided for a conventional origin. Working almost alone, I have discovered and, with others, provided coercive evidence that  $^{210}\text{Po}$  halos in coalified wood did originate in a

conventional manner, i.e., from polonium derived from uranium decay. Those studying this problem will find three of my reports referenced in the Eos symposium write-up, but may otherwise overlook, as others have and are still doing, a most important contribution by another author, viz., Commun. Roy. Soc. Edinburgh, 11, 147—158, 1978; and in this respect I will consider my thesis to be doubly falsified by the synthesis of a biotite which contains just one  $^{218}\text{Po}$  halo (some of my natural specimens contain more than  $10^4$  Po halos/cm<sup>3</sup>).

A further consequence of this model is that evidence of U-series disequilibria and abnormally high  $^{238}\text{U}/^{206}\text{Pb}$  ratios should still persist in those sedimentary formations in which uranium was partially separated from its daughters during the second singularity, about 4 millennia ago. Studies of radiohalos in coalified wood from geological formations, presumably ~  $10^8$  years old, suggest that such evidence does exist and that it admits the possibility that the formations are only several thousand years old. Incidentally, current theory predicts that any  $^{14}\text{C}$  and  $^{10}\text{Be}$  originally emplaced within old geological formations would have decayed away long ago. But I propose that nuclear accelerator techniques be used to search for trace amounts of these radionuclides in geologically old coal and amber (for  $^{14}\text{C}$ ) and fossiliferous rocks (for  $^{10}\text{Be}$ ). In particular, the new model suggests that the  $^{14}\text{C}$  concentration may have grown from zero to about  $10^{-4}$  times the present level before the major sedimentary formations were emplaced, with a  $^{14}\text{C}$  increment occurring during the second singularity. As a practical matter the possible reduction of atmospheric  $\text{CO}_2$  during that singularity further suggests that the present  $\text{CO}_2$  buildup from fossil fuel burning will prove beneficial to the biosphere.

Neither my collaborators; nor my employer (listed below) for the past 13 years; nor any government agencies which have funded me directly or otherwise assisted me, through the use of research facilities, are in any way implicated in the views stated herein. Rather it appears that individuals and agencies have each provided assistance in accord with the National Academy of Sciences resolution of April 1976, 'An Affirmation of Freedom of Inquiry and Expression,' which reads in part '...That the search for knowledge and understanding of the physical universe and of the living things that inhabit it should be conducted under conditions of intellectual freedom, without religious, political or ideological restrictions.' '...That freedom of inquiry and dissemination of ideas require that those so engaged be free to search where their inquiry leads...without political censorship and without fear of retribution in consequence of unpopularity of their conclusions. Those who challenge existing theory must be protected from retaliatory reactions.

I submit this letter to the members of the scientific community, not as an antagonist purporting

to have the final word in a dispute, but as a colleague who, in the spirit of free scientific inquiry, genuinely seeks a vigorous critical response to the evidence discussed herein.

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Damon's letter takes issue with Gentry. I, myself, make no claims as a geochronologist. As an engineer, however, I am interested in designing structures that will be safe. Such designs are termed 'conservative,' as in-opposed to 'risky' or 'hazardous.' If the accepted time scale assigns a longer duration for things to happen than actually occurred, structures that are predicated on such a time scale may be subject to destruction a lot sooner than expected—this would make the designs unsafe. For example, if waste containment is needed for 50,000 years, a formation should be selected where geologic history suggests that no significant changes have occurred for the past 100,000 years or more. If our time scale is in error and the last movements (faulting upheavals, etc.) occurred 10,000 years ago Instead of 100,000 years ago, then the formation originally selected for long-term containment of waste must be PO abandoned and another, with a longer history of geologic stability, found instead.

The point made by the participants in the symposium is that there are great uncertainties in the time scales used by (1) solar astronomers, (2) cosmologists, e.g., the Sirius mystery, and (3) geologists. No single one of these uncertainties would be sufficient to affect in engineering evaluation. However, all of them taken together, which indicate that we have overestimated the period of time that is required for geologic and cosmologic processes, serve as a caution signal.

If the symposium has attracted the attention of those persons interested in the kinetics of geologic and cosmologic processes and has delineated areas ripe for further investigation and study, It has served its purpose. The list of problems that confronts engineers who are interested in the actual elapsed-time history of Pb natural formations includes the siting of dams, the sitin of nuclear facilities of all kinds, and the permanent, or very long term, containment of noxious wastes (including nuclear). These projects are all based on assumptions as to the validity of the geochronology of the area studied. So I have no apologies to make for organizing the meeting, and I am sure the participants are capable of defending their positions in the matter.

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