assigned by Satan to oversee the kingdom of Persia."

Daniel does not "make it plain that the Temple would be destroyed at the end of the 70 weeks". Daniel 9:24–25 tells us what would happen in the first 69 weeks.

Verse 26 tells us what would happen after that. The Messiah would be cut off (Isaiah 53:8; "he was cut off out of the land … for the transgression of my people was he stricken"), the Prince would come and destroy the city and the Sanctuary—AD 70, and desolations were determined.

Verse 27 tells us the covenant would be *confirmed* not *made*. The writer does not mean to say in verse 27 that he will *make* a covenant but that he is going to *confirm* a covenant for a 'week of years', i.e. the covenant of grace, which covenant has already been made (Genesis 3:15) and which shall, in that 70th week, cause to prevail, and many shall experience its benefits and many shall be saved. There were many conversions at Pentecost. The ordinary idiom to express such a thought of 'made a covenant' would be 'cut a covenant', #3772, refer Gen. 15:18, *karath*, to cut. The Hebrew word 'confirm', #1396, used in Daniel 9:27, means to be strong, prevail, exceed, be great, be mighty, confirm.

Certain eschatological schools of thought theorize that in the last days of the Gentiles—some say after the 'Rapture' and in the 7 years of the 'great tribulation' period, when God takes up Israel's cause again—a certain power will arise who will '*make*', not '*confirm*', a covenant with that nation (this school of thought depends upon Daniel 9:27 for its theory) promising protection, etc. The Jews would be allowed to set up the temple worship in Jerusalem and the long-abolished sacrificial system would again be established. All this against the teaching of Hebrews, which was written to professing Hebrew Christians to show the absolute supremacy of Christianity over Judaism and to declare the end of the 'OT shadow ministry'. In the midst of that last week the sacrifice (*singular, not plural as you have stated, Brian*) and the oblation would cease; referring to our Lord Jesus Christ's redemptive work on the Cross and the 'once offering' to bear the sins of many, we find that Hebrews 10:26 states: "there remaineth no more sacrifice for sins". After this we are told of the desolation that would come (the armies of Titus encompassing Jerusalem which told the desolation was nigh; Luke 21:20), but nowhere does it state that this desolation came by the time the 70th week was up. It is more than interesting to note that from 457 BC, when the captivity of the 70 years ended (refer to article on Darius is Artaxerxes for this date, taking into account the 4 years error in the calendar) until AD 30 when Christ died on the 14th of Nisan, is very close to 69½ weeks of years = 486.5 years.

Concerning the giving of decrees, I know the Lord works all things after His own will, but he does so either mediately, or immediately. The medium through which the decree was issued was Cyrus the Great (Isaiah 44:26–28), who issued the decree 'by saying'. When Darius issued a decree to find the 'lost' scroll, not build a city (Ezra 6:1), it does not say that God issued it but that Darius was the one responsible.

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Argon diffusion data support RATE's 6,000-year helium age of the earth

In both a reply to a letter[1] and a later article in this journal,[2] Dr Russell Humphreys mentions me by name as a critic of the RATE helium project. Since, in his reply to my earlier letter,[3] he thanked me for pointing out a serious error of his that was previously missed by the reviewers and editors of the RATE project, I thought that it was appropriate for me to point out the additional mistakes made in his recent article. This article lacked original scientific content. Most of it was devoted to merely rehashing an earlier paper by Harrison, Morgan, and Blackwell.[4] The only substantive argument was that these authors 'ignored the volcano' when considering the thermal history of Fenton Hill, since it conflicted with his own 'best uniformitarian picture'.[1] Therefore, it is worth considering how good this 'best uniformitarian model' really is.

Humphreys constructed his estimate of the thermal history by synthesizing results from three earlier papers.[5] In his hybrid model, Sasada's first heating episode[6] (figure 1) was assigned to the emplacement of the magma body[7] in the Kolstad and McGetchin model,[8] and the second heating episode was assigned to the recent transient event in the Harrison *et al.* model.[4] This interpretation required adjustments to both the Kolstad and McGetchin model and the Harrison *et al.* model. Specifically, Humphreys selected a radius of 9–10 km for the magma body,[9] a depth of burial of 3 km, and a background temperature of 170°C prior to the final transient heating event.[10]

This kind of 'eyeball interpolation' from figures is problematic at best, since no rigorous mathematical self-consistency is imposed. More importantly, though, his 'best uniformitarian' model

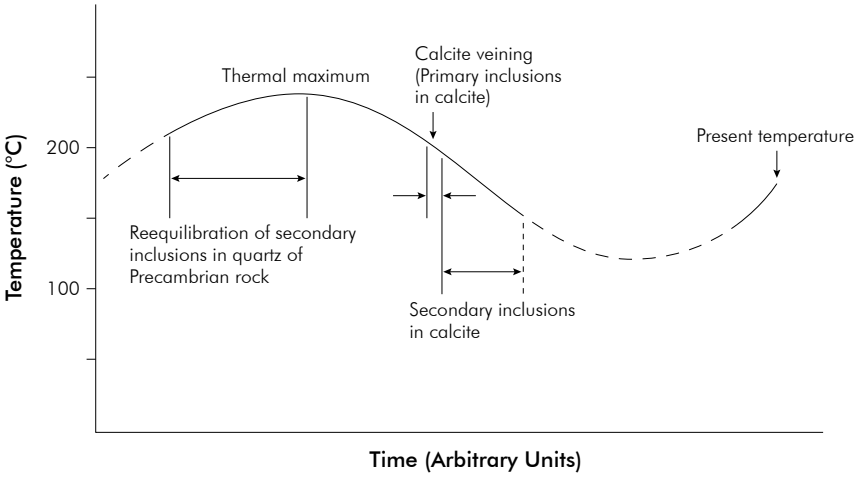

Figure 1. Schematic diagram for temperature change with time at a depth of 2,624 m down the GT-2 geothermal well. Temperatures were estimated from fluid inclusions in the Precambrian basement rock. (Fig. 9 from Sasada, ref. 6, p. 264.)

Table 1. Comparison of the measured properties of the Valles Caldera magma chamber with the parameter values assumed by Humphreys in his "best uniformitarian" model.[1] Overall, the real magma chamber is smaller, deeper, and cooler than the one proposed in the model.

	Humphreys' model[1]	Measured data	Measurement technique	Reference	
chamber radius	9–10 km	7.5 km	seismic data	Ankeny[11]	1986
		8.5 km		Roberts[12]	1991
depth of burial	3 km	~5 km	seismic data	Ankeny[11]	1986
		6–9 km		Roberts[12]	1991
		4.7 km	mechanical deformation	Nielson[13]	1984
		5–7 km	mineral chemistry	Warshaw[15]	1988
chamber thickness	20 km	12–15 km	seismic data	Ankeny[11]	1986
magma temperature	1,000° C	~800°C	mineral chemistry	Warshaw[15]	1988

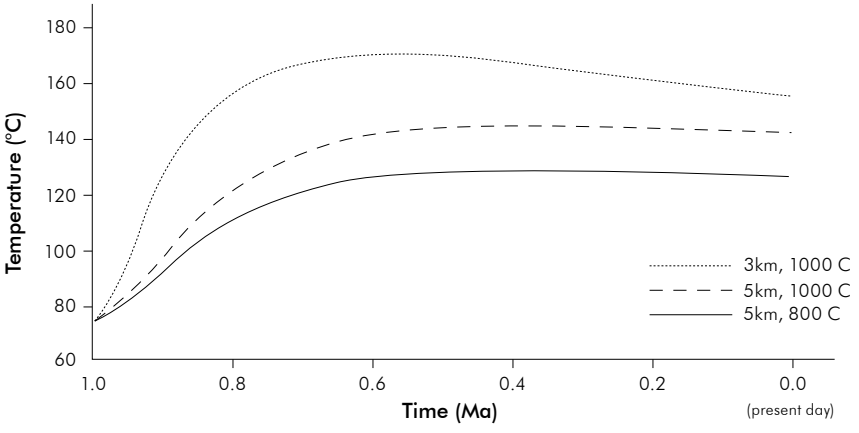

Figure 2. Subsurface thermal histories of Fenton Hill, New Mexico, US, at a depth of 3 km predicted by a conductive heat transport model which assumes that the primary heat source is a magma chamber located beneath the Valles Caldera. Three different depths and initial temperatures for the magma body are considered, as indicated in the legend. (Fig. 11, curves (a) and (c), from Kolstad and McGetchin, ref. 8, p. 213. The 800°C curve was proportionally scaled from the 1,000°C curve.)

posits specific physical and thermal properties of the magma chamber lying beneath the Valles Caldera, which can be tested against available geophysical and geochemical data. There are considerable discrepancies between measurements and the assumptions of his model (table 1).

What is the impact of these discrepancies upon the thermal predictions? Simply put, the actual magma chamber beneath the Valles Caldera[11] was too small, too deep, and too cold to account for the elevated temperatures measured down the Fenton Hill wells. Quantitatively, this effect can be seen in figure 2. The first curve (dotted line) represents the heating from a pluton of radius 8 km, which is smaller than the 9–10 km assumed in Humphreys' model, but is more in line with measured data from seismic studies.[11,12] The peak temperature only reaches 170°C, well short of the 230°C required to account for the thermal maximum inferred from fluid inclusion studies.[6] The discrepancy is much worse for a more realistic pluton depth of 5 km (dashed line).[13] Finally, if an adjustment is made for a lower magma temperature,[14] as indicated by mineralogical and geochemical studies,[15,16] a peak temperature of only about 130°C is reached (solid line). This peak corresponds to the minimum, not the maximum, of Sasada's temperature diagram (figure 1)! Thermal conduction from a cooling body of magma beneath the Valles Caldera can neither account for the current elevated temperatures nor the fluid inclusion data at Fenton Hill.

If the elevated temperatures were not caused by heat conduction from a cooling body of magma, then what was the cause? The answer is the hydrothermal system of the caldera. The shallow temperature gradients are not symmetrical about the centre of the caldera, as one would expect from a conductive heating model.[17] Figure 3 shows a map of the horizontal flow patterns of the convective heating system.[18] The source reservoir in the

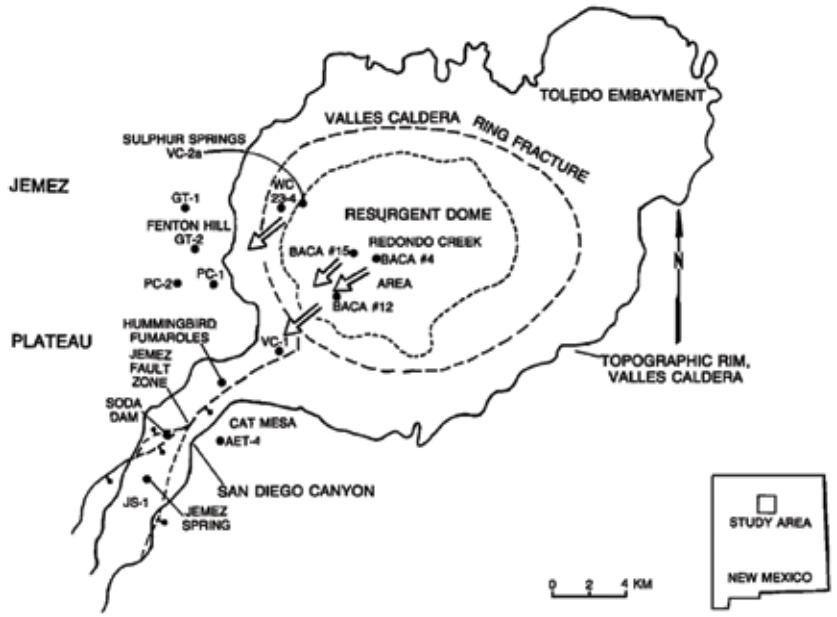

Figure 3. Map showing the locations of 12 geothermal wells in the Valles Caldera region. Large arrows depict the two source reservoirs and direction of lateral flow of the Valles Caldera hydrothermal plume. Note that flow from the Sulphur Springs reservoir is directed towards the Fenton Hill area. (Fig. 1 from Goff *et al.*, ref. 18, p. 6042.)

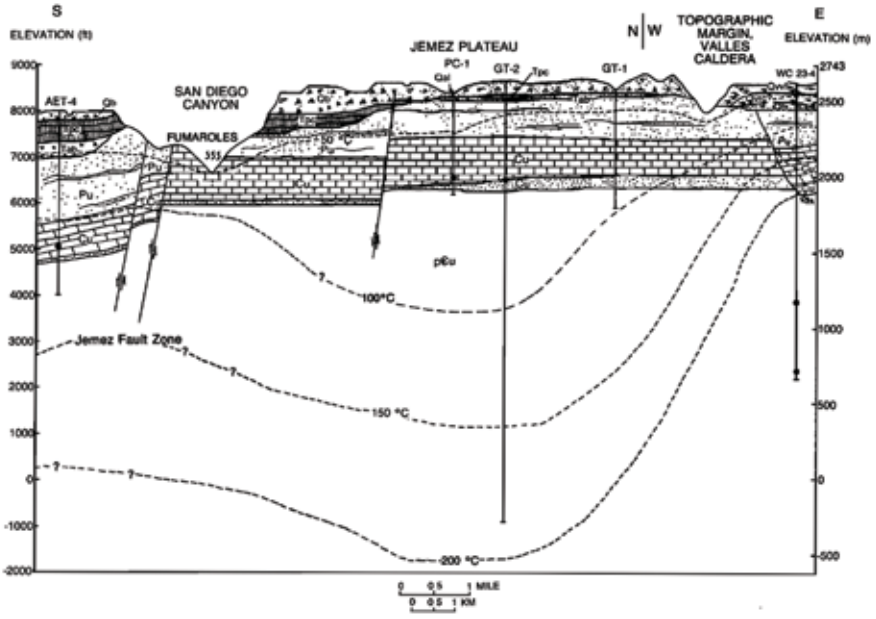

Figure 4. Cross-section showing stratigraphy, structure, and isotherms along the section defined by wells AET-4, PC-1, GT-2, GT-1, and WC 23-4. Note the sharp upward bend in the isotherms near the topographic margin of the caldera. (Fig. 3 from Goff *et al.*, ref. 18, p. 6045.)

western caldera at Sulphur Springs discharges to the southwest, towards the Fenton Hill site. Here, the vertical isotherms bend sharply up near the topographic margin of the caldera, forming a high temperature wall (figure 4).[18] This thermal boundary condition is exactly what Harrison *et al.* concluded based purely upon temperature gradient data.[4] The hydrothermal system provides the best explanation for the vertical heat source in their model.[19]

This hydrothermal system does not have the same geologic constraints as the cooling pluton model. Since the timing of the heating event does not have to coincide with a particular eruption of the Valles Caldera, there is no inconsistency between the thermal history proposed by Harrison, Morgan, and Blackwell and geologic evidence.[20] In short, they did not "ignore the volcano". Rather, it was Humphreys who ignored the hydrothermal system. When this hydrothermal system is taken into account, the resulting recent heating of the Fenton Hill site supports an alternate helium diffusion model which does not require accelerated nuclear decay.[21,22] It also calls into question whether the RATE model provides the best explanation for the retention of helium in zircons at this site.[23,24]

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2. Humphreys, D.R., Argon diffusion data support RATE's 6,000-year helium age of the earth, *J. Creation* **25**(2):74–77, 2011.
3. Loechelt, G.H., Critics of helium evidence for a young world now seem silent? *J. Creation* **24**(3):34–35, 2010.
4. Harrison, T.M., Morgan, P. and Blackwell, D.D., Constraints on the age of heating at the Fenton Hill site, Valles caldera, New Mexico, *J. Geophysical Research* **91**(B2):1899–1908, 10 February 1986.
5. Although Humphreys incorporated fluid inclusion data in his 'best uniformitarian model', he omitted it from his young-earth creation model, claiming that "since heat conduction is very slow in rock, the temperature should remain roughly constant for thousands of years". Therefore, the work of Sasada invalidates Humphreys' young-earth thermal model unless he can demonstrate how a cycle of heating–cooling–reheating can be accommodated within a 6,000-year timeframe.
6. Sasada, M., Fluid inclusion evidence for recent temperature increases at Fenton Hill hot dry rock test site west of the Valles Caldera, New Mexico, US, *J. Volcanology and Geothermal Research* **36**:257–266, 1989.

7. It should be noted that this assignment of thermal events is purely arbitrary and not uniquely determined from the data. An equally valid interpretation of Sasada's fluid inclusion data would be to assign the first heating episode to the Precambrian event in the Harrison *et al.* paper.

8. Kolstad, C.D. and McGetchin, T.R., Thermal evolution models for the Valles caldera with reference to a hot-dry-rock geothermal experiment, *J. Volcanology and Geothermal Research* **3**:197–218, 1978.

9. Kolstad and McGetchin considered pluton models only at 8 and 12 km in radius.

10. Harrison *et al*. started with an initial background temperature of only 90°C at a depth of 3 km.

11. Ankeny, L.A., Braile, L.W. and Olsen, K.H., Upper crustal structure beneath the Jemez Mountains volcanic field, New Mexico, determined by three-dimensional simultaneous inversion of seismic refraction and earthquake data, *J. Geophysical Research* **91**(B6):6188–6198, 10 May 1986. See fig. 9 for a schematic cross-section of the magma chamber underlying the Valles Caldera.

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13. Nielson, D.L. and Hulen, J.B., Internal geology and evolution of the Redondo Dome, Valles Caldera, New Mexico, *J. Geophysical Research* **89**(B10):8696–8711, 30 September 1984. The authors also noted that all of the deep wells drilled inside the caldera rim "failed to intersect any intrusive bodies that could be considered the cause of the resurgent doming". Since some of these wells were deeper than 3 km, this piece of direct evidence alone invalidates Humphreys' model.

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17. Sass, J.H. and Morgan, P., Conductive heat flux in VC-1 and the thermal regime of Valles Caldera, Jemez Mountains, New Mexico, *J. Geophysical Research* **93**(B6):6027–6039, 10 June 1988. See fig. 9 for a contour map of the shallow temperature gradients in and around the Valles Caldera.

18. Goff, F., Shevenell, L., Gardner, J.N., Vuataz, F.-D. and Grigsby, C.O., The hydrothermal outflow plume of Valles Caldera, New Mexico, and a comparison with other outflow plumes, *J. Geophysical Research* **93**(B6):6041–6058, 10 June 1988.

19. Although Harrison *et al*. modelled this heat source using a plutonic intrusion, they were quick to emphasize that "a wide variety of models representing hydrothermal or magmatic systems could be used with similar results".

20. Harrison *et al*. also considered the Bonco Bonito obsidian flow along with a hydrothermal event as possible heat sources. This eruption is now dated at 40 ka using conventional methods. See Goff, F., *Valles Caldera, a geologic history*, University of New Mexico Press, Albuquerque, NM, pp. 41–49, 2009.

21. Loechelt, G.H., Fenton Hill revisited: the retention of helium in zircons and the case for accelerated nuclear decay, American Scientific Affiliation, www.asa3.org/ASA/education/origins/helium-gl3.pdf, 11 September 2008, accessed 22 March 2012.

22. Loechelt, G.H., A response to the RATE team regarding helium diffusion in zircon, American Scientific Affiliation, 18 March 2009, www.asa3.org/ASA/education/origins/helium-gl4.pdf, accessed 22 March 2012.

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Russell Humphreys replies:

The persistence of Gary Loechelt's many-year efforts to discredit RATE[1] testifies to the pressure that project has put on his own worldview. He is a uniformitarian, accepting the billions of years that secularists demand as a framework for evolutionism. His latest letter briefly tries to dismiss a recent article of mine[2,3] showing that argon diffusion at the RATE site (figure 1) supports the RATE helium diffusion age[4] of 6,000 (±2,000) years.

However, he is mainly responding to a letter of mine appearing in this journal about two years ago.[5] Loechelt is continuing to try to revise the underground thermal history of the site, trying to make it much colder than it now is. He wants to find some way to have minerals (zircons) at the site retain large percentages of their radioactivity-generated helium for the alleged 1.5 Ga they have existed. Cooler zircons would leak helium more slowly. Unfortunately, he fails to acknowledge that, by themselves, even such cooler temperatures would not solve his basic problem. There would still be very little helium left in the zircons after millions or billions of years.

For example, notice his revised model at a depth of 2.6 km for heat diffused (not carried by hot water) from the volcano, the solid line in his figure 2. The solid line starts from 75°C. This probably corresponds to the 87°C 'baseline' he used for a depth of 2.9 km. Presumably he wants the rock to have been at those relatively low temperatures for the entire (alleged) 1.5 Ga history of the formation. But using lab-measured diffusivities (giving leakage rates) for zircons from the site shows that after that great a time, they would only have retained *0.0007%* of their helium.[6] That is far less than the 17% retention observed. In other words, zircons (and most other minerals) are simply too leaky to retain any appreciable helium for the alleged 'geologic ages', for any geologically-attainable temperature, no matter how low.

Loechelt knows about the above problem. But perhaps he is still hoping to solve it by writing many words and equations. Some years ago he tried to publish a complex theory claiming that, *in situ*, zircons would leak much more slowly than in the laboratory,

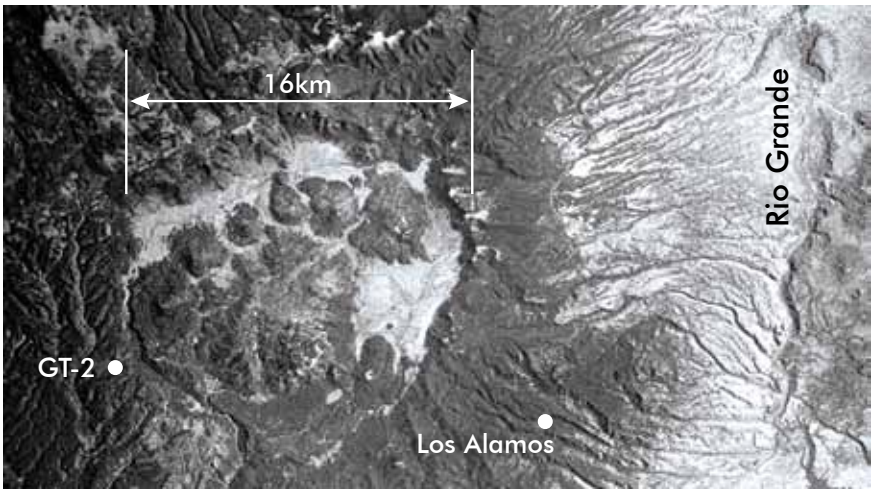

Photo courtesy of NASA. Annotations by Humphreys

Figure 1. Borehole GT-2, the site providing RATE's helium- and argon-bearing samples, is very near the western rim of an Ice Age volcano, Valles Caldera in Northern New Mexico, US.

especially at low temperatures. He did not succeed in getting it past peer review, so he settled for putting it (unreviewed by experts) on several old-earther Internet sites. Since it is difficult for science journal reviewers to see whether a complex theory might be concealing some 'hand-waving' (unlikely assumptions or incorrect reasoning), it might have done better had Loechelt performed experiments supporting his ideas.

However, even Loechelt's unsuccessful theory cannot make diffusion coefficients low enough at high temperatures. For that reason, Loechelt goes through all sorts of speculations and scenarios for the thermal history of the site, trying to have the formation be cooler in the recent past. He is probably right in suggesting some of the heat came from the magma part-way to the site by means of hot water. Though he is vague about the timing, apparently he wants such 'hydrothermal' flows to be relatively recent, within the last 20,000 years or so. He apparently does not realize that the hot water had to have begun flowing at the time of the enormous main eruptions (producing hot ash that covered much of New Mexico as the Bandelier Tuff), an alleged million years ago or so. Magma arriving at that time beneath the location of the present caldera would have released steam and strongly driven existing underground water flows with high temperatures and pressures. It would not have taken very long for the hot water to have begun heating nearby areas.

Thus today's high temperatures at the RATE borehole site, very close to the caldera (figure 1), probably started soon after the two main eruptions. If Loechelt wants to believe the uniformitarian age for the eruptions, then the site would have been about as hot as today for many hundreds of thousands of years. That would wipe out essentially all of the helium from the zircons.[7] That is why Loechelt wants to avoid this scenario, the most likely one an objective uniformitarian geoscientist would adopt.

In all of this, Loechelt is avoiding the obvious fact that the observed helium retentions are quite consistent with only thousands of years worth of diffusion at today's temperatures. That is why we were able to predict successfully the laboratory measurements of the diffusion coefficients before a uniformitarian expert made them. All we did to make the prediction was to connect the observed percentage retentions with the few thousand years the Bible says was available for the diffusion to occur. None of the critics, including Loechelt, has been able to explain how the prediction could have been so accurate by accident. Rather than concoct fantastic theories and scenarios, I urge the critics to simply face up to the most straightforward interpretation of the helium data: the world really is as young as Scripture says it is!

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6. Humphreys, ref. 4, pp. 34–36, 53. Get the 87°C diffusivity, about 2×10^{-18} cm^2/sec, by simply extrapolating the 'defect' line (often seen in diffusion data for natural minerals) a little down from our lowest point of 100°C (See fig. 5 of ref. 5). The line is established by the experimental data, and confirmed by diffusivities predicted using observed retention data in our creation model. Then use the 87° diffusivity for D and a t of 1.5 Ga (4.7×10^{16} seconds) in eq. (16), p. 53.
7. Humphreys, ref. 5, p. 38; see Model 1.