

On Solar Origin of Alleged Mass Extinction Periods in Records of Natural Data

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An acclaimed dismissal of the alleged ~ 62 Ma period of mass extinctions in the Sepkoski compendium of world marine fossils has been independently confirmed and a solar origin of that and other alleged Phanerozoic periods established. Here reported are corollaries of that confirmation for fundamental questions of paleontology and overall geophysics, including the Sun-Earth interactions such as magnetic reversals and the choice of methodology for treating natural data' sets. Due to its ability to analyze raw data directly and with remarkable accuracy and precision, Gauss-Vaniček spectral analysis is by far superior to other relevant methods of spectral analysis (notably Fourier's) in detecting periodicity in overwhelmingly gapped time series such as all records of the Phanerozoic data. Virtually all Phanerozoic periods of mass extinctions are spurious.

fossils, periodicity, astronomical processes, Phanerozoic, spectral analysis

1. Introduction

The subject of alleged mass extinctions of life has been an undying source of sensationalist media reporting for a long time. One of the most talked-about researches with such allegations is by Rohde and Muller (2005) who reported a 62 ± 3 Ma period of mass extinctions in the world's most complete compendium of marine fossils by Sepkoski (2002). However, their report has been repeatedly rejected on various grounds, e.g. by Omerbashich (2006) who has shown its bias as due to at least three critical data manipulations including arbitrarily detrending and inventing of data in order to prepare the data for Fourier spectral analysis (FA). For this, Omerbashich (2006) used Gauss-Vaniček spectral analysis (GVA) technique that can rigorously detect periods even in overwhelmingly gapped datasets, such as all records of the Phanerozoic data. On the other hand, Fourier method of spectral analysis is most used although it requires complete and evenly spaced time series. As it turned out, even the smallest alterations – of just a few percent – of the Sepkoski data result in the allegedly significant period(s) disappearing altogether, while entirely new “significant” periods emerge. Unfortunately, in order to fill the gaps and thus make a Fourier spectral analysis possible, Rohde and Muller (2005) had altered the Sepkoski's record by replicating more than 90% of his original data. The opposing work has sparked a significant attention from the scientific community and has been constantly referenced in relevant research in and reviews of paleoclimate science, e.g. Smith (2007), Balier-Jones (2009), Aberhan and Kiessling (2012), Baker and Flood (2015), Erlykin et al. (2017).

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AN INDEPENDENT CONFIRMATION OF SOLAR ORIGIN OF
ALLEGED PERIODS OF MASS EXTINCTIONS

Marine diversity	Impact craters (N = 65)	Tectonic episodes (N = 18)	Carbonatite intrusions (N = 28)	Kimberlite intrusions (N = 38)	Geomagnetic reversals (N = 24)	Solar harmonics R3 (fast)	Solar harmonics R5 (slow)
	12	12	13	12	12	11.49 L	13.18 L
	16	16	16	16	15	14.37 LT	16.48 LT
	20	20	23 ± 4	23	21	17.24 L2T	19.77 L2T
32.1	32 ± 1	33 ± 3	34 ± 5	35 ± 1	33 ± 1	34.47 L2T	32.96 LT
46	49	44			47	45.97 L	
			50 ± 3	56			52.73 L
63 ± 3 ²	61	61		68	63	68.96 L2T	65.92 LT
91.3	96		90			91.94 L	
110.3					114	114.93 L2T	105.47 L
140.2						137.19 L2T	131.83 L
	260	270	235	280	285	275.74 L2T	263.67 LT

Table 1. Periods in Ma, corresponding to the highest peaks in the spectral analysis of six Phanerozoic time series (after Rampino and Stothers 1984; Rohde and Muller 2005; Omerbashich 2006) and compared to Row 3 and Row 5 harmonic predictions from the Sun. (Baker and Flood, 2015) Confirmation of Omerbashich periods shown in bold. Note that only Omerbashich periods were given to a precision which is significant beyond the decimal point. In the below, L marks UNE Sun's active phase, while LT and L2T mark UNE Sun's passive phases with the latter having most chance to produce magnetic events.

Of interest here is the result by Baker and Flood (2015, Tab. 1) who, using their own (UNE – University of New England, Australia) model based on fractal self-similarity, examined the solar origins of longest of the periods commonly reported in records of natural data. The authors also pointed out that 110.3 Ma period at 95% confidence level as found by Omerbashich (2006) in the Sepkoski's marine diversity record (Tab. 2) has not been detected in any other relevant records of natural data except for the record of magnetic reversals, see Table 1.

² Omerbashich period from Sepkoski marine diversity record was 66.85 Ma, Omerbashich (2006, Table 1).

It can be seen from the UNE modeling – as centered around 62 Ma period alleged by Rohde and Muller (2005) – that 110.3 Ma Omerbashich period, which the UNE modeling did compute theoretically, has in fact arisen due to the coupling effect of the solar harmonics 114.93 (L2T) and 105.47 (L). The period has therefore settled precisely at the mean in between the model’s best relevant harmonics (harmonics from the UNE model-matrix’s best solar models). Thus 110.3 Ma real period is found to match the Sun’s mid-harmonic oscillation exactly, i.e. right between the UNE Sun’s most active (L) v. most passive phases (L2T), Table 1. Since this period has not been found in any other relevant records – which would have increased its likelihood for being a ghost (i.e. a spurious peak either due to gaps in data or biases in data preparation and analyses) – the period is not a ghost in the Sepkoski record. Rather, 110.3 Ma period is a trace of a physical – primarily magnetic – phenomenon occurring on/in the Sun and affecting the Earth’s solid mass to a detectable significance. It then follows that our star is the culprit responsible for magnetic reversals on Earth. This finding is not without its own merits.

Period (Ma)	Fidelity (Phi)	GVS (var%)	Power (dB)
<i>Above 99% confidence at a 5.46 var%:</i>			
194.13136	35.02508	9.8151	-9.63239
140.23021	18.27557	10.6993	-9.21501
91.29958	7.74685	5.7162	-12.17329
77.32198	5.5564	7.4639	-10.93347
<i>Above 95% confidence at a 5.46 var%:</i>			
110.31360	0	4.1056	-13.68413
66.84957	0	4.8538	-12.92313
32.13252	0	4.4945	-13.27350

Table 2: Spectral peaks found in the gapped Sepkoski series restored by deleting all zeroes and repetitive data from the Rohde and Muller (2005) record. (Omerbashich, 2006, Tab. 1)

At the same time, the positive identification of 110.3 Ma Omerbashich period’s physical meaning also means a positive verification of the ability of the Gauss-Vaniček method for detecting physical periodicity in natural data with absolute accuracy, i.e. to within the significant figure. It is worth noting here that all other relevant estimates in the literature – used also by Baker and Flood (2015) – are at least an order of magnitude coarser.

The above-stated ability – as based on an unambiguous match with the same harmonics from different UNE models – opens up a possibility for identifying ghosts in data as well. Thus ghost-periods can be identified based on their approximate matching other harmonics from different UNE models. Then another Omerbashich period, 140.23 Ma at 99% confidence level (140 ± 3 Ma, as reported by Rohde and Muller, 2005) – while not being found in any other records of interest – does indistinctly match the UNE solar harmonics 137.19 (L2T) and 131.83 (L), thus exposing 140.2 Ma period as a ghost. In addition, this ghost's double-companion has been detected in all records – while itself also been indistinctly related to solar harmonics, here 275.74 (L2T) and 263.67 (LT) – confirming additionally that 140.2 Ma period is indeed a ghost. Finally, and by the same token as 140.23 Ma period (of being only vaguely matched by best harmonics of a UNE model), another Omerbashich period, namely 32.12 Ma at 95% confidence level, is then spurious as well.

Such an ability of one robust and extremely accurate and precise spectral analysis technique like GVA – for detecting both ghosts and natural periods in the same dataset and with the absolute accuracy – is also a testimony to the correctness of the approach to spectral analyses using raw (gapped and non-detrended) data only. In addition, the extreme precision of Gauss-Vaniček method has been demonstrated from other studies which have used the raw-data approach as well, e.g. a study of big data collected using the Canadian superconducting gravimeter and containing over 10 billion 1Hz gravity (mass-acceleration) measurements spanning 10.3 years. That study has revealed – extremely precisely as well – tidal periods of the total Earth's (noise-inclusive) gravity field; see Omerbashich (2007, figure 5).

Furthermore, of all the periods shown in Table 1, only Omerbashich periods are given to a precision beyond the decimal point, which in the case of periodicity in natural data' sets turns out to be the extreme precision as now proven independently by the UNE modeling. Then the uniqueness and extreme precision of the above confirmation lend credibility to always using the raw-data approach for verifying the results obtained from using unrelated spectral analysis techniques such as GVA and FA.

A third period detected by Omerbashich (2006) in the Sepkoski record, 66.85 Ma at 95% confidence level, also is an excellent match with the UNE solar harmonics, here 68.96 (L2T) and 65.92 (LT). At the same time, of all the like periods found in the records of natural data, that Omerbashich period is the best match to the model harmonics' mean value, too. Finally, yet another Omerbashich period, 91.30 Ma at 99% confidence level, is also the closest match to a UNE model harmonic, 91.94 (L).

Therefore, and since significant Sun-Earth interactions (those which result in everyday-scale and larger-scales physical phenomena on Earth) can occur one-way only, the much-talked-about period of $\sim 62\pm 3$ Ma by Rohde and Muller (2005) (who do not explain their estimates' precision label of ± 3 Ma), is a spurious byproduct of solar activity. Their period arises primarily due to interacting magnetic fields within the Solar system – probably via the same mechanism which is responsible for magnetic reversals on Earth. Specifically,

Baker and Flood (2015) identify a major 66 Ma irradiance and electromagnetic pulses from the Sun.

Thus, the magnetic-reversals period of 110.3 Ma at 95% confidence level seems the only Omerbashich period that has been detected by others too and that appears positively real, i.e. not a ghost. However, this period could also represent a false-positive detection of temporal clustering in magnetic reversals on Earth as due to fossil gaps.

The only Omerbashich period that does not match any UNE solar harmonics and that has not been reported by anyone else is 77.32 Ma at 99% confidence level. The origin of this period as detected in marine genera remains unknown, but the period itself could be real, i.e. it could be arising due to a physical phenomenon. However, given the “bad luck” of all other periods in this study and the herein discussed confirmation, which all turned out to be spurious, 77.32 Ma too is most likely a ghost.

2. Discussion

Baker and Flood (2015) have succeeded in developing a matrix of robust solar models based on fractal self-similarity. The matrix contains an ingeniously simple vortical concept for Sun’s magnetosphere behavior, which describes a relationship between model-predicted solar harmonics and an arbitrary yet interacting dynamics, here the supposed galaxy dynamics that (supposedly) causes periods as seen normally in various proxy paleoclimate data.

The UNE modeling matrix fixes on real data, and it is centered on the 63 Ma period claimed by some including Rohde and Muller (2005) as a proof that galactic environment causes periodic mass extinctions of nearly all life on Earth as the Milky Way’s spiral arm containing our solar system rotates. However, while rotating, our Galaxy’s arm supposedly traverses once every 63 Ma an imaginary region of intergalactic Space which is tacitly believed to be catastrophic to life – yet itself mysteriously super-stable (energy-conserving; apparently stationary over vast time/distance scales; etc.). That is a practically impossible and highly co-dependent series of assumptions, which, as such, exposes the whole case for the 63 Ma alleged period as near-impossible at best.

Modeling as a standalone is innately unreliable for drawing any physical conclusions. Worse yet, the UNE modeling relied critically on speculations like the Sun’s unlikely flipping magnetic dynamo. Nevertheless, while their model-harmonics’ matching with the geomagnetic reversals indeed drifts away with wavelength shortening, at the same time, however, it does converge on Omerbashich periods and Omerbashich periods alone. That is a sure sign of both the UNE modeling and the Omerbashich periods describing and representing the real world rather faithfully.

Namely, modeling as such becomes both important and reliable only when it can be tuned to as well as checked against different real-world data. Given the internal robustness of the UNE models as well as the resulting excellent match with the Omerbashich periods primarily, Baker and Flood (2015) demonstrated the main finding from Omerbashich (2006): the Sepkoski compendium's signal is due to some intermediaries of low fidelity potential cf. vast gaps in paleoclimate data. As such, the signal is insufficient to alter the dynamics of either the Earth's dynamo or biosphere.

Based on their confirmation that identified our Sun as one such intermediary, it follows that the Omerbashich periods arise due to the solar magnetosphere's picking up magnetic and other fluctuations within the galactic environment. Then, as the Sun travels Milky Way – akin to a gramophone needle tracing a playing record – our star imprints the said continuously changing information tidally-gravitationally, in form of secondary ghost-projections relayed in real-time to the Sun's surroundings, the Earth structure in particular.

Then the above-described simple mechanism finds the kinetic energy needed to affect all Earth solids periodically (with most of the reported periods) – whenever the solar harmonic oscillation is at its midpoint (cf. the reverse-time effect of the “fixed-energy” smart concept of the UNE model matrix).

Thus there is nothing peculiar about periods in any of the natural data' sets, except for the records of magnetic reversal as the phenomenon which naturally gets most affected by the solar magnetosphere's irradiation precisely at solar oscillation midpoints when the magnetic poles can thereby even flip. Any other Earth records – particularly those of solid matter such as fossils and spanning millions of years – eventually end up recording the midpoints of our Sun's harmonic oscillation as odd yet periodic deformations in the molecular structure of the recorded solid. In acting so, only the record of actual magnetic reversals as preserved in rocks reveals a period which is physically meaningful on the said scales.

3. Conclusions

While failing to establish a causal relationship between our Sun's activity and Milky Way environment's relative variations along the Sun's trajectory, Baker and Flood (2015) have in fact demonstrated that 5 out of 6 longest natural periods that were obtained by Omerbashich (2006) in the raw-data-only approach to data processing and by using Gauss-Vaníček spectral analysis of Sepkoski compendium of marine fossil data, all arise as tidal ghosts. This has confirmed the Omerbashich (2006) main conclusion that certain intermediaries are to be blamed for the entire signal in the fossil data, and therefore for the hypothesized altering of the Earth's climate – alleged by some to be due to our galaxy.

The said auxiliary finding is highly significant because it excludes altogether (any and all) periodic galactic causes to mass extinctions of life on Earth. However, our Sun could still be causing short-term (under 0.1 Ma) catastrophic effects on Earth life, primarily through periodic climate change.

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