ANOXIA DURING THE LATE PERMIAN BINARY MASS EXTINCTION AND DARK MATTER

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ABSTRACT

Recent evidence quite convincingly indicates that the Late Permian biotic crisis was in fact a binary extinction with a distinct end-Guadalupian extinction pulse preceding the major terminal end-Permian Tartarian event by 5 million years. In addition anoxia appears to be closely associated with each of these end-Paleozoic binary extinctions. Most leading models cannot explain both anoxia and the binary characteristic of this crisis. In this paper we show that the recently proposed volcanogenic dark matter scenario succeeds in doing this.

Key Words: Permian-Triassic, anoxia, binary extinction, mass extinction, volcanism, dark matter
INTRODUCTION

Recently, Knoll, Bambach, Canfield and Grotzingen (Knoll et al. 1996a) have suggested a new model wherein the overturn of anoxic deep oceans led to the end-Permian Tartarian extinction by the introduction of carbon dioxide into surficial environments. This model could explain the selectivity of the extinction, with organisms tolerant of elevated carbon dioxide levels exhibiting higher degrees of survival across the P/T boundary. The C-isotope record also indicates that another anoxic event occurred at the end of the Guadalupian, approximately 5 million years before the Tartarian extinction.

Knoll et al. state that it is possible that the Siberian flood basalt volcanic episode (Campbell et al. 1992) could have led to the Tartarian overturn by means of tectonic realignment (Knoll et al. 1996a). It has also been realized that this extinction was in fact a double extinction (Stanley and Yang 1994), and the work of Knoll et al. is consistent with this fact. This double extinction shall be referred to as a "binary extinction" in this work; and the anoxia appear to be related to the extinctions. In this paper we set forth a scenario based on the recently proposed idea of volcanogenic dark matter (Abbas and Abbas 1998). This can consistently explain the binary nature of the extinction and the associated anoxia, and predicts binary anoxia and double extinctions at other major mass extinctions as well.

VOLCANOGENIC DARK MATTER

Dark matter may constitute more than 90 and ample evidence in favour of its existence occurs in the form of galactic rotation curves, the stability of galactic clusters etc. Several candidates have been proposed (Berezinsky 1993, Watson 1997). It is probable that dark matter occurs in a clumped form, with high-density clumps of dark matter existing within a uniform halo background. During the occasional passage of such a clump through the Earth dark matter would accumulate in the core and annihilate, producing vast quantities of heat (Kanipe 1997). Abbas and Abbas estimate that the heat output can exceed present-day terrestrial heat production by five orders of magnitude (Abbas and Abbas 1998). These large quantities of heat will in all likelihood lead to the creation of a superplume that initiates, upon arrival at the surface, the Siberian flood basalt volcanic episode (Abbas and Abbas, 1998). This volcanism may lead to changes in oceanic circulation patterns by tectonic realignment or the creation of new oceanic plumes above submarine eruption sites. Such a change could lead to anoxia with the consequent terminal P/T mass extinction as envisaged by Knoll et al. (Knoll et al. 1996a). In addition Vermeij and Dorritie (Vermeij and Dorritie 1996) pointed out that it is possible that Siberian volcanism may have released vast quantities of methane from permafrost and continental shelves,
which, on oxidation, would have yielded carbon dioxide, drawing down oxygen in
the process and leading to anoxia.

This volcano-induced extinction would occur after a time interval representing
the duration between creation of the superplume at the core/mantle boundary
and arrival of this plume at the surface. With a migration rate of a few cm per
year, this should be approximately 5 million years, and this is in fact the interval
separating the Guadalupian and Tartarian extinctions (Stanley and Yang 1994).

According to Isozaki (Isozaki 1997a), results from Japanese and British
Columbian deep sea cherts indicate that the onset of anoxia marked the Guadalup-
ian extinction, and the climax of the anoxia, or the superanoxia, coincided with
the Tartarian crisis (Isozaki 1997b, Retallack and Holser 1997). This is consistent
with the volcanogenic dark matter model; the anoxia would persist instead
of disappearing after some time. The duration of anoxia in this picture is de-
pendent on how rapidly ocean circulation patterns can re-oxygenate the seas. In
the model outlined herein Siberian volcanism may have released vast amounts
of methane from permafrost which on oxidation would have consumed oxygen and
led to anoxia; or oxidation of organisms that died as a result of dust, blockage
of sunlight, noxious gases (e.g. sulphur dioxide, nitrogen oxides) etc. would have
drawn down oxygen, thereby leading to anoxia. Further palaeontological work is
required to clarify whether anoxia is the cause or effect of extinctions.

CARCINOGENESIS DUE TO DARK MATTER

The direct passage of a dark matter clump itself may lead to the first extinc-
tion step by causing lethal carcinogenesis in organisms. Zioutas (Zioutas 1990)
studied the effect of dark matter on living organisms, and concluded that dark
matter may be responsible for mutation and cancers in living beings. Changes
of biorhythms depending on the direction of flight have been recorded for hu-
mans as well as fungi during flights across different time zones, and these may
be due to dark matter. Background radiation can only explain 1 in 20000 of the
observed spontaneous mutations in Drosophila; the remainder may be due to
dark matter interactions. Subsequently Collar (Collar 1996) analyzed the effect
that highly clumped dark matter may have on the biosphere. He discovered that
such an event could be highly detrimental to life on Earth. The dosage imparted
to organisms during the passage of a clump core would in principle be roughly
comparable to the neutron radiation from a close nuclear explosion protracted
over a time required for clump core passage. This dose protraction would further
aggravate these effects. Thus the passage of a clump core would induce a large
dose of highly mutagenic radiation in all living tissue. Collar then proposed that
dark matter could have caused palaeontological mass extinctions.

The dark matter, being weakly interacting, does not decrease in intensity
during passage through the oceans and hence immediate extinctions on land and
sea would result from the clump passage through the Earth. The oxidation of the
resulting organic matter would deplete oxygen from the oceans and atmosphere,
while simultaneously increasing the levels of carbon dioxide. Normally, as organic material descends through the ocean, it is oxidised on the way down. However, the full-scale destruction of life would lead to even the surface waters becoming anoxic (Smith 1989). Thus the first pulse of anoxia would have been a consequence of extinctions. The introduction of anaerobic life may further toxify the oceans as some of these organisms produce toxins like hydrogen sulphide, and further extinctions of those species that survived the clump passage would take place. In addition, for low dosages of dark matter the mutations engendered would take several generations to cause fatalities. Hence this first extinction need not necessarily be a sharp peak; it may very well be extended and drawn out.

Thus the passage of the Earth through a clump of dark matter would be highly detrimental to life. This leads to mass extinctions of phytoplankton and/or larger marine animals, and/or other types of marine biota. Their destruction gradually depletes dissolved oxygen at a faster rate than can be replaced by dissolving from the atmosphere, thereby removing the oxygen even from the surface waters. Thus, anaerobic conditions set in and microbes that can respire anaerobically thrive. Anaerobic sulphur bacteria produce hydrogen sulphide, which is toxic to most marine life (Smith 1989).

DISCUSSION AND CONCLUSION

Thus the model described above makes definite predictions, one of which is that most major extinctions should be binary at higher resolutions. In fact several appear to be so. Stanley and Yang (Stanley and Yang 1994) found that the end-Permian extinction, at which probably no major asteroidal/cometary impact occurred, was in fact binary, with the Guadalupian extinction eliminating 71 species, and 80 analysis of life across the K/T boundary by MacLeod et al. (MacLeod et al. 1997) rules out a single terminal catastrophe and we feel that overlapping binary extinction peaks in the framework outlined above are consistent with these results. The late Miocene extinction has recently been found to be binary (Petuch 1995), with a five million year interval between them. The scenario depicted above may be applicable to this case also. In fact the volcanogenic dark matter scenario (Abbas and Abbas 1998) provides a natural explanation for double extinctions (Abbas, Abbas and Mohanty 1998). Here in this paper we have shown how, in addition, anoxia can be explained.

Hence several features of mass extinctions have been considered. If, as it seems likely, anoxia, periodicity and a binary feature are characteristic of the major extinctions of palaeontology, then the volcanogenic dark matter scenario emerges as a viable model explanation.
REFERENCES

Abbas, S. and Abbas, A. 1998. 
*Volcanogenic dark matter and mass extinctions.*
Astroparticle Physics 8(4/12):317-320
http://xxx.lanl.gov/abs/astro-ph/9612214

Abbas, S. Abbas, A. and Mohanty, S. 1998. 
*Double Mass Extinctions and the Volcanogenic Dark Matter Scenario.*
http://xxx.lanl.gov/abs/astro-ph/9805142

Berezinsky, V.S. 1993. 
*High Energy Neutrinos from Big Bang Particles.*
Nuclear Physics B (Proceedings Supplement) 31:413-427

Campbell, I.H., et al 1992. 
*Synchronism of the Siberian Traps and the Permian-Triassic Boundary.*
Science 258:1760-63

Collar, J.I, 1996. 
*Clumpy Cold Dark Matter and biological extinctions.*
Physics Letters B 368:266-9

Isozaki, Y. 1997a. 
*Permo-Triassic Boundary Superanoxia and Stratified Superocean: Records from Lost Deep Sea.*
Science 276:235-238

Isozaki, Y. 1997b. 
*Response to: Timing of Permian-Triassic Anoxia.*
Science 277:1745

Kanipe, J. 1997. 
*Dark matter blamed for mass extinctions on Earth.*
New Scientist Jan. 11 1997, p.14

Knoll, A.H., Bambach, R.K., Canfield, D.E. and Grotzinger, J.P. 1996a 
*Comparative Earth History and Mass Extinction.*
Science 273:452-457

Knoll, A.H., Bambach, R.K., Canfield, D.E. and Grotzinger, J.P. 1996b 
*Late Permian Extinctions: Response to Letters.*
Science 274:1550
MacLeod, N. et al. 1997  
*The Cretaceous-Tertiary biotic transition.*  
J. of the Geol. Soc. of London 154:265-292

Petuch, E.J., 1995  
*Molluscan diversity of the Late Neogene of Florida. Evidence for a Two-Stage Mass Extinction.*  
Science 270:275-7

Retallack, G.J. and Holser, W.T., 1997.  
*Timing of Permian-Triassic Anoxia (Letter).*  
Science 277:1745

Smith, D.G. (ed.-in-chief) 1989.  
*The Cambridge Encyclopedia of Earth Sciences,* p. 345.  
Cambridge University Press, Cambridge.

Stanley, S.M., and Yang, X., 1994.  
*A Double Mass Extinction at the End of the Paleozoic Era.*  
Science 266:1340-44

Vermeij, G.J. and Dorritie, D. 1996.  
*Late Permian Extinctions - Letter.*  
Science 274:1550

Watson, A. 1997.  
*To catch a WIMP.*  
Science 275:1736-8

Zioutas, K., 1990.  
*Evidence for Dark Matter from Biological Observations.*  
Physics Letters B 242:257-264