

THE GREAT PERMIAN EXTINCTION DEBATE. J. A. Marusek, Impact, (RR 6, Box 442, Bloomfield, IN 47424 e-mail: tunga@custom.net or marusek_j@crane.navy.mil).

Introduction: The cataclysm that brought the Permian Period to an end was caused by a cluster of comet/asteroid impacts over a short geological time-frame, 5-8 million years. Several impacts were of sufficient size to rupture through the Earth's crust, producing deep impact effects including large fractures in the ocean floor along the tectonic plate joints. The resulting undersea vulcanization released massive quantities of acidic gases. Oceanic gas scrubbing led to acidification of the ocean. The impacts also focused destruction on the opposite side of the Earth creating fractures at continent/ocean seams. The resulting Emeishan & Siberian Traps generated prolonged periods of surface flood vulcanization inducing extensive acid rainfall. These two processes targeted evolutionary weaknesses within marine and terrestrial life forms, culminating in a massive die-off at the end of the Permian Period.

Impact Theory: Around 250 million years ago, a cataclysm of incomprehensible proportions struck a fatal deathblow. Ninety-six percent of all marine species along with seventy percent of all land vertebrates species became extinct [1, 2]. A rapid die-off of rooted plant life occurred [3]. Insect suffered their only mass extinction [2]. This event is referred to as the Permian Extinction. It is the greatest die-off of life on planet Earth, ever.

The Permian extinction was a cluster of mass extinctions tightly constrained in geological time [4]. The first mass extinction was at the Guadalupian-Lapingian Boundary (GLB). The next was at the Wuchiapingian-Changshingian Boundary (WCB). The third and largest was at the Permian-Triassic Boundary (PTB). These three major mass extinction events were clustered within a period of 5-8 million years [5].

This paper presents the hypothesis that:

* *The cluster of extinction events were caused by a cluster of impact events.*

* *That several of these impactors had sufficient kinetic energy to break through the Earth's crust.*

* *That these deep impactors produced massive flood vulcanization.*

* *And the release of acidic gases from magma was the leading cause of the ocean and terrestrial extinctions.*

After completing a study of mortality effects triggered by large asteroid/comet impacts, the analysis showed these effects are too localized to adequately explain the global nature of the extinctions that occurred at the end of the Cretaceous and Permian Peri-

ods. Several postulated effects, such as global fire-storm, ejecta debris-induced impact winter, and megatsunami with deep landmass penetration are not supported [6].

The effects of an asteroid or comet impact have been compared to that of a large nuclear weapon. Although the comparison may be a good approximation, there is one significant difference. In a nuclear weapons blast, the kinetic energy is released spherically in all directions. In an impact, the kinetic energy is focused along the line of the impact vector. This paper makes the hypothesis that a large impactor can tear through the Earth's crust and release most of its energy deep within the mantle. This is especially true for an impact where the crust is thin, such as an ocean impact. The process is called acoustic fluidization [7]. The impact energy turns the solid crust into liquid. The impactor in a fraction of a second cuts its way through the atmosphere, the ocean and the Earth's crust in a manner similar to a shaped-charge projectile penetrating tank armor. Unlike a surface impact that leaves behind a large crater and throws up a worldwide debris field, these deep impactors generate large scars or crustal uplifts burying much of the impact debris.

The impact energy can be thought of as the sum of the energy released at the surface and the energy released deep within the Earth. The surface component can be approximated to blast and thermal radiation effects from a comparable size thermonuclear weapon. The effects of the impact energy released in the mantle are obscure and are only observable in massive flood vulcanization, the creation of a deep magma hot spot and interior structures anomalies, such as magnetic pole reversals. This paper also theorizes that the energy released deep within the earth may be an order of magnitude greater than the surface component. [As an example, a 20-mile diameter Long Period Comet (LPC) traveling at 110,000 mph (50 kps) with a density of 0.75 gm/cc would release the kinetic energy equivalent to 38×10^8 megatons of TNT (1.6×10^{25} joules). Of this, approximately 6×10^8 megatons of TNT might be released at the surface, producing an impact structure 200 miles across. The scar left from a deep impactor might appear to be from a much smaller impactor because all that is visible is the surface component. A deep impactor will break through the Earth's crust and release most of its impact energy (in this example 32×10^8 megatons of TNT) as heat and momentum transfer deep within the Earth's shell.]

The interior shock wave from a deep impactor will flex the tectonic plate joints, producing large frac-

tures in the ocean floor and massive undersea flood vulcanization at these seams worldwide. But the shock wave will focus most of its destructive energy at the exit vector, devastating a large area of crust on the opposite side of the globe. Generally damage is greater if the exit vector is close to a continental/oceanic crust seam because a hinged joint is a weak flex joint. The tectonic plates function similar to a slow moving engine. Impact force can upset its delicate balance and cause plate fracturing and derailment, which will produce extensive long-term crustal damage.

In the GLB impact, the focused shock wave ruptured the crustal surface producing the Emeishan Traps. The GLB impact produced an acidic tuff bed (approximately 2 meters thick) with extensive distribution of air-borne ash over thousands of kilometers [8]. The GLB impact also drove the oceans into a state of anoxia.

The WCB was caused by another deep impactor that produced a magnetic pole reversal [9]. The WCB threw the oceans into a superanoxic state, which lasted for more than 10 million years [10].

In the PTB impact, the focused shock wave damaged the Earth's crust near Eastern Russia, producing terrestrial flood vulcanization referred to as the Siberian Traps. This surface wound generated 3-5 million cubic kilometers of lava [11]. The PTB impact also produced a magnetic pole reversal [9].

The vulcanization from the Emeishan and Siberian Traps lasted over 10 million years. The undersea vulcanization produced a marine ecological disaster. The terrestrial flood vulcanization produced a terrestrial ecological disaster and contributed to the marine disaster. The primary cause of the extinctions was the release of compressed gases in the magma. The actual die-offs took place very rapidly. In the PTB, the collapse of the marine and terrestrial ecosystems occurred in just a few tens of thousands of years [12].

The full paper includes a detailed discussion of the marine extinction mechanism, the terrestrial extinction mechanism, physical evidence supporting the extinction pathways, and evidence of the impact events.

References: [1] Raup, D.M. (1979) *Science*, **206**, 217-218. [2] Bowring, S.A. et al. (1998) *Science*, **280**, 1039-1045. [3] Ward, P.D. et al. (2000) *Science*, **289**, 1740-1743. [4] Knoll, A.H. et al. (1996) *Science*, **273**, 452-457. [5] Kaiho, K. et al. (2003) *The Double Mass Extinctions at the Ends of the Guadalupian (Middle Permian) and Permian* (submitted). [6] Marusek, J.A., *Impact*, <http://personals.galaxyinternet.net/tunga/17.htm> [7] Collins, G.S. et al. (2002) *Icarus* **157**, 24-33. [8] Isozaki, Y. (2001) *Geol. Soc. Am. Session 58-0*. [9] Erwin, D.H. (1994) *Nature*, **367**, 231-236. [10] Isozaki, Y. (1977) *Science*, **276**, 235-238.

[11] Bowring, S.A. et al. (1999) *Proc. Natl. Acad. Sci. USA*, **96**, 8827-8828. [12] Twitchett, R.J. (2001) *Geology*, **29**, 351-354.