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Mass Extinctions in the Fossil Record

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A recent scientific paper that received great news coverage described the immediate effects of the Chicxulub meteoritic impact and its role in the Cretaceous-Paleogene extinction.[1] At the Tanis site in southwestern North Dakota, ejecta, sediments, and a mass death mixture of marine and continental organisms were "emplaced immediately (minutes to hours) after the impact" and it is suggested "that the depositional event, calculated to have coincided with the arrival of seismic waves from Chicxulub, likely resulted from a seismically coupled local seiche.... The global extinction event, therefore could have had a rapidly delivered precursor, both at the local and global scales, minutes after impact."[2]

This explicit link between catastrophe and extinction captures the intent of this essay, which describes two major characteristics of the fossil record recognized today by mainstream science: (1) the worldwide occurrence of five main "mass extinctions" and of many more "smaller extinctions" that affected a lower number of taxa, but are still detectable and significant; and (2) the occurrence of numerous mass mortality events (aside from major extinctions) in the ocean and also on land, in which hundreds to thousands of organisms died quite simultaneously and are now often preserved as exceptional deposits.

The fossil record of the Phanerozoic (Cambrian to Recent) preserves numerous global and abrupt changes, interpreted as mass extinctions, in which many different animal and plant taxa disappear. Today, most authors recognize five major mass extinction horizons:

Upper Ordovician, Upper Devonian, Permian-Triassic (P-T) boundary, Triassic-Jurassic (T-J) boundary, and Cretaceous-Paleogene (K-Pg) boundary. It has been calculated that at each of these major horizons at least 70% of the marine species present in underlying strata became extinct. Surprisingly, however, over 90% of past species disappear at intervals other than the Big Five mass extinctions.[3] Many maintain that the greatest of mass extinctions is documented at the P-T boundary. However, the K-Pg boundary extinction is probably the most famous, because it includes the dinosaurs and its suspected cause of a massive bolide impact (the much-studied Chicxulub impact event).[4]

Some authors agree that there is evidence for at least 20–28 other minor extinction events in the Phanerozoic record.[5] One recent study reviewed approximately 20 biotic crises between the Cambrian and the end Cretaceous and suggests that for many of these events and proximal killers, volcanism is a major driver of mass extinction.[6] In addition, there are many more, perhaps myriads of localized mass mortality events, areas in which hundreds of specimens have died and are preserved, sometimes in an exceptional way (i.e., completely articulated or with soft tissues). Examples include the exquisite 3D preserved fossil fish of the Cretaceous Romualdo Formation from NE Brazil, tens of thousands of specimens of the dinosaur *Maiasaurus* as well as eggs with embryos from Montana, and the famous Cleveland-Lloyd Quarry in Utah that contains approximately 12,000 bones of 12 species of dinosaurs.

There has been much debate on the actual causes of extinctions. The many possibilities offered include flood basalts (massive and widespread lava flows, such as the Deccan Traps of India and the Siberian Traps); asteroid collisions (such as the Chicxulub impact event); major drops in sea level; global warming; global cooling; methane eruptions; anoxic events with drops in oxygen availability in the oceans; and other effects stemming from plate reconfigurations, ocean acidification, and poisoning by toxic trace metals.[7] It has proven difficult to pinpoint proximate and direct causes for any extinction, and it is more likely that the ultimate cause might be a combination of multiple mechanisms with varying effects on different environments.

Notwithstanding this debate on triggering mechanisms, it has become evident that the geologic column contains a record of hundreds of extinctions and mass mortality events that suggest a very catastrophic history. Furthermore, the preservation of these faunas/floras requires rapid burial for fossilization. The majority of the sediments containing these remains have been laid down by water under high rates of sedimentation. Many of these events involved massive inundation processes and could have been affected by volcanic eruptions, as indicated by the volcanic ash present in many of these sedimentary deposits.

Currently, these events are accepted by mainstream scientists in the context of a paradigm known as "the new catastrophism." This approach holds that numerous catastrophes punctuated the period of Phanerozoic sedimentation, conventionally believed to span approximately 540 million years, with long time lapses with little or no significant catastrophic events in between. An alternative view proposes that there is little evidence for the lapse of time proposed between extinctions and mass mortalities, constraining time for the fossil record to relatively shorter periods of time. A worldview that considers a short timescale for the Phanerozoic would therefore give more emphasis to the catastrophic nature of the geologic record.

It has been suggested[8] that the Designer created the universe and the earth for observation and discovery. Discovery requires the gathering of data, and it is gratifying that abundant data have been collected which provide greater confidence in the Designer's revealed biblical record of Earth's history. Although there is still much to learn and understand, my faith is affirmed by discovering that the biblical account of mass mortality and catastrophic activity during a global Flood finds resonance with a clear signal of catastrophe and extinction in the fossil record.

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1. RA DePalma, J Smit, DA Burnham, K Kuiper, PL Manning, A Oleinik, P Larson, FJ Maurrasse, J Vellekoop, MA Richards, et al. A seismically induced onshore surge deposit at the KPg boundary, North Dakota. Proceedings of the National Academy of Sciences (USA) 2019; 116(17):8190–8199. doi:10.1073/pnas.1817407116.
2. Ibid., pp. 8190, 8197.
3. D Jablonski. Extinctions in the fossil record. Philosophical Transactions of the Royal Society B–Biological Sciences 1994; 344(1307):11–17.
4. DM Raup, JJ Sepkoski. Periodic extinction of families and genera. Science 1986; 231(4740):833–836; A Hallam, PB Wignall. Mass extinctions and their aftermath. New York: Oxford University Press; 1986.
5. MR Rampino, BM Haggerty. Impact crises and mass extinctions: a working hypothesis. Ryder G, Fastovsky DE, Gartner S, editors. The cretaceous-tertiary event and other catastrophes in earth history. Boulder (CO): Geological Society of America Special Paper 1996; 307:11–30.
6. DPG Bond, SE Grasby. On the causes of mass extinctions. Palaeogeography, Palaeoclimatology, Palaeoecology 2017; 478:3–29.
7. Ibid. See their Table 1 for a detailed summary of data and proposed causal mechanisms implicated in ~20 mass extinctions since the Early Cambrian.
8. D Klinghoffer. Richards: "Designed for life, designed for discovery." Evolution News & Science Today, April 22, 2019. https://evolutionnews.org/2019/04/richards-designed-for-life-designed-for-discovery [accessed May 6, 2019].

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