h26 Deccan traps volcanism and E-K boundary extinctions < McLean, Mascarene Plateau >

Everything has been said before, but since nobody listens we have to keep going back and beginning all over again. —André Gide.[1]

Basalt melts [completely] at about 1,150°[Celsius] and a little above this temperature flows like very thin oil. —Arthur Louis Day, Robert B. Sosman, J. C. Hostetter, 1914.[2]

Earth's climate is affected by volcanism: Dust and sulfurous aerosols along with water vapor put in the atmosphere by Plinian eruptions (as classically described by Pliny) reflect sunlight. In the troposphere, rain quickly washes such out, but particles in the stratosphere must settle to leave and so can linger for years cooling the climate. Prolonged basaltic fissure eruptions can have the opposite effect when carbon dioxide from continental eruptions is added to the air directly or makes its way out of the oceans from underwater eruptions. The greenhouse gas carbon dioxide warms the climate.

Spanning many millions of years in time across the E-K boundary 65.5 Ma were massive, but episodic, outpourings of continental plateau (or flood) basalts—the Deccan traps (Indian *dakhan*: south[ern], Swedish *trappa*: stair[s]) of western India. Also, the now much dwindled mantle-plume hotspot that supplies oceanic basalt for the frequent eruptions described by W. J. Morgan in 1981 of Piton de la Fournaise, which builds Reunion island of the Chagos-Laccadive ridge, is one that that long ago produced huge startup outpourings (the oceanic Mascarene Plateau in the Seychelles).

A spurt in the episodic flood-basalt eruptions could have been the straw that figuratively "broke the camel's back" and caused an ecological collapse at the E-K boundary. This is **Dewey M. McLean**'s "volcano-greenhouse theory" advanced since 1978.[3] (Also the end-Permian extinction event—*see* Topic *i23*—coincided, McLean notes, with the Siberian Traps flood-basalt volcanism.[4]) However, of major extinction events (***Figure h26.1***), the recovery, which took some 200,000 years, was the swiftest on record.[5] Fifty percent of the terrestrial species prospered after the extinction of the formerly dominant reptilian life. The half that did not included the dinosaurs.

Gerta Keller notes that prior climatic and sealevel changes would have stressed shallow-marine adapted organisms. During the last 50-100 ky (thousand years) of the Maastrichtian: 1) a rapid cooling of 2-3ºC had followed a greenhouse warming ("probably caused by the tremendous volcanic Deccan Trap eruptions in India") between 100-200 Ky before the E-K boundary; and, 2) sealevel was down making continental shelves narrow, when 300 ky before it had risen 70-100 meters.[6]

All the above drawn-out woes, however, were simultaneously and dramatically bested by the Chicxulub event by chance of its location. Impacting into shelf carbonates and sulfates, the bolide exploded into the stratosphere hundreds of billions of tons of sulfur dioxide and carbon dioxide.

The biotic effects were selective. In fossil groups of marine microorganism, no species that comprised the bulk of the biomass and base of the marine food chain (planktic foraminifera, ostracods, radiolarians, diatoms, and dinoflagellates) went extinct in high latitudes. In low latitudes, as measured by Gerta Keller (***Figure h26.2***), mass extinctions diminished species numbers by l5%. The greatest declines were among planktonic foraminifera (half of their 65 species went extinct) and "highly specialized tropical-subtropical forms that were already highly stressed and endangered." [7]

There had been a long (prior bolide) decline during the last ~3 My of the Maastrichtian, of inoceramids and rudistids, and ammonites.

In evaluating all “reasonable” explanations and postulates for extinctions, one should keep in mind Hume’s sobering dictum that correlation is not causation.[8]

Organisms can survive in pockets that escape representation in the fossils record. For example, the benthic foramininiferal species in the Danian are reappearances of those that had migrated to havens during the Maastrichtian decline.

Signor-Lipps effect is that organisms that did become abruptly extinct can appear to have dwindled through ex and post ante because of:[9]

- Bioturbation back smearing and forward dilute scatterings of their remains in the fossil record.
- When seas are at a minimum, marine fossils will be reworked to become deposited in areas that are deep ocean basins from where they were formerly deposited on continents when seas were at a maximum.
- For statistical reasons, rare fossils can seem to “disappear” much earlier than numerous fossils, even when both groups become extinct simultaneously. ❑

Figure h26.1[10] Evidence (■) of environmental disturbances at mass extinction boundaries.

The often referenced five major events are numbered.

	EXTINCTION EVENT	$\delta^{13}C$	$\delta^{18}O$	$\delta^{34}S$	Eco. disturbance or biomass crash
	Late Pliocene		■		Marked
	Late Eocene		■		
1	Paleogene - Cretaceous	■	■	■	MAJOR
	Turonian - Cenomanian	■ ?	■		
	Cretaceous - Jurassic	■	■ ?		
2	Jurassic - Triassic	■ ?			MAJOR
3	Triassic - Permian	■	■	■	MAJOR
	Carboniferous - Devonian	■	■		Marked
4	Late Devonian	■	■	■	MAJOR
5	Late Ordovician	■ ?	■	■	MAJOR
	Late Precambrian	■	■	■	?

Figure h26.2[11] Species richness across the E-K (Paleogene-Cretaceous) boundary in marine microfossils of low latitudes.