

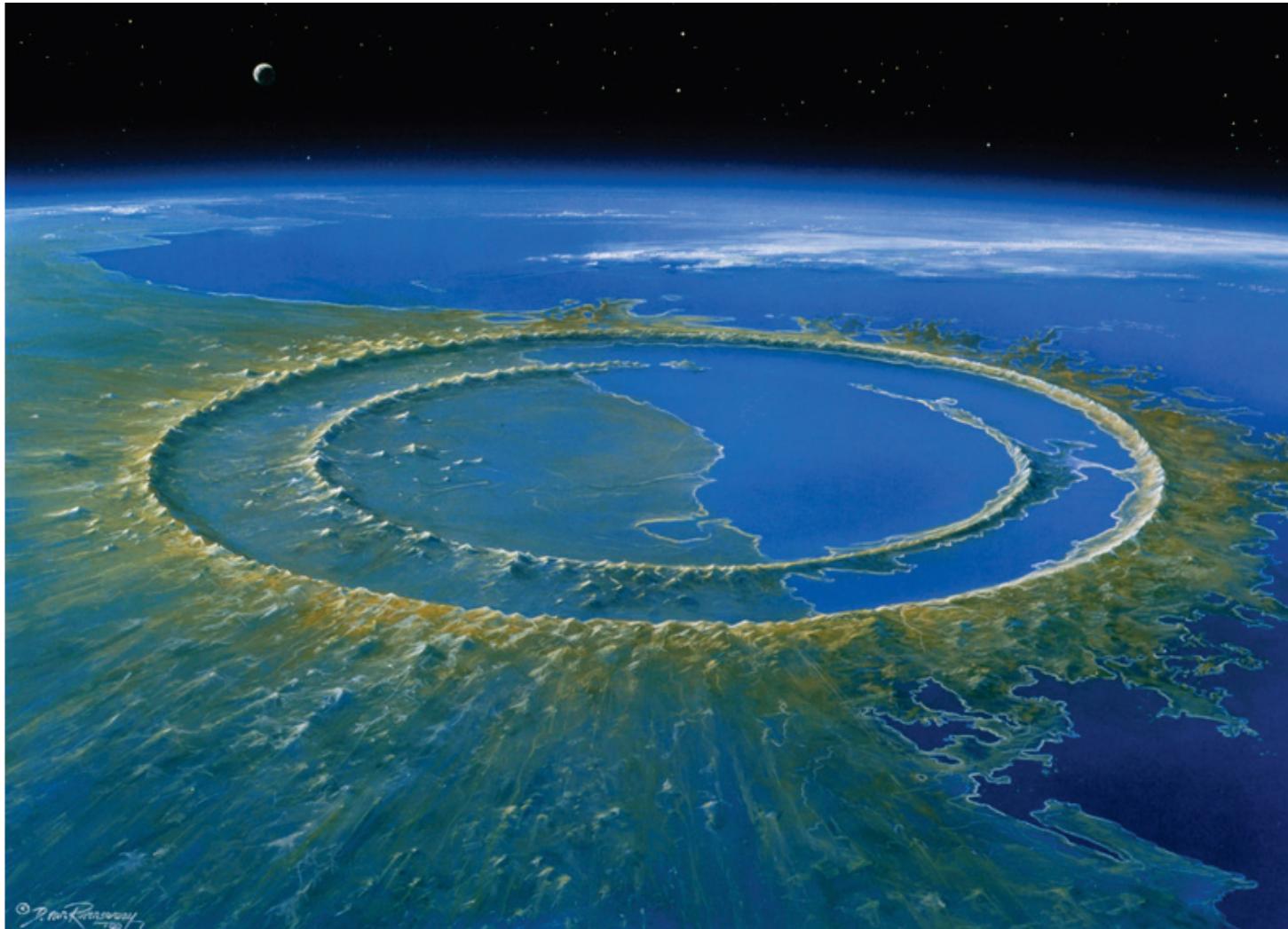
Day The Dinosaurs Died



<https://www.pbs.org/wgbh/nova/video/day-the-dinosaurs-died>

5 September 2020

65 Million Years Ago, On A Really Really Really Bad Day: ***Everything Changed***



An artist's impression of what the Chicxulub crater might have looked like soon after an asteroid struck the Yucatán Peninsula in Mexico. Researchers studied the peak rings, or circular hills, inside the crater. Detlev van Ravenswaay/Science Source

<https://www.nytimes.com/2016/11/18/science/chicxulub-crater-dinosaur-extinction.html>

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Extraterrestrial Cause for the Cretaceous-Tertiary Extinction

Luis W. Alvarez¹, Walter Alvarez², Frank Asaro³, Helen V. Michel⁴

Science 06 Jun

Vol. 208, Issue 4448, pp. 1095-1108
DOI: 10.1126/science.208.4448.1095

Summary. Platinum metals are depleted in the earth's crust relative to their cosmic abundance; concentrations of these elements in deep-sea sediments may thus indicate influxes of extraterrestrial material. Deep-sea limestones exposed in Italy, Denmark, and New Zealand show iridium increases of about 30, 160, and 20 times, respectively, above the background level at precisely the time of the Cretaceous-Tertiary extinctions, 65 million years ago. Reasons are given to indicate that this iridium is of extraterrestrial origin, but did not come from a nearby supernova. A hypothesis is suggested which accounts for the extinctions and the iridium observations. Impact of a large earth-crossing asteroid would inject about 60 times the object's mass into the atmosphere as pulverized rock; a fraction of this dust would stay in the stratosphere for several years and be distributed worldwide. The resulting darkness would suppress photosynthesis, and the expected biological consequences match quite closely the extinctions observed in the paleontological record. One prediction of this hypothesis has been verified: the chemical composition of the boundary clay, which is thought to come from the stratospheric dust, is markedly different from that of clay mixed with the Cretaceous and Tertiary limestones, which are chemically similar to each other. Four different independent estimates of the diameter of the asteroid give values that lie in the range 10 ± 4 kilometers.

<https://science.sciencemag.org/content/208/4448/1095.abstract>

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Science 06 Jun 1980:

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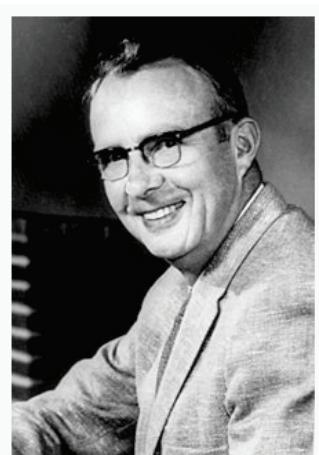
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Luis Walter Alvarez

From Wikipedia, the free encyclopedia

This article is about the American physicist. For his grandfather, the physician, see Luis F. Alvarez. For other people of the same name, see Luis Álvarez (disambiguation).

Luis Walter Alvarez (June 13, 1911 – September 1, 1988) was an American experimental physicist, inventor, and professor who was awarded the Nobel Prize in Physics in 1968 for development of the hydrogen bubble chamber enabling discovery of resonance states in particle physics. The *American Journal of Physics* commented, "Luis Alvarez was one of the most brilliant and productive experimental physicists of the twentieth century."^[1]



https://en.wikipedia.org/wiki/Luis_Walter_Alvarez

https://en.wikipedia.org/wiki/Walter_Alvarez

https://en.wikipedia.org/wiki/Frank_Asaro

<https://trowelblazers.com/helen-vaughn-michel>

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Michel's most famous contribution is undoubtedly her iridium analysis that helped to form the Alvarez hypothesis – the theory that a huge asteroid smacked into Earth 65 million years ago and brought hazardous fallout around the world, driving a mass extinction of at least 50% of all species, including the dinosaurs. Notable layers of the element iridium found in Earth's crust that dated back to the Cretaceous – Paleogene Boundary (the end of the Mesozoic Era, beginning of the Cenozoic Era) proved this by illustrating that because iridium was of rare abundance on Earth, but existed in copious amounts on asteroids, the spike had to trace back to an asteroid impact. This theory is considered one of the greatest scientific breakthroughs in history and has not been denied by the majority of the scientific community since its founding in 1980.

Helen Vaughn Michel was the only woman among her counterparts at the lab. With all her accomplishments, she is inspiring for future women in science as we step up in stride to better our worlds around us, one element, one bone, one leaf, one print, one rock, one artifact at a time.

https://en.wikipedia.org/wiki/Luis_Walter_Alvarez

https://en.wikipedia.org/wiki/Walter_Alvarez

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From left to right: Helen, Frank, Walter, and Luis



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<https://trowelblazers.com/helen-vaughn-michel>

Geological Evolution of Earth's Atmosphere: CO₂ and Temperature

What message were we trying to convey?

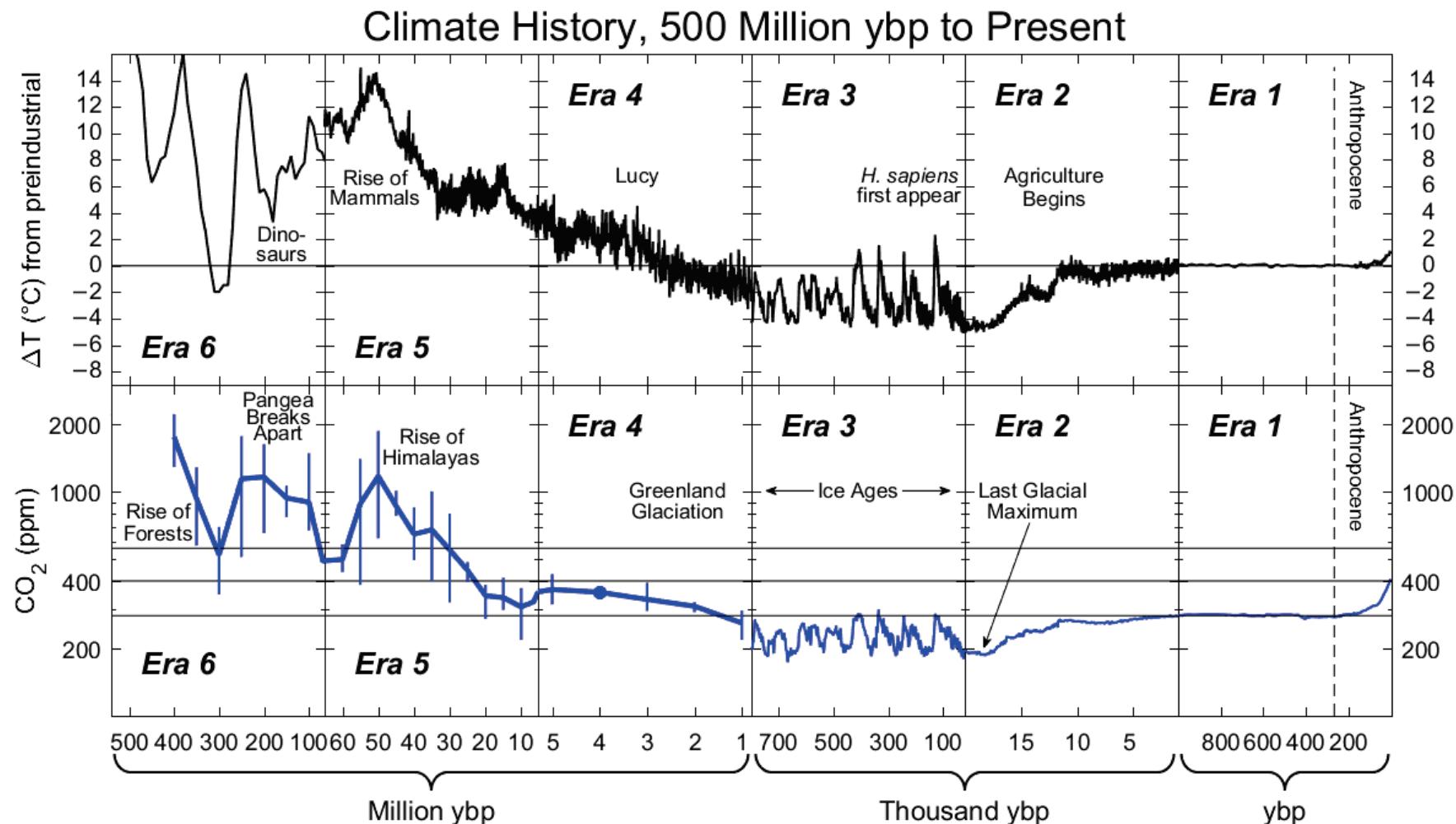


Fig 1.1, Paris Beacon of Hope

Geological Evolution of Earth's Atmosphere: One Day, *Everything Changed*

By understanding how the carbon isotopic ratio of the world's surface waters changed at the K-T boundary, as recorded by the shells of preserved oceanic organisms, we could compute the fraction of the world's biosphere that must have burned on this really bad day (or soon thereafter):

Carbon isotopic evidence for biomass burning at the K-T boundary

A new interpretation of existing carbon isotopic data combined with results from a biogeochemical model suggests that burning of terrestrial biomass occurred on a global scale at the Cretaceous-Tertiary (K-T) boundary. Carbon isotopic ratios from planktonic and benthic microfossils across the K-T boundary reveal not only a breakdown in the normal surface-water to deep-water gradient of $^{13}\text{C}/^{12}\text{C}$, but also a reversal at the boundary. This reversal cannot be explained by the cessation of primary production alone. We propose that combustion of terrestrial biomass with subsequent transfer of isotopically light carbon to surface waters is the most likely cause of this anomaly. A biogeochemical model is used to quantify the extent of burning at the boundary: combustion of roughly 25% of the above-ground biomass at the end of the Cretaceous is necessary to account for the observed isotopic signal.

Ivany and Salawitch, *Geology*, 1993

Link to this paper appears in auxiliary reading for today's class

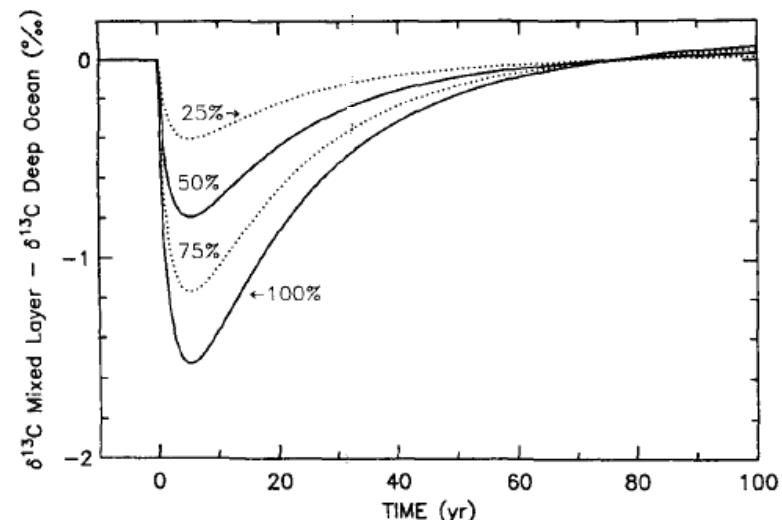


Figure 2. Variation of surface-water to deep-water gradient of $\delta^{13}\text{C}$ vs. time for simulations of biomass combustion, assumed to occur instantaneously at time zero. Results are shown for burning 25%, 50%, 75%, and 100% of above-ground biomass (10^{18} g C ; $\delta^{13}\text{C} = -25.7\text{\textperthousand}$) at end of Cretaceous assuming combustion efficiency of 50% (i.e., model result for 100% combustion corresponds to injection of half of above-ground biomass carbon into atmosphere as CO_2 at time zero).

New measurements reveal the true size of the massive megalodon shark

> X 88 | 🔒 bgr.com/2020/09/04/megalodon-size-shark-study/



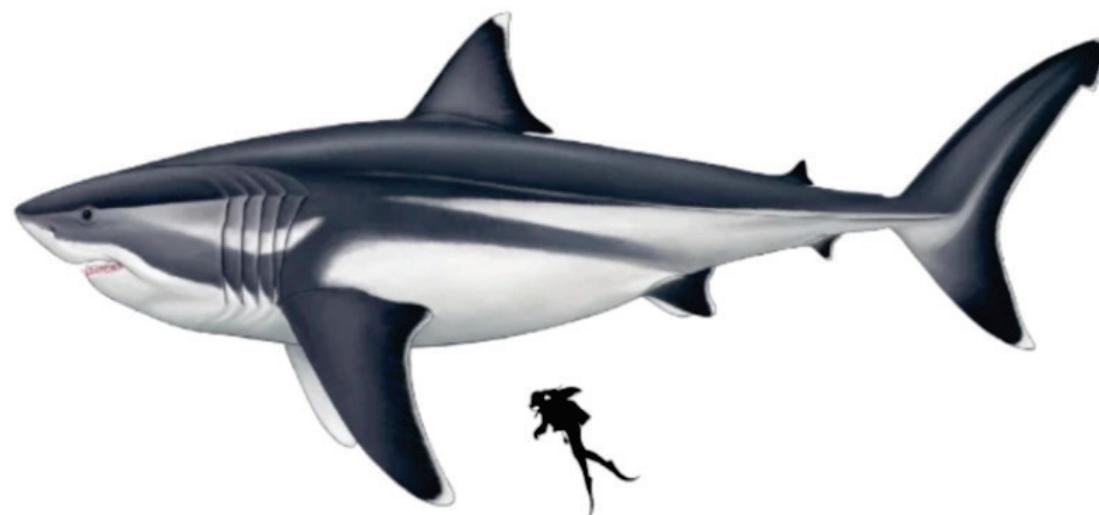
TECH

ENTERTAINMENT

DEALS

BUSINESS

SCIENCE



<https://bgr.com/2020/09/04/megalodon-size-shark-study/>

Long have researchers attempted to explain what happened to the Rapa Nui civilisation, finding fault in the slave trade, resource depletion and the introduction of European diseases.

A team of international scientists has now rejected two of the most popular theories and have, instead, attributed the gradual fall of Rapa Nui to a chain of events linked to **climate change**.



Easter Island: Researchers have explained how the Rapa Nui civilisation collapsed (Image: GETTY)

<https://www.express.co.uk/news/science/1331082/Easter-Island-mystery-solved-collapse-Rapa-Nui-stone-heads>