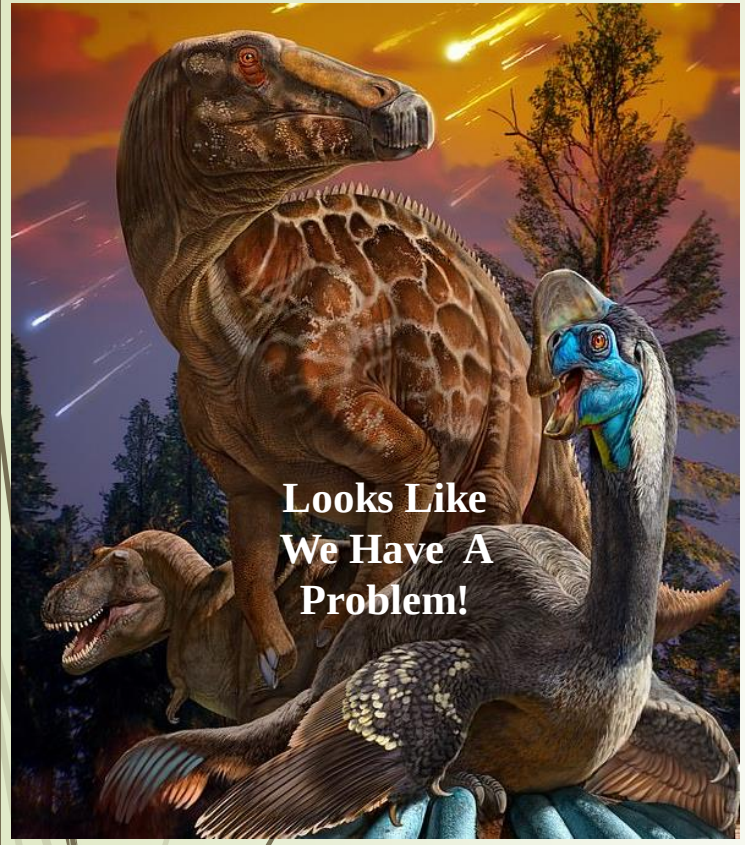
What Happened to the Dinosaurs? – Cox-Keller Paper



The accepted hypothesis (for a while now) has been that the dinosaurs were wiped out by a celestial impact (tied to the Chicxulub impact site). A recent paper (highlighted below) has put forward an alternate (or to be fair a joint) mechanism. The article headline (also highlighted below) summarizing the paper hints that the major Volcanic activity called the DeccanTraps "may have caused their extinction". I have highlighted "may" because the authors and the article do understand that all this work is not definitive, and my thoughts will also be subject to the limitations of working with proxy data from 66 million years ago. Did the Deccan Traps contribute to the dinosaurs' extinction? Probably, but the impact event was obviously the major factor. The model output (to the right) highlights some of the problems with the Deccan Traps hypothesis. The Deccan Traps began erupting around 66.25 Ma ago. However, the emissions in that pre-Chicxulub ±250,000 years were minor compared to the post-Chicxulub period. So, that begs the question, how could the volcanic emissions be responsible for an extinction event that occurred before the vast majority of the emissions occurred? There were huge emissions during the Deccan Traps eruptions (not limited to the Carbon and Sulfur components shown here). So, yes there was a lot of CO_2 emitted (which would add some warming). But (more typical for volcanic activity) there are also cooling emissions (that traditionally dominate) and real toxic pollutants that may have softened the dinosaurs up for the Chicxulub kill shot. And what of the CO_2 emissions. Could they cause enough warming to cause an extinction? Depends on whether we are talking about the real world, or the virtual reality created by the computer models. If these researchers use the same input parameters as the IPCC, their models will also run too hot. And despite their proclamation, they will *"see what you would get if you let the code decide"*, the output has their biases/*"human emotions"* built in.

Cox-Keller Dartmouth Paper I

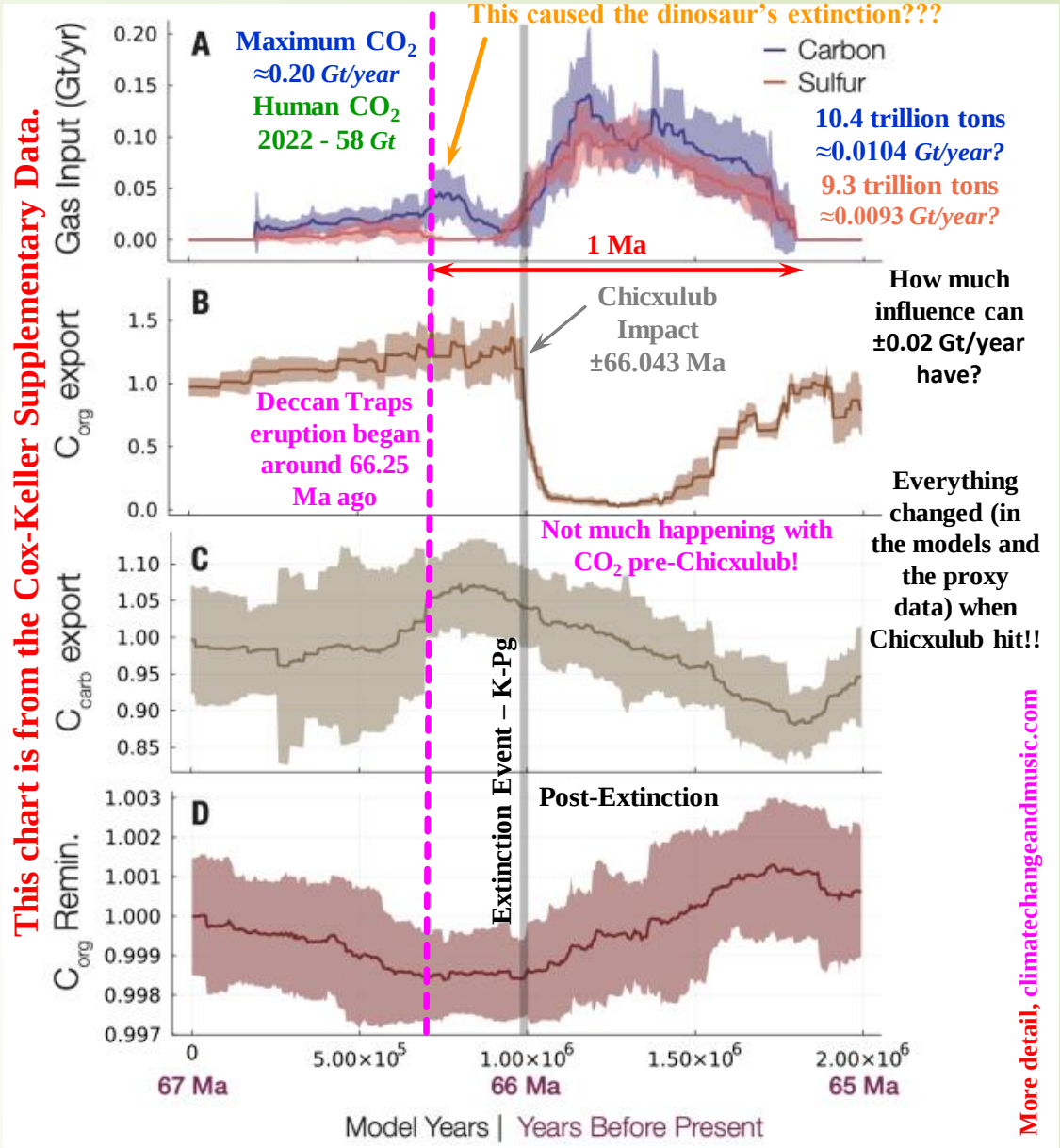


Fig. S3. A different set of model results. For the 10,000 model runs post-convergence of the MCMC algorithm with no priors on the amount or ratio of gas, their accepted inputs across the extinction boundary were recorded, and their mean and standard deviation was calculated. We show the accepted values of gas emissions (as carbon and sulfur, **A**), organic carbon export relative to steady-state values (**B**), relative carbonate carbon export (**C**), and relative organic carbon remineralization (**D**), in both their age before present (Ma), and their relative time in model years.

Dinosaurs may NOT have been wiped out by world-ending meteor: New model says mega volcano eruption may have caused their extinction | Daily Mail Online

A Bayesian inversion for emissions and export productivity across the end-Cretaceous boundary | Science

What Happened to the Dinosaurs? – Cox-Keller Paper II

More detail, climatechangeandmusic.com

Parameter From the Supplementary Data	Initial (log)	Inverse/antilog	Mean perturb. width (kyr)	Mean perturb. height (log)
C (Gt/yr)	-3.91	0.000123	1,000	0.05
S (Gt/yr)	-4.61	0.0000245	1,000	0.05
C_{org} export	0		500	0.01
C_{carb} export	0		500	0.02
C_{org} remin.	0		500	0.0005
CO_2 doubling	1.099	12.56	n/a	0.01

From the Daily Mail Article
10.4 trillion tons
≈0.0104 *Gt/year?*
9.3 trillion tons
≈0.0093 *Gt/year?*

Is there a decimal problem here?
The Cos-Keller values are an order of magnitude higher (±0.10 Gt/year)

Table S1. Model Configuration. The initial values for the parameters (C and S both in log(Gt)/yr), and the initial mean width and height of the perturbations in the MCMC algorithm.

Cox-Keller Dartmouth Paper II

The actual paper is behind a paywall so I cannot speak to the specifics (other than the Supplementary data available in the paper link below and as a pdf on my website). As with many papers, most of the 'climate change' hyperbole starts in the media. The author's abstract does not mention climate change specifically. That hyperbole starts in the article highlighted below (with some contribution from the authors). The paper and methods may be very useful for separating out the respective carbon and sulfur related emissions from overlapping events. The problem I see is related to the forcing application (i.e.: climate sensitivities) applied to those emissions. They laid out their temperature equation in the Supplementary data (shown below) and the initial values in Table S1 (above). The CO_2 doubling initial value is stated at 1.099. The inverse/antilog of that value is 12.56. If their CO_2 doubling (12.56) is equivalent to the CO_2 climate sensitivity (i.e.: the warming associated with a doubling of atmospheric CO_2 concentrations), then their temperature response is grossly overstated. The IPCC model range is just 1.8 to 5.7 °C, with 1.8 °C producing temperature projections that are higher (therefore incorrect) than observed temperatures. The climate sensitivity is somewhere less than 1.8 °C (certainly not 12.56). There is a discrepancy between my CO_2 levels (≈1250 ppm, normalized to the Komar-Zeebe data) and the Cox-Keller value (600 ppm) at 67 Ma ago. The GEOCARB CO_2 data (another option) puts the CO_2 levels around 800 ppm. The absolute CO_2 value does not change the discussion. Ultimately, the data (isotopic ratios) does not show significant changes in either CO2 or temperature that would have led to the dinosaurs' extinction. The only major CO_2 changes in the Cox-Keller model output took place at the K-Pg event.

Dinosaurs may NOT have been wiped out by world-ending meteor: New model says mega volcano eruption may have caused their extinction | Daily Mail Online

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$$\Delta T = log_2(pCO_2/600) \cdot r$$

where r is the CO_2 doubling rate

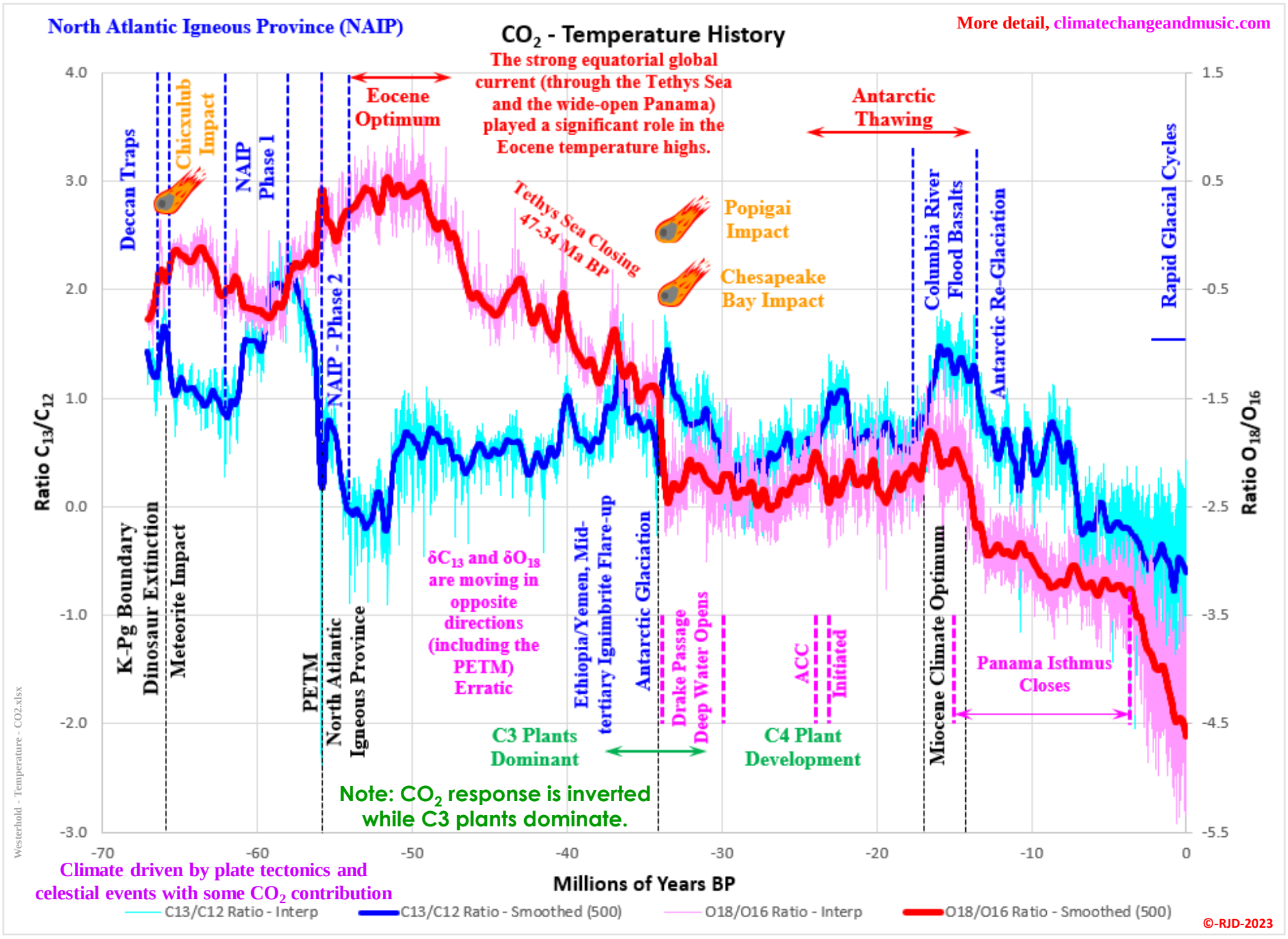
GSM – Grand Solar Minimum. The real "Climate Change" existential threat is right around the corner. Do the Research!

CSS-48c

What Happened to the Dinosaurs? Cenozoic History

Cox-Keller used isotope ratios from the benthic foraminifera remnants found in seafloor core sediments. The chart to the right shows that proxy data for the entire Cenozoic (which begins just before the dinosaur extinction). The $\delta C_{13} \equiv C_{13}/C_{12}$ isotope ratio can be used to develop a CO_2 concentration estimate. The $\delta O_{18} \equiv O_{18}/O_{16}$ isotope ratio is a temperature proxy. There is a lot of information here and we are not going to get into the detail in this post. Note, the C3 and C4 plants process C_{13} differently. C4 plants have dominated since the planet went into its glaciation phase 34 Ma years ago. The δC_{13} isotope ratio is directly proportional with C4 plants. The C3 plants have an inverse relationship (adjustment on the next slide). The climate indications of this data are discussed in my CSS-10 – A Ride Through the Cenozoic post. This data is available with the Westerhold et al's 2020 paper "*An astronomically dated record of Earth's climate and its predictability over the last 66 million years*". The slide from the Eocene climate optimum to the current Ice Age is geologically driven.

Cenozoic History T-CO_2



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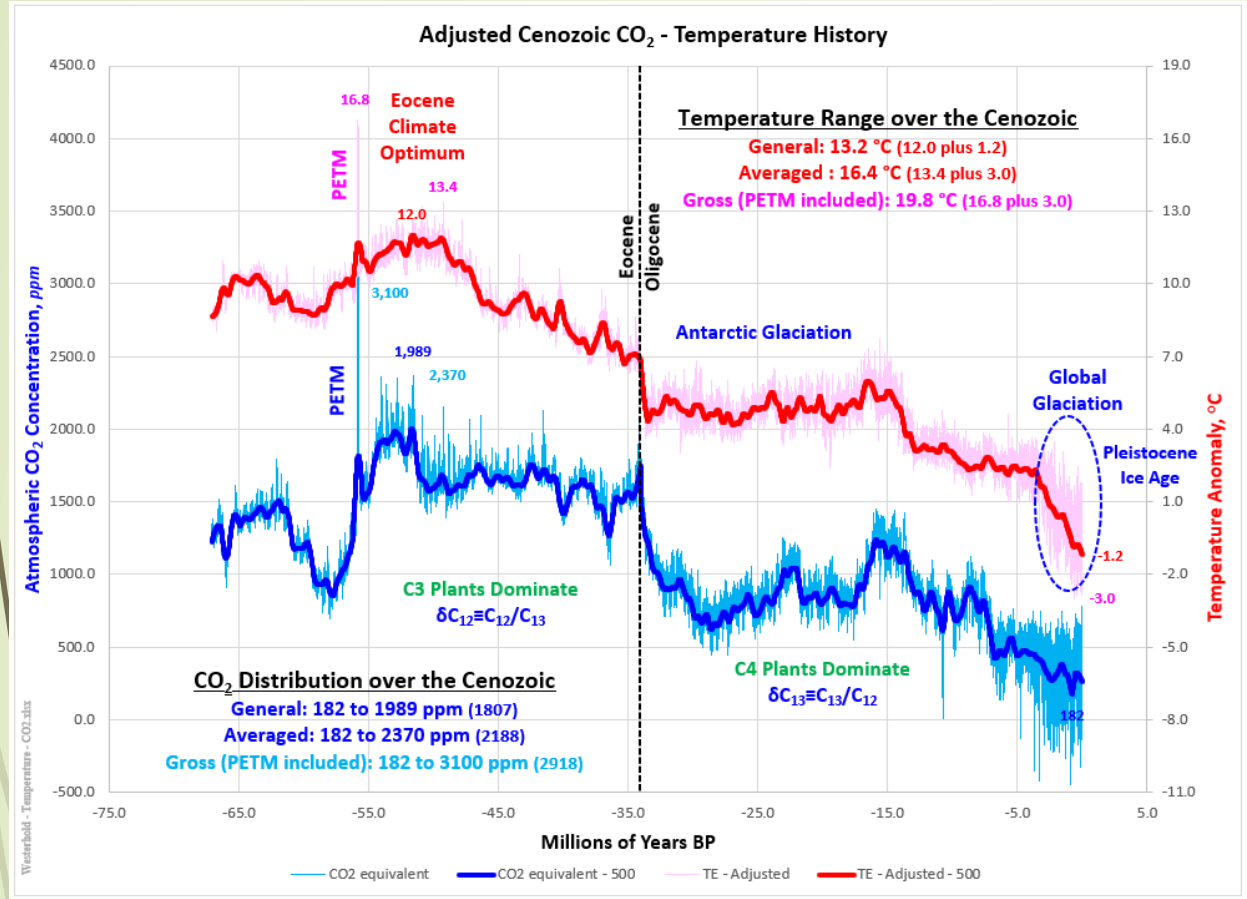
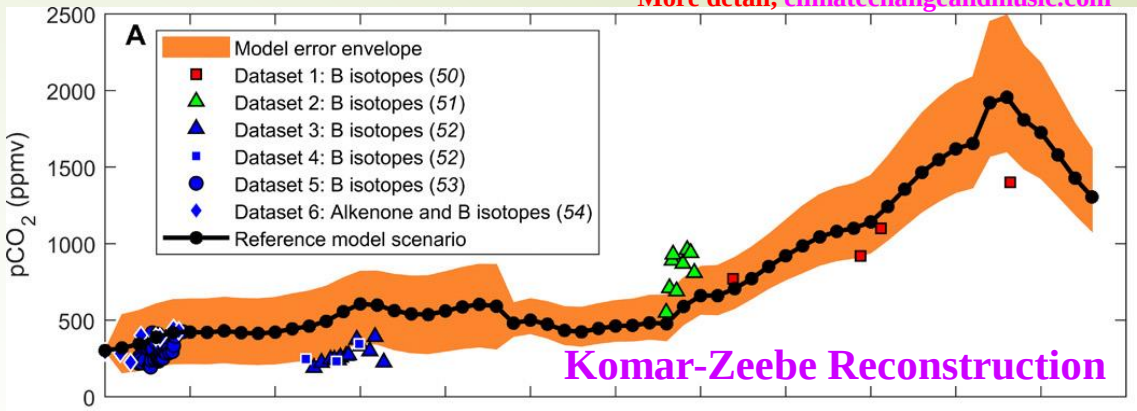
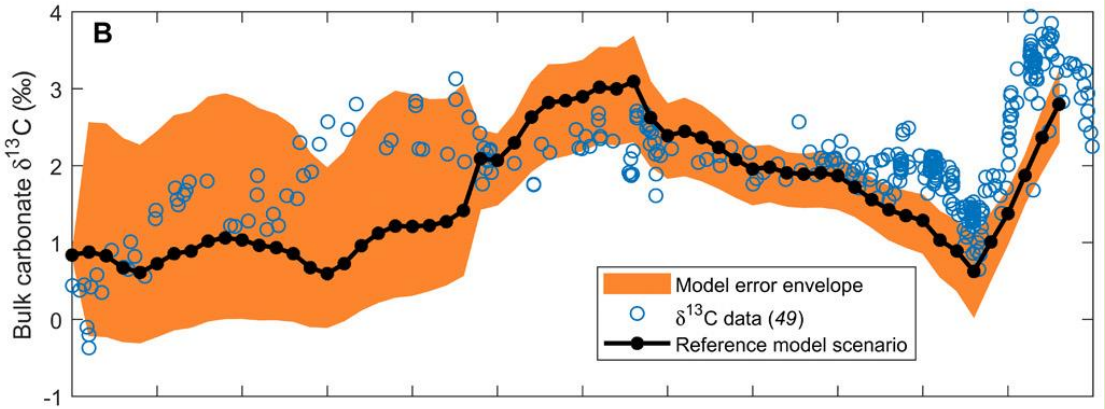
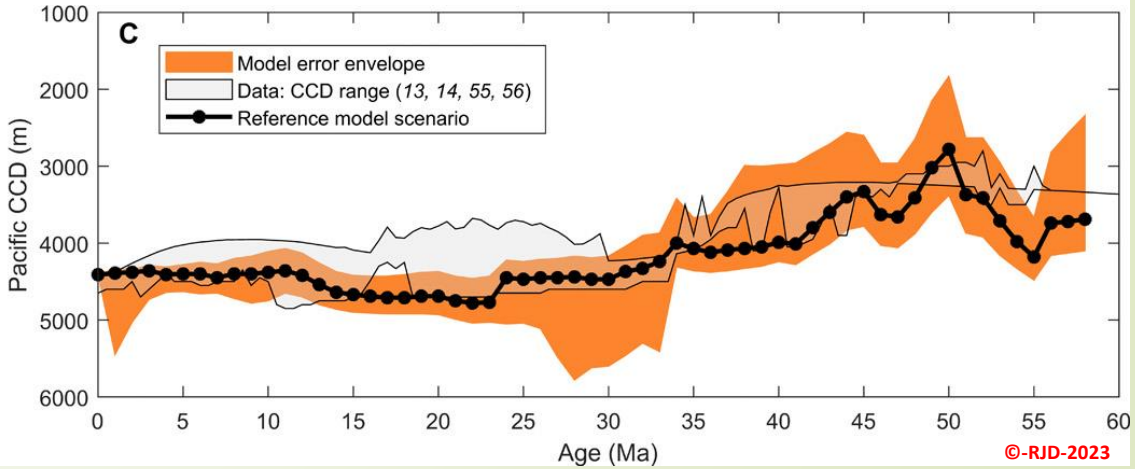




Note 1: CO_2 sequestration (carbonate deposition) is also active over this period.



Note 2: CO_2 is minor contributor (dependent on its climate sensitivity).



Cenozoic History CO_2 Adjusted

CSS-48d

What Happened to the Dinosaurs? Cenozoic CO_2 Adjusted

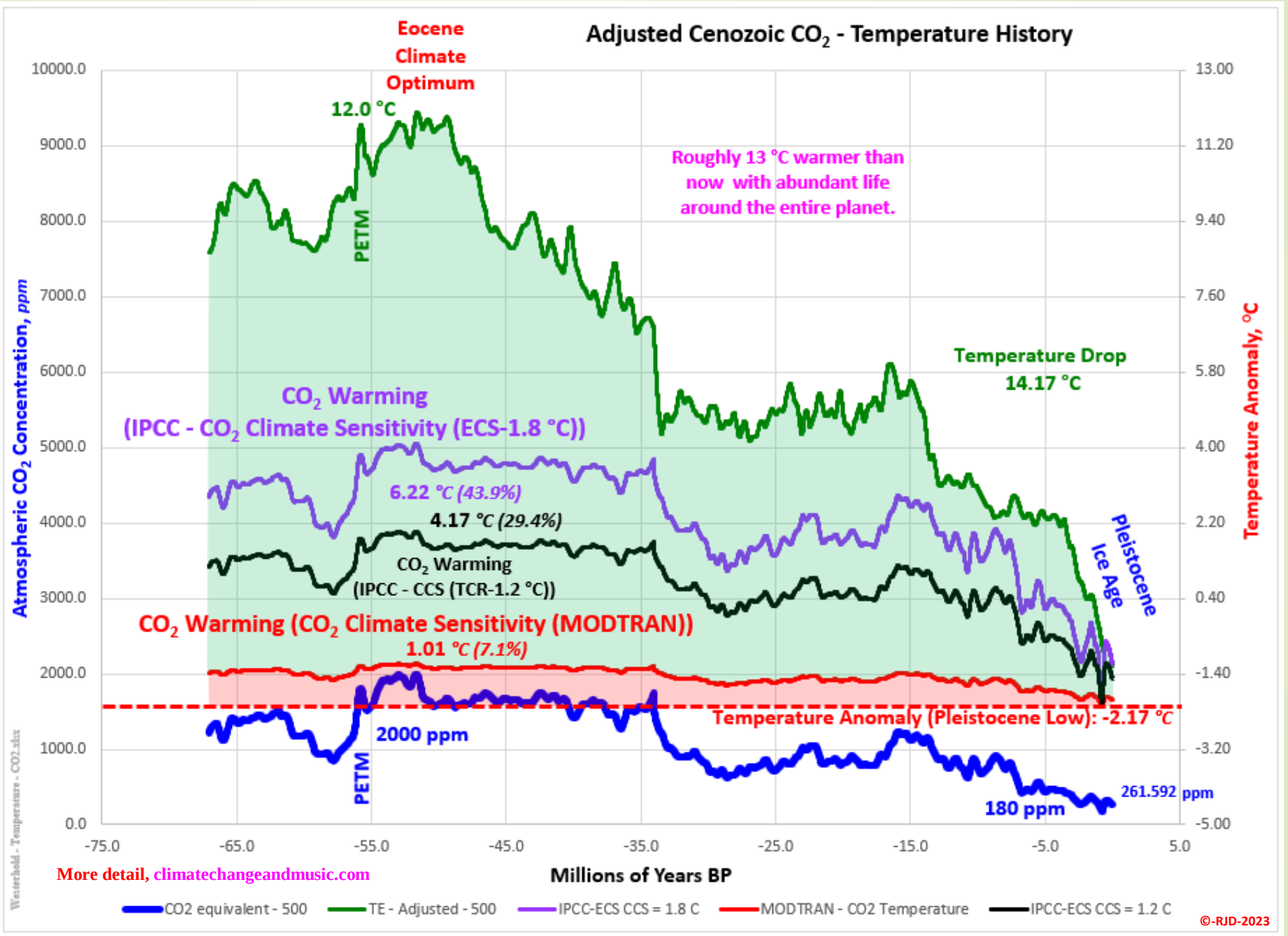
The C3/C4 plant adjusted data is plotted above. The δC_{13} isotope ratios have been inverted and then adjusted to reflect the peak CO_2 concentration (≈2000 ppm) shown in the 2021 Komar-Zeebe Cenozoic CO_2 Reconstruction ("*Reconciling atmospheric CO_2, weathering, and calcite compensation depth across the Cenozoic*"). Note, the CO_2 and temperature estimates do generally correlate over the Cenozoic. Not entirely unusual because there is a relationship between Temperature and CO_2. But like the ice core data correlations (which are tighter than the Cenozoic correlation), the correlation does not mean that CO_2 is driving the temperature. Pleistocene Ice Age temperature changes drive the global atmospheric CO_2 concentrations, not the other way around (oceans warm and cool cyclically, releasing and reabsorbing CO_2 as they do). On the Cenozoic time scale, geological (plate tectonics and celestial impacts) are the main drivers with the orbital cycles contributing on shorter intervals.

CSS-48e

What Happened to the Dinosaurs? CO_2's Role - Cenozoic

The CO_2 contribution to warming (or in this case mostly cooling) is completely dependent on its climate sensitivity. The IPCC models (which self-admittedly run way too hot) use an Equilibrium Climate Sensitivity (ECS) range of 1.8 to 5.7 °C (not exactly "settled science" in the IPCC shop). The concept was covered in some detail in my CSS-21 – CO_2 – Temperature Contribution Visualized post. For that analysis, I used ECS values of 0.8 (the intrinsic value used in the University of Chicago's MODTRAN space radiation model), 1.2 and 1.8 °C. There is no need to show any examples above 1.8 °C. The only IPCC models that come close to matching temperature observations, use the IPCC's lower end ECS (1.8 °C). The 1.2 °C value corresponds to the IPCC's unadjusted estimate of ECS. As mentioned, the 0.8 °C corresponds to the U of C's MODTRAN intrinsic value, but also the Urban Heat Island Effect (UHIE) adjusted ECS. Based on our official measured temperature record, the ECS is below 2.0 °C (assuming all the warming is due to CO_2, it is NOT). More discussion on this subject will be included in a near future post.

CO_2's Role Cenozoic



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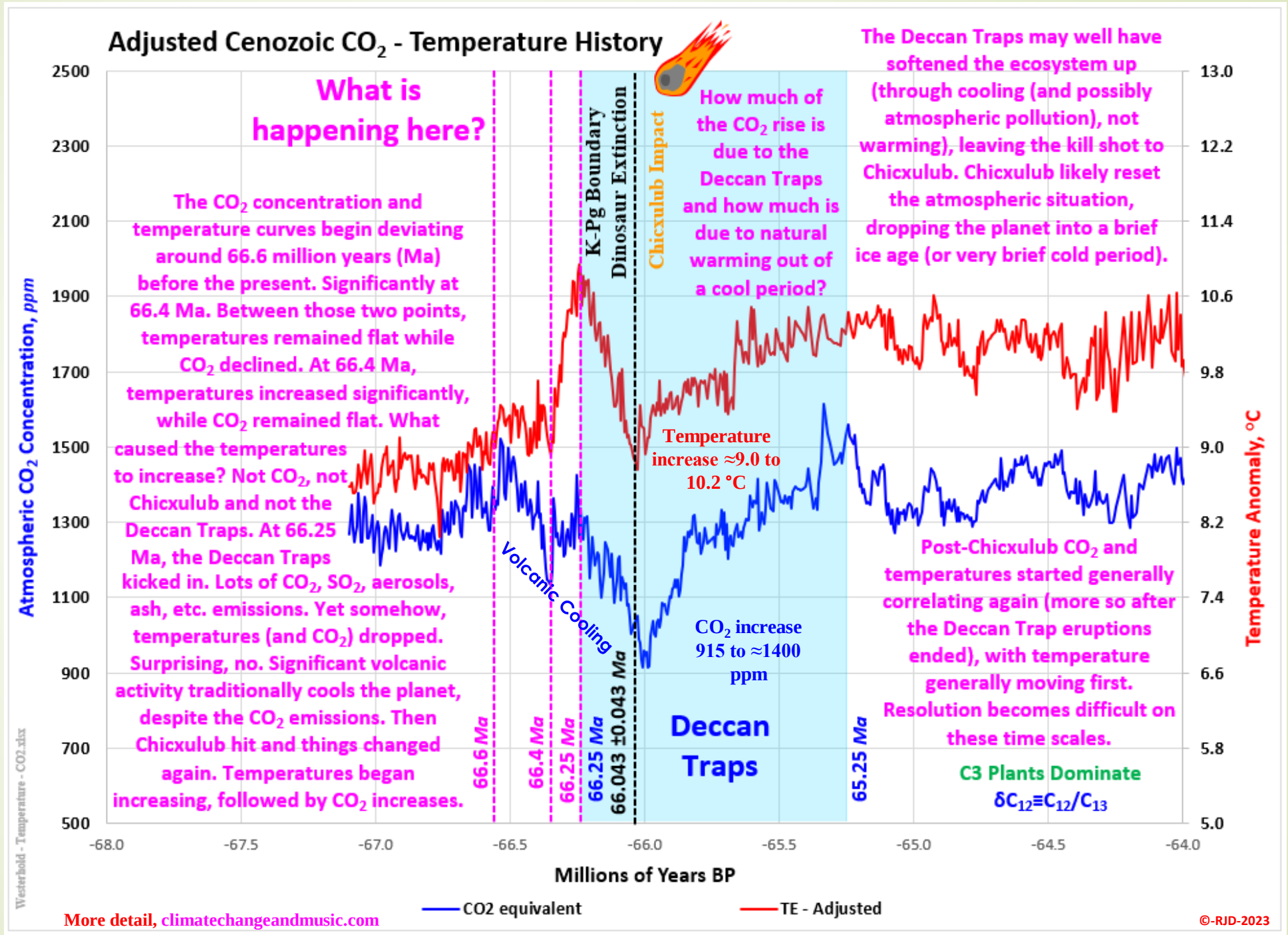
CSS-48f

What Happened to the Dinosaurs? K-Pg Boundary Data

K-Pg Boundary Data

This slide focuses in on the benthic foraminifera data on either side of the Chicxulub impact. Pre-66 Ma ago, the CO2 and Temperature data were generally moving in the same direction. At 66 Ma ago, those two parameters started moving in opposite directions and had nothing to do with either the Deccan Traps or Chicxulub. And what caused the temperature increase beginning at 66.4 Ma ago? When the Deccan Traps began erupting (66.25 Ma ago), temperatures dropped (typical for volcanic activity). After Chicxulub hit, temperatures immediately started climbing (followed by CO_2). How much of the CO_2 rise is due to rising temperatures or volcanic activity depends on the sensitivity. Regardless, neither hot nor cold temperatures (at this resolution) wiped out the dinosaurs. Dinosaurs are reptiles and thrive at higher temperatures (with the highest temperatures having nothing to do with high CO_2 levels, the Deccan Traps or the Chicxulub impact). Is it possible that the Chicxulub impact dropped the planet into a short-lived ice age (not great for dinosaurs or their primary food source, plants)? Not visible in the data.



More detail, climatechangeandmusic.com

CSS-48g

What Happened to the Dinosaurs? CO_2's Role - K-Pg

This is the same visualized CO_2 contribution data shown on the CSS-48d slide (just focused on the K-Pg boundary). The CO_2 warming contribution is not the major driver. Certainly less than 50% and very likely lower than 10%. Again, the magnitude is dependent on the CO_2 ECS. But the lower end is more likely, when the natural forcings (ignored by the IPCC and the alarmist community) are accounted for. So, are the Deccan Traps responsible for the dinosaur extinction 66 Ma ago. Not likely, given that the temperature changes were relatively insignificant and most of the volcanic emissions occurred after the extinction event was over. This is just another example of the alarmist community trying to "massage" the story to fit the narrative. The general concept sounds possible, but when the data is reviewed in detail, the story falls apart. To summarize, the alarmists rely on their models (look backs and/or forecasts), which self-admittedly run way too hot. The real interpretation lies within the empirical data. Chicxulub wiped out the dinosaurs and our problem will be cold!

CO_2's Role K-Pg Boundary

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