

Climate Change

a few remarks by Ronald F. Fox

Early in 2008 I came across the website:

http://www.geocraft.com/WVFossils/Carboniferous_climate.html

while searching for atmospheric oxygen level data over geologic time spans. Instead I discovered the figure below regarding temperature and atmospheric CO₂ levels for the past 600 million years. This covers the time during which multicellular life rapidly diversified giving rise to insects, vertebrates, flowering plants and mankind. Two features of the graph caught my eye: 1) temperature fluctuations have been confined between 12 C and 23 C, and 2) CO₂ levels have never been *lower* than they are now. There is another [graph](#) that has been frequently used by those alarmed by climate change showing atmospheric CO₂ levels during 1750-2008 monotonically rising from 300 ppm to 380 ppm. The usual claim was that this remarkable increase will lead to temperature increases followed by melting ice and rising sea levels. How does this jive with the graph below? 248 million years ago marks the P-T boundary (Permian-Triassic). It was preceded by a rapid (geologic time scale) increase in both the average global temperature and the atmospheric CO₂ levels. The CO₂ levels reached nearly 2000 ppm at the P-T boundary, much more than the contemporary 380 ppm.

I noted the sources for the data in the graph, C.R. Scotese at

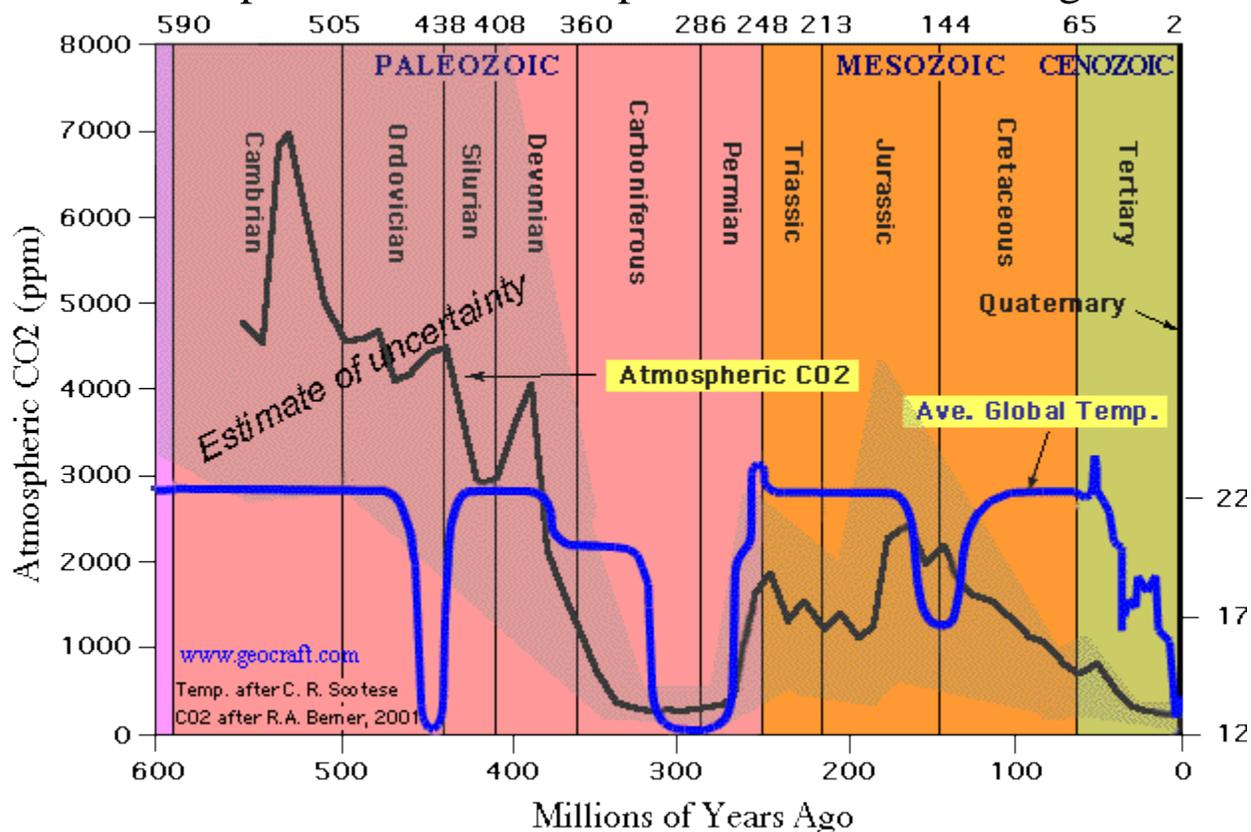
<http://www.scotese.com/climate.html>

and R.A. Berner in *American Journal of Science*, Vol. 301, February, 2001, pp. 182–204. This article also can be accessed at

http://www.geocraft.com/WVFossils/Reference_Docs/Geocarb_III-Berner.pdf

This source is from a very distinguished scientist. After some further study I decided to write to Robert Berner and ask about the apparent discrepancy between the popular point of view and this seemingly contradictory data.

Global Temperature and Atmospheric CO₂ over Geologic Time



In December of 2008 I sent the following email to Dr. Berner at his Yale University address:

I have come across your work on atmospheric CO₂ concentrations going back to the early Paleozoic era. I am well acquainted with the usual graph for 1750-2008 showing a nearly monotonic increase from 300 ppm to 380 ppm. Steve Chu has used this in his lecture on global warming as have many others (Al Gore!). I am of course curious about why your data are not also shown since the Earth has clearly survived much larger CO₂ concentrations, even thrived during them, and the temperature profiles for Earth averages have never exceeded about 22 C. Can you enlighten me about this apparent lack of scientific candor? I realize times may get tough for humans but the Earth seems to be OK with very high CO₂ levels.

So the rate of CO₂ increase seems to be critical to the discussion. Your take on this would interest me.

Ron Fox

Let me add that I heard Steve Chu first hand when he lectured in my department at Georgia Tech and I have also seen Al Gore's movie. Dr. Berner kindly responded quickly as follows:

Dr. Fox:

High CO₂ levels were indeed achieved in the geological past with attendant warmth. However, the changes that I have modeled occurred over millions of years during which organisms could adapt to the changing environments including sea levels much higher than that at present. (For example, during the Cretaceous Period the whole of North America was cut in the middle by a large seaway and there was no polar ice.) The changes induced by humans are extremely fast by natural geological standards and the ability of plants, animals and humans to adapt to present climate change and rising sea level is in danger because the changes are so extremely rapid. Biological and even sociological adaptation takes time!

My work does show a good correlation between CO₂ and climate in the geological past and the sensitivity of climate to change in CO₂ that I have calculated with others is in line with predictions of future global warming.

Robert Berner

My anticipation that rate was the real issue is realized. Geological time scales are long and processes are slow compared to the situation for humans. The rate of increase in CO₂ near the P-T boundary is very slow compared to what has happened during 1750-2008 !! (258 years has no width in the graph above where the horizontal scale is set by 100 million years.)

This account raises a few other issues. There has been talk in the recent news about data being distorted to make the case for global warming. The layperson should realize that science works in a manner that discovers and corrects such actions. Scientists are no more nor less honest than other humans. There is too much idea theft, data distortion and outright plagiarism (see my section *Science and Integrity* at www.fefox.com). If a claim or idea is noticed by enough other scientists it will be checked, and if found to be wrong the scientist responsible for the false claim loses credibility. So I have little doubt that there are distorted claims on both sides of the climate change debate. [recent example] That is why it is important to have a well educated populace, well versed in science and practiced in applying skepticism and analysis along with the ability to make up one's own mind about an issue. When still in doubt, ask an expert, as I have done. Science is a highly cooperative enterprise and information and ideas are freely exchanged. In the long run it is not political or sociological in spite of how it may appear to be in the short run.

The take home lesson here is that it is not atmospheric CO₂ level *per se* that is the problem but the rapid rate of increase that is unprecedented as far as we know. Maybe temperature will also rise rapidly but not far above previous limits around 22 C. Those processes that kept it from going higher before may still function even at the increased rate of CO₂ rise. Maybe not. Perhaps another ice age will be triggered. Maybe not. Sea levels may rise to catastrophic levels for maybe

1/3-1/2 of all mankind. Maybe not. Desertification may accelerate and make food scarce. But maybe Alaska, Canada and Russia will become a vast arable temperate zone. The last time atmospheric CO₂ levels were as *low* as they are now, vast regions of the Earth supported giant tree ferns and dragonflies with three foot wingspans ruled the skies.

Humans are at the same time remarkably combative and remarkably cooperative. I am frequently amazed at food, fuel and other goods distribution in the USA, at how harmoniously our daily lives are lived. I am also dismayed by unnecessary violence, and how easily the USA can kill unfortunate civilians thousands of miles away as if it were a video game. We will need to use that innate cooperativity if we are to be able to understand all the facets of global climate change and attempt to do something positive about it.

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