Ice Core Studies Prove CO_2 Is Not the Powerful Climate Driver Climate Alarmists Make It Out to Be

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For the past two decades or more, we have heard much about the global warming of the 20th century being caused by the rise in atmospheric carbon dioxide concentration that is generally attributed to anthropogenic CO_2 emissions. This story, however, has always been controversial [see Smagorinsky *et al*. (1982) and Idso (1982) for early pro/con positions on the issue]; and with the retrieval and preliminary analysis of the first long ice core from Vostok, Antarctica -- which provided a 150,000-year history of both surface air temperature and atmospheric CO_2 concentration -- the debate became even more intense, as the close associations of the ups and downs of atmospheric CO_2 and temperature that were evident during glacial terminations and inceptions in that record, as well as in subsequent records of even greater length, led many climate alarmists to claim that those observations actually *proved* that anthropogenic CO_2 emissions were responsible for 20th-century global warming.

This contention was challenged by Idso (1989), who wrote -- in reference to the very data that were used to support the claim -- that "changes in atmospheric CO_2 content never precede changes in air temperature, when going from glacial to interglacial conditions; and when going from interglacial to glacial conditions, the change in CO_2 concentration actually lags the change in air temperature (Genthon *et al*., 1987)." Hence, he concluded that "changes in CO_2 concentration cannot be claimed to be the cause of changes in air temperature, for the appropriate sequence of events (temperature change *following* CO_2 change) is not only never present, it is actually violated in [at least] half of the record (Idso, 1988)."

How has our understanding of this issue progressed in the interim? Our website provides several updates.

Petit *et al*. (1999) reconstructed histories of surface air temperature and atmospheric CO_2 concentration from data obtained from a Vostok ice core that covered the prior 420,000 years, determining that during glacial inception "the CO_2 decrease lags the temperature decrease by several thousand years" and that "the same sequence of climate forcing operated during each termination." Likewise, working with sections of ice core records from around the times of the last three glacial terminations, Fischer *et al*. (1999) found that "the time lag of the rise in CO_2 concentrations with respect to temperature change is on the order of 400 to 1000 years during all three glacial-interglacial transitions."

On the basis of atmospheric CO_2 data obtained from the Antarctic Taylor Dome ice core and temperature data obtained from the Vostok ice core, Indermuhle *et al*. (2000) studied the relationship between

these two parameters over the period 60,000-20,000 years BP (Before Present). One statistical test performed on the data suggested that shifts in the air's CO_2 content lagged shifts in air temperature by approximately 900 years, while a second statistical test yielded a mean lag-time of 1200 years. Similarly, in a study of air temperature and CO_2 data obtained from Dome Concordia, Antarctica for the period 22,000-9,000 BP -- which time interval includes the most recent glacial-to-interglacial transition -- Monnin *et al*. (2001) found that the start of the CO_2 increase lagged the start of the temperature increase by 800 years. Then, in another study of the 420,000-year Vostok ice-core record, Mudelsee (2001) concluded that variations in atmospheric CO_2 concentration lagged variations in air temperature by 1,300 to 5,000 years.

In a somewhat different type of study, Yokoyama *et al*. (2000) analyzed sediment facies in the tectonically stable Bonaparte Gulf of Australia to determine the timing of the initial melting phase of the last great ice age. In commenting on the results of that study, Clark and Mix (2000) note that the rapid rise in sea level caused by the melting of land-based ice that began approximately 19,000 years ago preceded the post-glacial rise in atmospheric CO_2 concentration by about 3,000 years.

So what's the latest on the issue? To our knowledge, the most recent study to broach the subject is that of Caillon *et al*. (2003), who measured the isotopic composition of argon -- specifically, $\delta^{40}Ar$, which they argue "can be taken as a climate proxy, thus providing constraints about the timing of CO_2 and climate change" -- in air bubbles in the Vostok ice core over the period that comprises what is called Glacial Termination III, which occurred about 240,000 years BP. The results of their tedious but meticulous analysis led them to ultimately conclude that "the CO_2 increase lagged Antarctic deglacial warming by 800 ± 200 years."

This finding, in the words of Caillon *et al*., "confirms that CO_2 is not the forcing that initially drives the climatic system during a deglaciation." Nevertheless, they and many others continue to hold to the view that the subsequent increase in atmospheric CO_2 -- which is believed to be due to warming-induced CO_2 outgassing from the world's oceans -- serves to amplify the warming that is caused by whatever prompts the temperature to rise in the first place. This belief, however, is founded on unproven assumptions about the strength of CO_2-induced warming and is applied without any regard for biologically-induced negative climate feedbacks that may occur in response to atmospheric CO_2 enrichment. Also, there is no way to objectively determine the strength of the proposed amplification from the ice core data.

In consequence of these several observations, the role of CO_2 as a primary driver of climate change on earth would appear to be going, going, *gone*; while the CO_2 warming amplification hypothesis rings mighty hollow.

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