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Peter Altman  
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611 South Congress, Suite 200  
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Dear Mr. Altman,

This letter is meant to summarize our email and telephone conversations over the past week or so regarding the use of my results published in *Science* (1996) by ExxonMobil. I have been puzzled by the bipolar response to that paper. Among my scientific colleagues, it was well-received and has stimulated new research into ocean climate history. Among non-scientists with a political agenda, the results have been manipulated. Here I will distill your several questions and my answers down to two.

First, you asked if ExxonMobil's characterization of the Sargasso Sea data is accurate. It is accurate only in the most narrow sense. I worked on a sediment core that recovered the last 3000 years of Sargasso sea sedimentation, but the main subject of the paper was the past 1000 years. The older data are more widely spaced and are "spikey", and it is not prudent to take those results literally. Within the past 1000 years my data show a warm-cold-warm cycle in sea surface temperature, with changes of 1-2 degrees C. The Little Ice Age cooling, of that amount, is small but it must have been persistent to survive as a measurable signal on the seafloor. Cycles like this are thought to have occurred throughout the present warm epoch and beyond. They are obviously natural but we do not know their cause.

Natural cycles operate on longer timescales as well. Earth's orbit is known to change periodically over tens of thousands of years, and these cycles change climate. Such changes just within the present interglacial regime caused maximum warming in the Sargasso Sea 6000-8000 years ago and cooling since. Thus, ExxonMobil's CEO is correct that it is cooler now than thousands of years ago. However, that doesn't mean a warming of one or two degrees now wouldn't be important; it would have widespread socio-economic impact.

Besides the older warm "spikes" in the record, the climate warming naysayers have focussed on the fact that present sea surface temperature in the Sargasso Sea has not come up to the level it reached during the Medieval Warm

Period. The problem with this logic is that the ocean is an enormous heat sink. Even though the atmosphere warmed in the 20th century, it will take a long time for the ocean to catch up. Curiously, the ocean has indeed warmed some at intermediate depths but it has not yet reached the surface of the Sargasso Sea.

Second, you asked if my results are the best estimate of Earth's temperature over the past 3000 years. The answer is an emphatic "no". They are my best estimate of what the Sargasso Sea was like, but that part of the ocean is not representative of the planet as a whole. To jump from the western North Atlantic Ocean to the globe is something no responsible scientist would do. The best attempts to reconstruct global temperatures have not extended beyond 1000 years (mostly because of data availability), but they all show dramatic warming beginning in the mid 1800s. The most important aspect of my 1996 paper was to show that we marine geologists could study climate of recent centuries and millennia at all. Just because the climate oscillations I documented were the first from the deep sea doesn't necessarily mean they are of high fidelity.

I should point out here, a key element in this discussion centers on the Medieval Warm Period. Most authors would acknowledge that this interval was probably warmer in the North Atlantic region, but few feel strongly that it was global. My data make it seem that it was warmer then than it is now, but it is very misleading to use those data to argue against important climate changes that began a century ago. In fact, I anticipated this when I wrote at the end of the 1996 paper "...human influence may be occurring at a time when the climate system is on the warming limb of a natural cycle." In other words, it's too bad the Industrial Revolution didn't happen 500 yrs ago!

In summary, I would have to say I believe ExxonMobil has been misleading in its use of the Sargasso Sea data. There's really no way those results bear on the question of human-induced climate warming, and we already knew that there were climate cycles during recent millennia. I think the sad thing is that a company with the resources of ExxonMobil is exploiting the data for political purposes when they could actually get much better press by supporting research into the role of the ocean in climate change. At the present rate of progress, we will be able to measure climate warming outside the kitchen window before we know how the climate system works.

Sincerely,



Lloyd D. Keigwin  
Senior Scientist