***Geological Perspectives of Global Climate Change* edited by Gerhard, L. C., Harrison, W. E., and Hanson, B. M., 2001, American Association of Petroleum Geologists in collaboration with the Kansas Geological Survey and the AAPG Division of Environmental Geosciences, AAPG Studies in Geology #47, 327 p., US$ 49.00, ISBN# 0-89181-054-4.**

This book by Gerhard et al. is a welcome addition to the controversy over global climate change/climate variation because it brings a different perspective to the debate. Part of the problem with this debate is that too much emphasis has been put on computer models, while geological evidence has not been considered. The conventional wisdom as presented by many in the media assumes that any deviation from the present climate will be bad for our civilization. As discussed by Rhem (2003), this is an example of a fixed idea (i.e., an idea that is not expected to change even though we know that the door to further observation is always open). However, as the book by Gerhard et al. points out, the Earth's climate has constantly varied for more than 560 million years. Change has occurred because of the interaction of various "drivers" (e.g., the earth's distance from the sun, the amount of energy given off by the sun, and/or volcanism).

The book consists of 18 chapters by different authors. Some of these chapters look at specific drivers while others look at methods of estimating temperatures, natural variability, and past temperature changes. As with any book covering a wide range of topics, some readers will find certain chapters more useful than others. I have found the chapters by Gerhard et al., Pekarek, Bluemle et al., and Jenkins, the most useful in teaching my earth system science class.

The introduction and overview by Gerhard et al. is an interesting and useful discussion of the different climate drivers. These are ranked according to their effect on the climate, with the first order being the greenhouse atmosphere, the general distance of the earth from the sun and solar luminosity (i.e., the amount of energy given off by the sun). First order drivers determine the basic nature of the Earth's climate. A second order driver would be the global distribution of continents and oceans which have major effects on climate that can last for millions of years. Third order drivers include orbital variations which change the amount of solar energy reaching earth. They have significant effects that can last for a hundred thousand years on average. Fourth order drivers include El Niño and La Niña oscillations, volcanoes, variations in solar energy, solar flares and storms, and human intervention (e.g., the addition of CO2 and other greenhouse gases to the atmosphere). These have impacts that last for only a few years to a few thousand years. An example of a fourth order solar cycle is given by Mayewski and White (2002) in Figs. 4.3 and 4.4.

The chapter by Pekarek on solar forcing discusses the variability in the amount of solar energy (i.e., solar wind) reaching the top of the Earth's atmosphere and relates that to the Earth,s climate. A variability of approximately 0.1% has been measured by satellites since 1979. These variations can be correlated to the sun spot cycle. Pekarek notes that indirect evidence by Baliunas and coworkers suggests variations in solar energy of as much as 0.5% which could have a significant effect on climate. This evidence is from a 30 plus year study of nearby stars that are similar to our sun (Radick et al., 1998). Variations in solar energy in these nearby stars are similar to that tied to the sunspot cycle in our sun; resting phases or quiet periods have been observed when few sunspots are present. During these quiet periods, as much as 0.5% less energy is given off by these stars. This is similar to the lack of sunspots during the Little Ice Age and suggests that a reduction in solar energy was the cause of this cooler period in the Earth,s climatic history. Mayewski and White (2002, Fig. 5.7) shows this change in solar output going from the Medieval Warm Period to the Little Ice Age.

A chapter by Gerhard and Harrison on the effect of the distribution of oceans and continents presents an interesting thesis. They relate the development of large-scale continental glaciation to a distribution of continents that deflects ocean currents poleward. Periods without continental glaciation have a distribution of continents that allows equatorial oceanic currents. This is different than the conventional wisdom which says that continental glaciers need large land masses near the poles in order to develop. If proven, this thesis suggests that there is one or more major climate drivers which are not fully understood.

The chapter by Bluemle and coworkers looks at geological evidence to determine climate variability during the Holocene. They suggest that the last 10,000 years can be characterized as a sequence of 10 or more global-scale periods of decreased temperatures similar to the Little Ice Age. These are separated by periods of global warming. The temperature changes during these events were in the range of one to two degrees C. They also suggest that the frequency, rate, and magnitude of climate variation of the recent warming is not unusual.

The chapter by Jenkins also looks at the record of past climate variation and finds time periods, such as the Holocene Maximum, where temperatures were over one degree C warmer than the present. One line of evidence the author cites for this has been a decline in the upper tree line in mountains in temperate latitudes. He notes that we are undergoing a slight temperature recovery from a low point during the Little Ice Age.

In summary, this book makes an important contribution to the climate change/variation debate by bringing in geological and astronomical data that has not been considered. It should be in the libraries of and used by all students and researchers working on the climate.

References

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