High Frequency Palaeoclimate Analysis: Impact on Climate Research and Exploration Strategy

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Paleoclimate analysis will not be useful as a way to predict future climate until we understand the causes of climate change and responses of the earth's atmosphere and environments at the appropriate temporal scales.

Presently, most paleoclimate analyses are resolved only for mean annual conditions at the scale of eccentricity. However, the greatest insolation changes occur seasonally at the scale of precession (~20 kyrs). Similar to the condition that causes summer in one hemisphere and winter in the other at the same time in the orbit, precession cycles cause Northern and Southern Hemisphere insolation to be about 10,000 years out of phase. Hot summers and cold winters in one hemisphere correspond to mild summers and mild winters in the other. The pattern reverses itself over a precession cycle so that similar climatic successions in opposite hemisphere, and their associated sediment yield cycles, will be 10,000 years out of phase, as well.

Further, until the Plio-Pleistocene glaciation was unipolar. Under this condition, precession-scale eustasy tended to track the insolation cycle of the glaciated hemisphere. Consequently, similar climatic successions in opposite hemispheres would have had sediment yield cycles with distinctly different phase relationships to glacioeustasy. Such differences would not exist in an ice-free world. The regional and temporal variations in the phase relationships between sediment and glacioeustatic cycles may not be consistent with basic assumptions about stratigraphy and can impact how we interpret the causes and frequencies of the stratigraphic cycles themselves.