Geophysical Research Abstracts
Vol. 18, EGU2016-14955-1, 2016
EGU General Assembly 2016

Millennial-scale climate variability in response to changing glacial and orbital boundary conditions during the Mid-Pleistocene transition

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The Mid-Pleistocene transition represents perhaps the most important climate transition in the Quaternary period, yet it is one of the most poorly understood. Although the exact timing and mechanism of the onset of the "100 kyr" regime remain a matter of debate, it is well established that the overall periodicity of the glacial–interglacial cycles changed from a dominant 41 kyr obliquity periodicity prior to ∼0.9 Ma to a dominant late Pleistocene 100 kyr variance. This change in the frequency domain was associated with an increase in the amplitude of global ice volume variations that, superimposed on a long-term climatic trend towards more glacial conditions over millions of years, produced some of the most extreme glaciations recorded.
This interval of time has often been considered to be important in relation to long-term Milankovitch-scale climate variability. In contrast, here, special emphasis will be placed on assessing the presence and the characteristics of the suborbital-scale variability, and reconstructing the evolution of millennial-scale climate variability as the average climate state evolve toward generally colder conditions with larger ice sheets, and the spectral character of climate variability shifted from dominantly 41 kyr to 100 kyr. Appealing evidence suggests that millennial-scale climate variability is amplified during times of intense forcing changes, but this rapid variability has not been thoroughly explored yet at the time when the major changes in climate periodicity occurred.
To address these questions, we have examined the record of climatic conditions from Marine Isotope Stages 25 to 16 (∼970-650 ka) using high-resolution stable isotope records from benthic and planktonic foraminifera from a sedimentary sequence in the North Atlantic (Integrated Ocean Drilling Program Expedition 306, Site U1313) in order to assess millennial-scale changes in sea-surface and deep-water conditions, the dynamics of thermohaline deep-water circulation and ice sheet-ocean interactions.
Detailed investigation of millennial scale variability depends strongly on the quality of age control and the ability of confidently placing the marine records on an accurate time scale. On orbital time scales, variations in stable isotopes at Site U1313 contain strong precession power and we have attempted to present the proxy data on a time scale constrained using a specific approach reflecting the distinctive precession signal at this site. Data sets have been processed in different ways, to determine: (i) the presence of long-term trends in the mean, interglacial, and glacial states; (ii) the evolution of the dominant periodicities expressed in our proxy record; (iii) changes in the amplitudes of millennial-scale variability during the glacial/interglacial periods examined in this study.