Millennial-scale climate variability over the last 3 Ma: ODP Leg 162

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It is well known that large, abrupt millennial-scale climate oscillations were superimposed on the orbital scale climate variations of the last glacial cycle. Rapid and dramatic swings in air temperature occurred over Greenland, as evidenced in ice cores, which correlate to variations in surface water conditions and thermohaline circulation in the North Atlantic, as recorded in deep-sea sediment. Whether such millennial-scale climate oscillations are driven by internal ice-ocean-atmosphere dynamics or external solar or orbital forcing is currently a topic of vigorous debate. Utilizing the Ocean Drilling Program's unique hydraulic piston coring ability, Leg 162 extended these high resolution pelagic sequences back in time millions of years, allowing us to characterize for the first time the amplitude and frequency of millennial-scale climate variability during times with smaller ice sheets (the early Pleistocene for instance) or even during periods significantly warmer than today (the middle Pliocene). Are marine-based ice sheets necessary to trigger the type of rapid climate fluctuations now commonly referred to as Dansgaard-Oeschger events? Continuous geophysical and sedimentologic measurements (including magnetic susceptibility, see below) were made on almost all recovered sections at four sites. These records, which reflect lithologic variations in the cores, clearly show millennial-scale variability including what appears to be a 2-3 Kyr cycle at Site 983. It thus appears that D-O-style cycles occur during other climate regimes (e.g. in the "41,000 year world") and are not exclusive to a climate system dominated by marine-based ice sheets. The exceptionally high sedimentation rates which characterize many of our recovered sequences have provided new insights into millennial-scale variations in climate and oceanography in one of the most climatically reactive regions of the world, the North Atlantic. By studying such natural variability, we will gain a deeper understanding of climate processes which have the potential to influence society over the next few hundred years.