

# Milankovitch cyclicity observed in ODP downhole logs

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Changes in Earth's orbital parameters are now recognized as a source of cyclical variations in global and regional climate and oceanographic processes. The periods of eccentricity (95-123 and 413 Kyr), obliquity (41 Kyr), and precession (19-23 Kyr) have been observed in a variety of sedimentary sequences. Geophysical logs in ODP drill sites provide the opportunity for quantitative analysis of these Milankovitch frequencies: the long, continuous log records are capable of detecting very subtle changes in mineralogy or porosity, independent of core recovery. Milankovitch cyclicity in ODP logs has now been observed from many ages and many climatically sensitive parts of the world ocean. For example, such cycles are detectable on or near continental margins in Early Pliocene sediments from Sites 646, 693, 728, and 815 and in Late Pliocene sediments from Site 645. At ODP Sites 645 (Baffin Bay) and 646 (Labrador

Sea), orbital influence on bottom current activity produced grain-size fluctuations that are evident in porosity-sensitive logs as dominant eccentricity and strong obliquity cycles. A doubling of sedimentation rate at 3.8 Ma in Site 646 generates a doubling of depth period but unchanged temporal period. Similarly, bottom-current control of hemipelagic contourites at Site 815 (near the edge of Marion Plateau offshore Great Barrier Reef, Australia) produces a strong cyclicity that may be driven by precession. At Site 693 (Dronning Maud Land Margin, Antarctica), orbital forcing of diatom productivity, via influence on either upwelling or sea-ice production, is evident in all logs. Cyclical changes in upwelling intensity may also be responsible for the strong eccentricity, weak obliquity, and significant precession periods at Site 728 (Oman Margin), evident in both geophysical and geochemical logs.

