Geophysical Research Abstracts
Vol. 13, EGU2011-5035, 2011
EGU General Assembly 2011

Climate and environment in early Miocene New Zealand: new evidence from an Otago maar lake

Bethany Fox (1,2), Gary Wilson (2,1), Daphne Lee (1), Andrew Gorman (1), Daniel Jones (1), and Uwe Kaulfuss (1)

(1) Department of Geology, University of Otago, Dunedin, New Zealand (bethany.fox@gmail.com), (2) Department of Marine Science, University of Otago, Dunedin, New Zealand

In 2009, two drill cores were recovered from the Foulden Maar in Otago, southern New Zealand (45ºS). The recovered succession is a ∼120-m-thick early Miocene diatomite, laminated on a millimetre to sub-millimetre scale, with white layers composed almost entirely of diatoms and sponge spicules and dark layers composed of organic matter and resting spores. White-dark couplets are interpreted to correspond to annual variations in diatom productivity and imply a markedly seasonal climate. Palaeomagnetic measurements combined with pollen and radiometric dating indicate that the deposit represents ∼100,000 years and coincides with the Mi-1 event.

Magnetic susceptibility and remanence measurements of the upper part of the succession indicate a relatively uniform and proportionally minor ferromagnetic fraction with few to no high-coercivity phases, suggesting a stable, calm environment. Variations in the thickness of the white laminae are linked to biological productivity within the lake.

Deformed horizons and turbidites increase in frequency and thickness downcore. In the lower part of the core, varves are thinner and more uniform, and there is a greater proportion of terrigenous material. In this part of the succession, variations in allochthonous input are more significant and biological productivity is relatively constant.

Time-series analysis of physical and magnetic properties reveals a range of cyclicities in the Foulden Maar core. Orbital-scale cycles are indicated at precessional and obliquity frequencies, although ability to resolve these is limited by the short duration of the record. However, both precession and particularly obliquity have been reported to have had a strong modulating effect on climate at the Oligocene/Miocene boundary.

Several millennial-scale cycles are also present, particularly at ∼5,000 years and ∼2,500 years. By analogy with similar Quaternary cycles, these may be linked to variations in solar output, thermohaline circulation and glacial advance and retreat. Short-term cycles in the core include an ENSO-like signal and a ∼12-year signal which may correspond to the sunspot cycle.

In its earliest stages, the depositional environment of Foulden Maar was affected by mechanical instability and climatic variations in the catchment area. It subsequently evolved into a stable, strongly seasonal environment where biological productivity was the major variable. Cyclical variations are consistent with a warm world which nonetheless had some polar ice. Variations in Antarctic ice volume across the Mi-1 event may be responsible for some of the cyclicities observed.