

Cenozoic terrestrial climate change and the demise of forests on Wilkes Land, East Antarctica

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Abstract

The lack of long and well-dated sediment records from Antarctica puts considerable constraints on a spatial and temporal reconstruction of palaeoenvironmental change after the formation of a continent-scale cryosphere at the Eocene–Oligocene boundary, 33.9 million years ago. The marine IODP Site U1356 at the Wilkes Land margin, East Antarctica, provides a unique opportunity to reconstruct with a single sediment record, the long-term Antarctic terrestrial climate and vegetation change over a period 53 million to 10 million years ago. Interrupted by several hiatuses, the site U1356 yields pollen bearing sediment layers covering the early- to mid-Eocene, Oligocene and Miocene. We applied a new quantitative approach using red fluorescence to separate reworked sporomorph assemblages, that have been transported into Antarctic marine sedimentary records by waxing and waning ice sheets, from non-reworked palynomorph assemblages, that can be used to reliably reconstruct past vegetation and climate for the time interval during which the sediment was deposited.

The palynological record shows a change from a diverse early Eocene paratropical rainforest (54–51 Ma) to a cooler temperate rainforest dominated by the southern beech (*Nothofagus*) at ca. 51 million years ago (Ma). The early Oligocene assemblages (33.9–23 Ma) indicate further cooling and are characterised by cool temperate *Podocarpus-Nothofagus* forests with *Dacrydium* and *Lagarostrobos* (both common in southern forests of New Zealand and Tasmania today). A decline in *Dacrydium* and *Lagarostrobos* (Huon Pine) and absence of Proteaceae indicate climate cooling during the late Oligocene (~25–23 Ma). Lowland tundra shrub became dominant on Wilkes Land following a strong cooling at the Oligocene-Miocene transition characterized by a sharp decline in tree ferns along with an increase in bryophytes. A return of some cool-temperate woody plants can be recorded for the Middle Miocene Climate Optimum (MCO 17–15 Ma). Following a return to polar tundra conditions at the end of MCO, vegetation appears to have been disappeared from the Wilkes Land after ca. 10.8 Ma.

Our pollen record suggests that throughout the Cenozoic, mean temperatures at Wilkes Land were higher than in the Ross Sea region (i.e. Andriill, Cape Roberts) and the Antarctic Peninsula (i.e. Shaldril). We conclude that the Wilkes Land margins were possibly one of the last refugia for temperate forest taxa on Antarctica during the Late Oligocene and Miocene.

Keywords: Antarctica, Paleogene, Neogene, pollen, vegetation