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Citation: Salzmann, Ulrich, Strother, Stephanie, Sangiorgi, Francesca, Bijl, Peter, Pross, Jorg, Woodward, John, Escutia, Carlota and Brinkhuis, Henk (2016) Oligocene to Miocene terrestrial climate change and the demise of forests on Wilkes Land, East Antarctica. In: EGU General Assembly 2016, 17th - 22nd April 2016, Vienna, Austria.

URL: <http://meetingorganizer.copernicus.org/EGU2016/EGU...<http://meetingorganizer.copernicus.org/EGU2016/EGU2016-2717.pdf>>

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Oligocene to Miocene terrestrial climate change and the demise of forests on Wilkes Land, East Antarctica

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The question whether Cenozoic climate was warm enough to support a substantial vegetation cover on the Antarctic continent is of great significance to the ongoing controversial debate on the dynamic behaviour of Antarctic land ice during the transition from a greenhouse to an icehouse world. Here we present palynological results from an Oligocene to Miocene sediment record provided by the Integrated Ocean Drilling Program Expedition 318 to the Wilkes Land margin (East Antarctica). The Oligocene assemblages (33.9-23 Ma) are dominated by pollen and spores from temperate forest and sub-Antarctic shrub vegetation inhabiting different altitudinal zones. These include a lowland cold temperate forest with *Dacrydium* and *Lagarostrobos* (both common in southern forests of New Zealand and Tasmania today) and a high altitude tundra shrubland comprising *Microcachrys*, *Nothofagus* (southern beech) and *Podocarpaceae* conifers. A decline in pollen percentages of *Dacrydium* and *Lagarostrobos* and absence of *Proteaceae* indicate climate cooling during the late Oligocene (~25-23 Ma). However, the continuous presence of *Lagarostrobos* suggests that the full transition to a tundra environment had not yet occurred and climate on Wilkes Land during the late Oligocene was still warm enough to support forest vegetation in sheltered areas. Temperature reconstructions derived from the fossil pollen assemblages using the Coexistence Approach suggest mean annual temperatures (MATs) between 6.7-13.7°C during the early Oligocene and a drop of minimum MATs to 5.8°C in the late Oligocene. Pollen of “unambiguous” forest indicators, such as *Lagarostrobos*, are absent in the Miocene sediment record (16.2 -12.5 Ma) but temperatures were still high enough (minimum MATs > 5°C) to sustain a woody sub-Antarctic vegetation under partially ice-free conditions. Wilkes Land provides a unique record of Antarctic vegetation change from a subtropical, highly diverse Eocene rainforest to an Oligocene cold temperate forest and an impoverished Miocene sub-Antarctic shrubland. The pollen record suggests that temperatures were higher than in the Ross Sea region (i.e. Andriill, Cape Roberts) and the Wilkes Land margins were possibly one of the last refugia for temperate forest taxa on Antarctica during the Late Oligocene.