

Ice in a greenhouse world

Jane Francis¹

¹British Antarctic Survey, Cambridge, UK j.francis@bas.ac.uk

Abstract

Prior to the onset of ice during the latest Eocene, the fossil and rock record indicates that Antarctica had a warm temperate climate for millions of years with no evidence for major ice caps. During the mid-Late Cretaceous (~90Ma) in particular, Amazonian-type vegetation spread to Antarctica as tropical climates spread to high latitudes.

There are, however, signs of cooler climates during the latest Cretaceous into the early Paleocene. The marine palynology record, marine oxygen isotopes, and terrestrial land plants suggest that there were periods of cold climate when sea ice may have formed around the Antarctic Peninsula region. This implies that ice sheets may have existed on the continent itself, although evidence for ice is currently buried beneath the present ice sheet.

Geological evidence indicates that the cool periods were cyclical in nature with a periodicity of ~2 million years, possibly signaling an orbital influence. This pattern continued from the latest Cretaceous into the early Paleocene (Danian), corresponding to proposed CO₂ levels for this interval of ~400ppm (similar to present day). A distinct warming phase marks the K-Pg transition and disrupted this climate pattern, however, it is apparent that the background climate was one of periodically cold phases at high latitudes in this so-called greenhouse world.

Keywords Antarctic Peninsula, Cretaceous, Paleogene, Amazonian vegetation, ice, greenhouse, carbon dioxide