

## EVIDENCE FOR GLACIAL AND POLAR IMPACTS IN THE PERMIAN COAL MEASURES OF THE SYDNEY BASIN

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Since the 1840s, geologists have speculated about the degree and timing of contributions by glacial processes in the formation of the Permian coal bearing and marine sequences of the Sydney Basin. Unambiguous classical glacial evidence occurs in the underlying Carboniferous but later Glendonites and dropstones were seen only as contributions from cold water and floating ice.

Continuing improvement in the resolution of the 'polar path' throughout time, place the Sydney Basin at latitudes of 75S to 90S from the Early to Late Permian (Klootwijk 2016). Current evidence of climate change and its influence on glacial environments demonstrate there is more evidence of glacial processes in the Permian coal measures themselves.

Major elements, of the Newcastle Coal Measures are suggested to have glacial signatures and the Sydney Basin coal seams themselves display enigmatic properties that are suggestive of high latitude 'interglacial' environments. The Teralba and Bolton Point Conglomerate strata, shown in the 1980s to form elongate, high energy, channel like, coarse clastic deposits, sit enigmatically in the supposedly flat and marshy coal forming environments. A coal forming model of freshwater lakes with 'Gilbert' deltas, (Conaghan 1981) is revisited but with compelling current global evidence. Recent observations in the Arctic, of waning ice sheets and melting processes clearly illustrate 'moulins', sub-glacial drainage and their links to 'tunnel valleys' and 'eskers'.

A high latitude, cyclical, glacial model for coal measure formation is suggested, which is similar to that now discernible in recent Arctic landforms. The required time scale and cyclicity are supported by Permian CA IDTIMS zircon age dating.