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# The global Mio–Pliocene climatic equability and coastal ostracod faunas of southeast Australia

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**Abstract**

This study on the Mio–Pliocene ostracod successions of southeast Australia outlines several faunal events indicative of climate warming and/or increased rainfall events. Ostracod faunas associated with a late Late Miocene sea level rise event suggest that the climate of this time in southeast Australia was similar to, or slightly warmer than that of present day southeast Australia. However, it was probably wetter and significantly warmer than immediately preceding (mid Late Miocene) palaeoclimatic conditions within the region. Evidence for a change to wetter and warmer conditions during the late Late Miocene is seen in the appearance of various extant euryhaline and semi-thermophilic ostracod species in coastal ostracod faunas. The appearance of euryhaline species, which are mostly absent from older shallow marine Cenozoic strata of the Bass Strait hinterland, suggests a major influx of fresh water into coastal marine settings, which contributed to the initial phase of development of the southeast Australian late Neogene barrier coastline and associated marginal marine palaeoenvironments.

During the time interval latest Miocene to earliest Pliocene, and during the early Late Pliocene, two subsequent global sea level rise events are also preserved in the southeast Australian coastal plain. Many of the species present in ostracod faunas associated with these two events are the same as in older local late Late Miocene faunas. In earliest (?) Pliocene faunas, there is minor evidence for the reappearance of semi-thermophilic ostracods. Faunas of early Late Pliocene age often exhibit a conspicuous faunal dominance by, or large abundance of euryhaline species, indicating the particularly strong influence of fresh water influxes into coastal marine palaeoenvironments. This may reflect the presence of especially wet local temperate palaeoclimatic conditions during a time of equable global climates.

Succeeding estuarine, lagoonal and coastal embayment ostracod faunas of late Late Pliocene age are associated with marginal marine sediments that are interbedded with coastal dune aeolianites. This suggests an overall seaward retreat of marginal marine environments that was initiated by a major global sea level fall linked to the onset of cooler Late Pliocene and Quaternary global climates.



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## 1. Introduction

Evidence for warm and equable global Pliocene palaeoclimates comes from many micropalaeontological and other studies on late Neogene strata from around the world. Dowsett and Cronin (1990) recorded mid Pliocene Ostracoda from North and South Carolina, U.S.A. indicative warmer ocean-water temperatures than prevail along eastern North America during the present time. Quilty (1984) discussed foraminiferal evidence from northwestern Australia that indicated warming during the earliest Pliocene. However, particularly pertinent to the research presented here is the study by Bint (1981)—from which some relevant conclusions can be drawn concerning late Neogene changes in southern Australian rainfall patterns.

Bint (1981) observed that Early Pliocene pollen assemblages from southern Western Australia were remarkably similar to coeval assemblages from southeastern Australia, suggesting that the regional phytogeographic differentiation of the southern Australian flora was not well pronounced during the Early Pliocene. This period of southern Australian floral biogeographic homogeneity corresponds in time to the period of supposed equable Pliocene global climates. Substantial regional differentiation of southern Australian floras developed during later Pliocene to Quaternary periods correlating with generally cooler global climates. Significantly, the Early Pliocene pollen assemblages of the Lake Tay area, southwest of Norseman, Western Australia, include elements indicative of a wetter climate than prevails in this regional at the present time (Bint, 1981). It is here suggested, based on Blint's (1981) observations, that the Early Pliocene floral homogeneity across southern Australia reflects similar rainfall patterns across the region from west (now mostly dry) to east (mostly wet) compared to the present day.

### *1.1. S.E. Australian coastal ostracod faunas*

The Cenozoic sedimentary successions of southeast Australia, including those of the southern Victoria coastal plain, generally yield rich ostracod assemblages. Successions of these ostracod assemblages closely mirror trends in global sea level change (Warne, 1993). Arguably, the most notable faunal change-over event within this region occurs across a conspicuous Late Miocene unconformity surface (Warne, 2000). Late Late Miocene to mid Pliocene ostracod faunas above this unconformity often include euryhaline species. By analogy with modern southeast Australian ostracod distribution patterns, these fossil occurrences indicate the presence of coastal lagoon and estuarine palaeoenvironments (Warne, 2002a). Older shallow marine Palaeocene to Miocene ostracod faunas from southern Victoria (i.e. McKenzie, 1974; McKenzie et al., 1991, 1993; Neil, 1997; Warne, 1993) generally do not include euryhaline ostracod species. As a consequence there is perhaps a surprising paucity of faunal evidence within these older sediments for widespread saline coastal lagoon and estuarine palaeoenvironments along the palaeo-coastline of southeastern Australia.

Major molluscan faunal turnover events during the latest Miocene have also been noted in New Zealand, these being equated with the latest Miocene–Pliocene enhancement of Antarctic Circumpolar Current circulation caused by the initiation of West Antarctic glaciation (Beu et al., 1997). However, similar Antarctic Circumpolar Current circulation influences on New Zealand Cenozoic ostracod faunas are not seen in southeast Australian ostracod faunas. For instance, species of the genus *Patagonacythere* Hartmann, which have relatively high latitude southern hemisphere Cenozoic distribution patterns presumably associated with the Antarctic Circumpolar Current (New Zealand, Antarctica, southern Atlantic and South America), to date have not been recorded from the Cenozoic of southeast Australia (Warne, 2000).

Major changes in southeast Australian molluscan faunas around this time have, however, also been noted, these being in part attributed to facies-related changes connected to a shallowing of depositional environments (Maxwell and Darragh, 2000). This broad scale shallowing (in southern Victoria) can be attributed in part to coastal hinterland uplift (Warne, 1988; Bolger, 1991; Dickinson et al., 2002) caused by the Australian craton being placed into compression by the collision of Australia's northern margin with island arc terrains near New Guinea (Hill et al., 1995).

The scope of this paper is as follows. Firstly, it extends knowledge of the distribution of euryhaline and semi-thermophilic ostracod species within the