EARLY CRETACEOUS HIGH LATITUDE MARINE REPTILE ASSEMBLAGES FROM SOUTHERN AUSTRALIA

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ABSTRACT
The Lower Cretaceous (Aptian-Albian) southern high latitude deposits of Australia have yielded a diverse range of marine reptile fossils. Ichthyosaurs and at least five distinct plesiosaur taxa have been recorded. Most of the current marine reptile specimens are derived from the predominantly Aptian Bulldog Shale and Wallumbilla Formation. These units, famous for producing opal, represent shallow epicontinental marine depositional environments. Fragmentary plesiosaur remains have also been recovered from high latitude non-marine deposits of the Wonthaggi, Eumeralla, and Griman Creek formations. These are Aptian to middle Albian in age, and comprise fine-grained fluviatile/estuarine sediments laid down in inland rift valleys and coastal flood plains near the Cretaceous southern polar circle. Estimates of palaeolatitude place most of southern Australia at around 60º to 80º S during the late Early Cretaceous. Sedimentary structures, fossils, isotope data, and climatic modeling indicate highly seasonal cool-cold conditions possibly with winter freezing. This contrasts markedly with climate regimes typically tolerated by modern aquatic reptiles, but suggests that some Mesozoic forms may have possessed adaptations to cope with low average water temperatures.

INTRODUCTION
Australian marine reptile fossils are common although currently poorly documented. At present, most of the described material is derived from extensive Early Cretaceous epicontinental marine rocks in northeastern Australia (Kear 2003). In recent years however, a number of fragmentary specimens have been recovered from Lower Cretaceous marine/non-marine sequences in the southern part of the continent (Figure 1). These fossil-producing strata include – 1) the Aptian-Lower Albian Wonthaggi (Gippsland Basin) and Eumeralla (Otway Basin) formations, southern Victoria; 2) Aptian Wallumbilla Formation (Eromanga Basin), White Cliffs, New South Wales; 3) Lower Aptian-Lower Albian Bulldog Shale (Eromanga Basin), northern South Australia; 4) Lower-middle Albian Griman Creek Formation (Surat Basin), Lightning Ridge, New South Wales/Surat region, Queensland. Interestingly, these units were deposited in an Early Cretaceous high latitude zone (60º-80º S), subject to highly seasonal cool to cold conditions and months of winter darkness near the southern pole.

Several previous reports have discussed Australian Early Cretaceous high latitude marine reptile fossils (e.g. Rich et al. 1988; Kear 2003, 2004, 2005, 2006). Despite this, relatively few specimens have been thoroughly described. It is therefore the purpose of this article to present an up to date summary of the Australian record and assess its palaeobiological/palaeoecological implications; this is intended as a companion for more detailed studies currently being undertaken by BPK (see Kear 2003).

Abbreviations—AM, Australian Museum, Sydney, NMV, Museum of Victoria, Melbourne, SAM, South Australian Museum, Adelaide.

GEOLOGICAL AND PALEOENVIRONMENTAL SETTING
The Wonthaggi Formation (Strzelecki Group) and middle Eumeralla Formation (Otway Group) comprise finely laminated sandstones and mudstones with locally abundant horizontally stratified fossiliferous claystone/mudstone conglomerates. The deposits were laid down by meandering to braided river systems in a mid-Cretaceous rift valley flood plain, which formed as...