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Review of Palaeobotany and Palynology 150 (2008) 5–21
Review of Palaeobotany & Palynology
www.elsevier.com/locate/revpalbo

An Early Jurassic flora from the Clarence-Moreton Basin, Australia

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Received 26 September 2007; received in revised form 31 December 2007; accepted 5 January 2008
Available online 17 January 2008

Abstract

A low-diversity Early Jurassic flora preserved in floodbasin siltstones of the Marburg Subgroup at Inverleigh Quarry in the Clarence-Moreton Basin, eastern Australia, is dominated by *Allocladus helgei* Jansson sp. nov., a conifer with denticulate leaves tentatively attributed to Araucariaceae. The assemblage also includes *Rintoulia variabilis* and Caytoniales, (*Caytonia cucullata* McLoughlin sp. nov. and cf. *Sagenopteris nilssoniana*), reinforcing the wide distribution of this order in Early to Middle Jurassic floras of Gondwana. Ferns (*Cladophlebis* and *Sphenopteris* species) and isoetalean lycophytes (*Isoetites* sp.) constitute the herbaceous elements of the flora. The palynoflora is dominated by cheirolepidiacean (*Classopollis*) pollen and is attributable to the upper part of the *Corollina* (=*Classopollis*) *torosa* Zone of late Pliensbachian–early Toarcian age (180–185 Ma). The Inverleigh flora represents one of the few Australian assemblages dated between the major phases of floristic turnover at the end of the Triassic and the Toarcian. Sedimentological characteristics, cuticular features of the conifer leaves and the abundance of free-sporing plants indicate a relatively humid palaeoclimate for the Clarence-Moreton Basin Early Jurassic.

Keywords: Australia; Pliensbachian; Toarcian; Marburg Subgroup; conifers; palaeoenvironment

1. Introduction

Two mass-extinction events profoundly reshaped Earth's biota during the early Mesozoic. The first of these, at the end of the Triassic represents one of the "big five" mass extinctions and saw major changes to both the marine and terrestrial biota (Hallam, 1998), although the cause of this crisis remains uncertain (Beerling and Berner, 2002). Terrestrial plants were among the most severely affected groups (Burgoyne et al., 2005), with the loss of 60% of species in some parts of North America but possibly up to 95% turnover in the North Atlantic region (Beerling and Berner, 2002). Floristic changes in Australia are expressed by a reduction in diversity (Balme et al., 1995) and the demise of *Dicroidium*, the dominant Triassic corystosperm, and many associated gymnosperms (Anderson and Anderson, 1989). Consequently, a mere 20–25 macrofossil species are known from the initial Early Jurassic flora (Balme et al., 1995) but this is the first to contain dominant elements with clear affinities to modern plant genera (Meyen, 1987).

A second-order mass extinction took place during the Toarcian Stage of the Early Jurassic. This event is characterized by a sharp negative carbon isotope excursion, exceptionally high rates of global organic-carbon burial, high temperatures, loss of marine taxa and its sedimentary record indicates anoxic conditions throughout the marine water column evidenced by deposition of extensive black shales (Jiménez et al., 1996; Beerling et al., 2002). The event appears to have a terrestrial signature with large-scale turnover of conifer families in both Northern and Southern hemisphere floras (Helby et al., 1987; Wang et al., 2005). Although the event is relatively well studied in the Northern Hemisphere marine realm (Hallam, 1961; Wignall, 2001), few investigations have been carried out in terrestrial sequences and in the Southern Hemisphere.

This study focuses on an eastern Australian Pliensbachian to early Toarcian plant assemblage that provides insights into the little-known floras occurring between the end-Triassic and Toarcian mass extinctions. The study aims to systematically

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doi:10.1016/j.revpalbo.2008.01.002

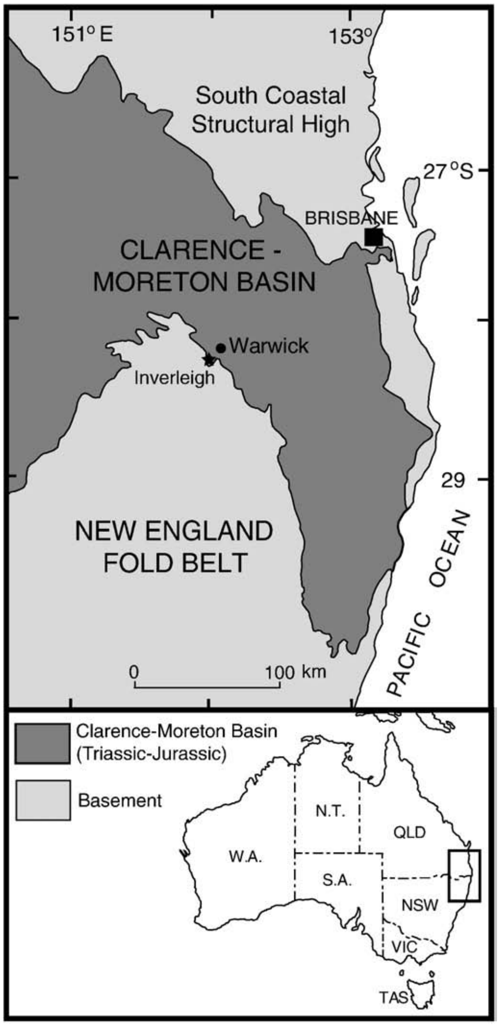

Fig. 1. Regional setting of the Clarence-Moreton Basin (modified from Exon and Burger, 1981).

describe the fossil plants and use their diversity, morphology and the sedimentary features of the host strata to interpret the Early Jurassic palaeoenvironment. Palynological analysis aims to provide age constraints on the strata and evaluate whether the macroflora is representative of the regional flora.

2. Geological setting

The specimens described in this study were collected from the Inverleigh quarry, intermittently used as a source of siltstone for brick-making. The locality (28°17′02.87″S 151°58′55.64″E) is situated in the northwestern part of the Mesozoic, epicratonic, Clarence-Moreton Basin, which extends from northern New South Wales to southeastern Queensland, Australia (Fig. 1). Basin sedimentation initiated during the Late Triassic (Day et al., 1983) covering moderately deformed mid- to late Palaeozoic accretionary prism and intrusive igneous rocks (O'Brien et al., 1994). The basin's oldest units consist of immature clastic sediments deposited in localized alluvial fan and braided river settings (Day et al., 1974). Deposition became more widespread in the Early and Middle Jurassic as a result of regional subsidence (Goscombe and Coxhead, 1995) but sedimentation ceased by the Tithonian.

The Clarence-Moreton Basin sedimentary sequence can be subdivided into the Woogaroo Subgroup, the Marburg Subgroup and the "post-Bundamba Group succession" in ascending stratigraphic order (Wells and O'Brien, 1994; Fig. 2). The studied assemblage derives from the Marburg Subgroup, a succession of mature quartzose sandstones and shales deposited by mixed sinuosity streams flowing generally in a northerly direction (Cranfield et al., 1975; O'Brien and Wells, 1994). The Marburg Subgroup is divided into the Gatton Sandstone (500 m thick) and overlying Koukandowie Formation (250 m thick) in the eastern part of the basin (Wells and O'Brien 1994; Goscombe and Coxhead, 1995; Fig. 2) but mappable units have not been recognized within the subgroup in the northwest where Inverleigh Quarry is located. The studied interval appears to be stratigraphically low within the subgroup and is below the oolitic ironstone marker beds documented by Cranfield et al. (1994). Palynological evidence (see below) favours correlation of the quarry rocks with the Gatton Sandstone.

The lower part of the quarry succession consists of organic-rich siltstones, shales and shaley coals interbedded with sparse, tabular, fine- to medium-grained, cross-laminated to massive sandstones

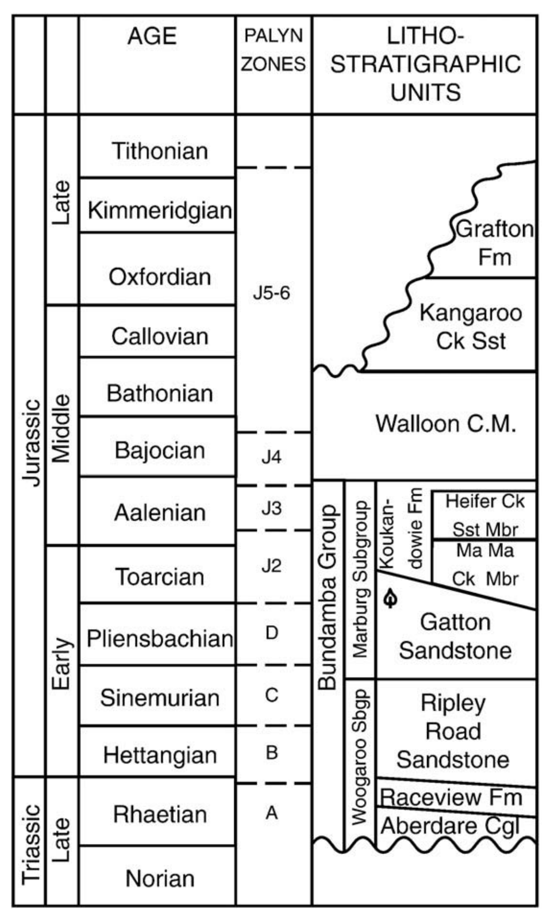

Fig. 2. Stratigraphy of the Clarence-Moreton Basin (modified from Wells and Obrien, 1994, who provided details of the thickness and depositional environments of each unit). Leaf symbol indicates the interpreted stratigraphic position of the macrofossil assemblage based on palynostratigraphy (see text).