PALAEOENVIRONMENTAL STUDIES OF THE MIDDLE TRIASSIC UPPERMOST NARRABEEN GROUP, SYDNEY BASIN: PALAEOECOLOGICAL CONSTRAINTS WITH PARTICULAR EMPHASIS ON TRACE FOSSIL ASSEMBLAGES

by

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ABSTRACT

The coastal exposures of the Triassic System in the Sydney Northshore area aggregate about 180 m in thickness and comprise the uppermost part of the Narrabeen Group (namely, in ascending stratigraphic order: the Bald Hill Claystone, the Garie Formation, and the Newport Formation, the latter divisible into Lower, Middle and Upper Members) and the overlying Hawkesbury Sandstone. With the exception of mainly allochthonous plant macrofossils and palynomorphs which occur sporadically and with varying abundance in the mudrock facies of these formations, environmentally-diagnostic body fossils are rare, and, where they occur, are nowhere unequivocally indicative of marine affinities. For this reasons, and because of the predominantly fluvial lithofacies characteristics exhibited by these formations throughout much of their stratigraphic extent and especially by their channel-form/channel-like sandstones lithosomes, most previous workers have interpreted these formations to be of fluvial or fluvio-lacustrine origin except possibly for several thin planar- and thinly-bedded fine-grained intervals encompassing the Garie and Newport Formations for which several lines of evidence, including lithofacies, equivocal palaeontological, and ichnological evidence, have prompted several workers to speculate a shallow-marine, possibility coastal lagoonal or estuarine origin.

Although trace fossils occur in reasonable abundance at various stratigraphic levels within these uppermost Narrabeen Group rocks and particularly within the Newport Formation, they have hitherto received very little systematic study. A comprehen-

sive study of this ichnofauna shows that it is relatively diverse, comprising almost 100 different ichnotaxa (including varietal categories) of predominantly invertebrate origin, and includes several new ichnogenera and ichnospecies among the more notable of which are: two large bioglyph-bearing dwelling-burrows of probable crustacean origin (Turimettichnus conaghani and T. webbyi) and one (Pytiniichnus trifurcatum) made either by a small reptile or an amphibian; a multi-stage spiral star-shaped feeding-trace (Helikospirichnus veeversi), probably made by a worm or worm-like deposit-feeder; several new species and varieties of Rhizocorallium (the first record of this ichnogenus in the Triassic of Australia); a new species and new variety of the saltatorial running vertebrate trackway Moodieichnus (an ichnogenus previously known only from the Late Permian of North America); and a new ichnogenus of vertical/steeply-inclined cylindrical branching dwelling-burrow (Barrenjoeichnus mitchelli).

An alternating stratigraphic pattern of trace fossil abundance and diversity characterizes the upper Narrabeen Group strata in the Sydney Northshore area, and involves four relatively thin separate assemblage zones of relatively diverse ichnofauna and thicker intervening assemblage zones which lack ichnotaxonomic diversity. The assemblage zones of diverse trace fossils contain some elements in common to two or more zones, notably: Thalassinoides, Skolithos, Ophiomorpha, Chondrites, Rhizocorallium, Palaeophycus, and Planolites, all of which are known to have unequivocal brackish- to shallow-marine palaeoecological affinities and which globally are characteristic of the Skolithos

ichnofacies. Additionally, each of these four diverse assemblage zones is characterized by one or more particular index ichnogenera which for convenience lend their name(s) to the zones as follows, in ascending stratigraphic order: Turimettichnus-Ophiomorpha assemblage zone; Skolithos-Diplocraterion assemblage zone; Helikospirichnus assemblage zone; and Rhizocorallium-Thalassinoides assemblage zone. The intervening ichnotaxonomically less-diverse and relatively impoverished assemblage zones are not similarly and separately named but are characterized by Barrenjoeichnus mitchelli and some species of Palaeophycus, Planolites and Skolithos as well as various plant-root petrifaction structures, all of which are here argued to have predominantly non-marine palaeoecological affinities. These latter assemblage zones can be referred to the Scoyenia-Teredolites ichnofacies. This stratigraphic pattern of alternating ichnologically diverse and impoverished assemblage zones confirms the suggestions of previous workers (notably Bunny and Herbert, and Retallack) regarding the presence of brackish-/shallow-marine palaeoenvironmental influence in these Lower and Middle Triassic strata and allow for the first time the stratigraphic resolution of the marine strata into four marine tongues which are here named after their respective type localities. These are, in ascending order: The Turimetta Head Tongue (2 m to 3 m thick; extending from at least the middle part of the Bald Hill Claystone almost to the top of this formation); the St. Michaels Cave Tongue (4 m to 5 m thick; encompassing the Garie Formation and the lower part of the lower Member of the Newport Formation); the

Bangalley Head Tongue (3 m to 5 m thick; extending from the uppermost part of the Lower Member into the lower part of the Middle Member of the Newport Formation); and the Palm Beach Tongue (3 m to 4 m thick; comprising the uppermost part of the Middle Member of the Newport Formation). The trace fossil assemblages in each of these marine tongues are indicative of a complex of brackish- to very shallow-marine low-energy palaeoenvironments typical of modern coastal lagoons or estuaries and imply the presence of a protecting coeval topographic barrier of some kind to the east or southeast. This lagoon is herein called the Newport (Coastal) Lagoon and its development in the central-eastern part of the Sydney Basin coincides approximately with the geographic and depocentral axis of the basin which trends NW-SE and intersects the present coastline in the Sydney metropolitan area. The non-marine affinities of the impoverished and less-diverse trace fossil assemblages in the intervening and overlying strata are consistent with the fluvial/fluvio-lacustrine environmental interpretations of these thicker and predominantly sandstone-dominant intervals made by many other workers. Palaeocurrent and petrographic data from these fluvial sediments show that the streams in which they formed debouched episodically into the Newport Lagoon variously from the northwest, west and southwest and were sourced variously from both the craton (Lachlan Fold Belt) to the southwest and the New England Orogen to the northeast.

With the exception of evidence of short-lived brackish-marine conditions at the base of the Narrabeen Group in the northeastern Sydney Basin and in the top of the Ashfield

Shale in the Wianamatta Group (above the Hawkesbury Sandstone) in the central part of the basin, the Triassic System of the basin is dominated by fluvial/fluvio-lacustrine sediments and the presently described marine tongues of the Newport Lagoon in the uppermost Narrabeen Group are the only other presently known record of marine conditions during the Triassic history of the basin. The development of the Newport Lagoon in the geographic and depocentral axis of the basin attests to the presence of a mild short-lived marine transgression in the latest Early and early Middle Triassic at the end of a period of declining piedmont clastic alluviation from the coeval New England Orogen to the northeast and immediately prior to the onset of a new phase of fluvial sedimentation sourced from the craton to the southwest and manifested by the deposition of the Middle Triassic Hawkesbury Sandstone.

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