Significance of Middle Cambrian Trilobites from Elcho Island, Northern Territory

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A recently discovered Templetonian (Middle Cambrian) trilobite fauna, with affinity to that of the Beetle Creek Formation of western Queensland, is reported from pebbles derived from the Elcho Island Formation (Wessel Group) on Elcho Island, in the Arafura Basin, northern Australia. Consequently, a previously determined isotopic age of 790 m.y., on glauconite from the Elcho Island Formation, is now clearly much greater than the age of deposition of the formation, and the age of the occurrence of *Skolithos* at the base of the Wessel Group (Buckingham Bay Sandstone) can be reconsidered as Early or early Middle Cambrian, rather than late Proterozoic. Regional correlation of the Buckingham Bay Sandstone and Raiwalla Shale of the Arafura Basin with the Bukalara Sandstone and Cox Formation of the McArthur River region is reiterated on the basis of rock types and presence of the trace fossil *Skolithos*.

During the course of hydrogeological investigations by Stefanski on Elcho Island in June 1974, an occurrence of fossils near Ularnga Point (shown as Warnga Point on published maps), Elcho Island (Fig. 1), was pointed out by Mr. E. W. Parr of Elcho Island Mission. Samples collected by Stefanski were assigned an early Middle Cambrian age by Miss Joyce Gilbert-Tomlinson (BMR) (unpublished preliminary note). Further samples collected in August 1974 by M. J. Wiltshire on behalf of Champlin Philippines Inc., and S. K. Skwarko (BMR) were determined by Shergold and confirm the Middle Cambrian age.

The fossils were collected from angular blocks and rounded pebbles of fine-grained quartz sandstone and siliceous siltstone, in gravels along the strand line of 'Tembi' and 'Second' Beaches on Elcho Island; similar material occurs, but becomes progressively less abundant, for several kilometres to the northeast (M. J. Wiltshire, personal communication, September 1st, 1974). Although no fossiliferous material has been positively identified in situ, the similarity of the host rock to nearby exposures of Elcho Island Formation (Wessel Group, Fig. 2), the distribution and volume of material and its occurrence close to the wave-cut platform, and the obviously slight abrasion of the large angular slabs, leaves little doubt that the fossils are derived from the Elcho Island Formation in the vicinity of Ularnga Point. Wiltshire (pers. comm.) has postulated a source just below the tidal zone off the northwest shoreline of Ularnga Point (Fig. 1).[1]

Outcrops of Elcho Island Formation are confined mainly to discontinuous weathered exposures beneath laterite, and to wave-cut platforms and low cliffs along the coasts of Howard, Elcho, and Drysdale Islands (Fig. 1). At Elcho Island Mission the basal beds of the formation consist of interbedded ferruginous sandstone, green micaceous and glauconitic fine-grained sandstone, and shale. These pass upwards into flaggy interbedded leached dolomitic and siliceous siltstone and chert, in discontinuous exposures along the coast to the north of the Mission (Dunnet, 1965; Plumb, 1965). The youngest beds of the Elcho Island Formation, and hence of the Wessel Group, preserved onshore were found at Ularnga Point.

The Fauna

The recovered fauna of the Elcho Island Formation is composed largely of trilobite remains—mostly fragmented, but occasionally articulated, xystridurid and eodiscid carapaces. Agnostina, Oryctocephalidae, and Ptychopariidae occur rarely, as do the non-trilobite elements of the fauna. The identified fauna includes:

Trilobita	*Lyriaspis* cf. *sigillum* Whitehouse, 1939
	Oryctocephalites runcinatus Shergold, 1969
	Pagetia cf. *significans* (Etheridge, 1902)
	Pagetia aff. *significans* (Etheridge, 1902)
	Pagetia sp. nov.
	Peronopsis cf. *normata* (Whitehouse, 1936)
	Xystridura cf. *templetonensis* (Chapman, 1929)
	xystridurid undet.
Bradoriida:—	aff. *Indota* sp. undet.
Hyolitha:—	*Hyolithes?* sp. undet.

Generically undetermined inarticulate Brachiopoda and sponge spicules also occur.

A conservative approach to the determinations is necessary pending the publication of a paper by A. A. Öpik (in preparation) dealing with some of the listed taxa, and continuing palaeontological investigations. Furthermore, specimens on weathered surfaces are often too badly abraded to permit precise specific determination.

The Elcho Island fauna has a Middle Cambrian age and belongs to the pre-*Ptychagnostus gibbus* portion of the Templetonian Stage as conceived by Öpik (1967, 136-7).

Similar generic associations occur widely in western Queensland and eastern Northern Territory, in the Arthur Creek Beds, Beetle Creek Formation, Border Waterhole Formation, Burton Beds, Sandover Beds and Wonarah Beds. The specific association determined here, however, is most similar to that occurring in the Beetle Creek Formation of western Queensland.

The fine grain size of the sediment and its fine lamination, coupled with a fauna having low species diversity but rich in individuals, often completely articulated, suggests a low energy, probably cool and/or deep water, ocean-facing depositional environment.

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[1] During a recent visit to Ularnga Point L. P. Black (BMR) located the fauna *in situ* on the wave-cut platform at low tide.

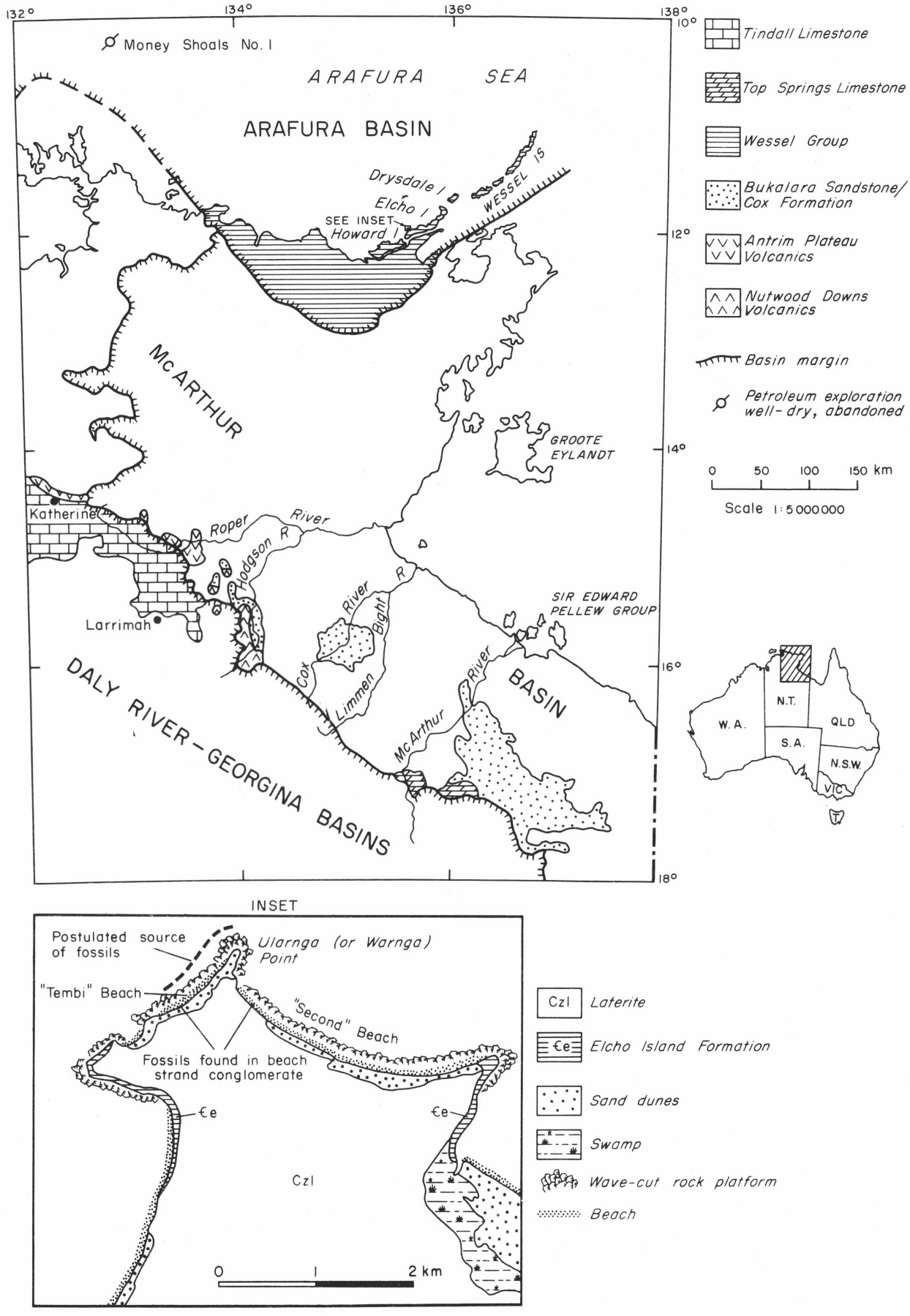

Figure 1. Locality maps

Previous Interpretation of Age

The Arafura Basin (Plumb, 1965; Plumb & Derrick, 1975) is a relatively undeformed epicratonic basin situated along the north coast of Arnhem Land, Northern Territory, and extending offshore beneath the Arafura Sea (Fig. 1). It overlies the Proterozoic McArthur Basin and older metamorphic rocks with strong angular unconformity and is unconformably overlain by Early Cretaceous rocks. Only the lowermost part of the basin succession, the 1450 m-thick Wessel Group (Fig. 2), is exposed onshore. Offshore the Wessel Group passes up into a largely unknown sequence, whose thickness, estimated by depths to aeromagnetic basement, is over 10 000 m.

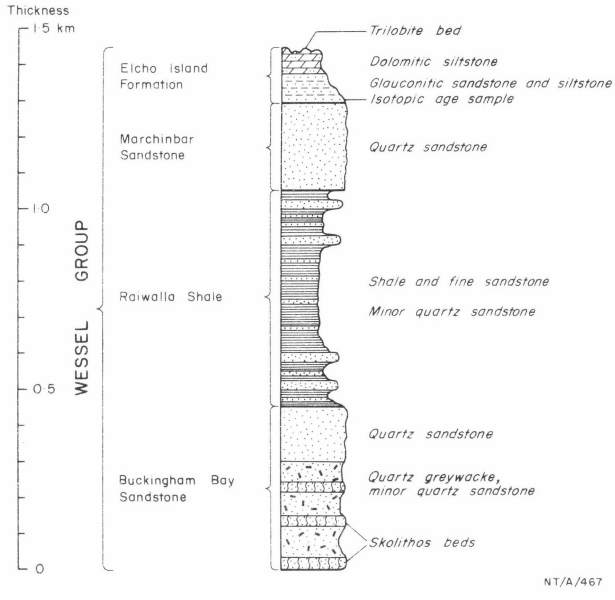

Figure 2. Schematic stratigraphic column

The assignment of the Wessel Group has been problematical: 'Permo-Carboniferous' (Brown, 1908; Jensen, 1914); Early Cambrian or Precambrian (Wade, 1924); Cambrian (?) (Plumb, 1963); Adelaidean or 'Upper Proterozoic' (Dunnet, 1965; McDougall, et al., 1965; Plumb, 1965; Dunn, Plumb & Roberts, 1966; BMR, 1967, 1974; GSA, 1971).

The tentative Cambrian age proposed by Plumb (1963) was based on the recognition of similar sequences in the Arafura Basin and unconformably overlying the McArthur Basin in the McArthur River region (Dunn, 1963; Plumb & Paine, 1964), and the occurrence of vertical tubes made by an unknown burrowing organism, *Skolithos*, in sandstones (Buckingham Bay and Bukalara) at the base of these sequences (Dunnet, 1965; Plumb, 1965; Plumb & Derrick, 1975).

However, isotopic dating of glauconite from the Elcho Island Formation, at the top of the Wessel Group in the Arafura Basin, produced ages of 770 m.y. by K-Ar and 790 m.y. by Rb-Sr methods (McDougal *et al.*, 1965). Since this was regarded as a minimum age for deposition, the Wessel Group was subsequently thought to be Adelaidean (or 'Upper Proterozoic') (eg. Dunnet, 1965; Plumb, 1965; Dunn, Plumb & Roberts 1965; BMR 1967). The range of *Skolithos*, found in northern Australia and elsewhere in rocks of Early Palaeozoic ages, was thus extended down to about 800 m.y., as noted by Glaessner (1966, p. 42).

Significance of New Dating

A Middle Cambrian age for the Elcho Island Formation at the top of the Wessel Group has important implications for the regional stratigraphy and proposed correlation of rock units of northern Australia (Fig. 3).

Although poor outcrop obscures the precise stratigraphic relationships between the Elcho Island Formation and underlying units in the Wessel Group, the formations show regional structural concordance and boundaries between them are gradational. Since there is no evidence for any major break in the sequence, the whole of the Wessel Group can be reassigned to the Cambrian with some confidence, and an Early or early Middle Cambrian age postulated for the occurrence of *Skolithos* at its base.

The Buckingham Bay Sandstone and Raiwalla Shale of the Arafura Basin have previously been correlated with the Bukalara Sandstone and Cox Formation (Dunn, 1963; Plumb & Paine, 1964) of the McArthur River region (Fig. 3), because of their strong similarity in rock types and structural setting, and the presence of *Skolithos* in the Buckingham Bay and Bukalara Sandstones. The Bukalara Sandstone also unconformably overlies the McArthur Basin (Roberts, Rhodes & Yates, 1963; Smith, 1964), and itself is generally overlain with slight unconformity by the Middle Cambrian Tindall or Top Springs Limestones (Dunn, 1963; Plumb & Rhodes, 1964). However, in the Hodgson River area, the Bukalara Sandstone is overlain by and intertongued with the Nutwood Downs Volcanics, which are regarded as equivalent to the Antrim Plateau Volcanics (Dunn, 1963). These correlations would seem to support an Early Cambrian age for the Antrim Plateau Volcanics.

The prospectivity of the Arafura Basin for hydrocarbons, dependant on the presence of a thick section of Palaeozoic rocks beneath the Mesozoic and Cainozoic of the overlying Money Shoals Basin, was reduced when a Proterozoic age was postulated for the Wessel Group. Since the Wessel Group marks the base of the Arafura Basin onshore, and Silurian fossils (palynomorphs) were found in one horizon of the otherwise unfossiliferous section intersected by Money Shoals No. 1 Well (Blake, *et al*, 1973), it is reasonable to reassign the whole of the basin succession to the Palaeozoic. The new fossil discovery therefore enhances the petroleum potential of the Arafura Basin.

Care has always been needed in interpreting isotopic ages obtained from glauconite; the experience in Australia has generally been that glauconite ages tend to be too young. Although McDougall *et al.* (1965) analysed only one sample, the age was considered reliable because of the close agreement between the K-Ar (760 m.y.) and Rb-Sr (790 m.y.) data. These ages are now clearly much older than the age of deposition (550 m.y.) of the rocks. Another example where the glauconite age is apparently too old is the Vaughan Springs Quartzite (Cooper, Wells & Nicholas, 1971; Marjoribanks & Black, 1974; 1280 vs 1076 m.y.).

An explanation of the anomalously old isotopic age of the glauconite is not immediately apparent, and further samples are under investigation. The glauconite sample originally analysed was a very pure concentrate, excluding contamination (R. W. Page, pers. comm., 1974). One possible explanation is that detrital glauconite was derived by erosion of a Precambrian terrain. However, the nearest and youngest available sources are the 1300 m.y. old Malay Road and Roper Groups, which are much older than the determined age (790 m.y.). It seems unlikely that soft glauconite pellets would survive transportation over the 50 km distance from the nearest source area. Furthermore, some of the glauconite is intimately associated with, and has apparently formed from, detrital biotite. Thus, another

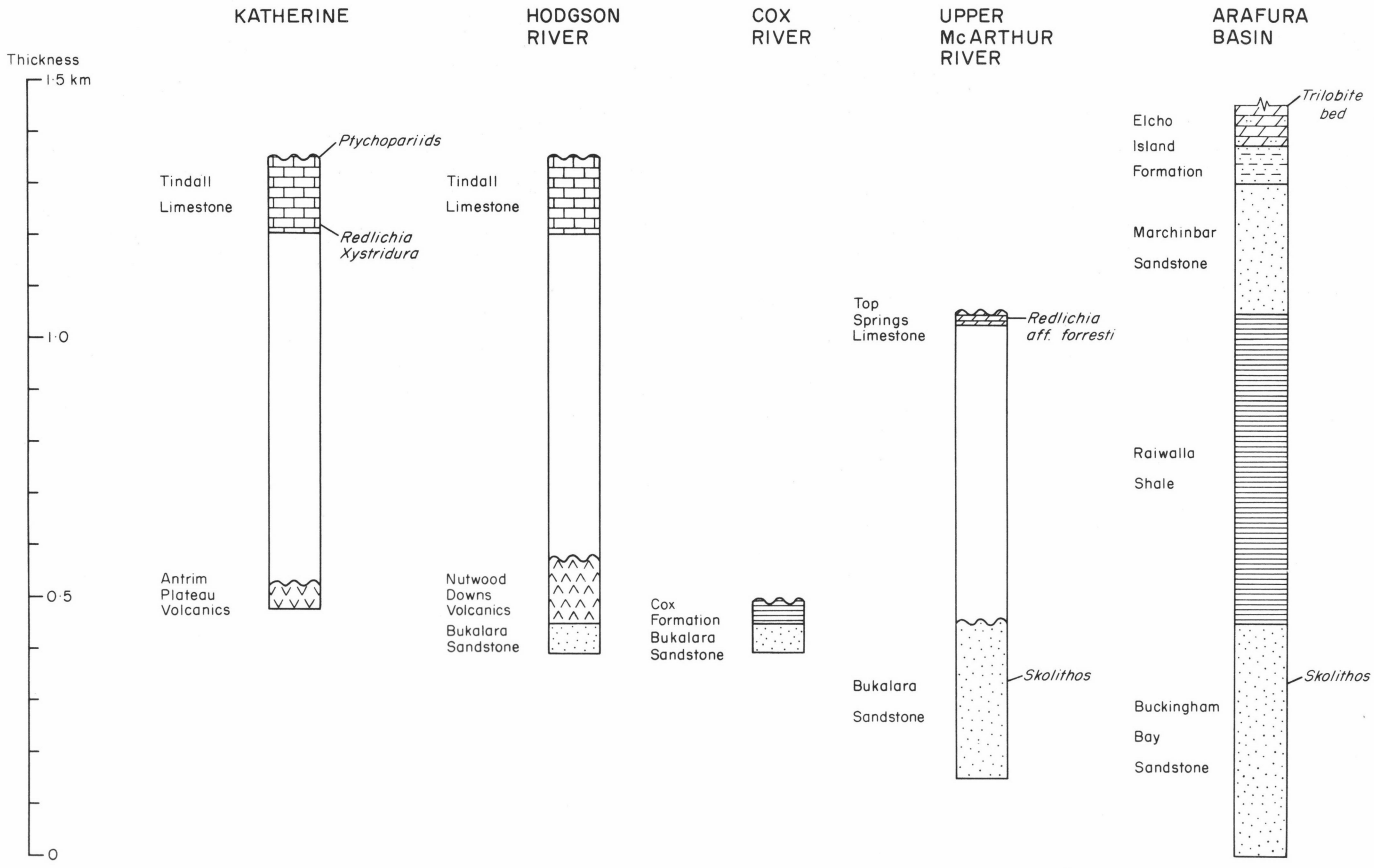

Figure 3. Regional correlation of Cambrian successions

explanation, favoured herein, is that the apparent age is partly inherited from the parent mica. The concordance of the original K-Ar and Rb-Sr data, however, still remains to be investigated.

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