Newly recognized Eocene sediments in the Beaufort River Palaeochannel

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Abstract

An Eocene palaeochannel has been identified for the first time on the western margin of the Yilgarn Craton. The 'Beaufort Palaeochannel' and its tributary have been traced for at least 60 km, from Quongering Pool, 25 km north-northeast of Kojonup, to Haddleton Springs, 60 km west-northwest of Kojonup. The palaeodrainage system probably discharged across the Darling Fault into the Perth Basin and was the precursor to either the Preston or Collie River.

The palaeochannel sediments comprise up to 65 m of sands, silts, and clays. They reflect initial deposition by a meandering riverine system, followed by development of lacustrine conditions as tilting of the Yilgarn Craton reduced the gradient for surface flow along the palaeoriver.

The sediments yield a rich spore–pollen assemblage of late-Middle to Late Eocene age, with no evidence for any marine affinities.

The relationship between the low-level palaeochannel sediments and the Kojonup Sandstone, which is at a higher elevation on a nearby modern drainage divide, is not certain. The Kojonup Sandstone may reflect coeval deposition in tributaries to the main palaeoriver. Alternatively, it may have been deposited prior to a period of rapid uplift and dissection within the Eocene, although the lack of widespread Eocene sedimentation in the Perth Basin makes this explanation less likely.

KEYWORDS: Yilgarn, Eocene, palaeochannel, sediment, Beaufort River.

An Eocene palaeochannel has been identified for the first time on the western margin of the Yilgarn Craton. Previously, Eocene sediments were known from the eastern and southern Yilgarn Craton (Balme and Churchill, 1959; Hos, 1975; Hocking and Cockbain, 1991; Kern and Commander, 1993), but the age of sediments in palaeodrainages that drained towards the west was uncertain. In the Blackwood River catchment (Fig. 1), and to the north, probable Eocene plant fossils in arenaceous sediments have been identified at a few localities on or near drainage divides (Wilde and Backhouse, 1977; Hill and Merrifield, 1993). Recent drilling has confirmed the presence of Eocene sediments in the newly defined palaeochannel (which drained to the west) of the westerly flowing Beaufort Palaeoriver. It is located to the west of the Meckering Line (Mulcahy, 1973), where Tertiary palaeodrainages have not previously been recognized (van de Graaff et al., 1977; Morgan, 1993) and where only one Eocene age has been reported (Hill and Merrifield, 1993).

This paper records the occurrence of these sediments and discusses their geological relationships. The recognition of Eocene palaeochannels in the southwestern Yilgarn Craton is important for the identification of low-salinity groundwater resources, which may occur where palaeochannels are not coincident with present saline drainages, such as at Dardadine near Darkan, to the north of the Beaufort River (Wharton, P. H., 1990, written comm.).

Previous work

Sediments described from many palaeochannels elsewhere in the western part of the Yilgarn Craton (Laws, 1993; Salama et al., 1993) have not been dated due to lack of suitable material. Eocene palaeochannel sediments in the western Yilgarn Craton were previously known from Darkin Swamp, 65 km east-southeast of Perth (Hill and Merrifield, 1993). The nearest definitely Eocene palaeochannels are just north of the Stirling Ranges (Appleyard, in prep.), adjacent to the Bremer Basin.

In 1992, R. J. George collected samples of cuttings from an exploration drillhole described by Muggeridge (1981) near Duranillin. These were determined to be Eocene in age and their geology and geomorphological position suggested that they were part of a palaeochannel system, as indicated on the geological map of Western Australia (Myers and Hocking, 1988).

In February 1994, groundwater exploration drilling programs were carried out to investigate both the

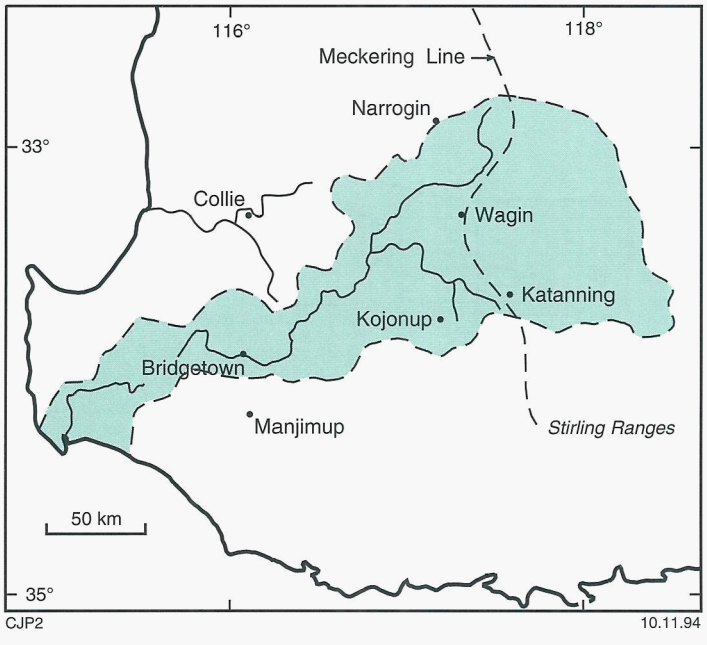

Figure 1. Blackwood River catchment

Geological and geomorphological setting

The study area is located within the southwestern portion of the Yilgarn Craton, where the bedrock mainly consists of Archaean granitic rocks. The area lies within the Darling Plateau, in the 'Narrogin semi-stripped etch plain' subdivision of Finkl and Churchward (1973). The highest points in the landscape are Archaean rocks at an elevation of about 360 m.

A number of post-Permian sedimentary units which overlie bedrock in the southwest Yilgarn Craton, including Bremer Basin sediments, have been described by Finkl and Fairbridge (1979) and Backhouse and Wilson (1989). Those for which firm dates have been established are Cretaceous or Tertiary in age.

Isolated remnants of the Kojonup Sandstone (which is of assumed, but unconfirmed, Eocene age, and fluvial in origin) are preserved on drainage divides at the southern margin of the Blackwood catchment (Wilde and Backhouse, 1977) at an elevation of about 320 m. These exposures are located within 20–30 km of the study area.

palaeochannel near Lake Towerrinning, and sediments in the Boscabel area where the occurrence of low-salinity groundwater was known from a 48 m-deep artesian borehole. The two areas are now recognized to be part of the same palaeochannel system (Fig. 2), and by the location and size of the palaeovalley it is inferred to be the former course of the Beaufort River. The palaeochannel has been recognized over a length of some 60 km, with a markedly different orientation to the modern drainage patterns in the Towerrinning area. The sediments it contains are Eocene in age.

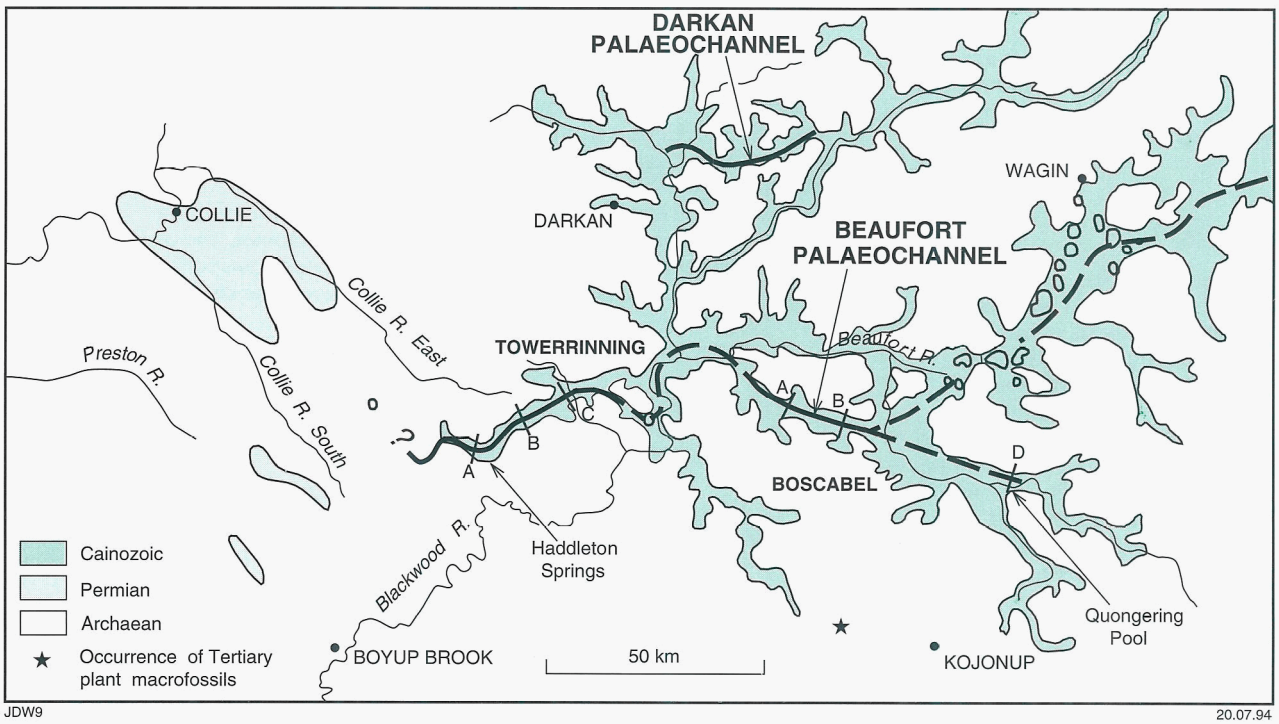

Figure 2. Location of the Beaufort Palaeochannel

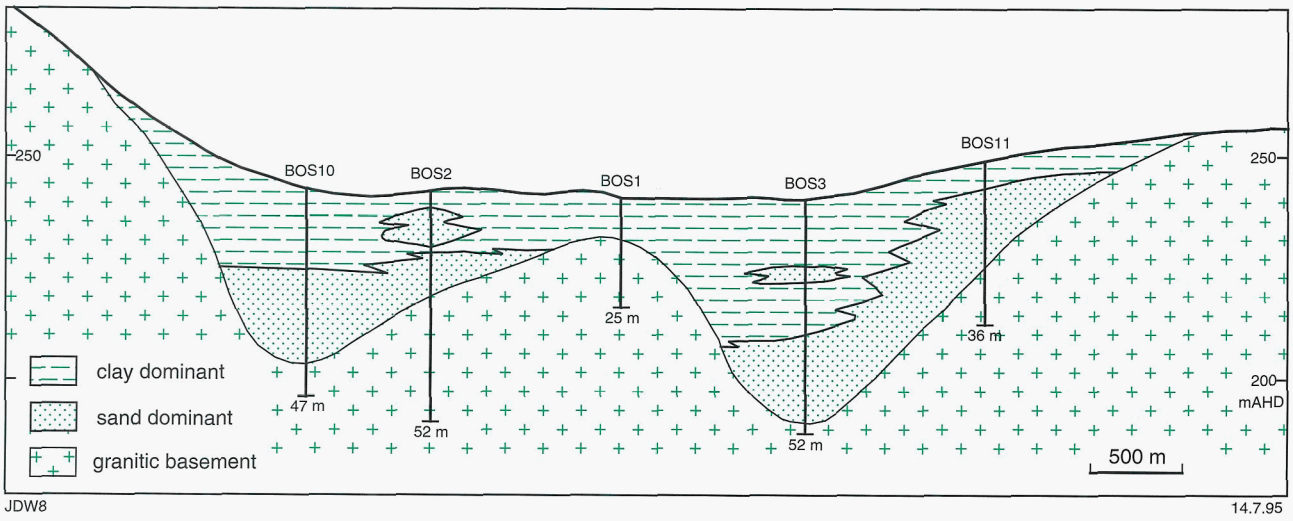

Figure 3. Geological cross section across the Beaufort Palaeochannel

The Beaufort Palaeochannel, where recognized over its length, occurs low in the landscape within a discontinuous valley. In places, the modern drainages cross this palaeovalley, making its continuity less obvious; however, its course can be traced once these overprinting features have been recognized. In comparison with the known outcrops of Kojonup Sandstone, the valley floor where the Beaufort Palaeochannel is present ranges in elevation from 220–260 m (Fig. 3), with the base of the sediments as much as 60–70 m lower. The palaeochannel sediments are thus consistently 100–150 m lower than the nearest known outcrop of Kojonup Sandstone.

Stratigraphy

The sediments in the palaeochannel can be divided into two units. The lower unit consists of interbedded sands, clayey sands, and clays, which are all carbonaceous in places. The upper unit, where present, is dominantly composed of clay and silt, with lesser amounts of sand. The lower unit is commonly dark brown and grey, and is oxidized in places to yellow and red, whereas the upper unit is typically pale grey to white.

The sediments in the lower portion of the palaeochannel occupy a relatively narrow channel that is 200–500 m wide. They overlie weathered Archaean bedrock. In places, the overlying clay extends over a wider area to the flanks of the palaeovalley (Figs 3 and 4). White clay, presumably weathered, can be seen close to the surface along parts of the course of the palaeochannel in excavated farm dams. Its characteristically massive appearance distinguishes it from exposures of deeply weathered basement rock, in which some remnant igneous or metamorphic textures are preserved.

At most locations the sequence includes a wide range of interbedded sediments without a consistent upper clay unit. The multiple layers of differing sedimentary materials show little apparent correlation from borehole to borehole, which typically are spaced at 400–500 m intervals along the transects. This is interpreted to reflect deposition by a meandering river system with an associated wide range of depositional environments within the palaeovalley. Later, more uniform lacustrine conditions may have prevailed throughout the system, with subsequent erosion of some of the areas where lacustrine clay was deposited. Alternatively, a system of separate lakes may have developed along the palaeovalley as gradients decreased, in a similar way to the chains of lakes presently occupying the palaeodrainage east of the Meckering Line (Fig. 1).

On Towerrinning Transect C (Fig. 2), the lacustrine clay is well developed and overlain by a second fluvial sand sequence with an overlying less well-developed clay. The deeper sands, in the earlier-formed fluvial sequence, are subrounded to rounded, typical of those elsewhere in the palaeochannel, and are believed to have been transported along it. However, the shallower sand is

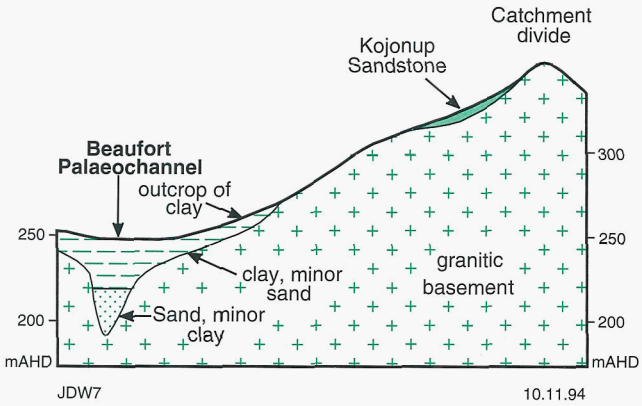

Figure 4. Relationship of Tertiary units in and around the Beaufort Palaeochannel

remarkably angular and appears to have been derived locally. The upper fluviatile/lacustrine sequence, with its angular sands, may reflect local rather than regional conditions along the palaeodrainage.

Palynology

Carbonaceous material from depths of 12 to 42.5 m, representing almost the entire palaeochannel sequence, contained rich and diverse spore and pollen assemblages. The assemblages are dominated by *Haloragacidites harrisii*, *Nothofagidites* spp., bisaccate gymnosperm pollen, and a diverse range of proteaceous pollen. Marine indicators have not been recorded from any samples examined to date.

The spore–pollen assemblages belong in the Middle or Upper *Nothofagidites asperus* Zone of Partridge (1976) and Stover and Partridge (1982), with a possible late-Middle to Late Eocene age. Broadly similar Eocene spore–pollen assemblages are recorded from the Bremer Basin (Hos, 1975; Stover and Partridge, 1982) and from the western margin of the Eucla Basin (Milne, 1988).

Geological evolution

The sedimentary sequence in the Boscabel–Towerrinning area provides a record of early Tertiary geological events in the southwest Yilgarn Craton.

Prior to the Eocene epoch, flat-lying sediments of the Cretaceous Nakina Formation (Backhouse and Wilson, 1989) were deposited, overlying Permian strata. These are preserved in the Collie, Boyup, and probably Wilga Basins. Their elevation and attitude indicate that the present Darling Plateau was in existence at that time. The absence of extensive deposits of clastic sediments younger than Early Cretaceous in the southern Perth Basin suggests an absence of significant erosion from the southern Darling Plateau, although local erosional events associated with the Avon Palaeoriver in the Perth area correspond with the deposition of the Kings Park Formation during the Paleocene.

The palaeochannel trends westwards from Towerrinning, suggesting that the Beaufort Palaeoriver discharged across the Darling Scarp in the vicinity either of the present Collie River, which occupies a deep valley through the Darling Scarp, or the Preston River, which contains a substantial thickness of sediments that are as yet undated (Commander, 1993).

The relationship of the palaeochannel sediments with the more elevated Kojonup Sandstone is intriguing. If the Kojonup Sandstone represents an earlier deposit on a landscape that was subsequently rapidly dissected by uplift associated with continental breakup along the margin of the craton, substantial evidence of sedimentation in the Perth Basin might be expected; however, it is more likely that the Kojonup Sandstone represents deposits that were formed by tributaries coeval with the basal sediments in the main valley.

Further uplift from the west is likely to have reduced the gradient sufficiently enough for fluvial sedimentation along the drainage to cease, with lacustrine conditions developing instead. Subsequent tilting to the south (Cope, 1975) has resulted in drainage diversion and capture, and the modern Blackwood River has cut through Archaean bedrock south of Lake Towerrinning to behead the ancestral Beaufort River. The palaeochannel west of Towerrinning has also been cut by Darlinup and Haddleton Creeks, both of which are southerly flowing tributaries of the Blackwood River.

The palynomorph assemblages indicate that Eocene marine influences do not appear to extend into the Blackwood catchment, and are restricted to the area south of the Ravensthorpe Ramp (Hocking and Cockbain, 1991).

Deep weathering and lateritization of the Archaean bedrock and exposed Kojonup Sandstone appears to post-date the deposition of the palaeochannel sediments. This is consistent with development of laterite on a dissected surface as postulated by Playford (1954) and Prider (1966).

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