Australasian Quaternary Association Inc.
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AQUA 30th Anniversary Pre-Conference Field Trip

Along the Burke and Wills Track

Melbourne to Mildura

ca. 600 km

Saturday 28th June 2014

Bernie Joyce

Itinerary

Leave Melbourne and on Calder Freeway travel across basalt plains of the Newer Volcanic Province of Southeastern Australia, with 3Ma old flat-topped volcanoes near Sunbury and also younger volcanoes; flows heading downslope (south) towards Port Phillip Bay.

Great Divide at Mt Macedon

Bypass Kyneton

Campaspe River and nearby plateaus capped by lava flows which ran downslope to the north (inland).

Mt Alexander ahead (north) – a long granite and metamorphic ridge.

Harcourt - granite tors and deep regolith in cuttings.

At Ravenswood take road to Marong and Bridgewater, bypassing Bendigo.

Leave the Western Uplands and follow down the Loddon Fan on to the Loddon Plain, part of the Riverine Plains.

Serpentine, Bears Lagoon, Durham Ox.

Pyramid Hill and Mt Hope of the Terrick Terrick Range to the east (right). Red Brown Earth soil developed on parna (wind-blown calcareous clay).

Leaghur Fault and Gredgwin Ridge to west (left) across Loddon Fan.

Tragowel Swamp – Burke & Wills camp number 12. (Turn off left about 10 km south of Kerang.)

Kerang, with Lake Wandella and lunette to the west after leaving town.

A series of lunette lakes including Lake Charm and Kangaroo Lake; Avoca River from the west (left) meets course of Loddon River.

Pass Lake Tutchewop to the east, and then Lake Boga just to the right of the road.

Swan Hill on the River Murray – Burke & Wills Explorers' Memorial, Moreton Bay fig tree, Charley Gray Memorial and camp number 15 in Riverside Park.

North out of Swan Hill, across a large palaeolake - the "Flats" irrigation area - to Tyntynder Homestead.

Nyah West railway cutting with section of east-west Mallee dunes ("Linear Dunes" of GEOMORPHIC MAP OF MALLEE REGION by Bowler) and palaeosols.

West across east-west Mallee dunes to **Towan Plains Boinka** of Macumber - **gypsum (copi) flats and dunes**.

Chinkapook - take road southwest to Daytrap area (weather permitting). Box Gully archaeological and geomorphological sites to south (left) - not stopping).

(If necessary leave Chinkapook on alternate road NW then west to join Calder Highway.)

Views of Lake Tyrrell from lookout near northwest corner.

Join Calder Highway and then west and north to Ouyen.

North to Hattah Lakes (east, right) and parabolic dunes of Sunset Desert to west, with **possible lookout stop** to view the Raak Boinka and Raak Plain (west, left).

Following near the left bank of the River Murray through Redcliffs to **Mildura**.

References

Bowler, J.M., Kotsonis, A. & Lawrence, C.R., 2006. Environmental evolution of the Mallee region, Western Murray Basin. Proceedings of the Royal Society of Victoria 118 (2): 161-210. ISSN 0035- 9211.

Joyce, Bernie & McCann, Doug. 2011. Geology, soils and landscapes of the expedition route. Chapter 3, In Joyce, E. B. & McCann, D. A. (eds), 2011. Burke & Wills: The Scientific Legacy of the Victorian Exploring Expedition, CSIRO PUBLISHING, Collingwood, Australia. pp.58-96.

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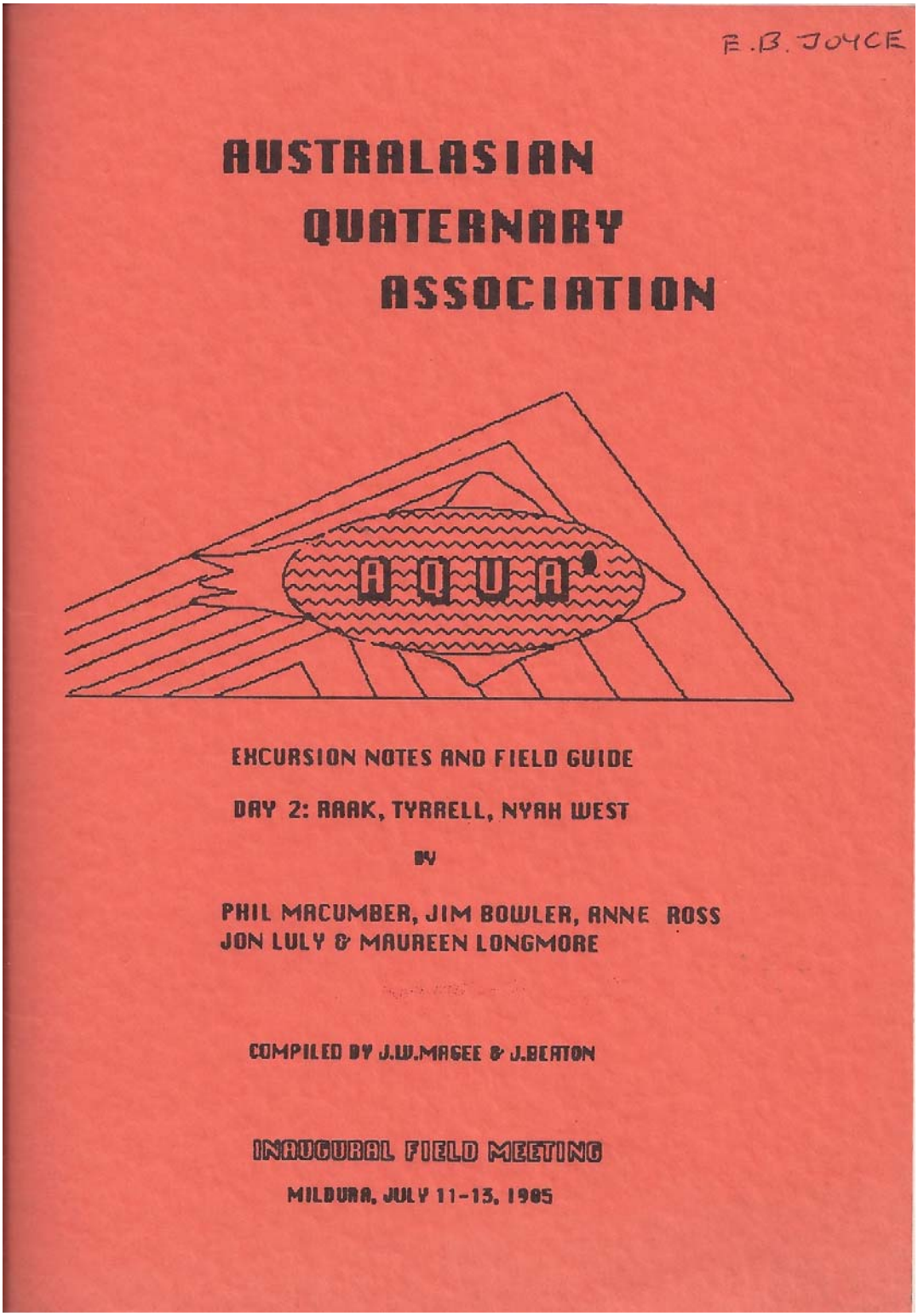

The first time…

ENVIRONMENTAL EVOLUTION OF THE MALLEE REGION, WESTERN MURRAY BASIN

JIM M. BOWLER, ANDREW KOTSONIS & CHARLES R. LAWRENCE

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BOWLER, J.M., KOTSONIS, A. & LAWRENCE, C.R., 2006. Environmental evolution of the Mallee region, Western Murray Basin. *Proceedings of the Royal Society of Victoria* 118 (2): 161-210. ISSN 0035-9211.

The Mallee region preserves legacies of past environmental changes, an understanding of which illuminates our understanding of the present and constrains some options for the future. An amazing record of sea level changes spanning the last 6 million years provides a template against which later developments of lacustrine and aeolian changes are defined in spatial and temporal contexts. The preserved shorelines of Plio-Pleistocene Parilla Sand provide a virtual contour map of Plio-Pleistocene landscapes clearly displaying effects of later tectonics. Development of acidic lateritic soil profiles of the Karoonda Surface progressed synchronously with tectonic interruption of drainage to form the large freshwater lake, Lake Bungunnia about 3.5 million years ago. Lake Bungunnia cut a southern overflow channel to the sea excavating the Douglas Depression until uplift on the Padthaway Ridge reached near 60 m AHD. Overflow ceased, the lake temporarily became a closed system with development of alkaline facies in the west, the Bungunnia Limestone. Climates throughout this time remained wet and relatively warmer than today. A later outlet in the south-west drained the lake about 5-700,000 years ago. Major environmental changes are recorded in the transition from low energy, siliceous Parilla Sand to high energy Bridgewater calcarenites near 1.3 ma (millions of years). Pliocene 20-40 ka (thousands of years) cyclic sea level oscillations were followed by 100 ka full glacial cycles near 1 million years ago. Later expansions of aridity in dune fields and associated calcretes are superimposed on a previously humid controlled landscape. High discharge Murray River incision on the dry lake floor preserves a pattern of high amplitude variability (big wet to big dry) far exceeding anything in younger sequences. Dune fields of the Big Desert, Sunset and Little Desert expanded to the east. Wet and dry events of the last glacial cycle (last 120,000 years) preceded maximum aridity of the glacial maximum near 20 ka. The arrival of people near 60-50 ka introduced an entirely new agent of change into the already fragile Mallee landscapes. The scene was set for the much later arrival of Europeans, the impact of which is now superimposed on 6 million years of natural environmental change. The lessons from one are essential to a better understanding of the other.

Key words: Climatic change, eustatics, tectonics, Lake Bungunnia, palaeohydrology, mineral sands, Northwest Bend Formtion

THE MALLEE REGION of semi-arid south-eastern Australia, with its expansive dune fields traversed by Australia's major river system provides a key area to elucidate Australia's semi-arid landform history. Its broad range of spatial and temporal data offers unique insights into climatic change, system dynamics and biological responses. Additionally, the Mallee is host to an expanding tapestry of archaeological data with time depth and levels of detail rarely equalled elsewhere in the world. This is recognised in the establishment there of one of Australia's major heritage sites, the Willandra Lakes World Heritage region.

The geomorphology and geological history set the scene for exploring this unique legacy of natural and cultural change. Following the footsteps of many previous workers, this paper expands on new data derived mainly from improved topographical analysis. The legacy of Plio-Pleistocene marine shorelines provide a baseline against which later tectonic, lacustrine and aeolian events have combined with changing fluvial systems to provide the landforms of the region today.

In two respects, this contribution responds to and builds upon new data sets previously unavailable to earlier workers. Firstly, new stratigraphic data are provided by detailed mapping of Kotsonis (1995) and by synthesis of outcrop and core details in the Victorian sector by Thorne et al. (1990). Secondly, the last few years have seen a virtual explosion of surface information by way of satellite imagery now immediately accessible by internet access (*Google* or *Whirlwind* systems). Thirdly, the recent acquisition of detailed topographic data via

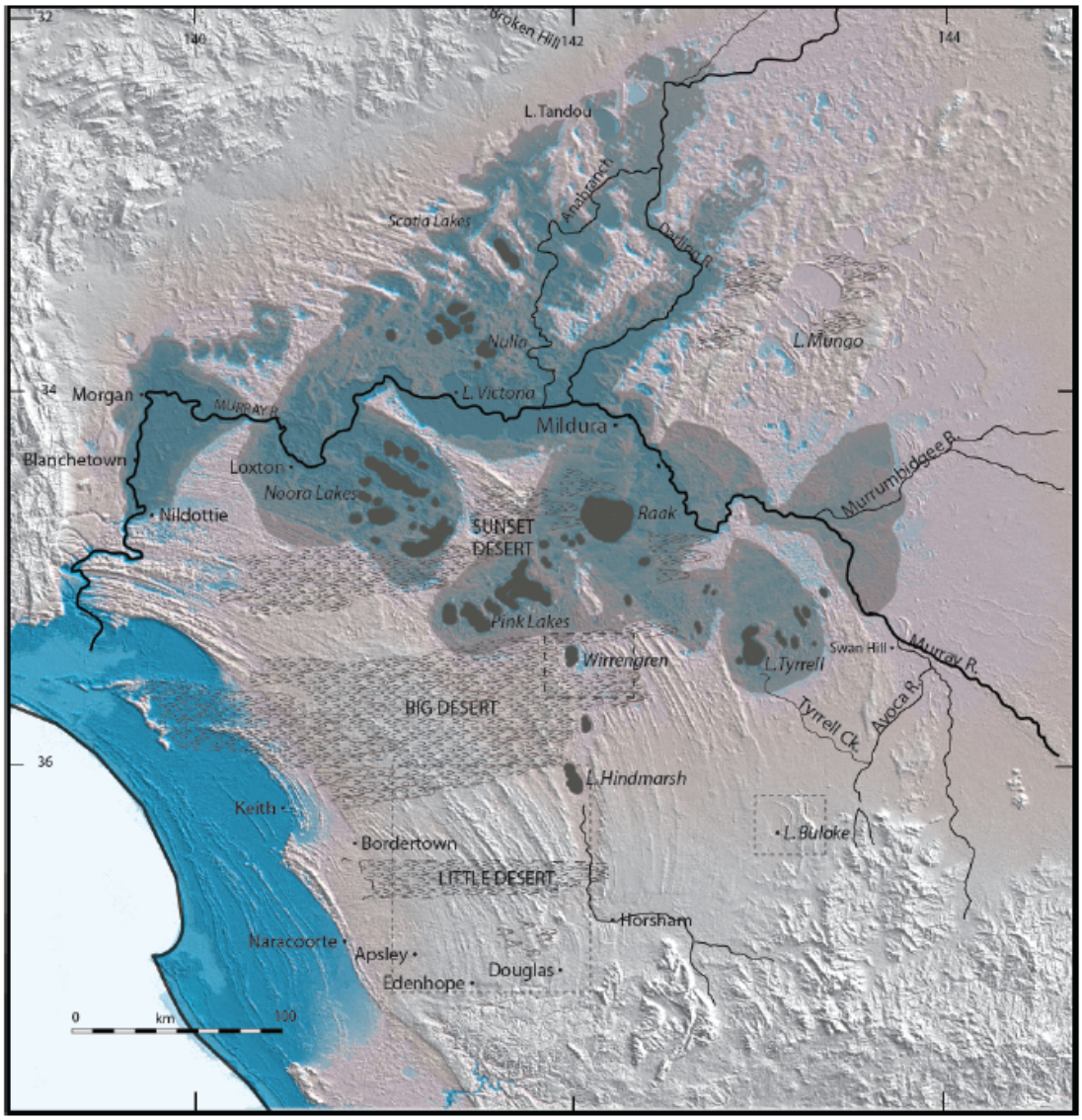

Fig. 10. Elevation diagram showing salt lakes (salinas) and boundaries of major parabolic and irregular dune fields (Lowan Sands of Lawrence, 1980, and Molineaux Sands of Firman, 1966c) in western Murray Basin with outlines of the former lake. Note association of salinas with central depressions of Lake Bungunnia basins. Boxes define area of Figs. 11 & 12.

comm) proposed lake formation by damming a major drainage system, that of the ancestral Murray which flowed south excavating a wide valley now occupied by the Wimmera River , the Douglas Depression (Figs. 10 & 11).

In this alternative interpretation, the Douglas Depression is seen as defining the course of the ancestral Murray in which uplift near Douglas resulted in the formation of Lake Bungunnia. This theory makes an important contribution in drawing attention once more to the anomalous nature of the Wimmera River flowing in the Douglas Depression. However, the notion of lake formation by uplift and defeat of a south-flowing ancestral Murray River by uplift near Douglas is not supported by geomorphic evidence.


Along the Rivers
B400
C246
SWAN HILL
Camp 15
Riverside Park
Murray River
NEW SOUTH WALES
Murray River
C261
Lake Boga
Camp 14
The Clump
Murray Valley Highway
Murray River
Lake Tutchewop
B400
Kangaroo Lake
C263
Lake Charm
Lake Charm
Third Lake
Middle Lake
Salt Lake
Camp 13, Reedy Lake
Reedy Lake
KERANG
Camp 12
Tragowel
10 km
Tragowel
Swamp
B260
Loddon
River
109

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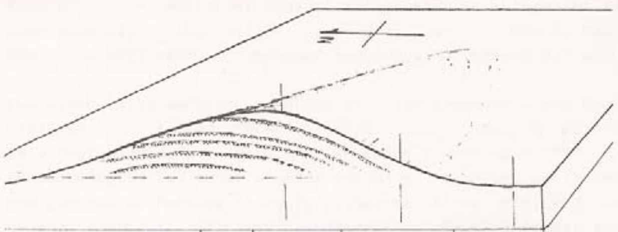
GEOMORPHOLOGY OF THE MALLEE REGION



DEPTH	Clay	$CaCO_3$	Clay	$CaCO_3$	Clay	$CaCO_3$
0–50cm	5	1	15	1	11	1
50–100cm	16	5	25	20	29	16

FIG. 5 — Perspective diagram showing relationship of internal soil horizons to form of subdued linear dune. Geometry of buried soil horizons (not necessarily groundsurfaces), extrapolated from photograph of Nyah West railway cutting. Analyses refer to catenary data; the two sets of figures refer to percentage clay and carbonate respectively on crestal, midslope and swale sites. Profile data generalised after Rowan and Downes (1963) and Churchward (1963).

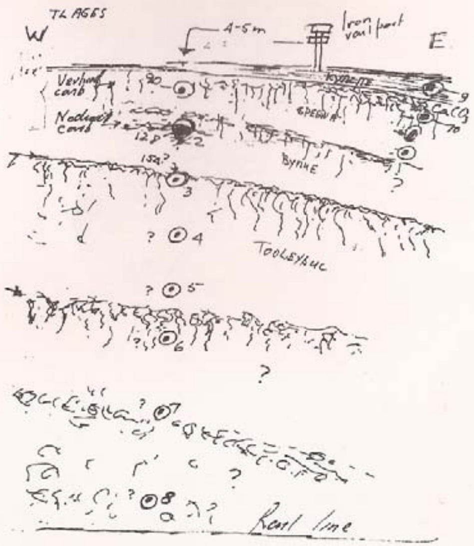
Note on TL dating
John Prescott of Adelaide (?)
Dates opposite from MD by ?

NYAH WEST Jim Bowler

The railway line travelling to the north-west has intersected one of the typical west-east longitudinal Mallee dunes. These dunes, surveyed in detail by Max Churchward, reveal a buried soil complex in which up to 5 carbonate zones pick out ancient soil horizons. Each soil represents a period of relative stability following those unstable conditions during which dune accretion occurred during relatively arid episodes.

In their morphology and sediment content these subdued, relatively short dunes which occur throughout the Mallee are significantly different from the steeper, more mobile quartz dunes. Their high clay and carbonate content is particularly significant. In thin section, the clays reveal relict pelletal fabric suggesting deflation from swales in a manner related to those processes of efflorescence that produce the clay-rich transverse dunes, the lunettes.

One of the intriguing questions they pose is just how they relate to those other dune-buillding events recorded throughout the region such as the lunettes on the shores of Tyrrell or the Willandra stratigraphic sequence. New dating evidence is shedding light on these questions.



TL AGES : KYALITE ≈ 22-28K
SPEEWA ≈ 120-140K

next layer below ca 200 K } say JMB at outcrop

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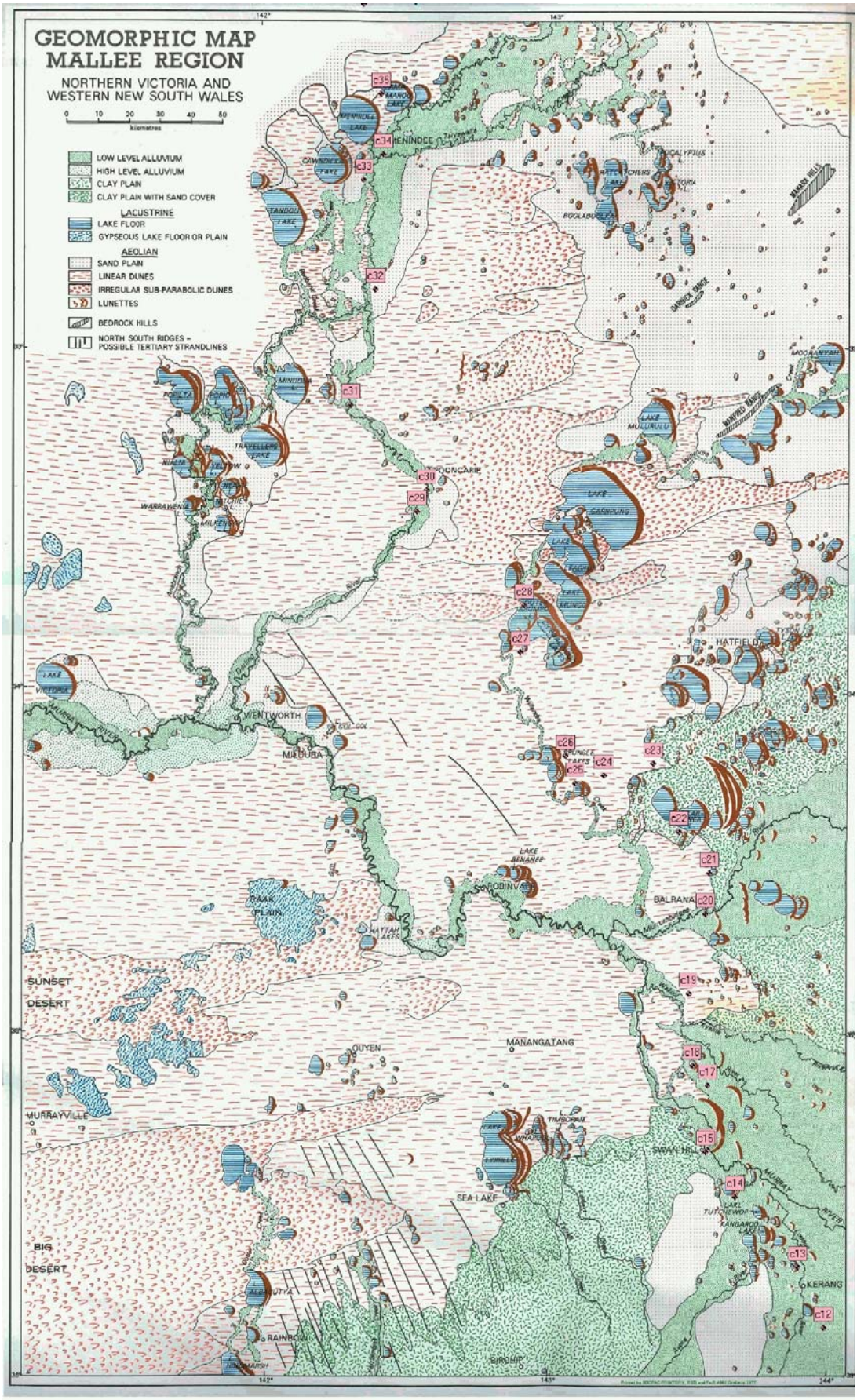

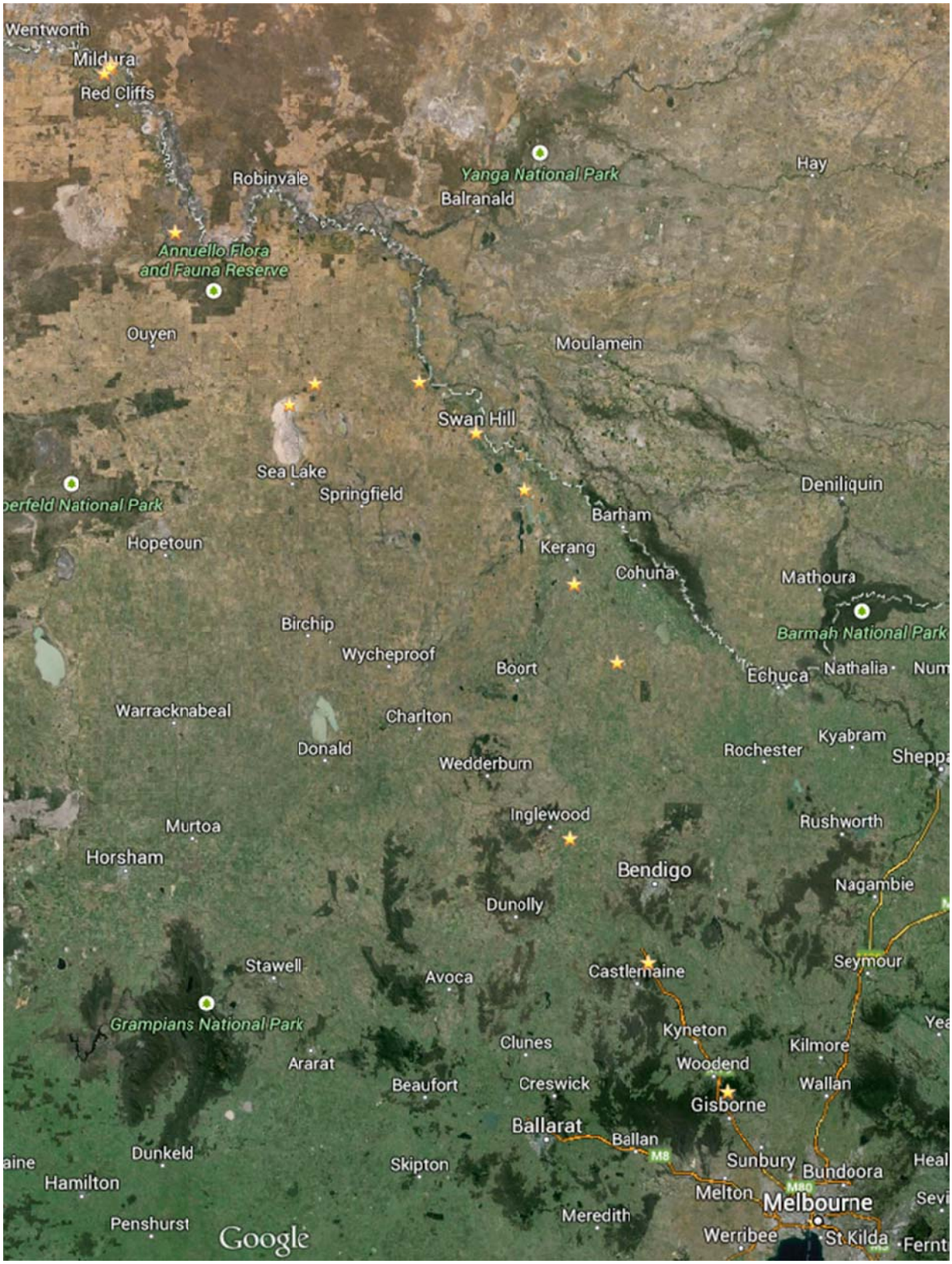
Wentworth
Mildura
Red Cliffs
Robinvale
Yanga National Park
Balranald
Hay
Annuello Flora and Fauna Reserve
Ouyen
Moulamein
Swan Hill
Sea Lake
Springfield
Deniliquin
Barham
Hopetoun
Kerang
Cohuna
Mathoura
Barmah National Park
Birchip
Wycheproof
Boort
Echuca
Nathalia
Warracknabeal
Charlton
Donald
Wedderburn
Kyabram
Rochester
Inglewood
Rushworth
Murtoa
Horsham
Bendigo
Nagambie
Dunolly
Seymour
Stawell
Avoca
Castlemaine
Grampians National Park
Kyneton
Clunes
Kilmore
Ararat
Woodend
Beaufort
Creswick
Wallan
Gisborne
Ballarat
Ballan
Dunkeld
Skipton
Sunbury
Bundoora
Hamilton
Melton
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Penshurst
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