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MURRAY BASIN HYDROGEOLOGICAL PROJECT

PROGRESS REPORT 7

for half year ending 31 March 1982

Compiled by W.J. Perry

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MURRAY BASIN HYDROGEOLOGICAL PROJECT

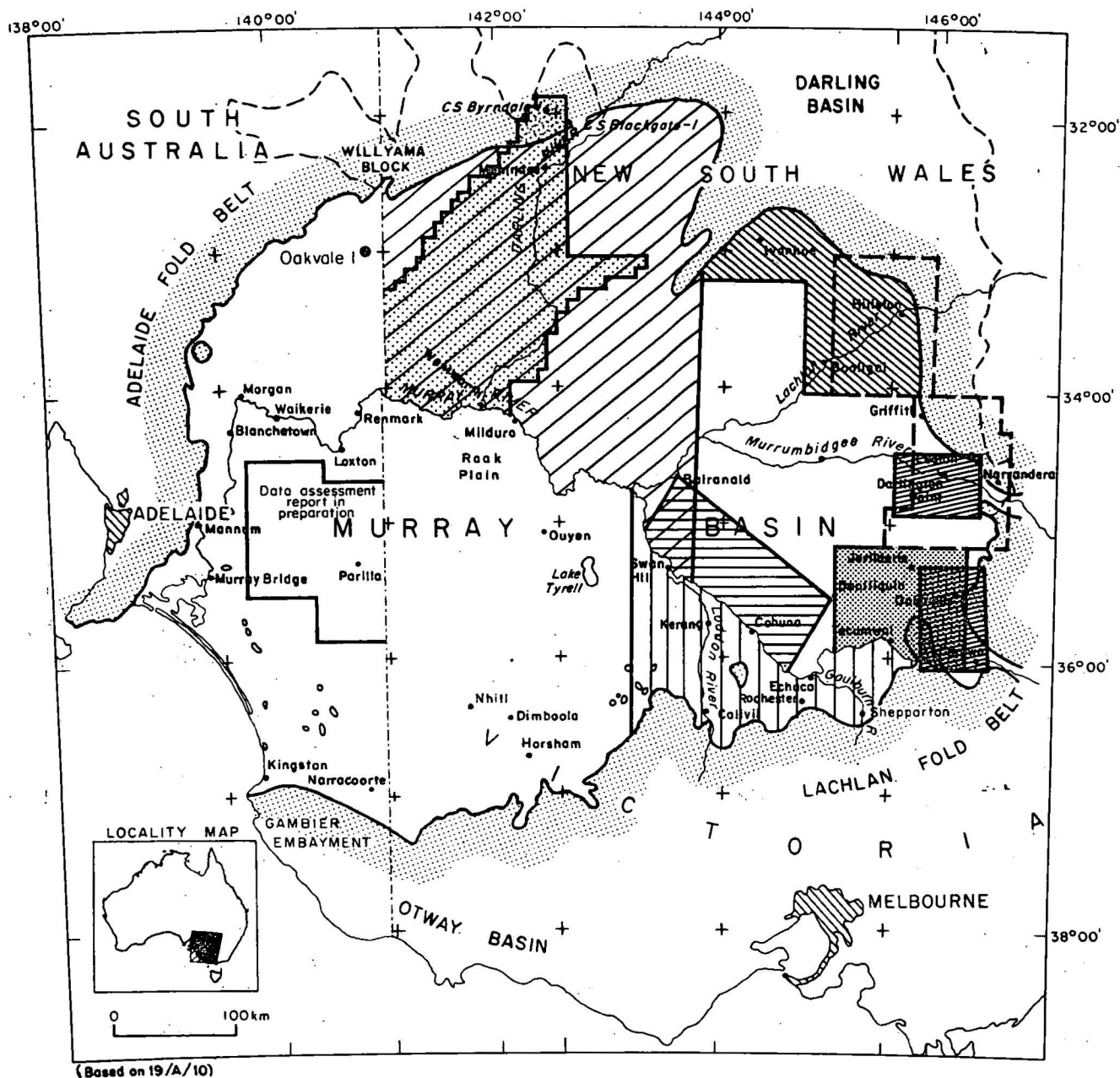
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Water Resources Commission

Geophysical survey

Water sampling

Hillston area

Potentiometric levels and, in Darling Point area, water dating

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Geological Survey of Victoria

Groundwater/salinity studies

NSW Petroleum Exploration Activity

Comserv farmout to ESSO

Comserv reprocessing of geochem

Meekatharra Minerals seismic

19/A/14

Fig.1 Locality diagram

MURRAY BASIN HYDROGEOLOGICAL PROJECT

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INTRODUCTION

Steady progress with the first phase of the Project continued. Two highlights during the period described in this report are first, the design and implementation of a preliminary groundwater model of the whole Basin, and second, the field inspection of parts of the Basin in South Australia, Victoria and New South Wales undertaken by Project workers during October 1981 mainly to discuss stratigraphic correlation problems. The Steering Committee met in Sydney on 5th November, 1981.

PROGRESS REPORTS

SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

by

S.R. Barnett

Ten holes have been completed in the western margin area to investigate the Murray Group and Renmark Beds aquifer systems. A levelling program of Departmental bores in the northwestern margin is continuing.

A data assessment of the Mallee region has been completed and a report is in preparation. A field survey of existing wells within 5 km of the river, south of Morgan, has been completed and wells selected for levelling.

Radio-isotope work by CSIRO has shown that sinkholes allow a considerable amount of local recharge in areas near Blanchetown. Recharge has been found to be considerably higher under cleared sand dunes than under those covered with mallee.

Biostratigraphic examination of stratigraphic hole Oakvale No. 1 is almost complete and a report is in preparation. Only the Oligo-Miocene transgression has been detected in the fossiliferous section of this hole. This particular transgression is also being studied in holes near Mannum. The Geera Clay appears to be a very useful lithostratigraphic unit to be applied in the northwestern margin.

WATER RESOURCES COMMISSION OF NEW SOUTH WALES

by

D.R. Woolley

1. Geophysical Interpretation:

Thirty-five km of seismic refraction traversing was completed in the area between Deniliquin and Balranald. Interpretation and compilation of the geophysical data is proceeding and should be completed by mid-1982.

A report on the geophysical surveys by the Commission in the New South Wales section of the Ovens Valley Graben should be completed by the end of 1982.

2. Bore/Stratigraphic Data:

Compilation of stratigraphic data from the Hillston area is proceeding and should be completed by mid-1982.

3. Potentiometric levels:

- (a) Darlington Point Area: Water level data from this area (which in some bores now cover a period of 10 years) are being examined to determine the effects of irrigation on the head conditions in different levels of the aquifer system.

3.

- (b) Jerilderie Area: Water level data from a number of sources are being compiled to show the past and expected future effects of extensive irrigation in this area.
- (c) Regional: Water level data from a number of sources are being compiled in an attempt to produce a regional potentiometric surface map for the top aquifer.

4. Water chemistry:

A systematic sampling program is being conducted in the N.S.W. part of the Basin west of Balranald. About 150 bores have been sampled and the area should be completed by the end of 1982. Samples are being analysed for major ions.

5. Water Dating:

The results of a carbon-14 water sampling program in the Darlington Point area conducted by the Atomic Energy Commission in conjunction with the Water Resources Commission, have been compiled and a report on this work will be available in May, 1982.

GEOLOGICAL SURVEY OF VICTORIA

by

C.R. Lawrence

At the recent Institution of Engineers Hydrology conference (Melbourne, May 11-13), Dr Rob Williamson presented a paper describing the work done on a preliminary groundwater model of the Murray Basin. Hydrogeological data compiled and supplied by BMR, WRC, and DME were used in a three-dimensional steady state finite difference groundwater flow model. Aquifer recharge in the major irrigation areas was estimated from data in the 1970 Murray Basin consultants report, and groundwater extractions were estimated from a recent

AWRC survey of water use in Australia. Recharge and discharge over the basin was estimated using a simple approximation based on the relative difference between ground surface and head. The modelling exercise must be considered approximate and very broad brush, for example 75 km square grids were used, thus detailed predictions cannot be made, however some generalised conclusions can be reached.

Two steady state situations were modelled, the first represented the pre-European settlement scenario, the second, that of the present day. In both cases major discharge areas were predicted along the main rivers downstream from about Swan Hill and in the Mallee Region of Victoria. The major surprise was that the aquifer systems accepted only 30 to 50% of the estimated drainage from each of the major irrigation areas. It seems that the other 50 to 70% must appear as surface discharge (i.e. evaporation and streamflow) within the irrigation areas themselves. Further, it seems that this situation has not been reached as yet, consequently any water table and salinization problems could be viewed as only just commencing.

In the modelling the same recharge-discharge function of head was used for each of the two scenarios, i.e. any change of recharge due to land-use is ignored. Recent evidence indicates that it is not unreasonable to expect a tenfold increase in recharge as a consequence of the conversion from native vegetation to conventional dry land agriculture. It is hoped that it will be possible to include data of this type in the next version of the Murray Basin Groundwater model.

For the eastern part of the Murray Basin the groundwater/salinity studies continue, carried out by S. Tickell and W. Humphreys. Main progress has been:-

- a) Hydrogeological Mapping : The Bendigo 1:250 000 Sheet has been completed and is ready for drafting.

- b) Intermediate depth drilling - Rochester : Study completed, unpublished report 1982/7.
- c) Regional drilling : Twelve holes were drilled during 1981. Piezometers were installed at 5 sites with four monitoring the Calivil Formation and one the Shepparton Formation. As yet none of these bores have been surveyed.
- d) Pump-testing the deep aquifer : Five twenty-four hour tests were carried out on the Calivil Formation and Renmark Group aquifers. This included one test on a privately owned bore.
- e) Geophysical surveys by G. Pettifer : Five seismic/resistivity traverses were carried out at Yarrawonga (on the Murray 40 km west of Corowa), Rochester, Elmore (on the Campaspe River 17 km south-southwest of Rochester), Corop (14 km southeast of Rochester) and Nagambie (on the Goulburn River about 50 km upstream from Shepparton). The purpose was to determine bedrock topography for bore hole location and to calculate cross-sectional area of valley-fill type aquifers. Preliminary results have been obtained and reports on this work will be completed in 3 months time.
- f) AEC water sampling.

N.S.W. DEPARTMENT OF MINERAL RESOURCES

by

D.H. Probert

1. COAL EXPLORATION

(a) MURRAY BASIN

Discussions have been held with officers of the New South Wales Department of Industrial Development concerning the Tertiary brown coal potential of the northwestern portion of the Murray Basin in New South Wales.

(b) MURRAY INFRABASIN COAL DRILLING PROGRAM

The drilling program was completed and final reports prepared in 1981. A proposal for a further coal exploration program in the Oaklands area is being considered.

(c) PACIFIC COAL PTY LTD

Assessment of coal resources is continuing.

(d) MITSUBISHI PTY LTD

The company has submitted a coal conversion feasibility study to the Department. A review of this document is to be carried out.

2. PETROLEUM EXPLORATION ACTIVITY

- (a) Comserv (No. 779) Pty Ltd - recently farmed-out a major portion of their work commitment to ESSO. ESSO as operator is to undertake a 930 km seismic survey within the next 18 months and drill two holes to 2500 m within the next 24 months - with a total minimum expenditure of \$2.8 million. The seismic traverses are to be run over geochemical anomalies identified from Comserv's earlier work. The Department has not, as yet, been given the exact position of these surveys. The work will be conducted within PEL's 212, 213, 214 and 216.
- (b) Comserv (No. 779) Pty Ltd PEL's 233, 234 - re-processing of previously run geochemical surveys.
- (c) Meekatharra Minerals Ltd PEL 231 intends to carry out seismic investigation in two areas north and east of Jerilderie. This will be followed by drilling if results obtained are promising.

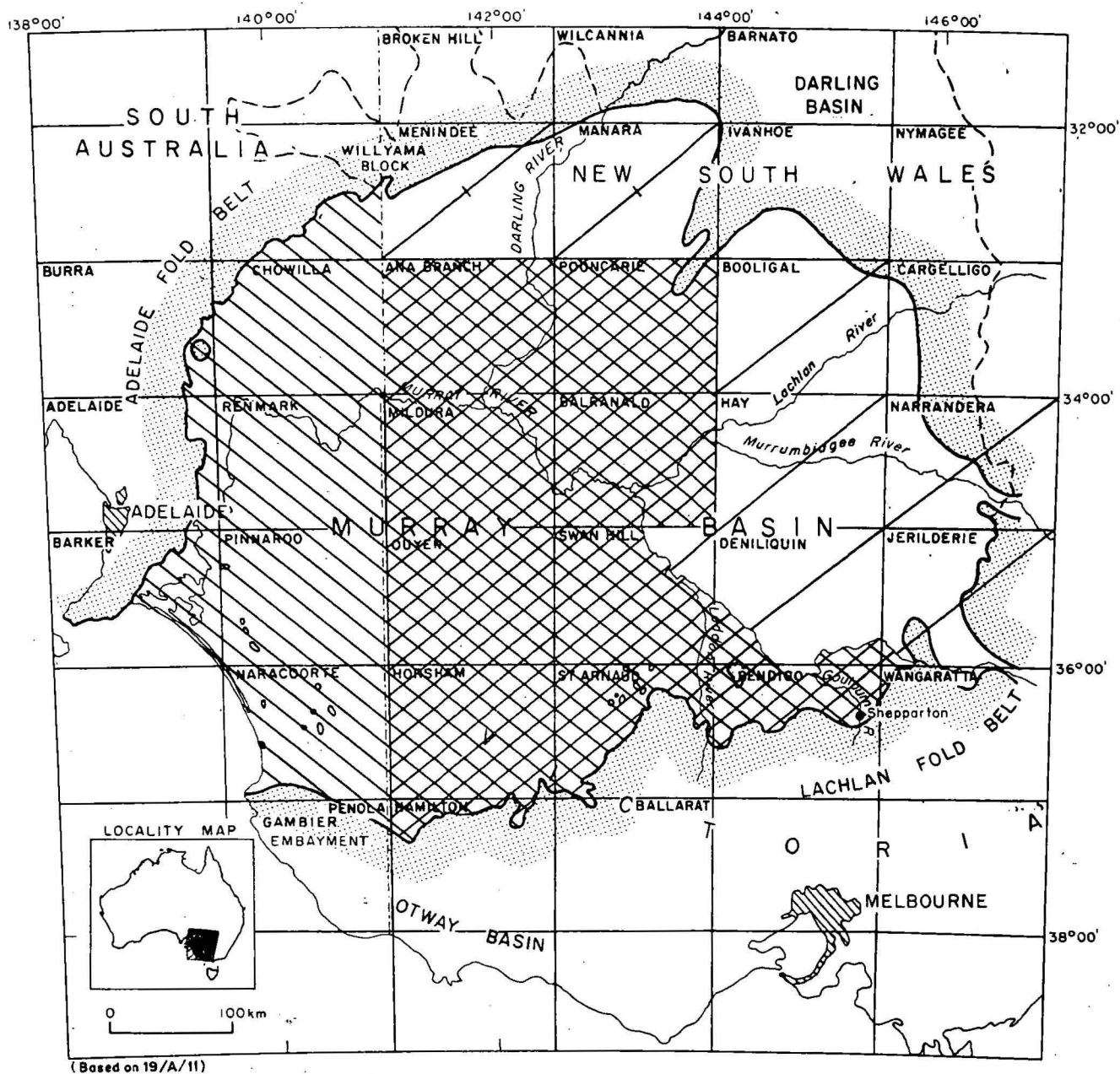
BUREAU OF MINERAL RESOURCES

by

C.M. Brown

Work continued on the documentation of the regional distribution, depositional environment and geometry of lithostratigraphic units and the major aquifer systems of the basin. Plotting of borehole locality maps and tabulation of downhole stratigraphic information was completed for a further ten 1:250 000 sheet areas (Fig. 2). Stephenson has nearly completed examination of the 27 000 microfiche bore logs from South Australia and about 700 logs have been selected for tabulation and plotting on 1:250 000 and 1:1 000 000 locality maps. Some revision of interpretation of downhole stratigraphy in both South Australia and western New South Wales may be necessary prior to production of final subsurface maps. Details of a further 150 boreholes in the eastern Murray Basin were received from the Water Resources Commission of NSW and will be transcribed in the near future. Bore logs from the Ivanhoe 1:250 000 sheet area and northeast Manara 1:250 000 sheet area have also been requested from the WRC.

A field inspection of parts of the Murray Basin in Victoria, South Australia and New South Wales was undertaken, by BMR and State participants in the Project, between 5-15 October 1981. The main purpose was to discuss stratigraphic correlation problems. The field component was preceeded by a one-day seminar held at the Shepparton regional office of the Geological Survey of Victoria on October 6. C.M. Brown, with the aid of block-diagrams, cross-sections and slides of rock cuttings presented a talk on the rationale behind the stratigraphic subdivisions adopted by BMR, and further elaborated on the apparently close correlation between global cycles of relative change in sea-level and the stratigraphy of the basin. Particular emphasis was given to stratigraphic correlations problems associated with units deposited during the mid-Tertiary marine transgression (Fig. 3) and proposed



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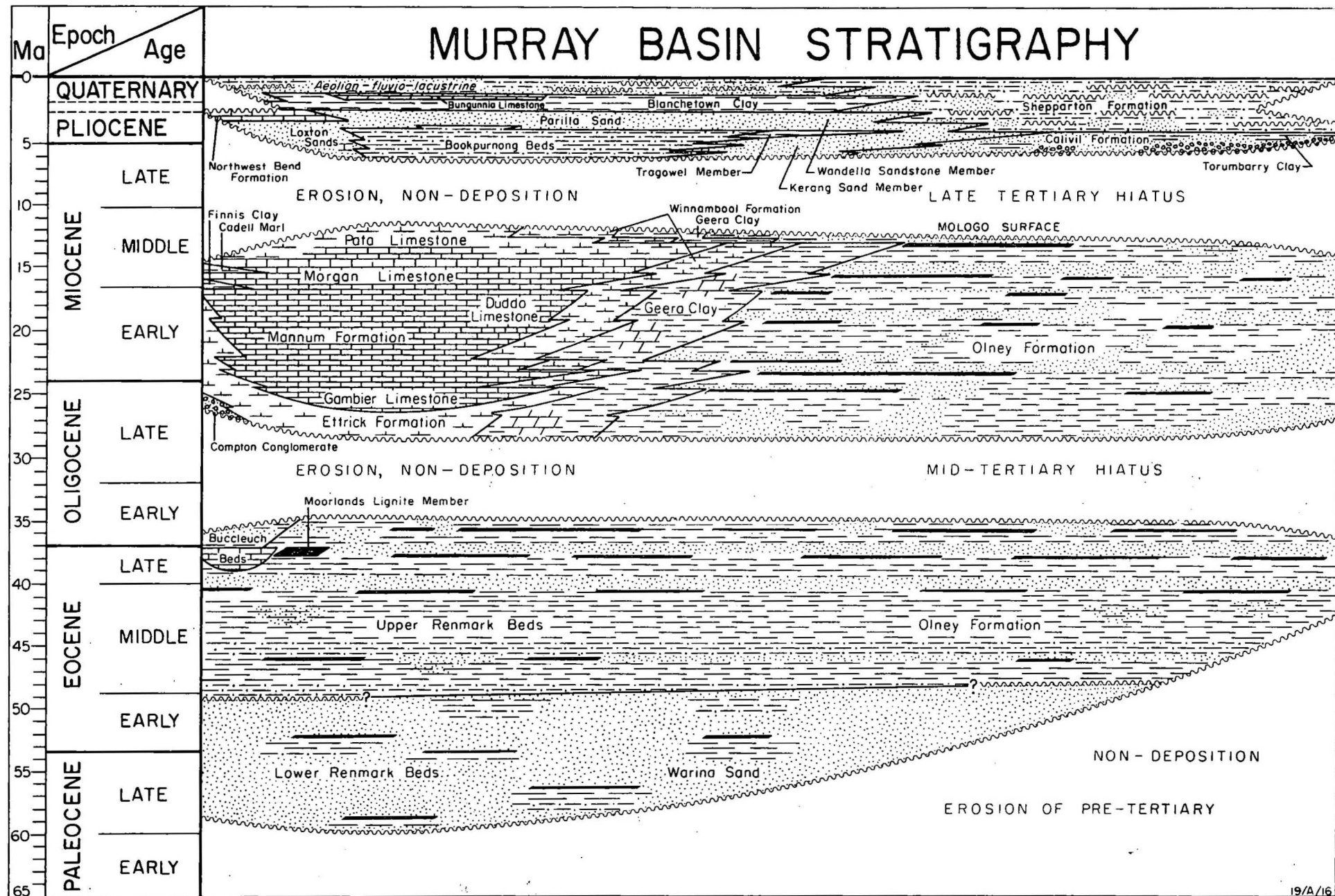
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Fig 2 Plotting of borehole localities and tabulation of downhole stratigraphic information

solutions were discussed. A.E. Stephenson, with the aid of borehole data, slides of cuttings and the interpretation of Landsat scenes/aerial photographs by W.J. Perry, gave a talk on stratigraphic problems associated with the Pliocene sands of the basin, with emphasis on the distribution of marine/non-marine components in South Australia.

The revisions of stratigraphic and facies relationships between mid-Tertiary formations and proposed correlations between States (outlined in the previous progress report, p.7), were generally acceptable to those present. In particular the proposed presence of Geera Clay and Winnambool Formation in the northern part of the basin in South Australia appears to have been confirmed by recent drilling (S. Barnett, pers. comm.). However interpretation of the distribution of marine and non-marine components of the Pliocene sands, especially in South Australia, provoked considerable discussion regarding interpretation of depositional environments, aquifer geometry and correlation with equivalent units in Victoria. Alternative interpretations of ridges seen on Landsat scenes on the Renmark and Chowilla 1:250 000 Sheet areas encompassed discussion on the distribution of calcrete ridges, genesis of calcrete horizons, calcrete stratigraphy and facies relationships between the Loxton Sands, Parilla Sand, North-west Bend Formation and Blanchetown Clay. These issues provided a focus for discussion during the subsequent field examination of Pliocene sand units.

Little progress was made on other aspects of the Geological Phase of the Project as both Brown and Stephenson worked on the Project for only a part of the review period. The paper on the hydrocarbon source rock potential of the western Darling Basin (Brown and others, 1982), the results of which have previously been reported, was published in March.



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Fig. 3

RECENTLY PUBLISHED AND UNPUBLISHED REPORTS ON THE
GEOLOGY AND HYDROLOGY OF THE MURRAY BASIN

Barnett, S.R., 1981. Murray Basin Hydrogeological Investigation, Data Assessment - Northwestern Margin. S. Aust. Dept. Mines and Energy report RB 81/85 (unpublished).

Edwards, D.R., 1981. Murray Basin Hydrogeological Investigation, Drilling Programme - Upper Murray and Northern Region, Progress Report No.2. S. Aust. Dept. Mines and Energy report 81/110 (unpublished).

Geological Survey of Victoria unpublished reports:

- 1981/84 Shallow Groundwater Chemistry of part of the Murray Valley Irrigation Area.
- 1981/90 Bedrock Aquifers in the Bendigo 1:250 000 Sheet Area.
- 1981/111 Completion Report, Numurkah Town Water Supply Bore.
- 1981/127 Pumping Test on the Campaspe Deep Lead Aquifer, Rochester West 10018.
- 1981/128 Completion Report on Kanyapella 22/81/2 and 31/81/4, pumping test.
- 1982/7 Intermediate Depth Drilling, Rochester Area.
- 1982/24 Pump test in the Parish of Millewa on bores 31/81/3 and 22/80/5.
- 1982/25 Pumping test on the Goulburn Deep Lead Aquifer, Mooroopna 7/81/6.
- 1982/26 Pumping test on the Calivil Formation Aquifer, Diggorra 10017.
- 1982/28 Use of a preliminary model of groundwater flow in the Murray Basin.

Teller, J.T., J.M. Bowler & P.G. Macumber, 1982. Modern sedimentation and hydrology in Lake Tyrrell, Victoria. Journal of the Geological Society of Australia, 29, 159-175.

Williamson, R., 1982. A three-dimensional steady state groundwater model, with application to the aquifers of the Murray Basin, Paper presented at Institution of Engineers Hydrology Symposium, Melbourne 11-13 May, 1982.

Brown, C.M., K.S. Jackson, K.L. Lockwood & V.L. Passmore, 1982. Source rock potential and hydrocarbon prospectivity of the Darling Basin, New South Wales. BMR Journal of Geology & Geophysics, 7(1), 23-33.

APPENDIX

General Statement - Murray Basin Hydrogeological Project

This project is a long-term study which is being undertaken jointly by South Australian, Victorian and New South Wales geological surveys and water authorities and by the Commonwealth Bureau of Mineral Resources, Geology and Geophysics. It will be co-ordinated by a Steering Committee comprising members of those organisations.

The Murray Basin is a geological structure with an areal extent of some 300 000 km². In each of the three States the basin sediments contain very large groundwater reserves. Where the groundwater has a low salinity it is increasingly being used for irrigation and town water supply purposes. In much of the basin, the groundwater is suitable only for stock use and is extensively used for this purpose. In other parts of the basin the groundwater is too saline for any use. There is a complex interaction between groundwater and surface water which may be beneficial, as in recharge areas in some parts of the basin, or harmful as in areas of saline groundwater discharge to rivers. In recent years, the States involved have stepped up the rate of assessment of the groundwater regime in the basin.

The primary aim of the Project is to improve the understanding of the groundwater regime of the basin by examining it as a single entity, unencumbered by State boundaries. Since a knowledge of the geology of an area is basic to the understanding of groundwater occurrence, a geological study of the basin is an essential part of the Project and as a consequence it will also be possible to make an assessment of other mineral resources.

The Project is planned initially to last five years and will be organised in five phases:

- (1) Geological synthesis, using all available geological and geophysical data.
- (2) Hydrogeological assessment, on the basis of available data.
- (3) Documentation of deficiencies in geological and hydrogeological information and formulation of proposals for appropriate work programs.
- (4) Additional work as approved which could include stratigraphic drilling, aquifer testing, biostratigraphic analysis and isotope hydrology studies.
- (5) Development of numerical model(s), if found to be appropriate in the light of the data then available.

Investigations currently being undertaken by State authorities will continue, and data generated by them will be used for the joint Basin Project. Collection, collation and compilation of data during the first phase, and interpretation and documentation of the second and third phases, will be undertaken by officers of BMR with assistance from officers of the State authorities. Additional work required in Phase 4 (e.g. stratigraphic drilling, geophysical investigations) may be conducted by BMR or by appropriate State authorities. The development of a numerical model (Phase 5) if found to be feasible, may be undertaken by BMR. The Project will depend on the close co-operation of staff from all organisations involved, and some movement of staff between organisations for short periods will be necessary. Throughout the study, individuals and organisations will be encouraged to publish results of various aspects of the work. Results of the overall Project will be incorporated into joint publications.