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MURRAY BASIN HYDROGEOLOGICAL PROJECT

PROGRESS REPORT 3, MARCH QUARTER 1980

compiled by W.J. Perry

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MURRAY BASIN HYDROGEOLOGICAL PROJECT
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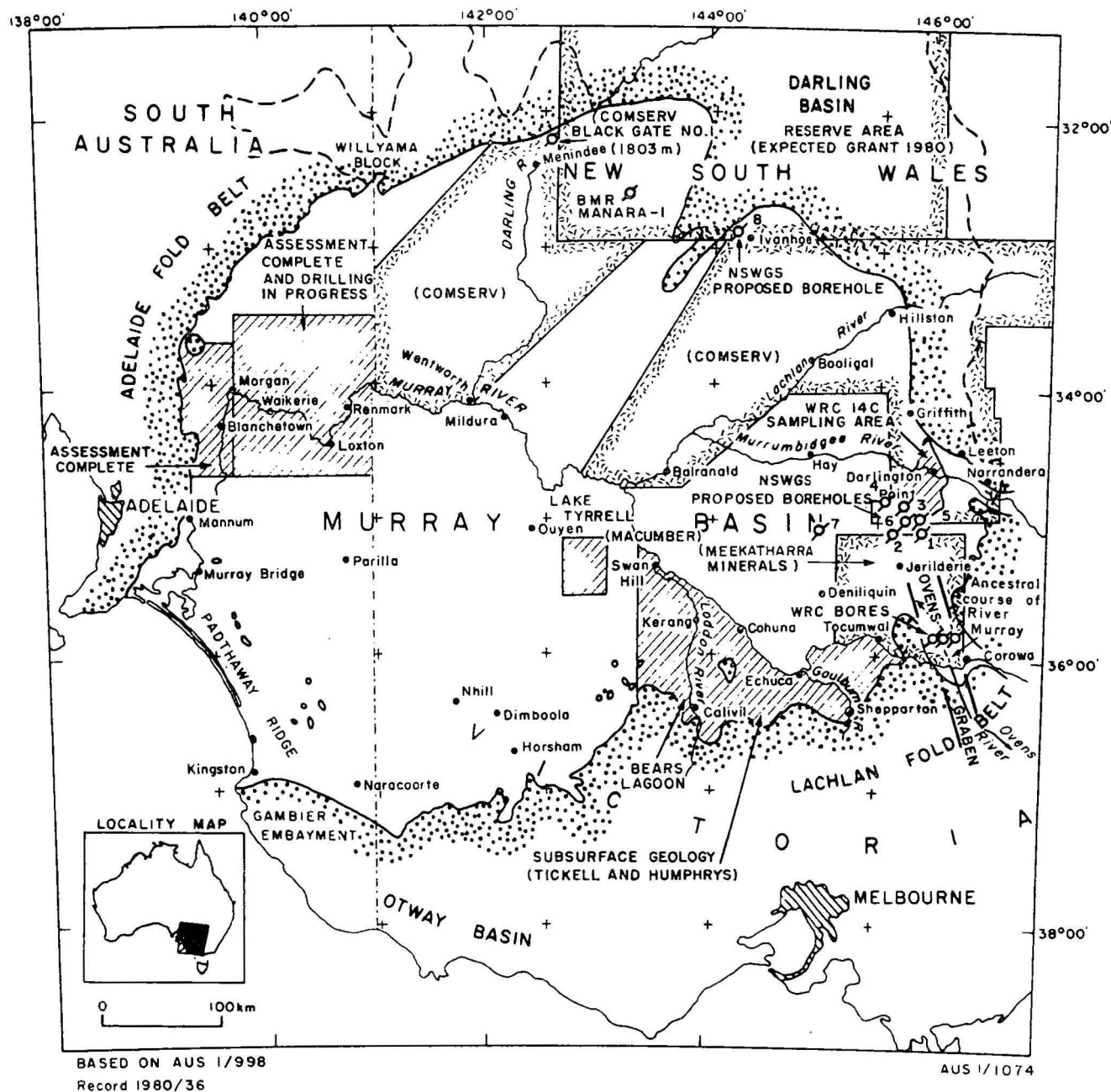
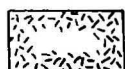


Figure 1 LOCALITY DIAGRAM
MURRAY BASIN HYDROGEOLOGICAL PROJECT
QUARTERLY REPORT MARCH 1980



NSW Petroleum Titles and Reserve area

Geological Survey of NSW proposed boreholes (1980), proposed depth in metres

ø1-250	ø5-400
ø2-500	ø6-400
ø3-375	ø7-400
ø4-400	ø8-500

MURRAY BASIN HYDROGEOLOGICAL PROJECT

PROGRESS REPORT 3

March Quarter, 1980

INTRODUCTION

This is the third quarterly report on the progress of the Murray Basin Hydrogeological Project. Participating organisations are the Geological Survey of New South Wales, the Water Resources Commission of New South Wales, the Geological Survey of Victoria, the State Rivers and Water Supply Commission of Victoria, the Department of Mines and Energy of South Australia, and the Bureau of Mineral Resources.

As indicated in the previous quarterly report BMR has divided Phase 1 of the Murray Basin Hydrogeological Project, i.e. the geological synthesis, into a number of sub-projects which are listed and described below. The program of work includes summaries of the limited data available on the geology of the underlying infrabasins, and reviews of resources other than groundwater. However it should be emphasised that the primary objective of the geological synthesis is to provide a basin-wide understanding of the geology of the Cainozoic Murray Basin sequence. The intention is to document the sub-projects in a series of unpublished BMR records/microfiche records which collectively will provide a stratigraphic and structural framework for the hydrogeological Phase 2 of the Project.

Sub-projects

- (1) Bore localities and borehole data - Murray Basin
 - (2) Geophysical compilations - Murray Basin
 - (3) Stratigraphic tables and correlation charts - Murray Basin
 - (4) Geology of the Cainozoic Murray Basin - structure contour and isopach maps
 - (5) Geology of the pre-Tertiary infra-basins underlying the Tertiary Murray Basin
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- (6) Compilation of 1:1 000 000 scale geological map - Murray Basin
 - (7) Landsat interpretation - Murray Basin
 - (8) Summary of hydrocarbon exploration activity - Murray Basin and associated infra-basins
 - (9) Economic mineral deposits and occurrences - Murray Basin and associated infra-basins
 - (10) Tertiary biostratigraphic zonation and correlation chart - Murray Basin
 - (11) Bibliography - Murray Basin
 - (12) Relationship between surface geomorphology, Quaternary palaeoclimates and groundwater - Murray Basin
- (1) Bore Locations and Borehole Data Sheets - Murray Basin

The systematic collection and collation of water and mineral exploration borehole locality and downhole stratigraphic information is an essential prerequisite for the compilation of structure contour and isopach maps depicting the sub-surface geology of the Murray Basin region. The objectives are to integrate existing compilations of sub-surface geology and to provide a data base indicating the location and density of control points and hence reliability of the maps produced. In addition, the compilation should highlight areas where stratigraphic drilling may be required in Phase 4 of the Project.

The available borehole localities are to be plotted on 1:250 000 transparencies and a summary of depth control on stratigraphic units is to be tabulated on data sheets.

(2) Geophysical Compilations - Murray Basin

Virtually the entire 300 000 sq km surface area of the Murray Basin is blanketed by Quaternary fluvial and aeolian units which conceal the geology of the Murray Basin and underlying infra-basins. Interpretation of the geology is therefore based on sub-surface facies analysis of lithologic logs in combination with palaeontologic and regional geophysical control.

Maps and Accompanying Notes to be Compiled

- (i) 1:1 000 000 Bouguer Gravity Map
- (ii) 1:1 000 000 Total Magnetic Intensity Map
- (iii) 1:1 000 000 Seismic Survey Location Map
- (iv) 1:1 000 000 Radiometric Map

(3) Stratigraphic Tables and Correlation Charts - Murray Basin

During the course of systematic regional mapping of the Murray Basin differing stratigraphic terminologies have been applied to what are now recognised as lithologically distinct stratigraphic units. In addition, differing concepts of the characteristics, status, and lateral and vertical variation of particular formations have also contributed to a lack of uniformity in the application of stratigraphic nomenclature. It is hoped that a compilation of stratigraphic tables and correlation charts will help to identify nomenclature problems. The basic objectives are not to revise or redefine the existing detailed stratigraphic nomenclature of the Murray Basin sequence, but to clarify nomenclature correlation so as to allow lithostratigraphic units to be examined as single entities.

Tables and Accompanying Notes to be Compiled

- (i) Stratigraphic tables
- (ii) Correlation charts - summarising lateral and vertical stratigraphic relationships and age ranges of the major formations in different parts of the Murray Basin.
- (iii) Locality map of the Murray Basin showing location of surface and sub-surface type sections.

(4) Geology of the Cainozoic Murray Basin - Structure Contour and Isopach Maps

Following compilation of existing basic borehole and geophysical data it is intended that structure contour and isopach maps be compiled at 1:1 000 000 scale by integrating existing compilations. The following list of structure contour and isopach maps of stratigraphic units (or combinations of facies equivalent units) is proposed. It may not be possible to complete all of these on a basin-wide basis owing to lack of data in certain areas. Explanatory notes summarising the stratigraphy, geological history, and distribution of aquifers should accompany the maps.

Proposed Structure Contour and Isopach Maps

- (1) Tertiary sub-crop and base Tertiary structure contour map, and isopach map.

- (2) Warina Sand (Lower Renmark Beds, Lower Knight Group) - aquifer, late Paleocene-Eocene.

- (3) Olney Formation (Upper Renmark Beds/Upper Knight Group) - aquitard/Buccleuch Beds - aquifer, Eocene
major regional unconformity.

- (4) Ettrick Formation/Geera Clay - aquitards, late Oligocene-early Miocene.

- (5) Mannum Formation/Morgan Lst/Pata Lst/Naracoorte Lst/Gambier Lst/Duddo Lst/and Winnambool Formation - all aquifers, late Oligocene-mid-Miocene
major regional unconformity.

- (6) Bookpurnong Beds-aquitard/Calivil Sand - aquifer, Late Miocene-early Pliocene.
- (7) Northwest Bend Formation/Loxton Sands/Parilla Sand - all aquifers, Pliocene

unconformity.
- (8) Quaternary units in the west - Shepparton and Coonambigal Formations in east - mixed aquifers, aquitards, Quaternary.

- (9) Renmark Group (Renmark Beds, Knight Group) - combination of (2) + (3) - late Paleocene-Eocene.
- (10) Murray Group - combination of (4) + (5) - late Oligocene-mid Miocene.
- (11) Post-Murray Group sediments in west, Wunghnu Group in east - combination of (6) + (7) + (9), late Miocene-Quaternary.

(5) Geology of the Pre-Tertiary Infra-Basins underlying the Cainozoic Murray

Basin

The systematic compilation of petroleum and water bore data, in combination with geophysical data, should allow the Project to produce maps which summarise the available information on pre-Tertiary rocks underlying the Cainozoic Murray Basin. The maps could show: the distribution of the bores which intersected the various units; lithologic summaries and the thickness of the sections penetrated; and where possible the distribution limits as defined by geophysical surveys.

Proposed maps at 1:2 500 000 scale with accompanying explanatory notes

- (i) Distribution and Geology of Cretaceous rocks beneath the Murray Basin
- (ii) Distribution and Geology of Permo-Triassic rocks beneath the Murray Basin
- (iii) Distribution and Geology of Devonian rocks beneath the Murray Basin
- (iv) Geology of the pre-Devonian basement.

(6) Compilation of 1:1 000 000 Scale Geological Map - Murray Basin

Transparent copies of the available 1:250 000 and 1:500 000 scale geological maps are to be photo-reduced to 1:1 000 000 scale. Details of the Cainozoic, Cretaceous, Permian, and Devonian units are to be retained whereas the geology of the surrounding 'basement' will be generalised.

(7) Landsat Interpretation - Murray Basin

The intention is to prepare a 1:1 000 000 Landsat mosaic from which a photo-lineament and geomorphic trend map can be compiled. It is hoped that this information, in combination with geophysical data, will provide further control on sub-surface basement features, and facies distribution within the Tertiary, and may help in identifying discharge areas. In addition, digitally enhanced Landsat scenes over parts of the Murray Basin in South Australia/Victoria will be compared with the detailed 1:250 000 scale published geological maps; the feasibility of using Landsat scenes to upgrade the level of geological content on the published 1:500 000 scale maps of the Murray Basin in New South Wales will also be tested.

(8) Summary of Hydrocarbon Exploration Activity - Murray Basin and Associated Infra-Basins

The systematic compilation of petroleum company data as part of the geological phase should allow the project to provide a summary of the available data generated by petroleum exploration activity in the Murray Basin.

Proposed Maps and Well Summary Tables

- (i) A 1:1 000 000 scale map showing structure contours on crystalline basement, petroleum exploration well locations, sub-surface structural trends and features, seismic shot-point locations.
- (ii) Stratigraphic tables summarising depth information on downhole stratigraphy.

(9) Economic Mineral Deposits and Occurrences - Murray Basin and Associated Infra-Basins

The published and unpublished literature on the Murray Basin contains references to a number of mineral commodities which occur within the Murray Basin area. The location of mineral deposits may be superimposed on the 1:1 000 000 geological map and details briefly summarised in text or tabulated form.

(10) Tertiary Biostratigraphic Zonation and Correlation Chart - Murray Basin

The proposed objective of this sub-project is to produce a biostratigraphic correlation chart which could be used as a standard chart for current work in the Murray Basin. The literature on the biostratigraphy of the Murray Basin contains reference to a number of differing local biostratigraphic zonation charts which have been developed by various micropalaeontologists working in the Tertiary basins of southeast Australia. Abele et al. (1976, in Geology of Victoria) discuss the development of these schemes and highlight some of the significant discrepancies between age ranges assigned to different assemblages by different authors.

It is proposed that a text discussion on the development of micropalaeontology and palynological biostratigraphic zonation systems, as applied to the Murray Basin, might be of assistance in integrating data from the various States. A correlation chart similar to Table 8.1 (Geology of Victoria, Douglas and Ferguson, 1976) might be useful, particularly if some agreement can be reached on developing a standard biostratigraphic correlation chart for the basin.

(11) Bibliography - Murray Basin

When the Murray Basin Project was first envisaged it was decided that a computerised bibliographic data base would be established using the Geodx data base, on the IMAGE 1000 data base management system for use on the BMR Hewlett-Packard computer.

(12) Relationship between Surface Geomorphology, Quaternary Palaeoclimates and Groundwater Levels in the Murray Basin

Observations on the interaction between groundwater and surface geomorphology and effects of climate, land clearance and poor water management provide additional evidence on controls on groundwater levels. It is proposed that this sub-project describe the surface geomorphology of the Murray Basin and emphasise the relationships between geomorphic features, Quaternary palaeoclimates and groundwater levels.

WATER RESOURCES COMMISSION OF NEW SOUTH WALES

by D.R. Woolley

Exploratory drilling continued in the Ovens Graben area, and a re-interpretation of the pre-Tertiary surface contours has been made. The ancestral Ovens valley now appears to be more sinuous and not as deep as previously thought, and appears to contain less significant aquifers than the old Murray valley. Low-salinity water appears to be restricted to a quite narrow zone along the Murray River in the Ovens Graben, but in the old Murray valley deposits the low-salinity water extends down valley for a considerable distance from the intake area east of Corowa.

Refraction seismic profiling has also continued in the Ovens Graben area. Interpretation of the field data is proceeding but lags behind the field work at present.

Drilling in the Darlington Point area continued with the completion of two further observation bore sets.

Water samples for ^{14}C and tritium age determination were collected from 18 bores in the Darlington Point area, jointly with AAEC. Four samples were obtained from private (equipped) bores in the Shepparton Formation, and the remainder from irrigation bores deriving water from the Calivil Formation (or in two cases the Calivil and upper Olney Formations). The sampled area covers the main extent of existing high-yield irrigation bores south of the Murrumbidgee River.

BUREAU OF MINERAL RESOURCES

by C.M. Brown

Work continued on the plotting of geological data currently available to BMR. During the quarter the project received a contribution on the geology of the Riverina Plain in Victoria by Tickell and Humphrys (1979) and a progress report on the Upper Murray Groundwater investigations in South Australia by Edwards (1980). Work is expected to commence on the hydrogeological phase 2 in mid-1980.

Phase 1 - Geological Synthesis - In future quarterly reports progress will be reported under the sub-project headings listed in the introduction to this report.

(1) Bore Locations and Borehole Data Sheets - All borehole localities currently available to BMR have been plotted on 1:250 000 transparencies, and downhole stratigraphic information has been tabulated (Fig. 2). Detailed requests for the additional data required were distributed in early February to the Steering Committee representatives of the participating organisations.

(2) Geophysical Compilation - The required data are largely available within BMR and advice is currently being sought from the relevant geophysical sections within BMR concerning the integration and interpretation of the data. Participating State organisations have also been requested to advise on the availability of small-scale seismic survey data which could be incorporated in the seismic survey location map.

(3) Compilation of 1:1 000 000 scale geological map - As previously reported, transparent copies of the available 1:250 000 and 1:500 000 scale geological maps have been photo-reduced to 1:1 000 000 scale. Further work was done to integrate the maps and solve sheet boundary problems.

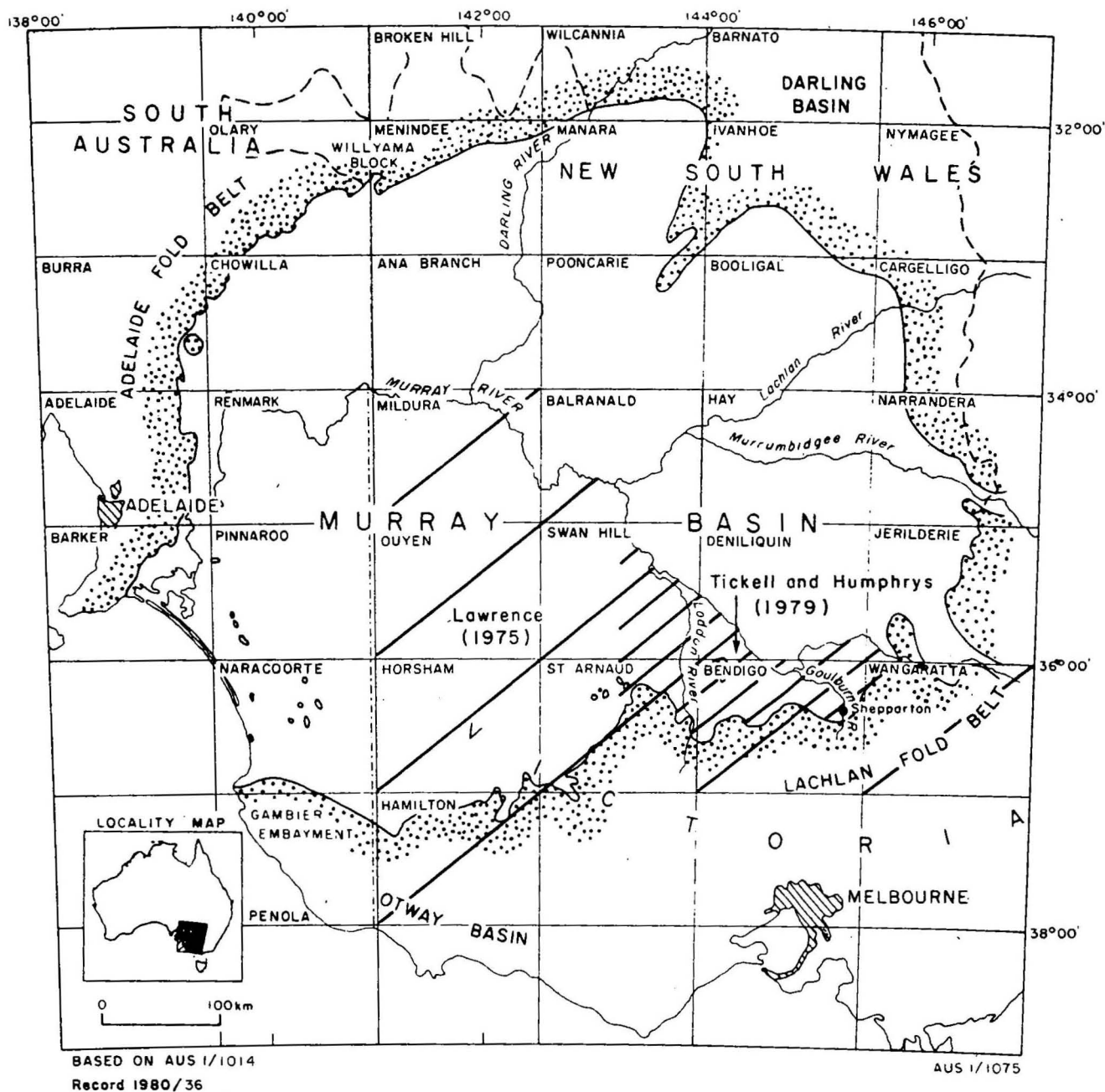

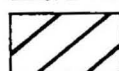


Figure 2 BORE LOCATIONS AND BOREHOLE DATA SHEETS-PROGRESS

-  Plotting of borehole localities and tabulation of downhole stratigraphic information in progress
-  Plotting of borehole localities and tabulation of downhole stratigraphic information completed

(4) Landsat Interpretation - Digitally enhanced Landsat scenes were obtained from CSIRO during the quarter and preparation of a Landsat mosaic will probably commence in late May. Preliminary examination of Landsat scenes covering the South Australian/Victorian border area indicates that Landsat can be used to solve some of the problems of stratigraphic correlation across map sheet boundaries. The Quaternary Woorinen Formation (Vic) is seen to overlies areas mapped as Pliocene Parilla Sand in the Naracoorte sheet area (S.A.); the upper part of the Pliocene Parilla Sand, thought to be fluviatile in South Australia and to be shoreline deposits in Victoria, is seen to consist mainly of regressive beach/barrier bar ridges in both South Australia and Victoria and to be contiguous with the Quaternary Bridgewater Formation at the coast in South Australia; the distribution and trend of ridges of Bakara Calcrete (e.g. Pinnaroo sheet) appear to parallel the interpreted Parilla Sand ridges seen on Landsat; the (internal morphology of the) Quaternary aeolian Lowan Sand (Vic.)/Molineaux Sand (S.A.) forms west to east directed blow-out features, and therefore NW-trending ridges mapped as Quaternary Lowan Sand in S.W. Victoria can be correlated with NW-trending Pliocene Parilla Sand ridges which are probably flanked by local west to east trending small-scale blow-out deposits of Lowan Sand.

(5) Murray Basin bibliography - Compilation of the computerised bibliography on coding forms was completed during the previous quarter. Part of the bibliography has been entered into the data base but delays in completing the project are expected during a changeover period while BMR upgrades its Hewlett-Packard Image data base management system.

Associated Activities: Darling Basin Source Rock Study - The objectives of this project were outlined in the previous quarterly report. Drilling of the second hole (Fig. 1) commenced in late March and penetrated 172.6 metres of Cainozoic Murray Basin sequence before drilling problems were encountered and the hole abandoned. A further hole, BMR Manara No. 2, will attempt to reach the Lower Devonian drilling target in April.

SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

by J. Selby

A district office has been established at Waikerie to supervise the extensive drilling programme which will commence during next quarter.

A study of all water-level data available on the regional groundwater irrigation mounds is in progress. The mound at Waikerie has stopped rising and is declining as a result of more economical irrigation practices stimulated by the 'Water on order' system recently introduced by the E & W S Department.

Groundwater observation wells, drilled by the Department in the Upper Murray area some years ago, are being evaluated with a view to including them in a proposed River Murray regional observation well network.

Preparations are in hand to supply the Bureau with all borehole data for the Murray Basin held in the Department's records.

Reports

Issued:	Edwards, D.R., Progress Report on 1979 Drilling Programme. S. Aust. Dept. Mines & Energy Rept. Bk. 79/131 (unpubl.).
In prep.	Read, J.A., Data Assessment: Upper Murray and Northern Region. Barnett, S.R., Data Assessment: Western Margin (North).

GEOLOGICAL SURVEY OF NEW SOUTH WALES

by D.H. Probert

Ten Petroleum Exploration licences have been granted, nine to Comserv Pty Ltd and one to Meekatharra Minerals Pty Ltd, over large areas of the Murray Basin. These licences are due for renewal in late 1980 or in the first quarter of 1981. Preliminary company reporting is being received at statutory intervals. One stratigraphic hole Black Gate No. 1 has been drilled by Comserv Pty Ltd near Menindee to a depth of 1803 m (approx.). The hole intersected more than 260 m of Recent, Tertiary and probable Permian sediments. Ages of materials intersected have not yet been confirmed.

Mitsubishi Development Pty Ltd and Pacific Coal Co. Ltd (C.R.A. Group) are continuing work on exploration areas in the Oaklands Basin. Hydrogeological studies of aquifer-bearing sediments lying above the coal have been made in parts of the area.

Tenders have been called for a program of drilling to further investigate the coal potential of Permian infrabasins underlying the Murray Basin. Six holes will be drilled in the Oaklands Basin, to the north of the areas currently being prospected by Mitsubishi Development Pty Ltd and Pacific Coal Co Ltd. The holes have been located on the basis of a seismic reflection survey, reported by Palmer (1977). The coal measures are overlain by between 200 and 400 metres of cover in this area (Fig. 1, 1 to 6).

One "wild cat" hole will be drilled in each of the two other areas where Permian infrabasins have been predicted from petroleum exploration records and regional geophysics. One hole will be drilled about 25 km WNW of Ivanhoe, near the northern margin of the Murray Basin (Fig. 1, 8).

It is expected that Permian sediments in this locality will be overlain by about 200 metres of Quaternary, Tertiary and possibly Cretaceous sediments. The other hole will be drilled 55 km south of Hay (Fig. 1, 7), where it has been predicted that the Permian sequence will be overlain by about 350 metres of Quaternary and Tertiary cover.

GEOLOGICAL SURVEY OF VICTORIA

by C.R. Lawrence

1. The report "Geology of the Riverine Plain" by S.J. Tickell and W.G. Humphrys was completed at the end of 1979.

This report is based on all the known bore logs, government and private, for the study area.

There is a brief explanation of the stratigraphy, but the bulk of the report is a table of bores and the depth at which stratigraphic units are encountered.

There are a series of cross-sections, and contour maps (originals are at 1:250 000 scale) of:

- a) buried pre-Tertiary geology, structure contours, and depth to bedrock
- b) Renmark Group isopachs; structure contours
- c) Calivil Formation isopachs, structure contours
- d) Parilla Sand isopachs, structure contours
- e) Shepparton Formation, isopachs.

Another report in this series is being prepared on "The hydrogeology of the Riverine Plain".

2. Drilling is continuing at three locations:

- a) Shepparton: where auger drilling is helping in the pilot study of hydrogeologically mapping a 1:100 000 sheet.
- b) Bears Lagoon: where the interaction between shallow, intermediate and deep aquifers is being studied.
- c) Lake Tyrrell: where bores are being drilled to carry out pumping tests to determine the hydraulic conductivity of the Parilla Sand.

3. A series of unpublished reports on drought and groundwater in Victoria have been prepared by Mr M. Malone. They summarise the drought relief drilling undertaken by the Victorian government during the droughts 1967/68, 1972 and 1978/79.

RECENT PUBLISHED AND UNPUBLISHED REPORTS ON THE GEOLOGY AND HYDROGEOLOGY OF
THE MURRAY BASIN

Edwards, D.R., 1980 - Progress report on 1979 drilling programme.

South Australian Department of Mines and Energy Report Book
79/131 (unpublished).

Tickell, S.J., and Humphrys, W.E., 1979 - The geology of the Riverine
Plain in Victoria. Geological Survey of Victoria Report 1979/135
(unpublished).

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 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 for town water supply. 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 from 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 might 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 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.

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