BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1985/22

MURRAY BASIN HYDROGEOLOGICAL PROJECT

PROGRESS REPORT 13

for half year ending 31 March 1985

compiled by

W.J. Perry

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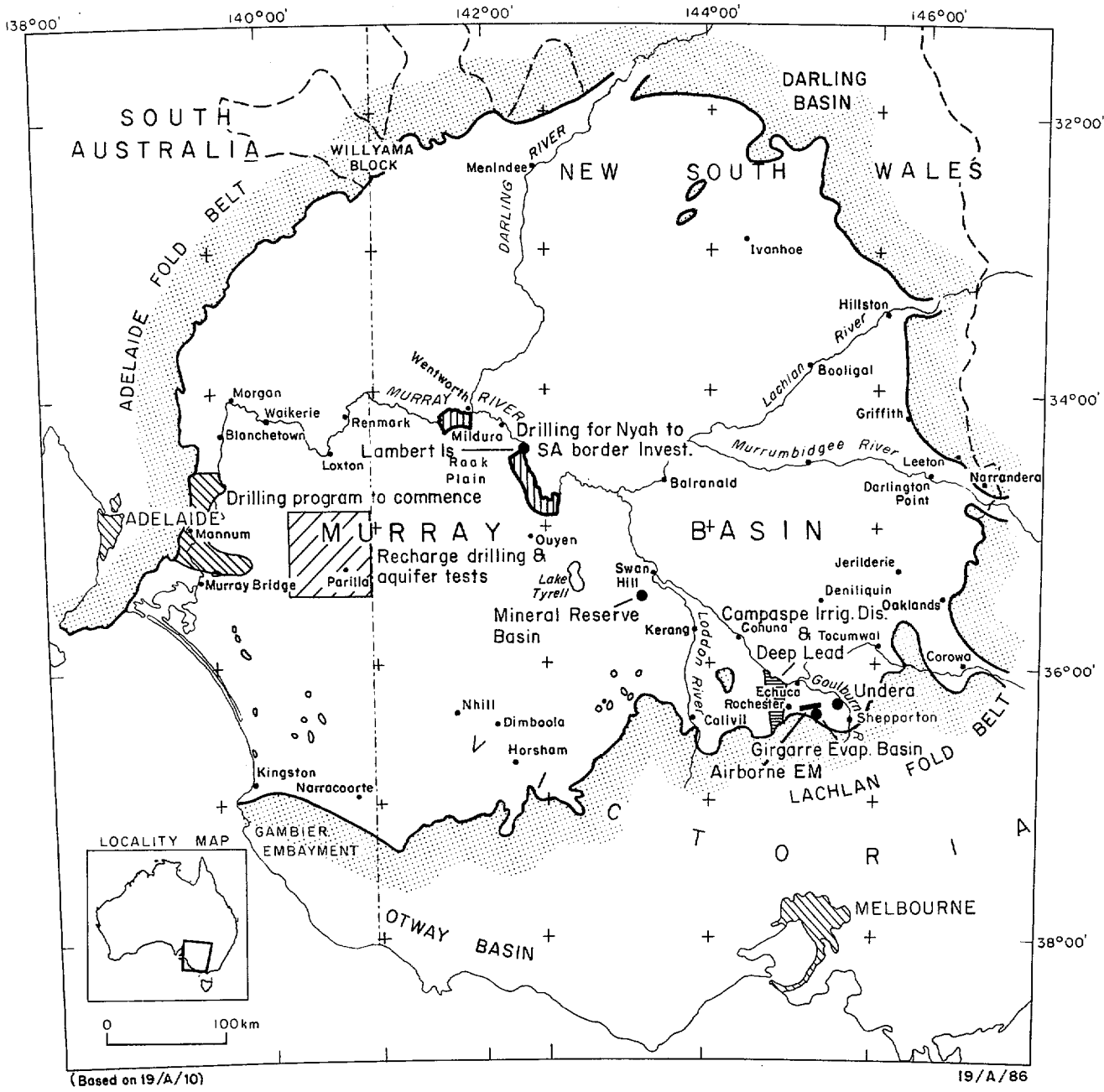

(Based on 19/A/10)

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Fig.1. Locality diagram

INTRODUCTION

At BMR, Project staff concerned with the geological phase have devoted much effort to checking and editing borehole stratigraphic data and in compiling a report on the subsurface stratigraphic database; these tasks have proceeded in parallel with the computer-assisted drawing of structure contour maps of stratigraphic units and aquifers. The cartographic work, together with the writing of a text on the geology of the Basin, is continuing. A preliminary edition of a 1:1 million scale Cainozoic geology map of the Basin was published in February. Work on the hydrogeological aspects of the Project continued with the compilation of data from four ¼ million scale map sheets, and some water sampling in previously little known areas.

PROGRESS REPORTS

SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

by

S.R. Barnett

Observation wells in the river alluvium at Mypolonga were sampled for nitrate in an effort to determine the source of nitrate in the River Murray.

Representative sites (cleared and uncleared) were drilled to established chloride profiles and hence recharge rates. Preliminary results from CSIRO indicate very low recharge under uncleared Mallee (about 0.2 mm), with dramatic increases in recharge after clearing.

A program of 3 day pumping tests in the Mallee on existing town water supply wells with observation wells is half complete.

A drilling program of about 12 investigation holes on the southwestern margin (Swan Reach-Murray Bridge-Karoonda) is about to commence.

WATER RESOURCES COMMISSION OF NEW SOUTH WALES

by

D.R. Woolley

1. Drilling

Micropalaeontological examination by V. Scheibnerova, Dept. of Minerals and Energy, N.S.W. of samples from the first bore at Mallee Cliffs is still being undertaken.

Four bores in the Hillston-Euabalong area are currently being drilled to determine groundwater chemistry and aquifer distribution changes. The first bore of this program has indicated that a major outlet for the Lachlan River in Miocene - early Pliocene time was along a line between Euabalong and Roto.

Drilling of seven bores in the Tocumwal-Deniliquin area is planned to start in July, 1985. They will be used to monitor the good quality groundwater associated with Tertiary sediment aquifers known to supply large yields of good quality groundwater to suitably constructed bores.

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Palynological examination of strata samples collected from private bores drilled as part of drought relief work has been commenced. Preliminary results confirm the presence of Tertiary marine sediments at depth to the north west of Balranald and in the Willandra Lakes area.

2. Geophysical surveys

Seismic refraction traverses totalling 56 km were carried out during the period in the Lachlan and Murrumbidgee groundwater areas of the Murray Basin.

The results indicate a NNE trending pre-Tertiary bedrock ridge that occludes the Renmark Group aquifers west of Balranald. A report on this work is currently being prepared.

3. Water level and water quality recording

Monitoring of water levels and water quality continued in the Commission's observation bore network in the eastern part of the Basin.

4. Clay analysis samples

A report based on clay samples from 25 bores in the Coleambally-Darlington Point area is currently in an unedited draft stage. It indicates that the groundwater chemistry in this area is currently evolving along the flow lines by concentration and interaction with the sediments it is passing. The change in ion ratios has implications for the usability of groundwater, particularly for irrigation. Differing recharge rates due to changes in past climate which are consistent with C-14 ages also may be indicated.

5. Radio-carbon dating

Eighteen C-14 samples were taken, for analysis by the Australian Atomic Energy Commission, in the Lower Lachlan area west of Hillston. They will be analysed in conjunction with those taken early in the year to give a more complete view of groundwater flow in this area.

6. Staff

A hydrogeologist has been appointed to Leeton. After familiarisation, he will commence relevant duties on this project.

GEOLOGICAL SURVEY OF NEW SOUTH WALES

by

D.H. Probert

Little activity has occurred during the period within the Basin from a mineral and petroleum point of view. No developments in coal have occurred. On the petroleum scene, Claremont Petroleum NL have acquired the issued capital of Comserv (No. 779) and proposed to carry out further extensive seismic surveys in the areas of PEL's 212, 213, 214, 216 and 217. These areas cover the areas of Tararra Trough between Ennisvale No. 1 to north of Popiltah No. 1. It is proposed to examine both Permo-Carboniferous and Devonian sequences.

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RURAL WATER COMMISSION OF VICTORIA

by

R.Evans

The Rural Water Commission's groundwater related activities in the Murray Basin are generally concerned with licensing and regulation of groundwater usage and with salinity. All the projects listed below are concerned, in one way or another, with the investigation, design and construction of salinity mitigation schemes.

1. Girgarre Area. Following on from the previous report, project construction is underway which will include allowance for interception of possible leakage from the evaporation basin, if required. A comprehensive monitoring program, to gauge the effects of the scheme, is being set up.

2. Mineral Reserve Basins. Exploratory drilling and pump testing at the interception bore sites is continuing. Six tubewells have been installed and tested. Yields varied between 1 and 5 L/sec. It is planned to install an additional five tubewells before August 1985. Geomorphologically, the Mineral Reserve Basins occur at the intersection of the Riverine Plain and the Mallee. Consequently the stratigraphy is typically aeolian Woorinen Formation over-lying alluvial Shepparton Formation, which in turn overlie the lacustrine Blanchetown Clay and the marine Parilla Sand.

3. Geophysical Surveys. Processing of the airborne electromagnetic (EM) survey which was flown by Geoterrex in March 1984 has been completed and the results appear promising. A contour map of the depth to the half space correlates well with the aquifer map of the area. A report is now being prepared. Drilling in the area suggests three aquifers in the upper 30 m of the Shepparton Formation, with the topmost aquifer containing low salinity groundwater which is pumped by private diverters. This drilling has delineated the boundary of these aquifers containing groundwater of salinity less than about 5000 EC. Where shallow bedrock occurs the correlation is not as good and other processing techniques are currently being applied to delineate these areas.

4. Campaspe Irrigation District. This area is, in part, affected by high watertables and soil salinisation. Consideration is being given to control measures and options for disposal of saline water. Investigations currently underway include monitoring the effect of two long term pumping tests from shallow aquifers, finite element computer modelling of flows in the "deep lead" aquifer which underlies the area, and analysis of trends in surface soil salinities.

5. Regional Drilling. Drilling along a section through the Kanyapella depression proceeded, with bores being drilled to 25 metres depth at 500 metre intervals. Pressure levels in this area are approximately 2 metres lower than the central Goulburn valley. The Upper Shepparton Formation in this area comprises floodplain and lacustrine clays and sandy clays with interspersed channel sands.

6. Farm Exploratory Drilling. Dipole-dipole resistivity surveys and exploratory drilling were carried out on a number of private properties in the Shepparton Region with a view to locating a usable groundwater supply.

7. Undera Recreation Reserve. Exploratory drilling, well point installation and pump testing have been carried out in this area (12 km north of Tatura) to locate a well point system which would protect the area from high watertables and associated salinisation which are now evident. Because of low well point yields it is envisaged that the system would have an extended header pipeline with offsets to the well points.

8. Mallee Cliffs - Lambert Island Groundwater Interception Investigation. It has been recognised for some time that a 4 km stretch of the Murray River near Lambert Island exhibits a disproportionately high increase in salinity. Investigations by the RWC and the WRC of NSW have been underway for several years to determine the most appropriate strategy for dealing with this saline inflow. Analysis of available data is continuing.

9. Nyah to South Australian Border Hydrogeological Investigation. Seventy percent of proposed exploratory drilling and piezometer construction has been completed with recent drilling between Wemen and the Darling anabranch. At Wemen, Parilla Sand is an unconfined aquifer hydraulically connected to the river, but further west the overlying Blanchetown clay increases in thickness to 40 metres at Hattah and extends north with similar thickness towards Mildura. West of Mildura, Blanchetown Clay occurs as an aquitard only a few meters

thick. Four alluvial terraces are recognized, the oldest extending up to 12 kilometres from the present river underlies Woorinen Formation dunes, and these may be of considerable age.

OFFICE OF MINERALS & ENERGY, VICTORIA

by

C.R. Lawrence

The Office of Minerals and Energy (OME) drilling program in Northern Victoria is continuing. Work has been concentrated around the Campaspe Valley with test and observation bnres being constructed in the Calivil/Renmark aquifer system (deep lead system) near Elmore, Rochester, Echuca and Torrumbarry. Pumping tests to determine aquifer parametric values have been carried out near Echuca and Rochester. Updated bore hydrographs show aquifer pressures rising over most of the Northern Plains and the highland front to the south.

A detailed water sampling program has been in progress and is almost completed. Samples from each of approximately 200 OME observation bores as well as numerous private irrigation bores have been taken for full chemical analysis. Many of the analyses have been completed and put into data storage. A study of the hydrochemistry of the groundwater in Northern Victoria is underway.

Geophysical surveys have been carried out by OME for groundwater/salinity studies by OME, Rural Water Commission and Soil Conversation Authority (SCA) in 1984/85 as part of ongoing groundwater studies in the Murray Basin.

The geophysical surveys include:-

1. Test INPUT MKV airborne electromagnetic surveys; surveys funded by Rural Water Commission at Girgarre and SCA at Kamarooka have been flown by Geoterrex under OME supervision. The tests are to determine if an airborne EM system can be used for mapping salinity hazards and shallow/deep groundwater/geological conditions related to salinity. This is believed to be the first application of airborne EM salinity studies in the western world. Results are very encouraging and a final report is expected in June 1985.

   Preliminary indications suggest the airborne EM can identify shallow (less than 20 metres) freshwater aquifers in the Girgarre area and may give information related to total salt store of the Tertiary sequence above bedrock. At Kamarooka, kaolinized, deeply weathered zones can be mapped.

2. Follow up ground surveys to the airborne survey have been carried out to verify the anomalous areas, aquifers etc. identified in the airborne surveys. Groundsurveys include electromagnetic and DC resistivity methods.

3. Seismic and gravity has been used to profile the Campaspe lead between Ballendella and Strathallan.

BUREAU OF MINERAL RESOURCES

Documentation of geological data

by

C.M. Brown

During the review period considerable time was spent on the structural design, development and editing of a computer-based subsurface stratigraphic database. The study of borehole data has involved interpretation of stratigraphic information from a dataset of several tens of thousands of unpublished water borelogs, of which some 3,000 were used. A report summarising the results of this systematic compilation of borehole data has also been completed and is to be published in the BMR Report Series. The database can be accessed using a number of retrieval strategies, which allow sorting and extraction of data specific to a particular map sheet, or stratigraphic unit, or regional aquifer. The major datasets which were generated are tabulated in a series of Microform Appendices contained in the accompanying report. Microform borehole locality maps are also included. The report contains a discussion on stratigraphic correlations, along with recommendations for future uniformity of stratigraphic nomenclature. In addition it includes an assessment of the reliability of borehole data in terms of distribution, accuracy of locations and elevations, quality of drillers logs, and contains recommendations for future work.

The borehole datasets have been transferred to an Intergraph computer graphics system with the objective of assessing the capability of the system to model the sedimentary fill of the basin and to produce automated subsurface maps. Initial results have not been satisfactory and further development work is continuing.

Drafting of a 1:1,000,000 scale Cainozoic geology map of the Murray Basin, with accompanying block diagrams and cross-sections, was completed during the period and a preliminary edition was published in February. In addition, a report providing a synopsis of stratigraphic correlations and resource potential of the Murray Basin was completed and is also to be published in the BMR Report Series. Writing of sections of the text of a BMR Bulletin on the geological aspects of the project continued during the period.

During the review period, colleagues in the Geophysical Division produced a series of colour and grey tone 1:1,000,000 scale aeromagnetic pixel maps of the Murray Basin. These have been used in conjunction with an examination of borehole and gravity data to identify the location and configuration of a number of geophysical domains concealed beneath the Cainozoic succession of the basin. In the past, tectonic and palaeogeographic reconstructions of the region have been particularly handicapped because large portions of the Palaeozoic Lachlan Fold Belt and Proterozoic to Lower Palaeozoic Adelaide and Kanmantoo Fold Belts are concealed beneath the Murray Basin succession. Consequently, interpretation of the identified geophysical domains, in terms of tectonostratigraphic terranes, offers the possibility of resolving some of the conflicts concerning the evolution of southeastern Australia.

Documentation of Hydrogeological Data

by

R. Evans

The compilation of existing data at 1:250 000 scale continued on those sheets previously commenced and, in addition, on OLARY, CHOWILLA, IVANHOE, CARGELLIGO. The data forming the basis for this compilation are now being stored on a hard disk attached to a micro-computer.

Analysis of samples collected during the September-October 1984 field work in western New South Wales are slowly becoming available. Preliminary analysis does not indicate anything out of the ordinary; in most cases it reinforces existing conceptual models. The isotope values obtained indicate that similar processes are operating in different regions. All waters lie on a single evaporation line, with the possible exception of waters from bores in the ANABRANCH-MENINDEE region of N.S.W.

The only exception to the conservative nature of the results is provided by the bromide values for waters from the Ivanhoe Block region which appear to be about an order of magnitude too high.

No carbon-14 results have as yet been determined.

Another sampling program is being planned for the northern margins of the basin durin April-May.

In a related area, Evans and Kellett have begun implementing a solute transport model on the micro-computer system. At this stage only code associated with head approximation has been implemented.

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

BROWN, C.M., & STEPHENSON, A.E., 1985 - Murray Basin 1:1,000,000 scale geological map, Preliminary Edition. Bureau of Mineral Resources, Australia.

Brown, C.M., & STEPHENSON, A.E., in press - Murray Basin - stratigraphic correlations and resource potential - a synopsis. Bureau of Mineral Resources, Australia, Report.

BROWN, C.M., in press - Murray Basin. In - Stratigraphic correlation between sedimentary basins of the ESCAP region, ESCAP Atlas of Stratigraphy, United Nations Mineral Resources Development Series.

APPENDIX

Murray Basin Hydrogeological Project

Description and status

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 is 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 km^2. 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 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 was planned initially to last five years and is 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 of appropriate work program.

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.

The geological synthesis is nearing completion, and a draft document reporting results with accompanying 1:1 scale geological maps is expected to be finished by late 1985.

Phase 2 began at BMR in 1983. Hydrogeological data available from the States are being entered into a BMR data base designed for the Project: BMR and State workers will prepare a report assessing these data, and the results will be illustrated on several maps including the following: 1:1 million scale maps showing (i) amount of water abstracted-added per unit area (ii) recharge-discharge areas, distribution of aquifer parameters for a 7 layer hydrogeological model. (Both Victoria and South Australia have

tested the feasibility of making a preliminary model of the basin as a whole based on a coarse (75 km) rectangular grid).

The hydrogeological assessment and phase 3, the documentation of deficiencies in geological and hydrogeological information are scheduled for completion in 1986.

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 or by State authorities. 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 to various aspects of the work. Results of the overall Project will be incorporated into joint publications.