

ASPECTS OF REGIONAL GROUNDWATER MOVEMENT
AND HYDROCARBON MIGRATION IN THE EROMANGA BASIN

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BIOGRAPHY

M.A. (Rien) Habermehl obtained his Candidaats Examen (B.Sc.-Hons) in Geology from Leiden University, The Netherlands in 1966, and his Doctoraal Examen (M.Sc. degrees) in Sedimentology and Hydrogeology from Leiden University in 1970, following postgraduate research on Devonian sediments in the Spanish Pyrenees, and on a carbonate-rock groundwater basin in the Celtiberic Mountains, central Spain. He completed his Doctor Wiskunde en Natuurwetenschappen - Ph.D. (Geology) at Leiden University in 1970 on research in sedimentary geology on a shallow marine Devonian sequence in the central Pyrenees, Spain. He joined the Bureau of Mineral Resources, Geology and Geophysics, Canberra, in 1971, and has since studied the geology and hydrogeology of the Great Artesian Basin. Additional studies include the isotope hydrology, hydrochemistry and hydrocarbon occurrences in the basin. A feasibility study was carried out in Thailand in 1978. He currently holds the position of Research Scientist in BMR's Division of Continental Geology. He was the Hon. Secretary of the Commonwealth Territories Division of the Geological Society of Australia Inc. from 1979 to 1981, and a Committee Member of the Hydrological Society of Canberra Inc. He is a Member of several Sub-Committees of the Groundwater Committee of the Australian Water Resources Council.

SUMMARY

The Eromanga Basin is a constituent sedimentary basin of the hydrogeological Great Artesian Basin (Habermehl, 1980). Confined aquifers occur in continental quartzose sandstones of Jurassic and Cretaceous age in the Eromanga Basin. Intervening confining beds consist of siltstone and mudstone; a thick argillaceous sequence of sediments of marine origin and Cretaceous age forms the main confining unit. The basin is, in places, 3000 m thick, and forms a large synclinal structure, uplifted and exposed along its eastern margin and tilted southwest. Recharge occurs mainly in the eastern marginal zone, and minor recharge takes place in the western margin. Natural discharge occurs from springs in the southwestern, western and southern margins; most springs are associated with structural features.

Large-scale groundwater movement, interpreted from potentiometric maps which were prepared from long term and periodic measurements on large numbers of flowing artesian waterwells in the basin, is generally directed to the west, southwest and south in the main part of the basin. In the western part regional groundwater movement is towards the southeast and south; in the most northern part a northerly flow direction exists.

Epeirogenic uplift of the eastern recharge areas and lowering of the southwestern area during Late Cretaceous and Tertiary times established the present flow regime. The hydraulic gradient steepened slightly in the Late Quaternary as the spring levels in the southwestern margin were lowered. Groundwater development by flowing artesian waterwells since about 1880 caused significant changes of the potentiometric surface (Habermehl, 1980). The artesian water is of meteoric origin, as shown by environmental isotope analysis. Groundwater movement is slow, and residence times of the water are large, but groundwater salinities are low, generally between 500 and 1500 mg/l total dissolved solids, and increase only slightly along the flowpaths. Hydrochemical differences characterise different aquifers and regional groundwater flow patterns, particularly in the southwestern part, where groundwater derived from the eastern recharge area is characterised by Na-HCO₃-Cl and water from the western recharge area by Na-Cl-SO₄. Waters in the central part of the basin are mainly of the Na-HCO₃-Cl and Na-HCO₃-Cl-SO₄ type.

Hydrocarbons have been generated from relatively abundant source rocks in the marginally mature to mature Jurassic and Cretaceous sedimentary sequence since Late Cretaceous time, and their migration could be influenced by groundwater flow. A model of hydrodynamic migration of hydrocarbons, and their possible accumulation and entrapment in suitable structural zones or near barriers of stratigraphic or diagenetic origin was proposed by Senior & Habermehl (1980).

Gas samples were taken at the surface from about 50, long (several decades) established, flowing artesian waterwells (which were 'randomly' drilled in contrast to petroleum exploration wells) in the central part of the Eromanga Basin in 1980. Methane concentrations from the upper, main Lower Cretaceous-Jurassic aquifer (Cadna-owie Formation/Hooray Sandstone) range up to about 100,000 microlitres per litre, and the sum of the hydrocarbons ethane to heptane range up to about 2250 microlitres per litre. Several samples contain relative high values for the hydrocarbons ethane to heptane, which suggests that the groundwater acts as a migration agent for hydrocarbons derived from the adjoining source rocks or from existing reservoirs.

References

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