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THE STRATIGRAPHY, SEDIMENTOLOGY AND URANIUM DEPOSITS OF TERTIARY ROCKS: LAKE FROME AREA, SOUTH AUSTRALIA

by

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Wopfner et al. (1974). The Lower Tertiary Eyre Formation of the Southwestern Great Artesian Basin, plus appendices from S. Aust. Dept. Mines Rep. 73/89.

Callen, R.A., (1975 in press). Lake Frome Area - Regional Geology, Tertiary Stratigraphy and Uranium Localization.

Callen, R.A. and Tedford, R.H., (1975 in prep.). New Cainozoic rock units and inferred climate, Lake Frome area, South Australia.

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SUMMARY

The Tertiary rocks of the Tarkarooloo Basin in the Lake Frome area rest disconformably on Cretaceous strata of the Great Artesian Basin (Frome Embayment). Total thickness varies from 300 m in the Poontana Sub-basin flanking the Flinders Ranges to 50 m on the Benagerie Ridge in the central southern part of the basin. The sequence is divided into the Eyre Formation (Paleocene to Eocene), the Namba Formation (two members; Miocene), and Willawortina Formation (late Tertiary - ?Pleistocene). The Namba Formation, resting disconformably on the Eyre Formation, intertongues in its upper part with the Willawortina Formation. Marginally, a disconformity exists between the two younger Formations. The Namba Formation is equivalent and similar to the Etadunna Formation of the Lake Eyre Basin. The Oligocene to Lower Miocene was a period of non-deposition. Silcrete formed marginal to uplands during this period, and probably during deposition of the Eyre Formation.

Changes in clay mineralogy occur across disconformities and boundaries between rock units. These variations are explained primarily in terms of climatic change, secondarily in terms of tectonism. The clay mineral changes form approximate time markers, assisting stratigraphic differentiation and correlation in atypical or lithologically homogenous sequences.

The Eyre Formation, of mature moderately sorted carbonaceous crossbedded sand and minor kaolinite, was deposited in a fluviatile environment. Braided streams and coalescing low angle fans prevailed, with sands deposited in bars. Drainage was external. The sequence fines upward, Eocene sediments being mainly carbonaceous silts, probably partly lacustrine. Deeply weathered rocks of the Olary Region provided sediments in the south, Mesozoic rocks supplied the north. Channelling is more evident in the southern regions, and

hosts uranium mineralization. Climate was tropical to sub-tropical with high rainfall, supporting rainforest vegetation.

The contrasting Namba Formation is a fine grained sequence of smectite:randomly-interstratified-clay, olive and grey, with thin pale yellow sand beds in the lower member, changing abruptly to illite:randomly-interstratified-clay in the upper member. Persistent beds of dolomite and palygorskite are characteristic. These sediments are texturally and mineralogically immature low energy deposits, accumulated in a low relief environment. Sub-environments were irregularly distributed.

Deposition began in a fresh to hyposaline lake with stagnant bottom conditions, west of modern Lake Frome. The Lake shallowed and broadened, becoming hypersaline, and dolomite was deposited. Dolomite and calcite alternated as the groundwater-saline lake water interface fluctuated. Algal mats were present. Fluctuating lacustrine and fluviatile conditions followed, with regressive shorelines and river avulsion producing rather poorly defined cyclic sequences. Streams were probably deep and constantly flowing. Incipient soil formation took place under swampy conditions. Next, well-sorted fine sands accumulated in river channels and lacustrine offshore bars, in which uranium was later deposited. After deposition of more clay, a second phase of carbonate deposition occurred at the base of the upper member, subsequently locally calcreted.

Sedimentary structures resulting from thixotropic behaviour are common. Bioturbation is prevalent, especially associated with carbonates and laminated silt. Many beds have been homogenized, mixing ooliths with micrite mud. Bioturbation distribution indicates intermittent relatively rapid deposition.

A marine connection with the Murray Basin via a large river

is indicated from vertebrate evidence. Although an inland lake and floodplain is preferred, a lagoonal environment marginal to an epeiric sea cannot be eliminated, particularly during carbonate deposition.

Climate was warm temperate to subtropical, with periods of seasonal aridity. Gallery rainforest flanked rivers and lakes; savannah was elsewhere. Considered in relation to Australia's latitude during the Miocene, an expanded subtropical climatic zone is required. Widespread distribution of similar Tertiary deposits in Australia supports this. The change from smectite-degraded illite to kaolinite-mica clays in the upper Namba Formation and Willawortina Formation is attributed to uplift of the Flinders Ranges, though a similar widespread change in Tertiary southern hemisphere oceanic sediments suggests a more basic climatic cause.

Uplift of the Flinders Ranges is recorded by deposition of a flanking wedge of poorly sorted green and brown mottled illitic clay-silt, sand and conglomerate of the Willawortina Formation. The fan environment of channel and floodplain was accompanied by deposition from mud flows and related transport processes near the ranges. A change to smectite clay in the upper part of the sequence in one bore may indicate a marked increase in aridity.

Uranium could have been introduced at any time during the medial to late Cainozoic, and takes the form of roll front or sheet deposits of the geochemical cell type, still actively migrating. The Eyre Formation in the southern part of the basin is potentially most productive. Certain areas require further exploration though very large deposits are not expected, and mineralization is probably restricted to the margins of the basin.

STATEMENT

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university, and the thesis contains, to the best of my knowledge, no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signed . . .

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