SEDIMENTOLOGY AND PETROLEUM GEOCHEMISTRY OF THE OULDBURRA FORMATION, EASTERN OFFICER BASIN, AUSTRALIA

by

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ABSTRACT

Deposition of the Early Cambrian Ouldburra Formation, a mixed siliciclastic/carbonate, marine carbonate and evaporite succession, occurred in the shallow marine setting of the Manya Trough. The observed variations between the facies are interpreted as both autocyclic and allocyclic in nature, largely controlled by sea level fluctuations.

Periodic exposure of the carbonates resulted in dolomitisation and secondary porosity development. Secondary porosity was generated within the siliciclastic-carbonate zone by carbonate matrix and grain dissolution, and also by dolomitisation.

The sedimentary facies and rock character suggest that sabkha and brine reflux models can be used to explain early dolomitisation within the Ouldburra Formation. Dolomite mainly occurs in two stages: (1) common anhedral dolomites formed early by replacement of pre-existing limestone and (2) saddle dolomite and coarse crystalline dolomite formed during the late stages of burial diagenesis and associated with hydrocarbon shows. The diagenetic path includes cementation, dolomitisation, dissolution, compaction, silicification, dedolomitisation, burial dolomitisation, sulphide mineralisation, pressure solution, fracturing and hydrocarbon migration. The dolomite reservoirs were ranked on the basis of their porosity distribution and texture into groups I to IV. Dolomites with rank I and II exhibit excellent to good reservoir characteristics respectively. Petrophysical logs, including gamma ray and density logs, helped to identify porous intervals.

Stable carbon and oxygen analyses, together with fluid inclusion microthermometry, suggest that the early dolomite with relatively heavy $\delta^{18}O$ but depleted $\delta^{13}C$ formed in a sabkha environment under relatively low temperatures, and the late replacement and saddle dolomites with depleted $\delta^{18}O$ suggest deposition under somewhat higher temperatures.

In the Manya Trough, the organic-rich carbonates were deposited under anoxic to suboxic conditions. They are mature to overmature and have Type III to IV kerogen. In the Tallaringa Trough, the carbonates were deposited under highly anoxic conditions. They are early mature to mature and have Type II kerogen. The occurrence of live oil, together with thucholites in proximity to the common lamalginite, are characteristic features associated

with these excellent quality, oil-prone source rocks. The recognition of *Gloeocapsomorpha prisca* in these source rocks is the first reported occurrence of this organism from the Early Cambrian.

Biomarker characteristics of the clay-free Tallaringa Trough limestones are unusual and are characterised by high abundances of hopanes and diasteranes relative to steranes. Other significant biomarkers are dinosterane and 24-isopropylcholestane, where the former is the first reported occurrence of this compound from an Early Palaeozoic rock. The latter confirms an earlier report of this compound from the Ouldburra Formation and strengthens its significance as an age-specific sponge marker.

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