FACIES INTERPRETATION AND DIAGENESIS OF THE COSSIGNY MEMBER, BEAGLE SUB-BASIN NORTH WEST SHELF, WESTERN AUSTRALIA

Thesis submitted to the Faculty of Science,
University of Adelaide

In
Partial fulfilment of the Requirement for

the
M. Sc. Degree

in

Petroleum Geology and Geophysics,

The University of Adelaide

by
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1994

ACKNOWLEDGMENTS

I am greatly indebted to Dr. Bill Stuart for his support, guidance and encouragement throughout the course of this study. My thanks also go to Dr. Nick Lemon, Dr. John Warren and Mr. Andy Mitchell for their valuable advice and patience.

My appreciation is recorded to Bridge Oil Limited for supplying a scholarship and the data for this project. I wish to thank everyone at the Bridge Oil Limited especially to Dr. Barry Goldstein for assistance during my stay in Sydney.

My thanks also go to Mr. Sukru Apak for his help and moral support.

STATEMENT OF AUTHENTICITY

To the best of my knowledge and belief this thesis contains no material which has been accepted for the award of any other degree or diploma in any University, nor does it contain any material previously published or written by another person, except where due reference is made in text.

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ABSTRACT

The Triassic reef complexes of the North West Shelf represent a new exploration play involving reservoirs in the reefs themselves or within associated carbonate platforms. The Triassic carbonates are found in number of exploration wells on the North West Shelf, the most notable occurrences are shelf carbonates of the Outer Bonaparte Basin (Mory, 1988), the Outer Browse Basin (Willis, 1988), on the Exmouth Plateau (Barber, 1988) and Timor (Audly-Charles, 1968). In the Northern Carnarvon Basin a 100-140 meter thick carbonate unit of Ladinian age known as Cossigny Member was intersected by wells Phoenix-1, Phoenix-2 and Cossigny-1. The Cossigny Member represents the only significant carbonate deposition in the study area, and was deposited in shallow water conditions on a broad gently sloping shelf, similar to the modern day Persian Gulf.

The Cossigny Member represents a transgressive then a regressive sequence and was deposited as a result of a brief marine transgression during the Ladinian times (Blevin et al 1993, Bradshaw et al., 1988). Detailed sedimentological descriptions and thin section studies of the Cossigny Member reveal three characteristic lithofacies. Each carbonate lithofacies is distinguished by a dominant lithology or association of lithologies. XRD analysis and staining of the selected samples allowed the identification of mineralogy. At the base of the Member in Phoenix-2 well, which represents all of the lithofacies, is an oolitic grainstone facies. This facies is composed of well sorted, well rounded, medium to coarse grained oolites deposited within a moderate to high energy ooid shoal. The ooids show a radial-concentric fabric (Heller et al. 1980) that reflects a calcitic or Mg calcitic precursor. The absence of abundant oolites in the shoreward wells of Phoenix-1 and Cossigny-1 indicates that this facies did not extend shoreward. Oolitic grainstone facies is overlain by a mixed-ooid-peloid grainstone facies; in Phoenix-1 and Phoenix-2 this represents a transitional zone between the ooid grainstone facies and the overlying low-energy lagoonal facies. This facies consist of peloids, pellets, ooids and bioclasts. Ooids generally constitute a smaller percentage of the framework grains and show a heterogeneous fabric. The mixed-ooid-peloid grainstone facies grades upwards into a muddy peloidal wackestone facies. This facies dominantly consist of faecal pellets and peloids. The petrographic characteristics and the presence of miliolid foraminifera indicate that this facies was probably deposited in a quite water lagoonal environment.

The Cossigny Member carbonates show several phases of diagenesis. Micritization is dominant in the muddy peloidal wackestone facies, most of the grains in the mixed facies are also micritized. An early marine cementation of the sediments created a rigid frame work and thus, prevented grain to grain compaction. The marine cement is seen as bladed crystals growing perpendicular to the substrate. In most cases it envelops the early micritic cement. The last generation of cement is equant spar that fills the rest of the pore spaces. The crystal size of the spar increases towards the centre and was probably deposited in meteoric phreatic environment. The upper part of the lagoonal facies is dominantly dolomitized. Dolomite crystals have replaced constituent grains as well as the cement. Dolomites were probably formed by the subsurface mixing of sea water and meteoric water Hanshaw et at al., (1971).

The Cossigny Member carbonates represent an excellent seismic horizon. Due to the wide spacing of the wells in the Beagle Sub-basin the seismic correlation of the Member was necessary. To assist in the stratigraphic interpretation and correlation, two other horizons Main Unconformity (Seismic Green Horizon) and top Bedout Formation (Seismic Blue Horizon) were tentatively carried (where present) throughout most of the selected seismic data.

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