IN-SITU STRESS AND NATURAL FRACTURE NETWORKS IN THE CARNARVON BASIN, NORTH WEST SHELF, AUSTRALIA

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ABSTRACT

A total of 517 naturally occurring fractures are identified on 12 resistivity image logs in Carnarvon Basin on the North West Shelf of Australia. A range of fracture orientations were present. The fractures can be divided in to two sets using image logs. 1) Electrically resistive and conductive fractures orientated NE-SW, 2) electrically resistive and conductive fractures orientated E-W. There are 235 electrically resistive fractures that are considered to be cemented with electrically resistive cements. These electrically resistive fractures dominantly orientated NE-SW. There are 282 conductive fractures that are considered to be uncemented and filled with drilling mud. Thus, these fractures are considered to be open for fluid flow. The conductive fractures are dominantly orientated E-W.

The in-situ stress field is a major control on the ability for fractures to transmit fluid. 123 drilling induced tensile fractures and 175 borehole breakouts present in 12 image logs, determined a mean maximum horizontal stress orientation of 110°. Leak-off tests and density logs were used to calculate the in-situ stress magnitudes with a vertical stress (S_v) of 21.7 MPa/km, a minimum horizontal stress (S_{hmin}) of 16.8 MPa/km and a maximum horizontal stress of 23.4 MPa/km (S_{Hmax}), this indicates a strike-slip faulting stress regime ($S_{Hmax} > S_v > S_{hmin}$) in the Carnarvon Basin. Using fracture susceptibility plots and Mohr circles constrained by the in-situ stress values, we show that the majority of E-W striking conductive fractures are optimally oriented within the in-situ stress field, demonstrating a high likelihood for fluid transmission. Additionally, several of these fractures demonstrate significant losses of drilling fluids at corresponding depths. It is likely that the identified conductive fractures are indeed open to fluid flow; demonstrating that these fracture networks provide secondary permeability the Carnarvon Basin subsurface.

KEYWORDS

In-situ Stress, Carnarvon Basin, Natural Fractures, Structural, Geomechanics

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES 4