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Seismic Expression of Loss Zones within Carbonates of the Browse Basin

M. R. Power
Shell Development (Australia) Pty Ltd. QV1 Building, 250 St Georges Terrace, Perth WA 6000. Email: mike.power@shell.com

INTRODUCTION

This integrated study documents the drilling hazards associated with drilling through the complex overburden geology of the Browse Basin (Fig. 1). Previous drilling campaigns by other operators in the region have encountered severe problems when drilling riser-less with seawater and viscous mud sweeps through unconsolidated sands of Early Tertiary age. In an attempt to avoid these costly drilling hazards, a riser-less mud recovery system was implemented for the first time in the region. Some of the advantages that come with this system are 1) the ability to use a drilling fluid with properties specifically designed for the formation being drilled, 2) avoiding the build-up of cuttings around the well head, and 3) stopping any drilling fluids being discharged into the water column.

In late 2006 the Prelude-1 exploration well was spudded. While drilling through a highly permeable section of the Oliver Formation, with the closed mud system, unsustainable losses were encountered resulting in all the drilling fluids being lost to the formation at a rate of 41 m^3/hr (260 bbls/hr). Drilling progressed through the underlying section using conventional seawater and mud sweeps leading to borehole instability and repeated stuck pipe incidents leading to the well being abandoned. A new well location was identified and the well was respudded.

SHALLOW HAZARD DIAGNOSTICS

A comprehensive review of drilling hazards was completed as part of the initial planning for the Prelude exploration well (Fig. 2). This study examined all of the available offset well data including wireline logs, cuttings, well completion reports and drilling reports. Shallow hazard mapping was done in targeted areas with the original multi-client post-stack migrated Adele 3D dataset. This study supported previous findings and re-confirmed that difficult drilling conditions exist across the Browse Basin within several intervals, with the most common incidents being stuck pipe and pack-offs within unconsolidated sands of the Basset, Grebe and Cartier Formations. No obvious shallow hazards had been identified above this interval such as faults or shallow closures and there had been no indications of shallow gas above the target.

The current study has benefited from the delivery of a new pre-stack time migrated seismic dataset, reprocessed by WesternGeco, which is far superior to that used for the pre-drill shallow hazard study. Major improvements in the data include enhanced signal to noise ratio and better focussing and positioning of reflectors.

After inspection of the new pre-stack 3D dataset and correlation with logs from Prelude-1 it was immediately clear that the well had penetrated the fore-reef fringe of a buried carbonate reef complex (Fig. 3). This interpretation is consistent with the cuttings (above and below the loss zone), logs and the seismic data. Lithological descriptions of cuttings were of predominantly calcarenites grading to calcirudite and calcisiltite with occasional reef fragments such as bryozoans and larger foraminifera (Miogypsina spp.). Key sequence breaks within the Barracouta and Oliver formations correspond to inflections in the MWD/LWD gamma ray and resistivity, which are resolved on seismic as continuous reflections representative of a largely layer-cake stratigraphy. However, within the basal section of the Oliver Formation there are a series of discrete high impedance reflections, which when viewed in seismic timeslices form geometries remarkably consistent with those seen in