Seismic facies differentiation using a multi-variate process of the Early Jurassic, Browse Basin, North West Shelf, Australia

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ABSTRACT

This study investigated the regional seismic stratigraphy of the Jurassic in the Poseidon and Crown Gas fields in the Caswell sub-basin of the Browse Basin, NWS, Australia. The purpose being to understand the impact of tectonics on sediment depocentres, fault movement timing and movement of magma in fault networks. Across the NWS, volcanic facies are distributed contemporaneously with sands within the Bajocian to Callovian of the upper part of the Plover Fm. and Oxfordian Montara Fm., their emplacement linked to seafloor spreading of the Argo abyssal plain. They are often encountered when drilling for high amplitude seismic anomalies associated with gas filled sands. Findings from this work illustrate the varying movement of regional faults through time, how this variation leads to episodic depocentre growth and a potential link to the reason for the specific site of volcanic emplacement. The Browse Basin's Late Triassic and Jurassic sandstones host multiple trillion cubic feet of gas in reservoirs currently sourcing liquified natural gas (LNG) terminals- Prelude (Shell), and in the investment approval stage- Browse (Woodside). The presence of volcanic facies has been challenging to predict, and the consequences of failing to do so are enormous, with over 1000m of volcanics encountered at Grace-1, 40km north of the Poseidon Gas Field.

A seismic based workflow was created to unravel the multi-variate challenge of differentiating lithofacies of the Jurassic Plover and Montara fm.'s of the Browse Basin of the North West Shelf (NWS), Australia. The study incorporates full and angle stack reflection seismic data attributes, drill core, and geophysical logs. The primary goals of the study were to a) explore previously documented amplitude and frequency/lithology relationships in a hierarchical, multi-attribute process b) integrate mapping results into a model of the geologic sequence of events with a primary focus on volcanic facies. Three case studies evaluate the technique and the geological models derived from the seismic cluster facies (SCF) maps with a focus on the deposition of volcanic lithofacies. The extent of volcanic lithologies identified in the workflow are shown in fuchsia in Figure 1. Seismic geomorphological character associated with volcanic craters was observed and is shown in Figure 2.

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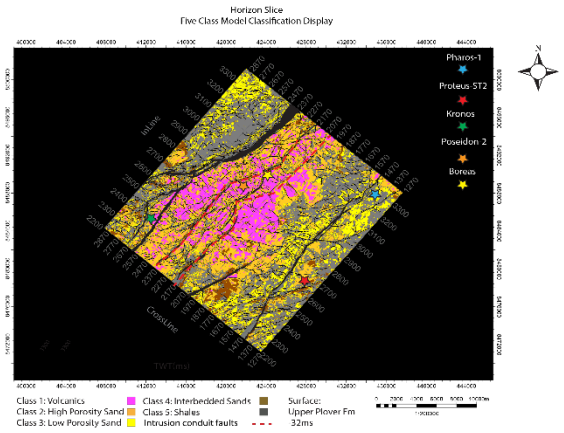

Figure 1: Seismic Cluster Facies displayed on Upper Plover Horizon (-32ms)

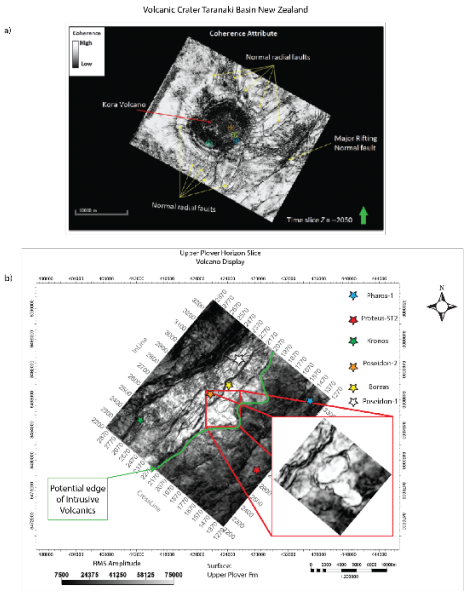

Figure 2: Identified point source of lava surface flows.