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Research paper

An interdisciplinary approach to reservoir characterisation; an example from the early to middle Eocene Kaimiro Formation, Taranaki Basin, New Zealand

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ABSTRACT

The Kaimiro Formation is an early to middle Eocene, NE-SW trending reservoir fairway in Taranaki Basin, and comprises a range of coastal plain through to shallow marine facies. A time of regional transgression is observed across the Paleocene–Eocene transition, which is linked to a general global warming trend and to regional thermal relaxation-related subsidence in New Zealand. The earliest Eocene transgressive deposits pass upwards into a series of cyclically stacked packages, interpreted as 3rd and 4th order sequences. Maximum regression occurred within the early Eocene and was followed by punctuated retrogradational stacking patterns associated with shoreline retreat and subsequent regional transgression in the middle Eocene.

The Kaimiro Formation is considered a good reservoir target along most of the reservoir fairway, which can largely be attributed to a consistently quartz-rich, lithic-poor composition and reasonably coarse sand grain size. Correlations demonstrate that within the early Eocene the main reservoir facies are channel-fill sandstones overlying candidate sequence boundaries in paleoenvironmentally landward (proximal) settings, and upper shoreface/shoreline sandstones in relatively basinward (distal) settings. Middle Eocene reservoir facies are not represented in distal wells due to overall transgression at this time, yet they form a significant target in more proximal well locations, particularly on the Taranaki Peninsula.

Depositional facies is one of the principal controls on sandstone reservoir quality. However, while reservoir facies have been proven along the length of the reservoir fairway, it is evident that diagenesis has significantly impacted sandstone quality. Relatively poor reservoir properties are predicted for deeply buried parts of the basin (maximum burial >4.5 km) due to severe compaction and relatively abundant authigenic quartz and illite. In contrast, good reservoir properties are locally represented in reservoir facies where present-day burial depths are <4 km due to less severe compaction, cementation and illitisation. Within these beds (<4 km) the presence of locally occurring authigenic grain-coating chlorite (shallow marine facies) and/or well-developed secondary porosity are both favourable to reservoir quality, while pervasive kaolinite and/or carbonate are both detrimental to reservoir quality.

These results illustrate how an interdisciplinary approach to regional reservoir characterisation are used to help reduce risk during prospect evaluation. Assessment of both reservoir distribution and quality is necessary and can be undertaken through integrated studies of facies, sequence stratigraphy, burial modelling and petrography.

1. Introduction

The Taranaki Basin lies partly onshore and mostly offshore in the central-western part of the North Island, New Zealand (Fig. 1). It is the only basin in New Zealand with commercial oil and gas production, where the majority of petroleum reserves are contained in a broadly NE-SW trending fairway of Paleogene shoreline and coastal plain sandstones. Discovery of hydrocarbons in the early to middle Eocene Kaimiro Formation occurred in the 1960's, with gas/condensate still being produced today from the Maui and Kapuni fields (D-Sands, K3E lower respectively). However, from the 1970's

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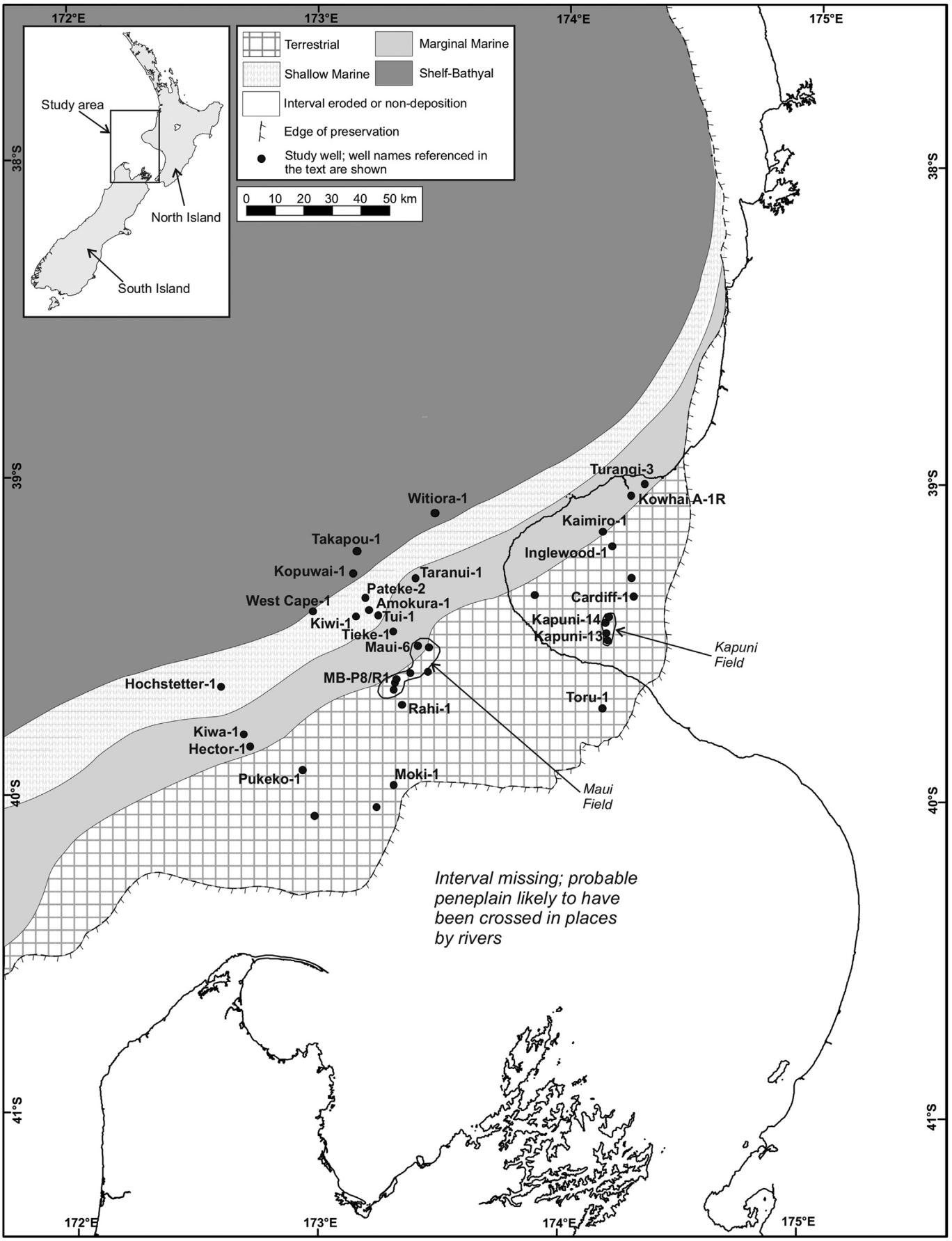

Fig. 1. Taranaki Basin map showing study wells and petroleum fields producing from early to middle Eocene reservoirs; well names referenced in the text are shown. Paleogeography showing orientation of the middle Eocene paleoshoreline and general position of facies belts for early Eocene strata are from Strogen (2011). The present-day shoreline of the Taranaki Peninsula, and latitude and longitude are also shown; see inset map for location of the study area.