CHAPTER 3

Qualitative Seismic Interpretation

The 3D Maari Seismic Survey was acquires in the southern part of the Taranaki Basin, inserted in a complex structural area known as the Southern Inversion Zone. The survey covers approximately 514 km^2 – 27 km long and 19 km wide – and is available as a full-stack seismic cube containing 1677 inlines (170-1846, step 2) and 2253 crosslines (379-2631, step 1). The inline spacing is 25 m and the cross-line is 12.5 m. Polarity of the Maari 3D data is such that an increase in acoustic impedance is a trough (negative number).

Figure 3.1 exhibits an amplitude spectrum taken from the Maari 3D seismic cube over the interval 400-3000ms, which is the interval where significant seismic events were interpreted for this study. The bandwidth ranges approximately from 12-56 Hz.

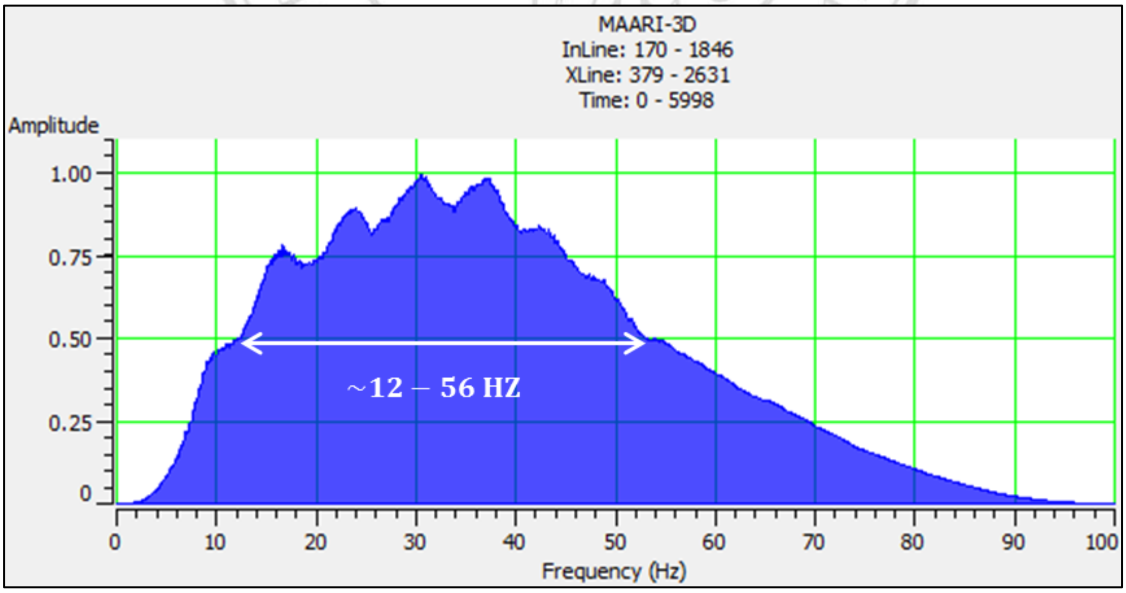

Figure 3.1: Amplitude Spectrum of the 3D Maari seismic cube

Four horizons were interpreted based on the top formations markers provided at the well locations. These horizons have many utilities, such as (1) mapping the top of important units, such as the reservoirs, across the Maari area, (2) guide the interpolation between wells during creation of a low-frequency model as well as constraining zones during seismic inversion and (3) check polarity of the dataset.

The four picked horizons were from top (younger) to bottom (older): Unconformity, Moki, Lower Manganui and Mangahewa. Figure 3.2 and 3.3 show the qualitative interpretation along an Inline (IL) and a Cross-line (XL), respectively. In general, horizon and fault interpretation in the 3D Maari area is complicated due to several issues. The main one was caused during acquisition, when the seismic was shot along the strike direction of a major fault in the area. The consequences are that it is likely to have affected the quality of migration and also amplitude preservation during processing. Another factor is the occurrence of gas anomalies that attenuate amplitudes below it. At these zones, reflectors cannot be accurately mapped and, generally, the only guide that the interpreter has is the trend of other mapped events below and across these "no-amplitude areas".

The Unconformity horizon (446 ms TWT at the vertical well Maui-4, IL 830) was interpreted on a high negative amplitude reflection (trough). It presents good continuity and truncates the underlying reflections (Figure 3.2b and 3.2b). The time structural map for the Unconformity horizon shows a structural high in the south and south-east and a structural low at the northeastern part, where it is affected by several faults (Figure 3.4).

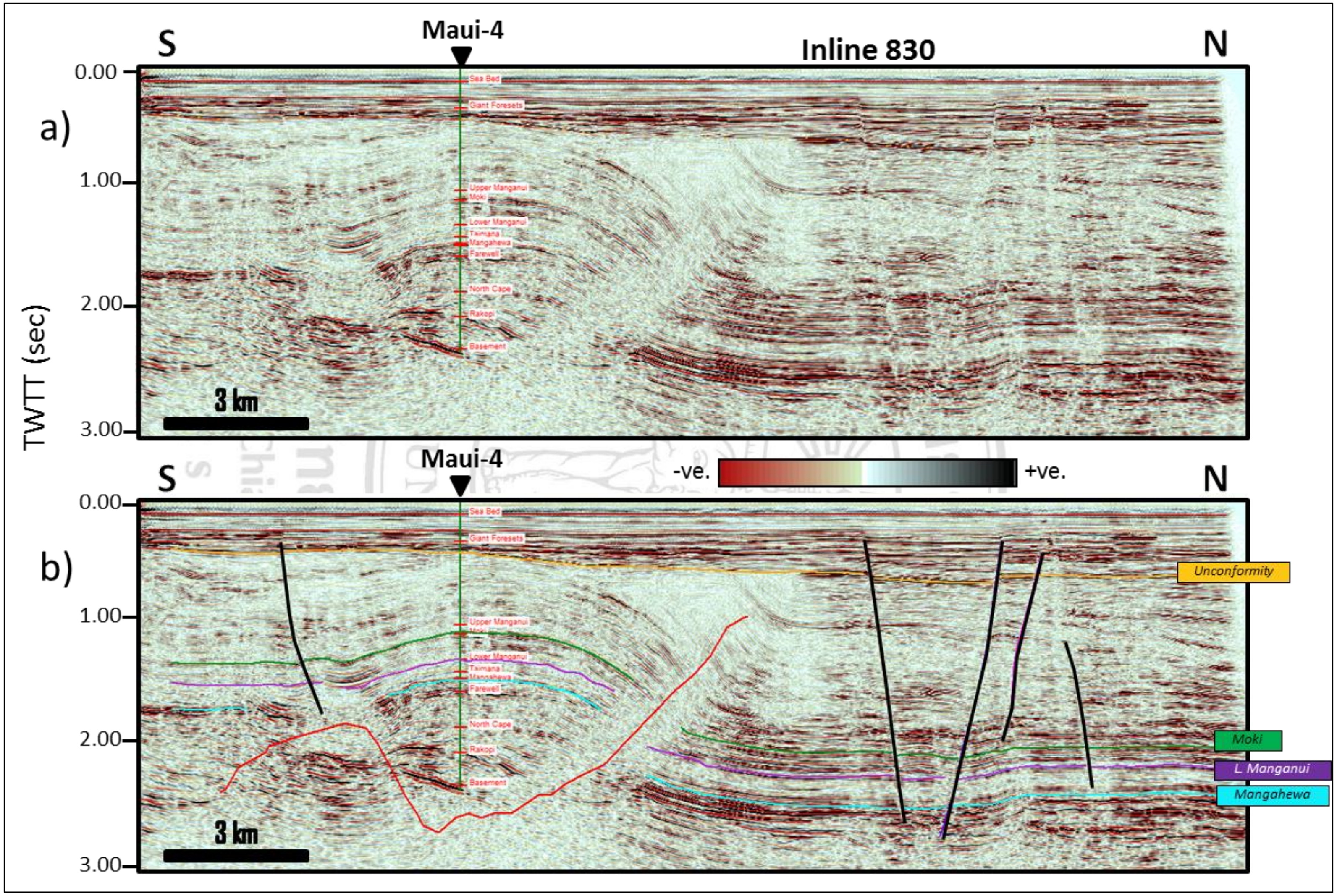

Figure 3.2: a) Uninterpreted and b) Interpreted seismic line (IL 830)

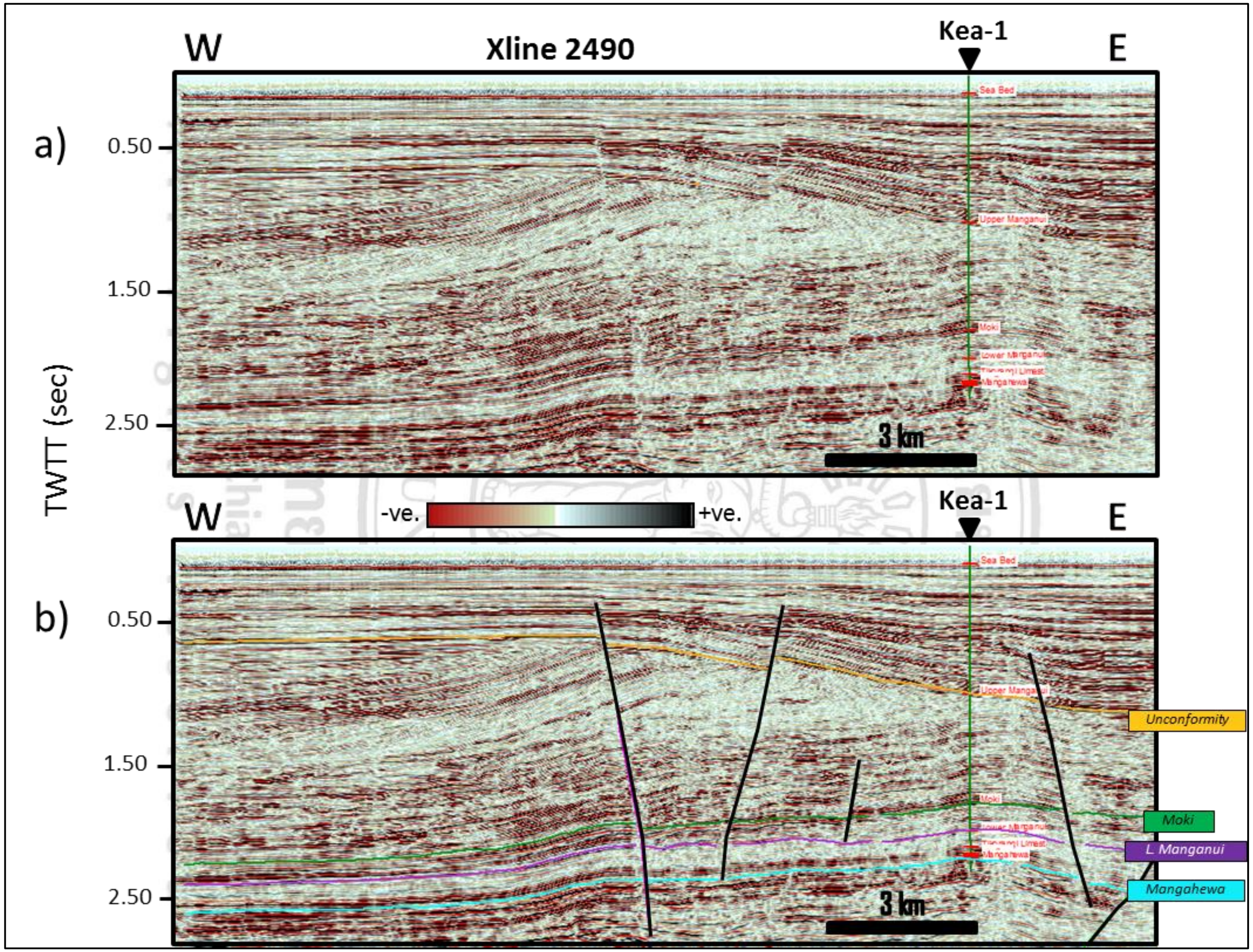

Figure 3-3: a) Uninterpreted and b) Interpreted seismic line (XL 2490))

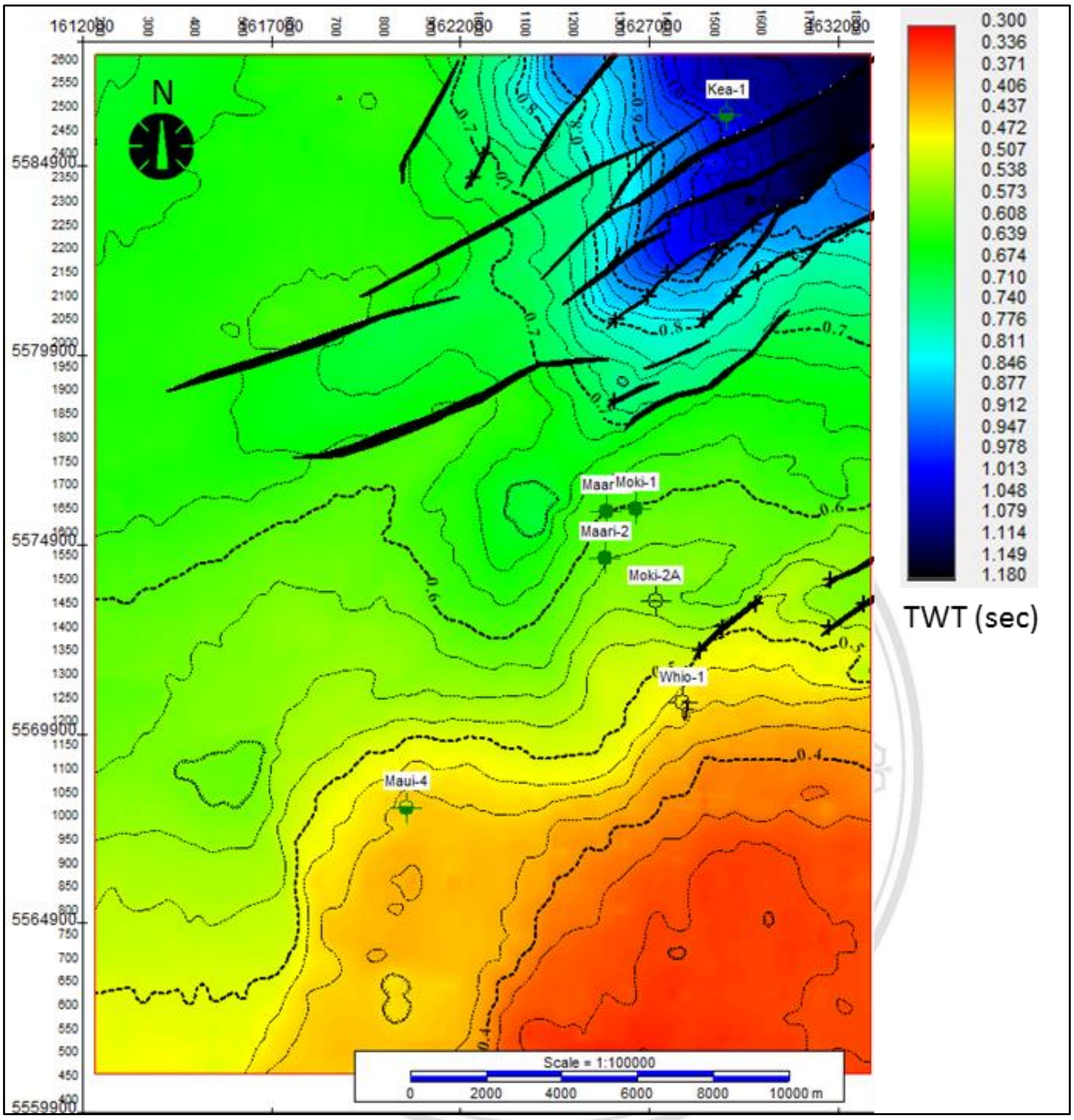

Figure 3.4: Time Structure Map – Unconformity Horizon

The Moki horizon marks the top of the main reservoir in the Maari field area. It was interpreted at a positive amplitude reflection (peak) that coincides with the characteristic low GR values indicating the sandstones of the Moki Fm (Figure 3.5). The horizon crosses the well Maui-4 (IL 830) at 1096 ms TWT. Laterally, it varies from semi-continuos to highly discontinuos in some places. The time structural map of the Moki horizon (Figure 3.6) shows a structural high in the SE and deeper zones in the west and north-west. The horizon is cut by a positively inverted fault that uplifted the sediments at the hanging-wall and produced two asymmetrical anticlines – commonly referred to as the Manaia and Moki structures.

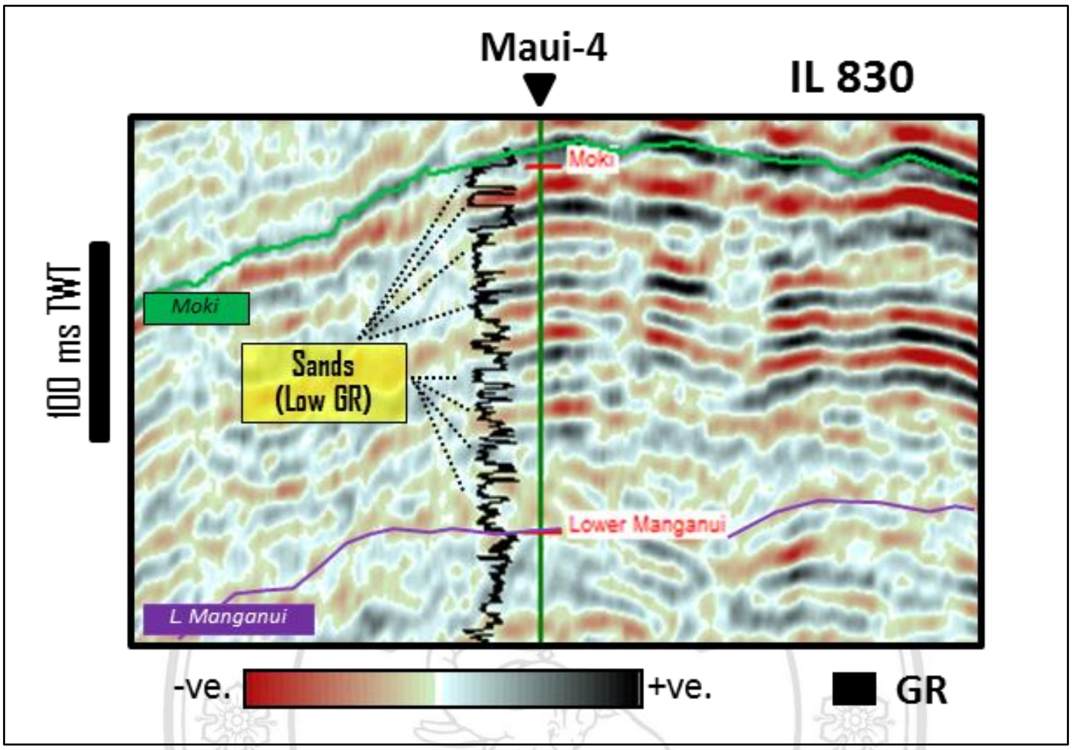

Figure 3.5: Detailed view of the top Moki marker in the Maui-4 well, showing the horizon picked at positive amplitude event (peak). Gamma-ray curve is also displayed

The Lower Manganui horizon is defined by a highly discontinuos negative reflection event (trough) that crosses the Maui-4 well at 1314 ms (TWT). It varies laterally from low to very low amplitudes. At the south-eastern sector, this event is very often indistinguishable within a reflection free zone that occurs between the Moki and the Mangahewa horizons. A time structure map of the Lower Manganui horizon (Figure 3.7) shows a structural high (~1200 ms TWT depth) in the uplifted hanging-wall of the major fault (eastern side) in the area. The topography gradually dips from South towards the North around this fault, while the western sector is marked by structural lows of ~2300 ms TWT depth.

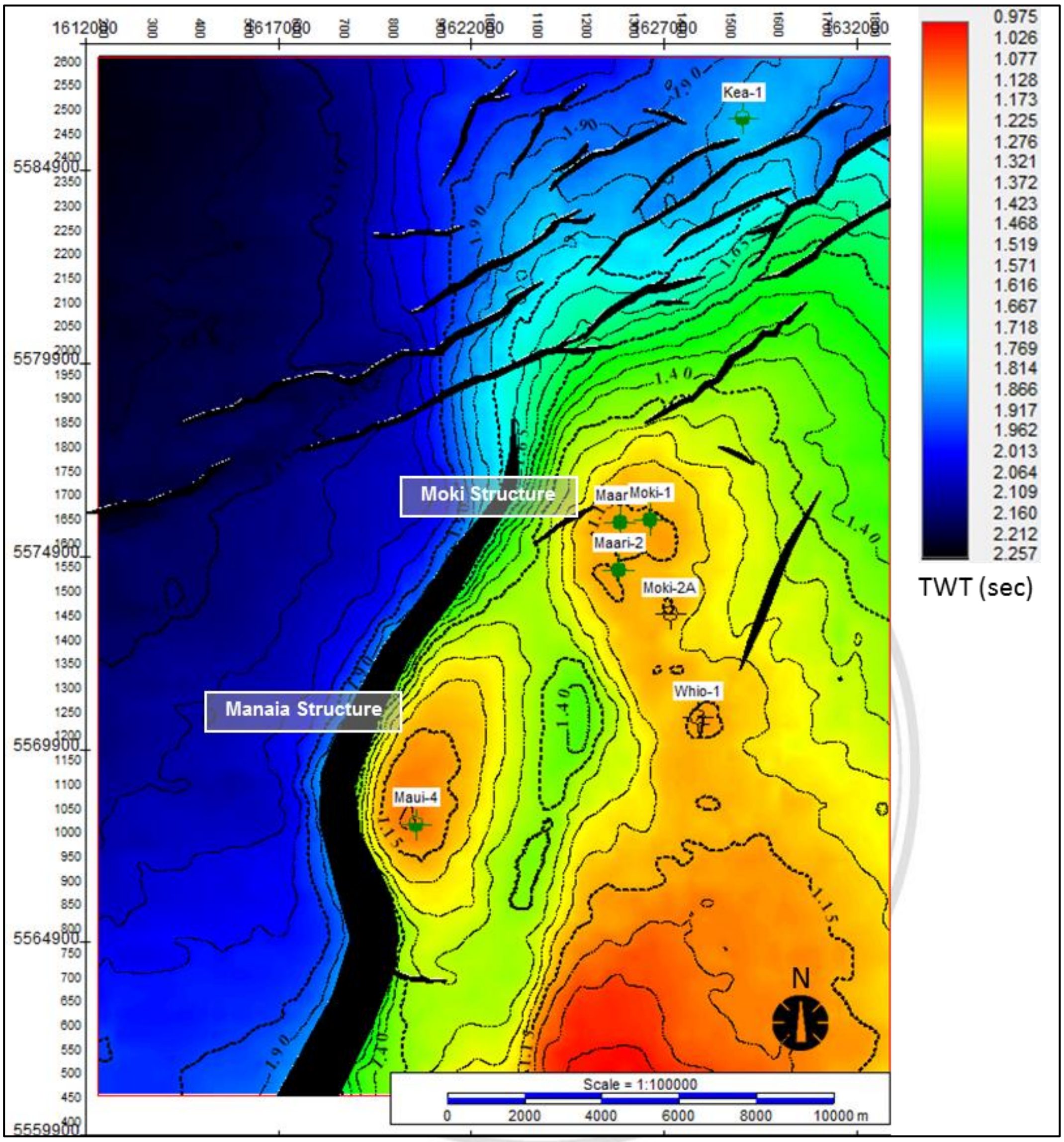

Figure 3.6: Time Structure Map – Moki Horizon

The Mangahewa horizon was interpreted on a positive amplitude reflecion (peak) of moderate to low continuity. Along the Xline 1020, it crosses the Maui-4 well at 1484ms TWT depth. This horizon presents a similar trend with the two horizons mapped above: Moki and Lower Manganui (Figure 3-8). These formations were deposited during the first influx of clastic sediments during the lower middle Miocene (~15 Ma). A change to a compression regime, around the same period, ended up affecting these layers via extensional faults that were positively inverted. The uplift caused by this type of structure is responsible for many anticlines, particularly at the

Southern Taranaki, exactly as the Manaia and Moki structures presented here. Structural highs are seen in the eastern side of the reverse fault (uplifted hanging-wall), particularly at the SE and E parts of the area. The deepest point is located in the NW sector (2600 ms TWT depth). In the NE sector, the horizon is cut by many faults, most related to the reactivation of pre-existent extensional faults.

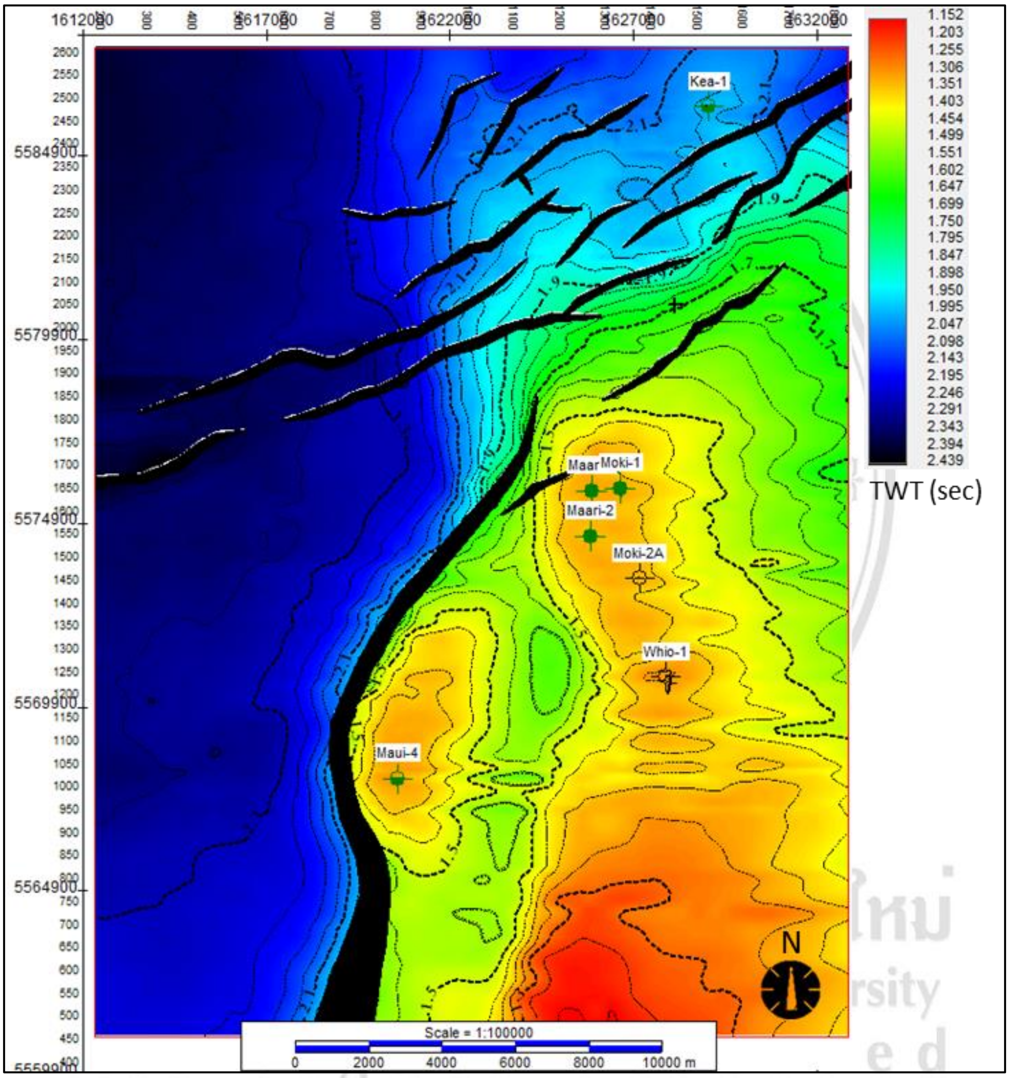

Figure 3.7: Time Structure Map – Lower Manganui Horizon

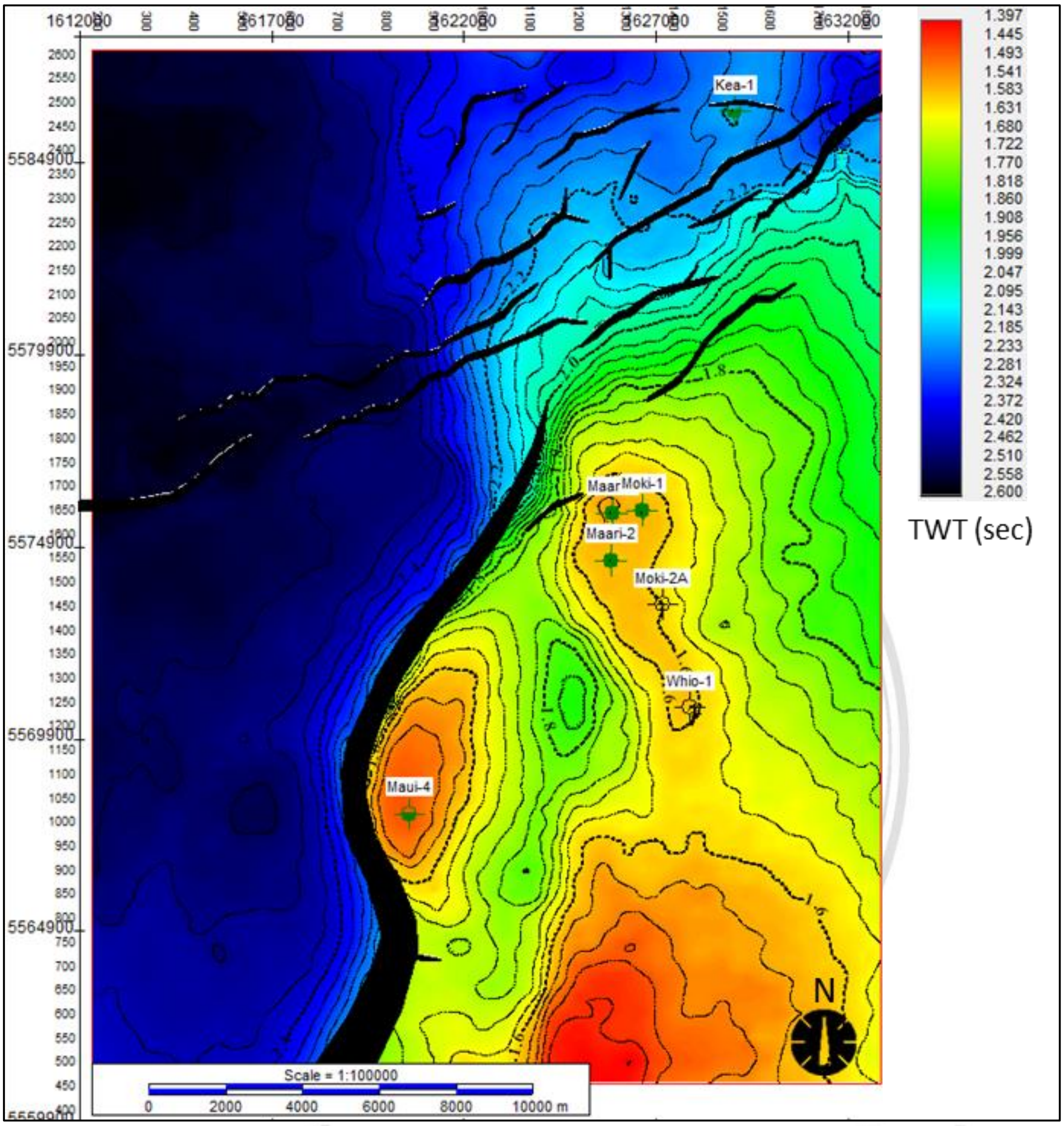

Figure 3.8: Time Structure Map – Mangahewa Horizon