CHAPTER 3

DATA AND WORKFLOW

3.1 Quality Control of Seismic Data

The 3D seismic data used in this research covers an area of 350.1 square kilometers (Figure 3.1.). The seismic survey was acquired by Veritas DGC Australia Pty. Ltd as per the request of New Zealand Overseas Petroleum Limited (NZOP). The acquisition began on 25 March 2003 and finished on 10 May 2003. The survey has 1500 inlines (inline range: 3000-4500) and 2474 crosslines (crossline range: 756-3230). The informations of the acquisition are summarized in Table 3.1. A more detailed informations in regards to acquisition and processing of the data can be found in appendix A and B respectively.

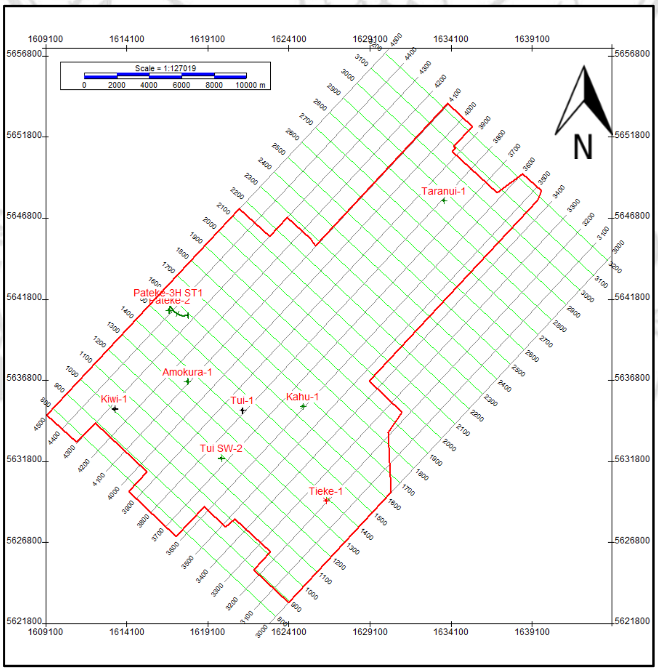

Figure 3.1. Basemap of the Tui-3D field. The polygon in red shows the area where the data are available (Veritas DGC, 2003).

Table 3.1 The acquisition geometry quick look

Survey type	3D
Client	New Zealand Overseas Petroleum Limited
Survey name	Tui 3D MSS
SP interval	18.75 m (Flip Flop)
Source	3200 in³, Sleeve guns
Groups	288
Fold	48
Water depth	120 to 150 m
Survey surface area	350.1 sq km
Full fold sail line km	10286.41 km
Port of supply	New Plymouth, New Zealand
Contractor	Veritas DGC
Vessel	M/V Pacific Sword
Client representation	Enquest Pty Ltd

3.1.1 Polarity

Polarity of seismic data is an essential parameter that has to be determined by studying the character of seismic traces. According to some recognized reflections, it is convincing to introduce the polarity of the seismic data as an icreasing acoustic impedance as a peak. Figure 3.2 shows the reflection from Tikorangi Limestone marked by high acoustic impedance is shown as a peak. As per the well-tie process, the extracted wavelet shows the current seismic data is not zero-phases. We therefore need to rotate the phase of the wavelet by -90° showing an optimum correlation which will be explained later on.

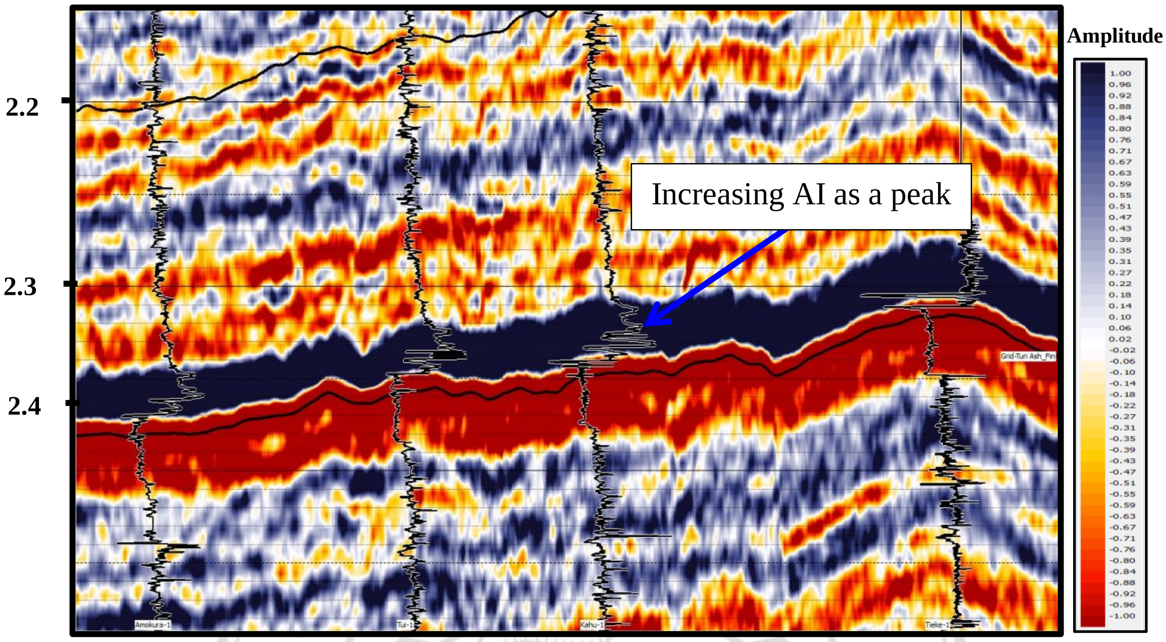

Figure 3.2. A zoomed seismic section around Tikorangi Limestone (a big black peak) showing an increasing acoustic impedance as a peak. The displayed logs are acoustic impedance log from well Amokura-1, Tui-1, Kahu-1, and Tieke-1 (left to right).

3.1.2 Seismic Artifacts

Something to be noticed in the seismic data prior to processing it further is the level of noise. Generally, the signal-to-noise ratio of the current seismic data is high (Veritas, 2003). It is marked by the medium to high continuity of the reflection character. However, some artifacts were still observed. Migration smiles start to appear at 1.8 s and continue through the basement (highlighted in the yellow rectangle in Figure 3.3). The migration smile is a seismic processing problem caused by inaccurate (high) velocity estimation.

Another noticeable artifact in the data is observed in time slices at 0.3s (Figure 3.4), where we see amplitude stripes. In many cases, these are caused by the acquisition footprint.

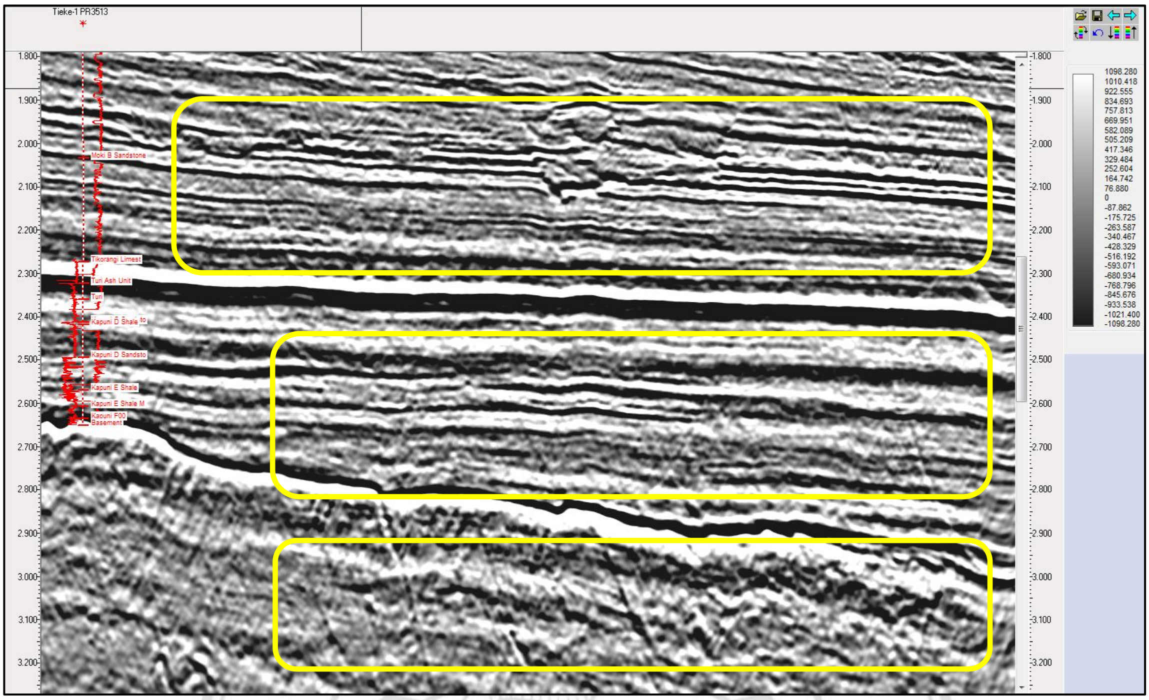

Figure 3.3. Crossline 1401 illustrating seismic artifacts present in the data. Migration smiles are quite obvious starting at 1.8 s. This is part of the area of interest in this study.

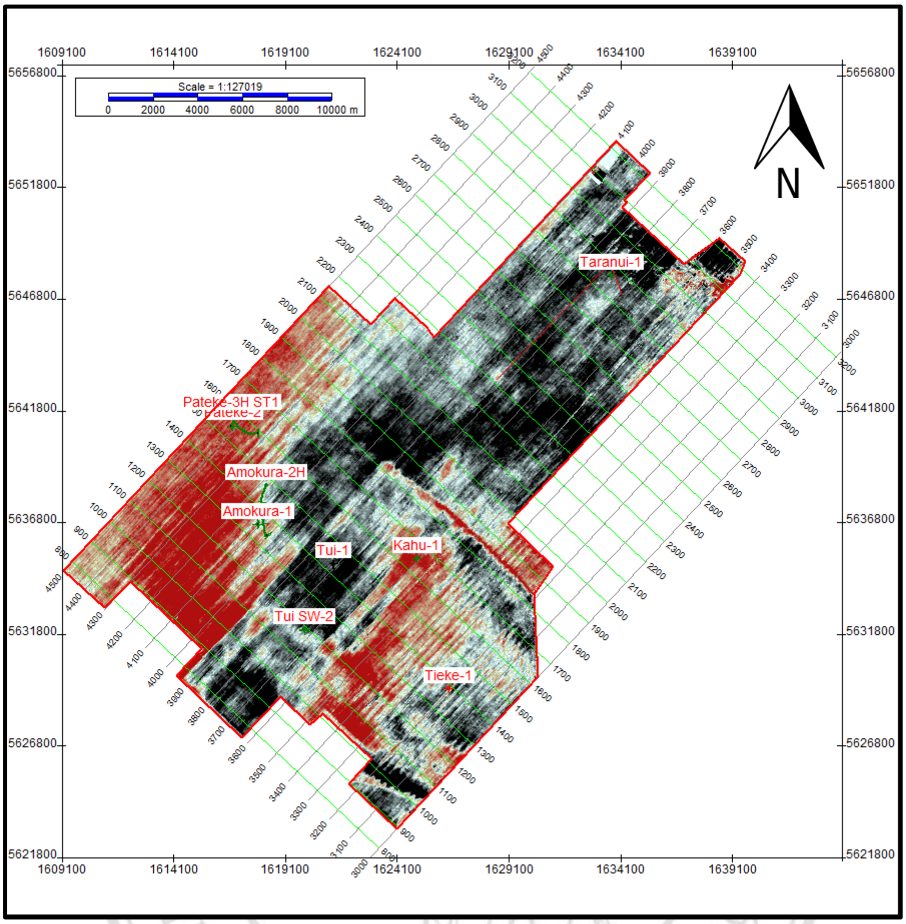

Figure 3.4. Time slices at 0.3s, showing in-line stripes, an acquisition-footprint artifact.

3.2 Quality Control of Well Log Data

Fourteen wells have been drilled in the Tui area. Available well log data include bit size (BS), caliper (CALI), gamma ray (GR), density (DENS), sonic (DTC and DTS), neutron porosity (NEUT), photoelectric (PEF), resistivity with specific penetration (shallow-RESS, medium-RESM, and deep-RESD), spontaneous potential (SP), temperature (TEMP), and cable tension (TENS). These logs are not equally available in each well. Two wells, Pateke-3H and Peteke-1, have no available data. The available logs for each well are tabulated in the Table 3.2.

The geometry of the wells included vertical, deviated, and horizontal. One horizontal well, Pateke-3H ST1, was not included in further stages. The information from this particular well was assumed to be represented by the well located 0.5 km away, Pateke-

2. In addition to well logs, some other essential data such as well markers, well geometry and checkshot data are also available in almost every well.

Table 3.2. Log summary of every well in Tui field

Well Name	BS	CALI	GR	DENS	DRHO	DTC	DTS	NEUT	PEF	RESD	RESM	RESS	SP	TEMP	TENS
Amokura-1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Amokura-2H	■		■												■
Kahu-1	■	■	■	■	■	■		■	■	■	■	■	■		■
Kiwi-1	■		■	■	■			■	■	■	■	■		■	
Pateke-2	■		■	■	■			■	■	■	■	■		■	■
Pateke-3H ST1	■	■	■	■	■			■	■	■	■	■		■	
Taranui-1	■	■	■	■	■	■	■	■	■	■	■	■	■		
Tieke-1	■	■	■	■	■			■	■					■	■
Tui SW-2		■	■	■	■	■		■	■	■	■	■	■		■
Tui-1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tui-2H	■	■	■							■	■	■			■
Tui-3H	■		■							■	■	■			
Pateke-3H	NO LOG AVAILABLE														
Pateke-1	NO LOG AVAILABLE														

■	Available
	Not Available

3.2.1 Log Investigation

As per the table 3.2 above, some of the wells do not have sonic logs (DTC) which are needed for acoustic-impedance calculation. We therefore need to estimate the sonic logs in those wells.

Turning to the details, a part of the sonic log is missing in Amokura-1, from 3110 m downwards, where the main targets are actually situated (Figure 3.5a). Looking at its caliper log, a small wash-out zone is identified at 1669 to 1684 m depth. This small wash-out zone is considered negligible since it is far away from interval of interest. The rest of the logged interval shows a relatively constant caliper value, which generally coincides with the bit size. This indicates a good borehole environment.

In Tui-1, a considerable wash-out zone was observed from 3330 to 3405 m, which is in the Kapuni D reservoir target zone. As can be seen in Figure 3.5b, such phenomenon significantly affects the density log. As a consequence, it is necessary to re-estimate the density in that particular interval. Four wells (Kahu-1, Taranui-1, and Tui-SW2, Tieke-1) show good borehole conditions, indicated by relatively constant caliper logs (Figures 3.6. and Figure 3.7). Kiwi-1 and Pateke-2, on the other hand, have no caliper logs recorded. Thus there is no control regarding borehole size, which lowers the reliability level of the data (Figure 3.8).

3.3 Software Used

Several software packages were used to conduct this study. These packages have different purposes.

1. IHS Kingdom 8.8 (64-bit)
    - Fault interpretation
    - Horizon interpretation
    - Time structural map
2. Interactive Petrophysics v4.2
    - Log estimation
3. Hampson-Russell 10.0 (HRS)
    - Well-to-seismic tie
    - Wavelet estimation
    - Initial model building
    - Seismic Inversion

3.4 Workflow

The schematic diagram of this research is shown in Figure 3.9.

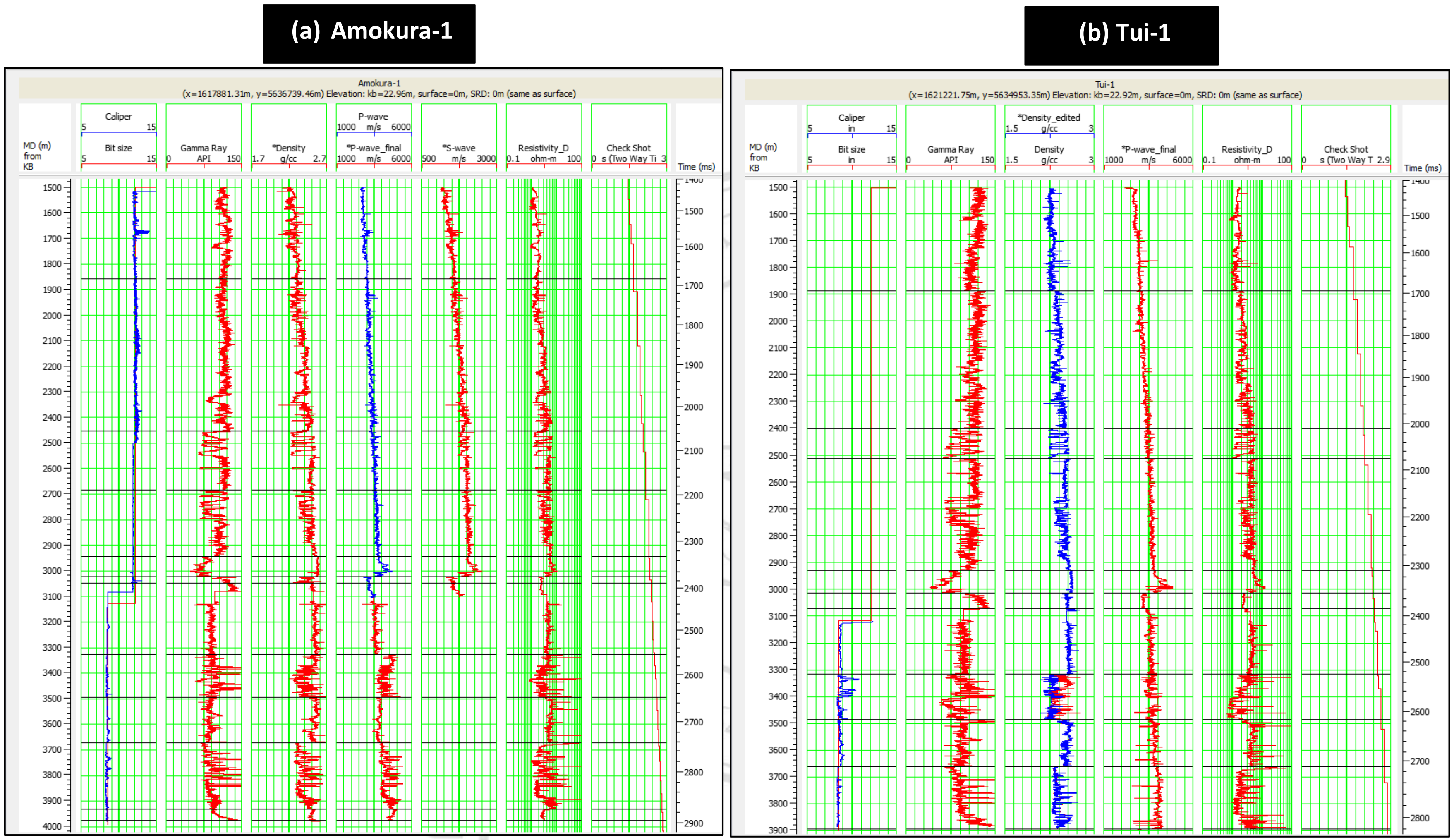

Figure 3.5. Quality control of well logs in Amokura-1 and Tui-1.

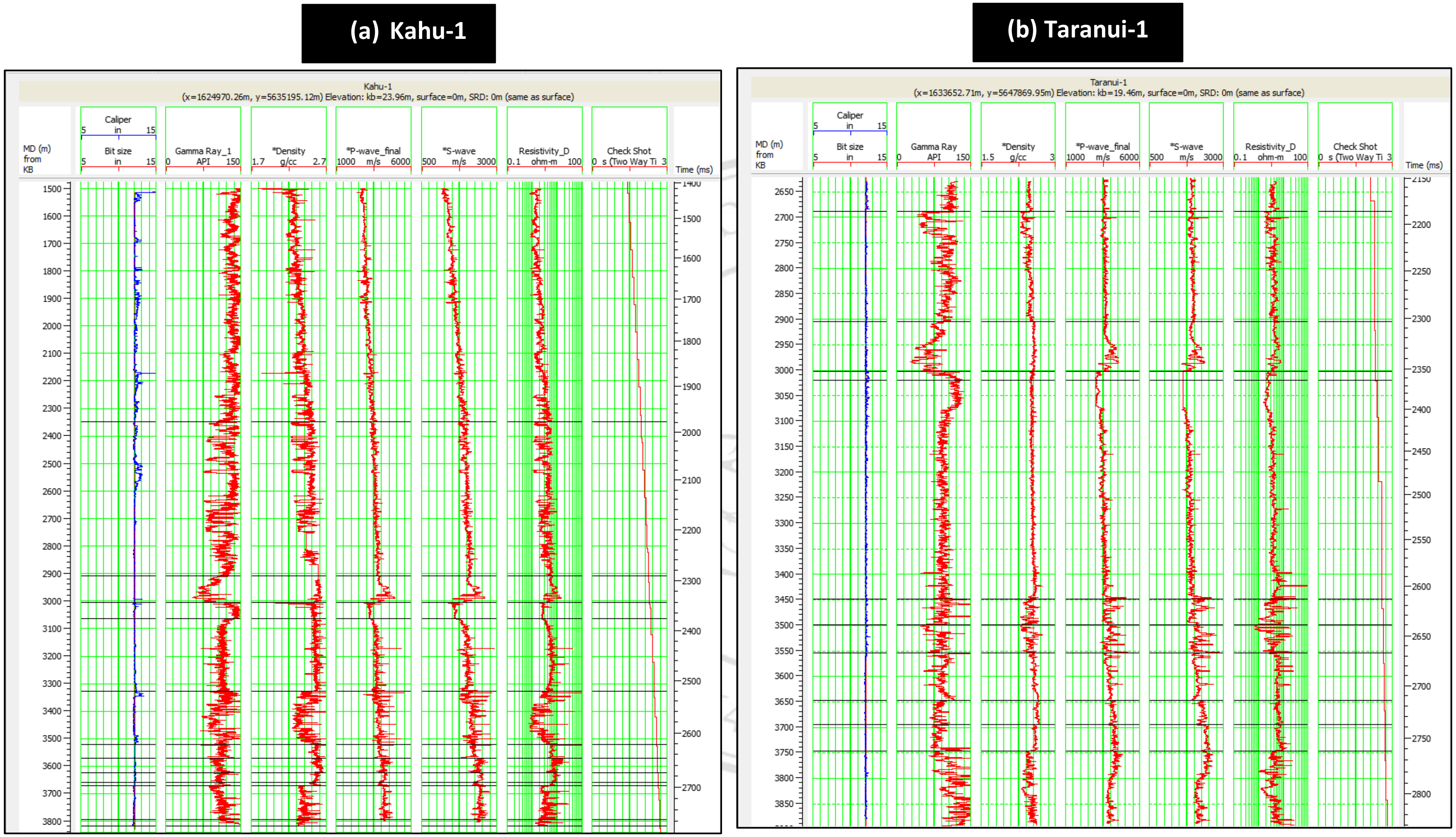

Figure 3.6. Quality control of well logs in Kahu-1 and Taranui-1.

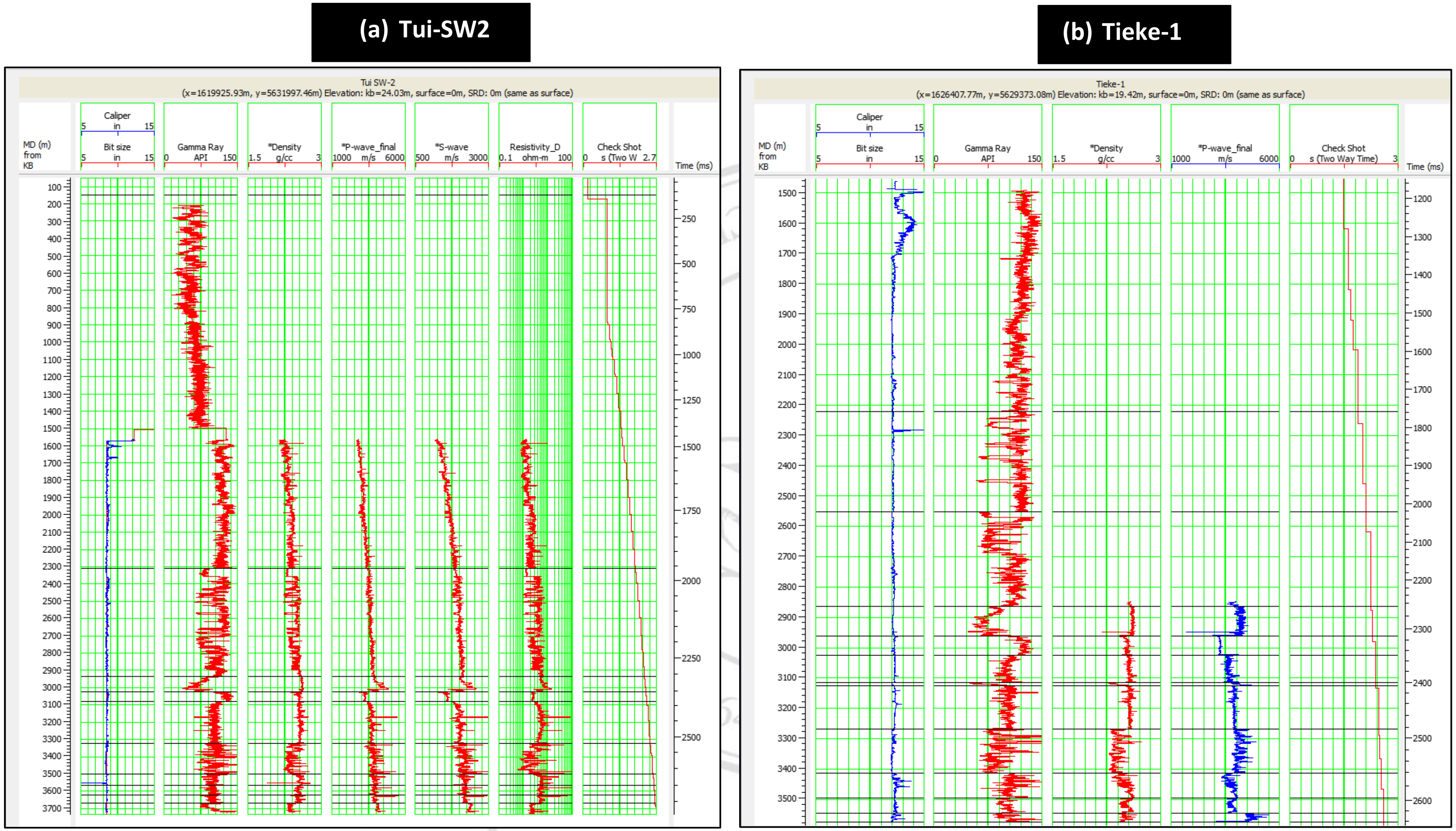

Figure 3.7. Quality control of well logs in Tui-SW2 and Tieke-1.

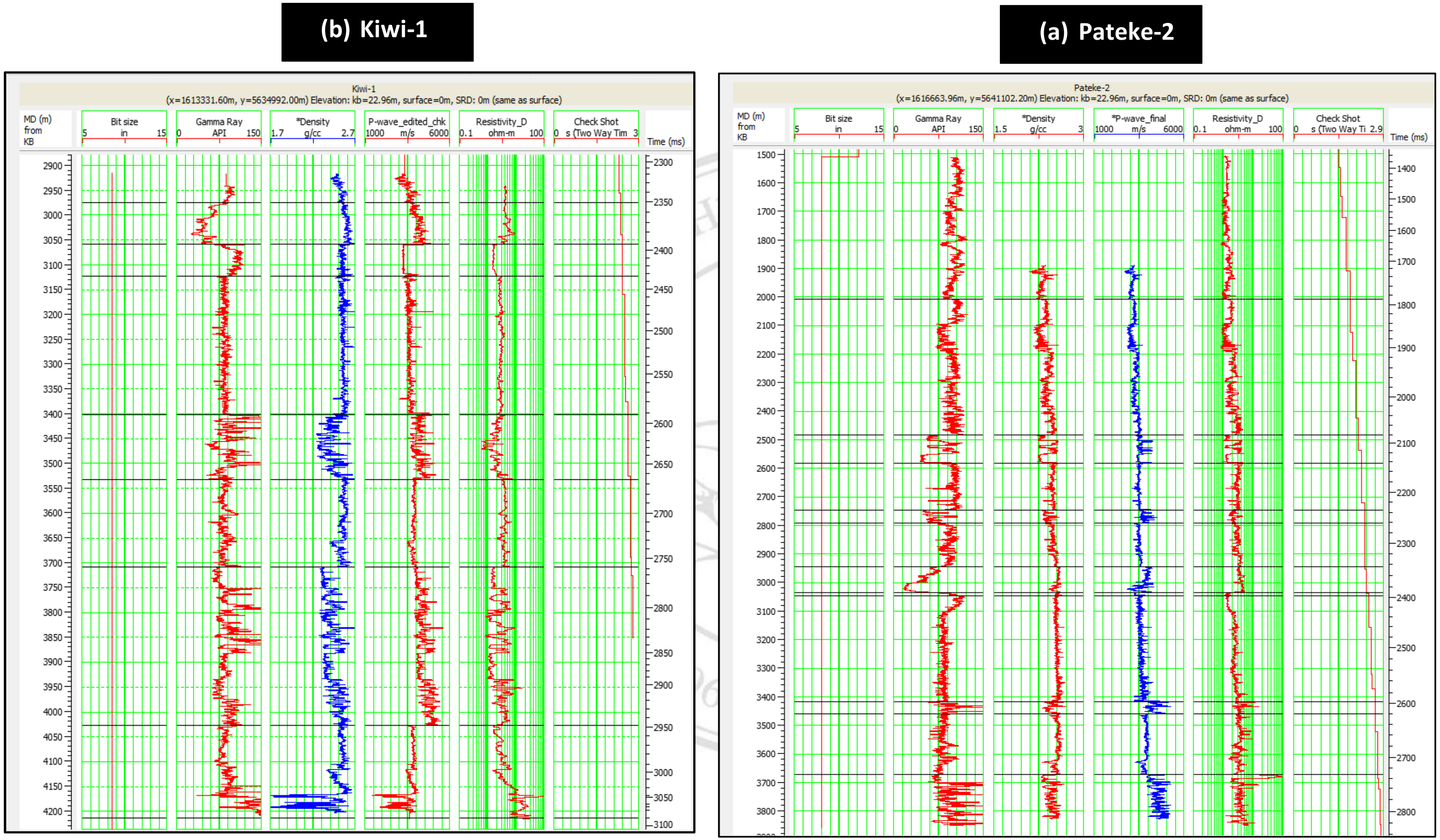

Figure 3.8. Quality control of well logs in Kiwi-1 and Pateke-2.

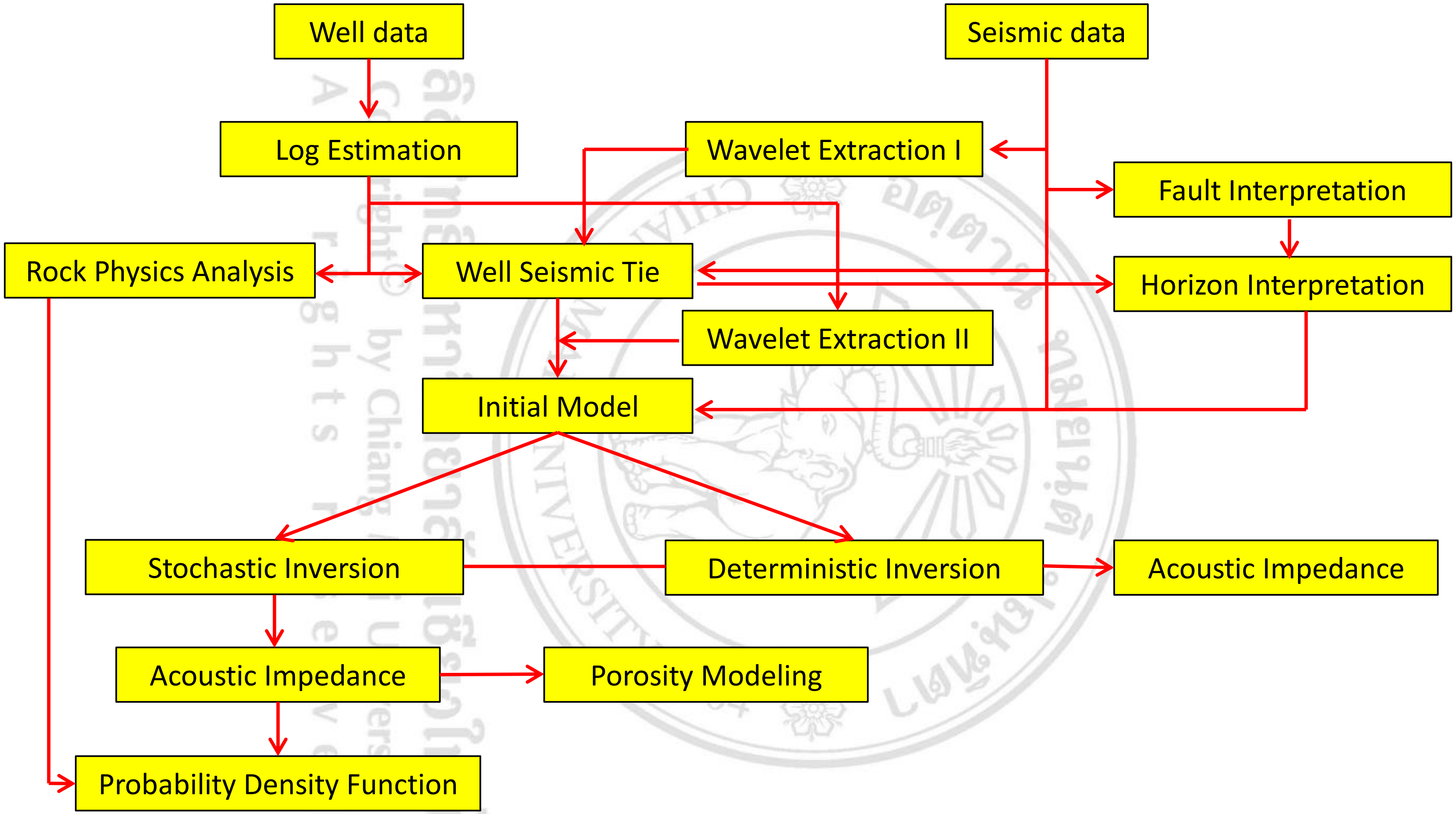

Figure 3.9. Workflow of the research.