CHAPTER 4

Conclusion and Discussion

The shallow subsurface geological geometry beneath Mae On area has been interpreted by the integration from all available information. This chapter will focus on the conclusions and discussions of the results derived from all existent data including four seismic reflection surveys, previous geophysical such as the electrical resistivity profile and the multichannel analysis of surface wave (MASW), geological map, and potential field data.

4.1. Results and discussion

The results from seismic method could be separated into two parts which involving the seismic shot records and cross-sections. The seismic shot records are preliminary analyzed for the first interpretation of near surface geology. The very top layer is determined from directed wave information resulted that it has thickness of 5-10 m with approximate P-wave velocity of 600-800 m/s. The second layer is determined from refracted waves which represent the high velocity layer with P-wave velocity about 4000-5000 m/s. The seismic cross-sections represent four horizontal stratified seismic units. The UU has interval velocity about 1500 m/s with 30 m average thickness. It is underlaid by MU1 that has interval velocity about 1800 m/s with an average thickness of 40 m. The MU2 has interval velocity 1900 m/s with 40 m average thickness. Overlaid by The MU2, the LU is the deepest unit which has interval velocity higher than 2100 m/s.

The UU unit shown on seismic cross-sections is the average of the top layer and second layers which could not be separated by the reflected wave because of the seismic vertical resolution. However, both of layers can be identified by the first arrival time of refracted wave in seismic shot records. The obtained results from the seismic shot gathers have been confirmed after joining interpretation with previous geophysical results which are the electrical resistivity profile and S-wave profile from MASW method that focusing on shallow geological structure.

The electrical resistivity survey had been conducted on the profile Line MO-2. The result is the true electrical resistivity model that displays three nearly horizontal layers with the maximum investigation depth of about 70 m. The first layer which is believed to be the top soil layer with low resistivity less than 50 ohm·m and has the thickness approximately 10 m. The second layer overlaying by top layer has the thickness of 30 m with high resistivity range from 50 to 600 ohm·m. The deepest layer from electrical resistivity model has resistivity range 35-200 ohm·m.

The MASW method had been done on the profile Line MO-2 as well. The result from MASW survey indicates the S-wave velocity model. The S-wave velocity model explores more detail of near surface layers with the maximum investigation depth of about 30 m. The S-wave velocity model are classified into two layers. The first layer, top soil layer, has low S-wave velocity less than 400 m/s with the thickness approximately 10 m. The second layer overlaying by top soil layer has a high S-wave velocity approximately might higher than 2000 m/s in the southern part of Line MO-2 which could be related to the hard rock layer.

The interpretation from integrated geophysical method, seismic preliminary data, resistivity, and MASW method indicates that the top layer could be interpreted as the sediment layer with low P-wave velocity (<600 m/s) and S-wave velocity (<400 m/s), and low resistivity (< 50 ohm·m) with the thickness approximately 5-10 m. The second layer overlaid by the sediment layer has high P-wave velocity (4000-5000 m/s) and S-wave velocity (2000 m/s) and high resistivity range from 50 to 600 ohm·m. Base on those properties, this layer is interpreted as the basaltic layer with more evident from the basaltic out crop that distributed in the study area. The basaltic layer is corresponding to UU unit in seismic section.

The seismic cross-sections are utilized with potential field data analysis to interpret the deep structure. The potential filed data support the result from the seismic interpretation. Magnetic and gravity maps were analyzed for the depth of volcanic plume. The depth of volcanic unit from the radially average power spectrum of Magnetic and gravity maps varies from 500 to 1000 m. The pseudo geological model was constructed base on the result from seismic interpretation and radially average power spectrum analysis. The model consists of 5-10 m of the weathering layer (or sediment layer) that underlaid by the basaltic layer. The bottom of basalt layer is controlled by the UU depth which range from 30-40 m.

Apart below the basaltic layer, there are the MU1, MU2, and LU units from seismic cross sections that presumed as many of the pyroclastic layers base on four reasons. First, those layers are contacted with basalt layer, therefore the environment when they accumulate should be similar. Second is the origin of pyroclastic deposits as a horizontal layer in each of event which confirmed by the seismic reflection profiles presented as horizontal reflectors (Figures 2.30, 2.31, 2.32, and 2.33). Third, there is the high resistivity layer which underlying basaltic layer in the electrical resistivity profile (Figure 2.35). It is consequence related to volcanic rock, however, this layer has lower resistivity value than that of basaltic layer. Last, the depth analysis by using the radially average power spectrum from potential field confirms that there is the volcanic rock at about 500-1000 m depth.

Moreover, Barr and Cooper (2013), Barr *et al.* (1990) and Phajuy *et al.* (2004), described types of volcanic rock that are the Permian tuff and basalt unit composed of green tuff, gray to dark green basaltic flows, hyaloclastite, pyroclastic and pillow breccia. This volcanic belt formed in back-arc basin and it was made up the successive layers of volcanic ashes deposited on each eruption.

4.2. Conclusion

The study objective is to extricate the conflict of the high anomaly gravity and magnetic values on quaternary sedimentary unit of geological map. The study result confirms the possibility of quaternary sediment that shows high gravity and magnetic anomaly when its thickness is relatively thin and underlined by high density and magnetic volcanic rock. Table 4.1 are summation of physical properties of the pseudo geological model resulted from gravity modeling that constrained by seismic and electrical resistivity methods.

Table 4.1 summaries physical properties from the pseudo geological model resulted from gravity modeling in the study area.

Type	Seismic unit	Depth (m)	P-wave velocity (m/s)	S-wave velocity (m/s)	Resistivity (ohm·m)	Density (g/cm^3)
Sediment	UU	≈ 5-10	<600	<400	<50	2.0
Basalt		≈ 40	4500	2000	50-500	2.95
Pyroclastic A	MU1	≈ 70	1800	-	35-200	2.75
Pyroclastic B	MU2	≈ 100	1900	-	-	2.8
Pyroclastic C	LU	-	2100	-	-	2.85

4.3. Problem and suggestion

This study used seismic reflection survey to investigate the subsurface structure. The results from seismic cross-sections were not satisfied because it could not detect the sediment layer which is topmost layer due to the vertical resolution. The vertical resolution of seismic reflection depends on the velocity of the subsurface layer and the dominant frequency of the source. An elastic wave generator (EWG) and a sledge hammer source are used in this study, it has low-frequency domain resulting to long wavelength and low vertical resolution.

Moreover, the seismic cross-section could not provide the deep structure more than 200 m due to near-surface reverberation within surficial layers of contrasting seismic velocities which can obscure the signatures of deeper sequences and generally reduces data quality and energy of source that blocked up at near-surface.

These two problems which are the low vertical resolution and low energy propagation into subsurface were also found by many researchers as well, such as, Bannister and Melhuish (1997), Carcione *et al.* (2013), and Osella *et al.* (2015). However, the high frequency source is better solution for seismic reflection survey when the area has the basalt accumulation or the contracting between the layers in subsurface.

Hence, the EWG and sledge hammer source are not unsuitable for this study. The source of seismic reflection method should be changed such as sledge hammer with a smaller plate or air gun to create the higher frequency and higher energy source.