

CHAPTER 4

CONCLUSION AND DISCUSSION

Integrated geophysical study consisting of ground penetrating radar (GPR) measurement, total magnetic field measurement, resistivity mapping, and continuous vertical electrical sounding (CVES) was conducted in Lao Pako archaeological site of Lao PDR. The aim of this study is to determine zones of geophysical anomaly which might be related to ancient artefacts. The study area comprises two sub-areas, namely, sub-areas A and sub-area B. There are all together 33 lines of measurement, 23.0 m in length and 1.0 m line spacing, in sub-area A covering an area of 32 m x 23 m, and 30 lines of measurement, 22.0 m in length and 1.0 m line spacing, in sub-areas B covering an area of 29 m x 22 m.

Three layers of ground, namely; topsoil, cultural layer, and sterile soil (Källèn, 2004), can be clearly identified in radar sections. For topsoil of 0.4-0.9 m thick, no reflected radar signal was observed in radar section after background signal was removed. This indicates that there is no artefact in this layer. For cultural layer of 0.6 and 1.5 m thick, disturbed zones and hyperbolic-shape anomalies were observed on the radar sections. The disturbed zones are probably parts of soil disturbed by human activities in the past or in the present time. The hyperbolic-shape anomalies might be resulted from buried artefacts such as potteries, fired clay, or big conglomerate. All together 6 disturbed zones and 34 hyperbolic-shape anomalies were located in sub-area A, whereas 4 disturbed zones and 10 hyperbolic-shape anomalies were located in sub-area B (Figures 3.39 and 3.40).

Only one magnetic anomaly related to subsurface artefact was observed in sub-area B, but not a single one in sub-area A. This anomaly was observed between distances 11.0 to 13.0 m on lines B05 and B06 and it was modeled as a rectangular-shape magnetic object dipping 68 degree northward at a depth of 0.4 m as shown in Figure 3.26. The physical dimensions of this object are 1.0 m in length, 0.8 m in width and 0.4 m in thickness whereas its magnetic properties are 0.006 SI in magnetic susceptibility, 1.3 in remnance ratio, -13 degree in remnance inclination and 131 degree in remnance declination. Since there is only

one magnetic anomaly related to buried artefacts in the present study area, this indicates that most buried artefacts are either not magnetic substances in nature or magnetic objects are in small pieces.

Anomalous zones of high and low resistivity in sub-areas A and B were delineated by resistivity mapping in the present study. Wenner configuration with electrode spacing of 1 m, station spacing of 1 m and line spacing of 2 m was designed for the mapping. Three high resistivity anomalous zones of greater than 4,078 Ωm and four low resistivity zones of less than 1,072 Ωm were observed in sub-area A (Figure 3.27), whereas two high resistivity anomalous zones of greater than 4,626 Ωm and two low-resistivity anomalous zones of less than 1,175 Ωm are observed in sub-area B (Figure 3.28). The high-resistivity anomalous zones were interpreted as normal ground whereas the low-resistivity anomalous zones were interpreted as disturbed zones of human activities in the past or in the present time. Moreover, most of low-resistivity anomalous zones are observed in the same places as disturbed zone on the radar sections.

CVES measurement was conducted in some selected GPR lines, 5 lines in sub-area A and 3 lines in sub-area B. Both measured apparent resistivity pseudosection and inverse model resistivity section show regions of low resistivity, less than 100 Ωm , in the top ground layer of high resistivity, higher than 1,000 Ωm . This top layer of high resistivity is likely overlaid a bottom ground layer of low resistivity, less than 100 Ωm . The top ground layer of high resistivity is interpreted as the top soil and cultural layer consisting of well sort fine silt and cultural material of different kinds. The bottom ground layer of low resistivity is interpreted as the sterile soil consisting of sandy clay with small lumps of laterite. In addition, the regions of low resistivity in the top ground layer are observed at the same locations as the disturbed zones in radar sections.

Combined results obtained from the geophysical measurement can delineate anomalous zones in the study area. There are 4 groups of anomalous zones. The first group is the zones of low resistivity and disturbed radar section which is interpreted as the disturbed soil by human activities in the past or in the present time. The second group is zone of only high resistivity which is interpreted as normal ground. The third group is zone of disturbed

radar section only which is interpreted as zone of ancient artifacts. The fourth group is zone of hyperbolic-shape reflection of radar signal which is also interpreted as zone of ancient artifacts. Fortunately, earthenware and pieces of small artifacts of various types were found in two of three previous archaeological excavation pits which are in the same locations as the anomalous zones of the third group. This indicates that geophysical anomalous zones are related to subsurface artefacts and geophysical technique is applicable for archaeological study.

It is observed that most of previous archaeological excavation pits in the study area are outside zones of geophysical anomaly and only pieces of small artefacts were found in those pits. If archaeological excavation pit is planned in the future, zones of geophysical anomaly should be considered of high priority.