A Preliminary Magnetic Survey at Yassıhöyük

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1. INTRODUCTION

In planning the new excavation of a site, information on the locations of architectural remains is essential. As our group has reported, magnetic survey is a powerful tool for rapidly revealing the distribution of buried features at excavation sites in Central Anatolia (Fukuda *et al*. 2001; 2002; 2003; 2005; Kumagai *et al*. 2006). This survey method is very suitable for preliminary survey of a new excavation site in terms of time and cost compared with other physical survey methods.

Yassıhöyük is a large, oval mound (EW 650 m, NS 500 m) in Central Anatolia, Turkey, that is to be excavated by the Japanese Institute of Anatolian Archaeology (JIAA). This report presents the results of magnetic surveys performed at Yassıhöyük in 2007 and 2008 as a part of the preliminary investigations of the site. For information about this site and the results of other preliminary archaeological research there, see Omura (2008).

2. SURVEY SITE

Fig. 1 shows a topographical map of Yassıhöyük, with the survey sites indicated in gray. The axis of the survey area was set using magnetic north. The survey

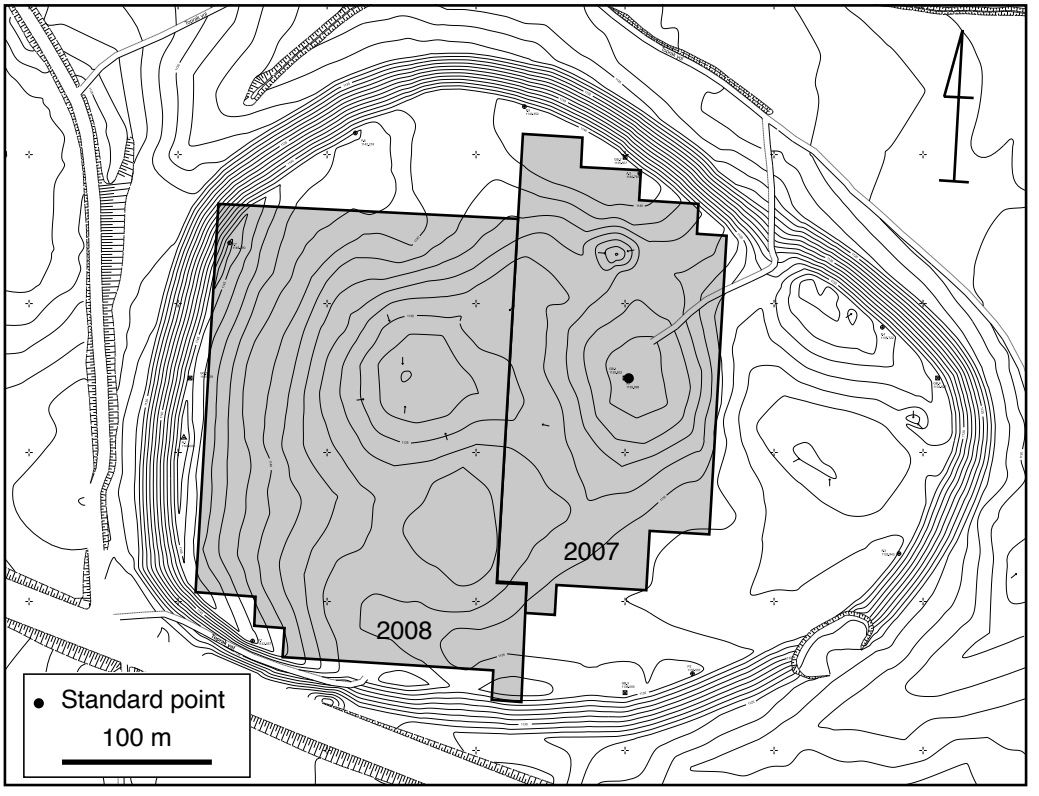

Fig. 1 Topographical map of Yassıhöyük. The solid circle shows the standard point. The shaded portion indicates the area surveyed in this study.

Fig. 2 A typical landscape of the survey area.

area consists of two parts. One is the central area of the mound, surveyed in 2007, where an area of high relief exists around the standard point. The other is the western part of the mound, surveyed in 2008. The total survey area is 96800 m^2. At present, the top of the mound is used for wheat cultivation, divided into several sections like patchwork. Fig. 2 shows the typical landscape of the survey field. The surface of the mound is flat and smooth, yet it is not ideal for magnetic survey because the fields have many stones 10 to 20 cm in diameter that can cause higher noise levels in the results.

3. MEASUREMENTS AND DATA ANALYSIS

The magnetic field gradient survey was carried out with Fluxgate Gradiometers (FM36 in 2007 and FM256 in 2008, Geoscan Research, UK). The survey was performed in the same manner as described in our previous reports (Fukuda *et al*. 2002; 2003). Data density in a unit grid (20 m x 20 m) is 8 points/m for the NS direction and 1 point/m for the EW direction. Magnetic resolution was set to 0.1 nT. Obtained raw data was processed by GEOPLOT 3.0 for Windows (Walker and Somers 2005). By combining the individual processed data, an overall map was made showing the distribution of magnetic anomalies presented as a series of gray-scale images. In the resultant map, regions of large positive magnetic field gradient are expressed as dark gray to black, and those of large negative magnetic field gradient are light grey to white.

4. RESULTS AND DISCUSSION

Magnetic field gradient data obtained on the mound is shown in Fig. 3. Note that the coordinates are shown in the distance from the standard point, and North and East are set to positive direction. In this figure, some data artifacts are seen that reflect magnetic bodies on

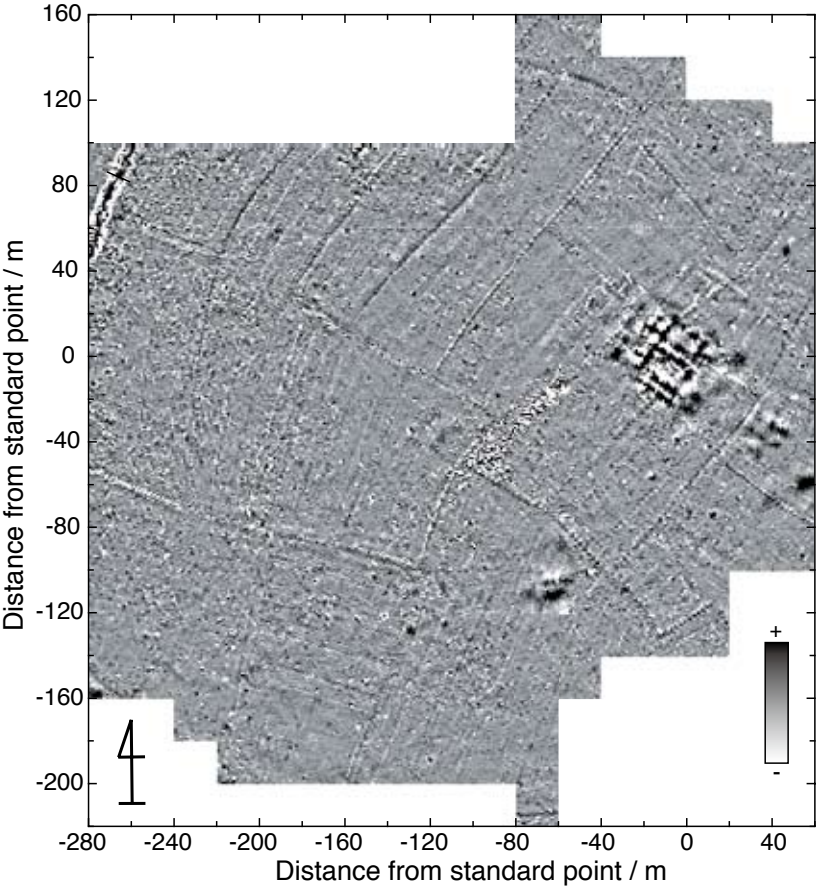

Fig. 3 Map of magnetic anomalies obtained in this study. The numbers on the horizontal and vertical axes show the distance from the standard point shown in Fig. 1.

the field surface. The paths dividing the fields appear in Fig. 3 as thin, long lines running NE-SW or NW-SE. In addition, there are very noisy magnetic anomalies in the area around (E, N) = (–80, –30) in Fig. 3. This is due to scattered iron wire on the field. It is difficult to remove the wire because it is broken into tiny pieces and spread over this area. Taking these artifacts into consideration, let us see the other magnetic anomalies.

Strong magnetic anomalies were detected around the standard point. We can clearly see the aspect of a structure in these anomalies consisting of straight lines and orthogonal corners. The dimensions of these anomalies are about 50 m in the NW-SE direction and 40 m in the NE-SW direction. There appear to be two large rooms in the SE, some small rooms in the NW and corridors between them. Judging from these features, this is interpreted as a large architectural feature such as a temple or a palace. The location of these anomalies corresponds to the high area on the mound. It is reasonable to interpret this height as a sign of a huge, buried structure. On the SE slope of this area of high relief, the area around (E, N) = (40, –40) and (50, –60), magnetic anomalies with oblong features were detected. Since these anomalies have almost the same orientation as those of the large feature on the high area, they may be associated with the same large structure. Other magnetic anomalies were detected in the area around (E, N) = (–60, –110). They are located on the east slope of another high area in the southern part of the mound. Although the lines are broad, the anomalies show a rectangular shape that can be interpreted as a structure. Magnetic anomalies with blurry and bold features are often caused by deeply buried magnetic bodies because of the divergence of the magnetic signals. Thus, we can deduce that the features causing these broader magnetic anomalies are more deeply buried than the huge remains on the central high area.

We see thick magnetic anomalies extending along the NW edge of the mound in the area around (E, N) = (–270, 80). The location and shape suggest the existence of a city wall surrounding the mound. There also exist similar magnetic anomalies on the SW edge (E, N) = (–280, –160) and south edge (–70, –210). These are also likely to be portions of the city wall.

As described above, evidence of several remarkable architectural remains has been revealed in this study, which will be valuable information for excavation planning. The distribution density of architectural remains shown in this magnetic survey is, however, rather low considering the scale of the mound; many other signs of occupation, as yet undetected, may be expected. There do exist local modulations of magnetic gradient, seen in Fig. 3, implying some buried structures, but they are too weak to have a clear aspect. Magnetic signal detection has a large dependency on the soil cover thickness, i.e., the distance between the object and the field surface. In magnetic survey, due to decay of the magnetic signal, it is generally difficult to detect a signal from magnetic bodies buried deeper than 2 m from the field surface. Variations in soil cover thickness may explain the different features of some of the anomalies seen in this survey. The mound may be covered with thick soil so that buried features are beyond the signal detection limit except around the heights and on the edge of the mound. In addition, in the present study, the noise signal caused by scattered stones on the surface is another factor that degrades the detection limit. The thickness of the soil cover and the distribution of features buried in deeper levels should be carefully studied by other physical survey methods, such as ground penetrating radar, as part of the future research at Yassıhöyük.

5. CONCLUSION

Our magnetic survey has revealed the distribution of several architectural remains at Yassıhöyük: 1) There is a large structure on the central high area of the mound and several oblong magnetic anomalies in the area surrounding this high area. 2) A city wall is detected on the west edge of the mound.

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