A Brief Report on a Magnetic Survey of the Area Surrounding Kaman-Kalehöyük in 2005

Kazuhiro KUMAGAI, Katsutoshi FUKUDA and Izumi NAKAI
Tokyo

1. INTRODUCTION

In order to identify the extent of the site of Kaman-Kalehöyük in the ancient times, and how it has changed, a program (system) of magnetic survey has been developed. Our previous fieldwork, disclosed a Chalcolithic site (Omura 2002) and several characteristic circular and rectangular magnetic anomalies (Fukuda *et al*. 2002; 2003; 2004) in the area surrounding the mound. In order to create a unified overview of the distribution of architectural remains and clarify their relationship, further magnetic survey was carried out and data was collected in 2005.

2. SURVEY SITE

The survey sites are summarized and indicated in the topographical map (Fig. 1) as shaded areas. The east surveyed area is located at the south of Ibrahim-höyük, where a Chalcolithic site was found (Fukuda *et al*. 2003). The southern area is a field on the west side of the modern cemetery, next to the area where characteristic circular and curved magnetic anomalies were detected. The northern zone is a field beside the national road designated as the striped line. A slight undulation can be found in the surface of this area. These areas are used as agricaltural land use at the present time.

3. MEASUREMENT AND DATA ANALYSIS

The magnetic field gradient survey was carried out with a Fluxgate Gradiometer (Geoscan Research, FM36). The survey method and processing of the raw data using GEOPLOT 3.0 for Windows (Walker and Somers 1999) were the same as the results in the previous years reports for previous magnetic surveys (Fukuda *et al*. 2002; 2003). By combining the individual processed data, an overall map was created showing the distribution of magnetic anomalies and presented in a series of gray-scale images. In the resultant map, the regions with large positive magnetic field gradient results are shown with dark gray to black and those with large negative magnetic field gradient results are shown with light grey to white.

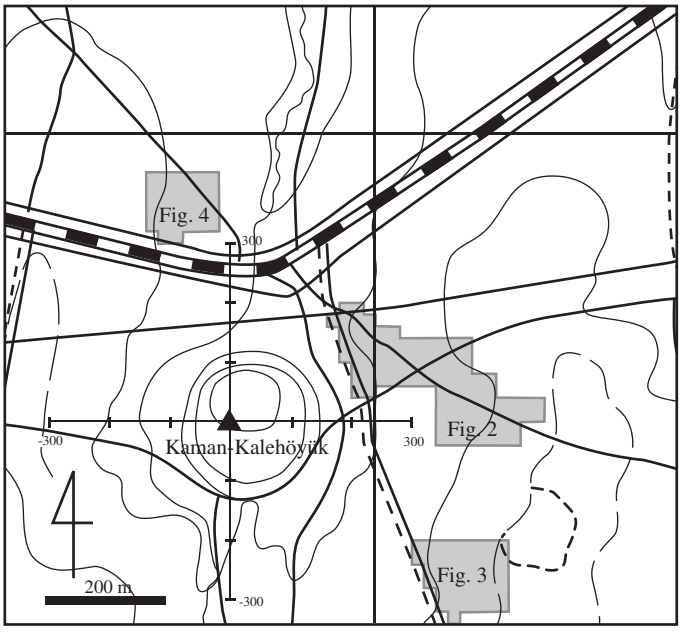

Fig. 1 A topographical map of the area around the excavation site of Kaman-Kalehöyük. The triangular symbol shows the standard point. The shaded portion shows the area surveyed in the present study.

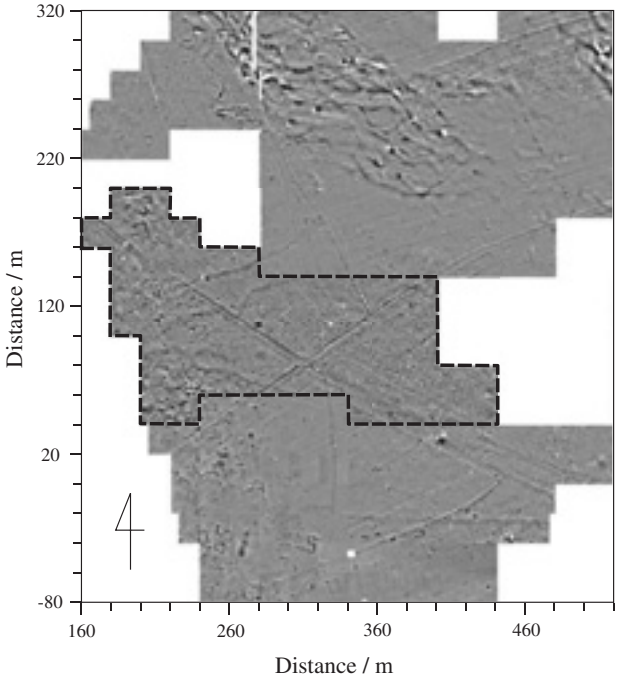

Fig. 2 Map of magnetic anomalies in the east area. Enclosed region by broken line is the area surveyed in the present study and is displayed as a higher resolution image. The numbers at the horizontal and vertical axis show the distance (+ North, - South) in meter from the standard point.

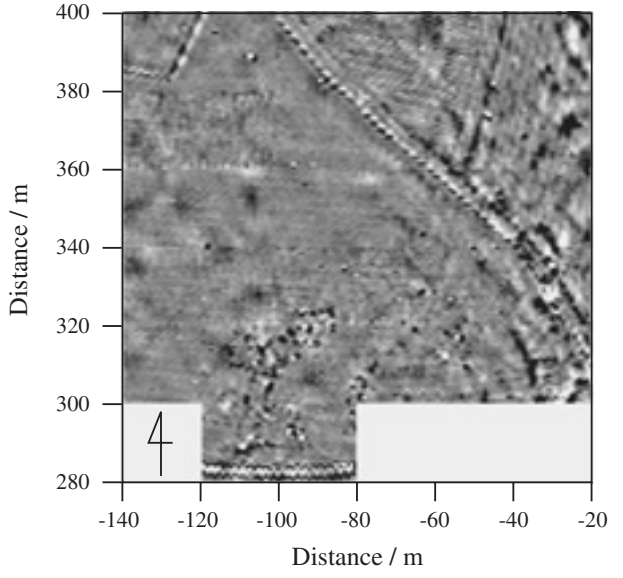

Fig. 4 Map of magnetic anomalies in the North area. The numbers at the horizontal and vertical axis show the distance toward North and West in meter from the standard point. Note that a striation running W/E in the bottom (~ North 280 m) is soil compression mark caused by recent passage of a bulldozer.

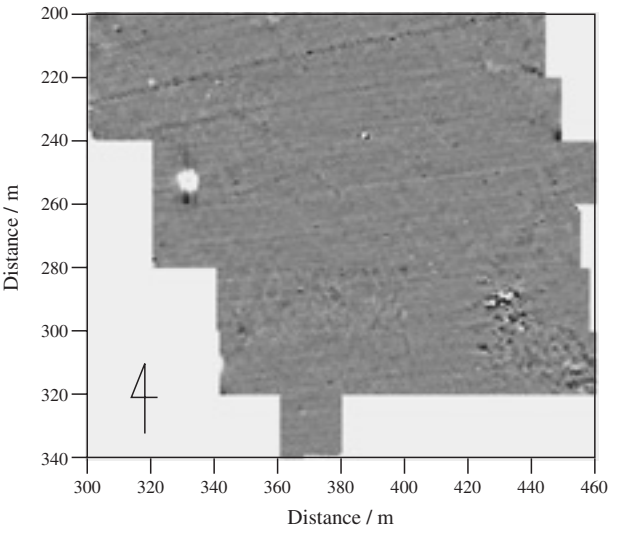

Fig. 3 Map of mag distance toward South and East in meter from the standard 11point.

4. RESULTS AND DISCUSSION

Magnetic field gradient data obtained in the eastern area, the southern area and the northern area are shown in Figs. 2, 3 and 4 respectively. It is the areas of positive magnetic anomalies that are archaeologicaly important.

A long magnetic anomaly extending north-south was observed, as shown in the center of Fig.2. The northern and southern portions of this long line were found in our previous studies and have been united as one line as a result of the new data. The anomaly, 340 m in length, 2 m in width, starts in the East 300 m, in the South 80 m, extends to the East 280 m and to the North 240 m, slightly curving westward as it surrounds the mound. Judging by its shape, this anomaly may reflect a long wall or an ancient road. It is not believed to be a rut made by the recent passage of a combine or tractor; this is confirmed by the fact that a small portion of the same anomaly can be seen in the data of Somers' 1996 survey (Somers 1997) and it has not changed in the nine years since that survey.

In addition to the above, three rectangular anomalies were detected 180 m to the North and 200 m to the East. Each anomaly has an area of 10 m by 10 m and is significantly similar to the two rectangular magnetic anomalies revealed near the Chalcolithic site

(North 230 m, East 200 m) and to many rectangular anomalies found around 40 m to the South and East 260 m (these are also seen in Fig. 2). As the authors predicted in a previous reports (Fukuda *et al*. 2004), the present findings suggests that the rectangular anomalies are widespread around the mound. Since these anomalies can be interpreted as residential structures, the existence of the remains of a large community is strongly suggested in this area.

It is remarkable that most of these rectangular anomalies exist between the mound and the long magnetic anomaly described above. It is possible that the long linear anomaly may reflect a wall surrounding the settlement, though we should wait for the excavation to be carried out in this area to be able to confirm this hypothesis.

In the southern area, complicated magnetic anomalies were found extending into the modern cemetery at the south-east corner of the site. The meaning of the anomalies can not be understood at the present. If these anomalies reflect remains belonging to the site of Kaman-Kalehöyük, it would suggest that the radius of the site extends a further 300 m southward.

In the Northern area, oblong magnetic anomalies were clearly detected around the West 100 m and to the North 310 m (Fig. 4). These anomalies consist of narrow lines, quite different from the broader lines that comprise the anomaly of the Chalcolithic site. This difference suggests a chronological gap, which can be estimated roughly and relatively by the comparison of the width of the line of the anomalies. Narrower lines may reflect shallower architecture, while the broader anomalies may reflect more deeply buried features of an earlier period.

These anomalies appear to reflect the existence of ancient structures, but they appear to be larger than the rectangular anomalies in the eastern area. The magnetic signature of the northern area is rather similar to that of the "North Western Area" reported in Somers' survey (see Fig.2 in Somers 1997). The magnetic anomalies found in the northern area seem to continue southward; the area between this site and the Somers' site has not been surveyed yet, but it is possible that there could be similar features between the two sites.

5. CONCLUSION

This magnetic field study has clarified the distribution of architectural remains around the areas of the mound of Kaman-Kalehöyük. In the eastern field, (1) ancient settlement may be widespread along the mound. A long anomaly, like a wall exists around the settlement, (2) around the outside of the long anomaly, there are large linear magnetic anomalies consisting of broad lines in the Chalcolithic site, north east of the field and the eastern field on the ridge. Magnetic anomalies revealed in the northern area may reflect ancient occupation.

ACKNOWLEDGEMENTS

This survey was performed as a part of the excavation program of Kaman-Kalehöyük in 2005 conducted by Dr. Sachihiro Omura of Japanese Institute of Anatolian Archaeology. The authors would like to thank Dr. Sachihiro Omura for his direction and kind advice.

BIBLIOGRAPHY

Fukuda, K., N. Aydın and I. Nakai
2001 "Magnetic field gradient survey at Kaman-Kalehöyük 2000," *AAS* X, pp.109-114.

Fukuda, K., K. Kashima and I. Nakai
2002 "Magnetic field gradient survey at Kaman-Kalehöyük 2001," *AAS* XI, pp.163-166.

Fukuda, K., K. Kashima and I. Nakai
2003 "Magnetic survey of the area surrounding Kaman-Kalehöyük in 2002: A new Chalcolithic site and other related sites," *AAS* XII, pp. 113-117.

Fukuda, K. *et al*.
2005 "A brief report on magnetic survey of the area surrounding Kaman-Kalehöyük in 2005," *AAS* XIV, pp. 167-171.

Omura, S.
2002 "Preliminary report on the 16th excavation season at Kaman-Kalehöyük (2001)," *AAS* XI, pp. 1-43.

Somers, L.
1997 "Geophysical Surveys at Kaman-Kalehöyük 1996," *AAS* IV, pp. 287-299.
Walker, R., and L. Somers
1999 Geoplot version 2.01, Instruction manual 1.01, Geoscan Research.

Kazuhiro Kumagai, Katsutoshi Fukuda and Izumi Nakai
Department of Applied Chemistry
Tokyo University of Science
1-3 Kagurazaka, Shinjuku
Tokyo 162-8601
Japan
j1305638@ed.kagu.tus.ac.jp
Fukuda.Katsutoshi@nims.go.jp
inakai@rs.kagu.tus.ac.jp