Prospection in Cooperation with Foreign Authorities (1991–1999) selected examples

Fig. 1. Ibbankatuwa, Sri Lanka. View of the survey area. In front some excavated graves (Photo. H.-J. Weißhaar)

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Magnetic Prospection of a Megalithic Necropolis at Ibbankatuwa (Sri Lanka)

In a cooperation with the Bavarian State Conservation Office, an international research project of the Kommission für Allgemeine und Vergleichende Archäologie (KAVA) and of the Unesco (Sri Lanka Cultural Triangle Dambulla Project, and the "Archaeology and Research University of Kelaniya Archaeological Team" a geophysical prospection was carried out at a protohistoric megalithic necropolis at Ibbankatuwa (Sri Lanka).

Introduction

The granite stones of the megalithic graves at Ibbankatuwa (Ibbankatuwa = translated from the language of the people of Sri Lanka: field of the turtles), are distributed over an area of 300 x 250 meters. Some of them were visible above the ground but it was believed that many others were covered by soil. Between

1988 and 1991 21 graves of the necropolis were excavated by the KAVA. It was suggested that the graves formed clusters belonging to different settlements or periods. The aim of the prospection (in the year 1991) was therefore first to find all graves, to make a detailed plan of the necropolis to avoid further excavation and to find out whether there is a clustering among the graves or do we have a random distribution. From the excavation we know that the undisturbed graves consisted of four site shapes (0.7–1.6 meter) and a coverstone. Some graves, one of which was extremly long, were divided into three parts. In the undisturbed graves were found one or two urns. Some urns were also found outside the graves.

Instruments

For the survey we used the cesium magnetometer system from Varian/Scintrex (V101, Canada). This consists of two magnetometer probes with an automatic data log on a handheld computer, the sensitivity ± of 0.1 Nanotesla and gives 10 readings per second. The intensity of the total earth magnetic field at Ibbankatuwa ranges from 36,000 by ± 1,000 Nanotesla. For the survey we used the instrument in a gradiometer configuration (Fig. 1). The reason was by using the variometer configuration we measured local disturbences of the magnetic field intensity of > 200 Nanotesla caused by the underlying granite rocks. The limitedness of the computer equipment however alowed only the dynamics of the original field data ± 99.9 Nanotesla. Readings were taken with a density of 0.5 x 0.5 meter in a 20 x 20 meter grid at a sensor hight of 0.3 meter and 1.3 meter respectivly.

The use of the portable computers or Laptops offers the opportunity of rough data processing right in the field. There are programs for prints of the 20 x 20 meter-block data and a graphic display as a symbol density plot, both on a battery driven printer. By this method, the main archaeological features can be made already visible in the field. For final data processing in the laboratory, the field computer is interfaced to the digital image computer. It is possible to present the magnetic data a digital image however (Fig. 3). The measured point in the field is considered as a picture point (a pixel) and the magnetic intensity values are transformed to gray values ranging from 0 (black) to 255 (white). After statistical analysis and depending on the intensity of the magnetic anomaly, we chose a window (normally from −10.0 to +15.5 Nanotesla) for a linear transformation of the magnetic intensity value into the gray value of the digital image to preserve the highest sensivity (± 0.1 Nanotesla) of the survey. All data corrections and enhancements were done in the interactive digital image processing technique. Filtering procedures, contrast enhancement and false color transformation allow easy identification of the archaeological features in the magnetic image.

Fig. 2. Ibbankatuwa. Caesium magnetometer system employed in Sri Lanka. The probes are covered by banana leaves to give them a shelter upon the sun. The caesium magnetometer with vertical gradient configuration of the sensors; difficult to see: the tilting of the probes by proximately 45° to the north direction

The archaeological relevant structures are marked by hand on a transparency over the hardcopy (photograph of the screen) and are transformed as vectorial data to the graphic computer or directly on the screen. The result which is given to the archaeologists is the plan drawn by a plotter with china ink (Fig. 4).

Magnetic properties of the soil

The use of magnetic prospecting techniques (Aitken, 1974; Becker, 1990) for the mapping of buried features, such as pits, ditches, posts and palisades as well as walls and tombs is possible when there is a magnetic contrast between the archaeological structures and the underlying sediment.

The magnetic properties of the soils differ from those of the underlying sediments or rocks and are therefore of great importance for the interpretation of magnetometer readings. Enhancement of the ferrimagnetic minerals magnetite and maghemite is frequently observed in the top layer of soil horizons (Mullins 1977). While the formation of maghemite in soils is due to natural or man made fires (Le Borgne 1955), pedogenic e.g. in situ formed magnetite may be ascribed to the magnetofossils of magnetic soil bacteria (Fassbinder et al. 1990)

The concentration of ferrimagnetic iron oxide was measured in terms of the susceptibility of soil samples, the susceptibility of the pottery and the susceptibility of the granite rocks of the gravestones. The granite rock showed an unexpected high susceptibility of 30 x 10^{-3} SI units. Table (1) shows the mean volume susceptibility (SI-units) of the A, B and C-horizons, the susceptibility of the pottery and of the underlying granitic rocks. The side shapes and coverstones of the graves consists of the same rocks.

Sample mean volume susceptibility (10^{-6} SI)	
A-horizon	370 ± 10
B-horizon	280 ± 10
C-horizon	235 ± 10
Pottery	1,700 ± 20
Granite rock	33,000 ± 100

Table 1.

Results

Magnetic prospection has been carried out in an area of 100 x 180 meters. Parts of the area cannot be measured because of the thick underbrush and the cobras hanging from the trees. The magnetic picture of the ground reveal some quadru or multipole

Fig. 3. Ibbankatuwa. Digital image of the magnetometer data of the surveyed area at Ibbankatuwa. Magnetogram in the digital image processing technique. Ceaesium magnetometer system from Varian/Scintrex, V101, Canada, sensitivity ± 0.1 Nanotesla, gradiometer configuration, dynamics -10.0 to + 15.0 Nanotesla in 256 grayscales, sampling rate 0.5 meter, grid 20 x 20 meter

anomalies resulting from the extraordinary remanent magnetization of the granite rocks. The graves consists of four site shapes (0.7–1.6 meter) and a sometimes big coverstone, each forming a magnetic dipole. This configuration forms sometimes a rather complicated magnetic anomaly pattern, which causes problems for a valid interpretation.

The natives of Sri Lanka use every, and even the smallest piece of metal as well as the caps of our soft drink bottles to make some tools for themselves. This is the reason why we had absolutly no noise due to modern scrap or waste in the magnetic survey. The magnetic picture reveal groups of graves. Most features in the prospection plan describe rather the whole grave than single stones. Beside some graves we found single anomalies which may be ascribed to the occurrence of pithoi as they where found by the excavation but these anomalies may also be caused by single granite rocks.

Conclusion

The magnetic survey at the megalithic necropolis Ibbankatuwa results in the identification and recording of several clusters of site shapes and cover stones of the necropolis. The results demonstrate that magnetic contrast between the granite rocks and the underlying soil is strong enough to detect all stone features. Together with the results of the excavation, it was possible to complete a detailed plan of the whole necropolis.

Acknowledgements

In memoriam Prof. H. Kilian. We thank Prof. S. Banderanayake and Dr. R. Silva for his continual encouragement and support during our work at Sri Lanka; K. Brianda a student of the Kelaniya Archaeological Team, Sri Lanka for his field assistance. The lively discussions with Dr. J. Weißhaar are greatly appreciated. Thanks to Robert H. Hetu for reviewing the manuscript.

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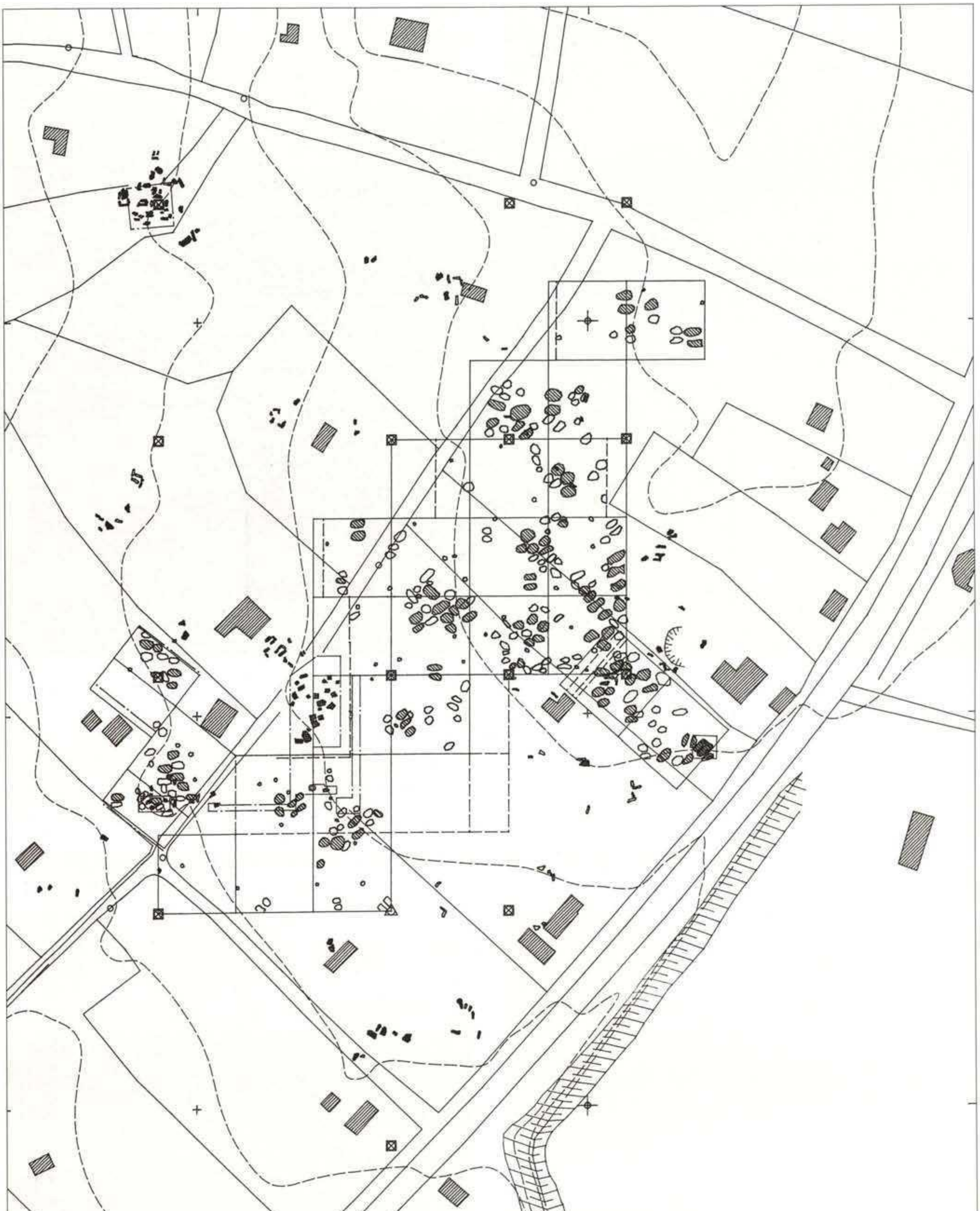

Fig. 4. Ibbankatuwa. Plan of the whole necropolis at Ibbankatuwa based on the interpretation of the magnetic prospecting data and on the excavation plan