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## ARCHAEOLOGY IN NEW ZEALAND



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## ARCHAEOLOGICAL INVESTIGATION USING GEOPHYSICAL TECHNIQUES

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Archaeological investigations are most frequently made by excavating with trowel and brush. This method is time consuming and is best suited to examining small areas of ground. Excavation irrevocably disturbs the shallow soil and destroys the spatial relationships of artifacts in the archaeological site.

Geophysical and other remote sensing techniques allow non-destructive investigation of human occupation sites. Preservation of the site recognises cultural sensitivities and allows the undisturbed site to be studied by future archaeologists with, presumably, improved archaeological technology. Geophysical surveys are relatively rapid to perform. They can be used to cover a large amount of ground and to guide excavators to areas of maximum interest on a site. Clark (1990) and Wynn (1986) review the use of archaeological investigation using geophysical techniques. This report summarises an assessment of two geophysical methods for archaeological investigation. The work was funded by the Foundation of Research Science and Technology and the DSIR.

The Kaiapohia (now Kaiapoi) Pa lies 27 kilometres north of Christchurch. This 3ha site was the centre of South Island Maori activity between 1700 and 1832 (Brailsford, 1981; Jacomb pers. comm.). Kaiapohia Pa was built on a sand dune which, during occupation, was surrounded by swamp (Figure 1) but which is now enclosed by farmland. Some features of the internal layout of the pa can also be seen today. In particular the central meeting house is expressed by a rectangular depression in the ground.

Features 2, 3 and 4 on an 1870 map of the site (Figure 1) were some of the gateways which provided the main access to the site. On the eastern side of the pa were two canoe landing sites; the canoes providing transport to the sea. The central meeting house was named Pukekura (the belly of the whale). Other buildings thought to have existed on the site include meeting houses, storehouses and domestic residences. In 1832 a seige by a tribal alliance, including the Ngati Toa under Te Rauparaha, resulted in the razing of Kaiapohia Pa. Attempts have been made during the last few years to make the surroundings of the pa more like they were prior to European settlement of the area, and some excavations near the Huirapa gateway and near the southwest corner have been undertaken.

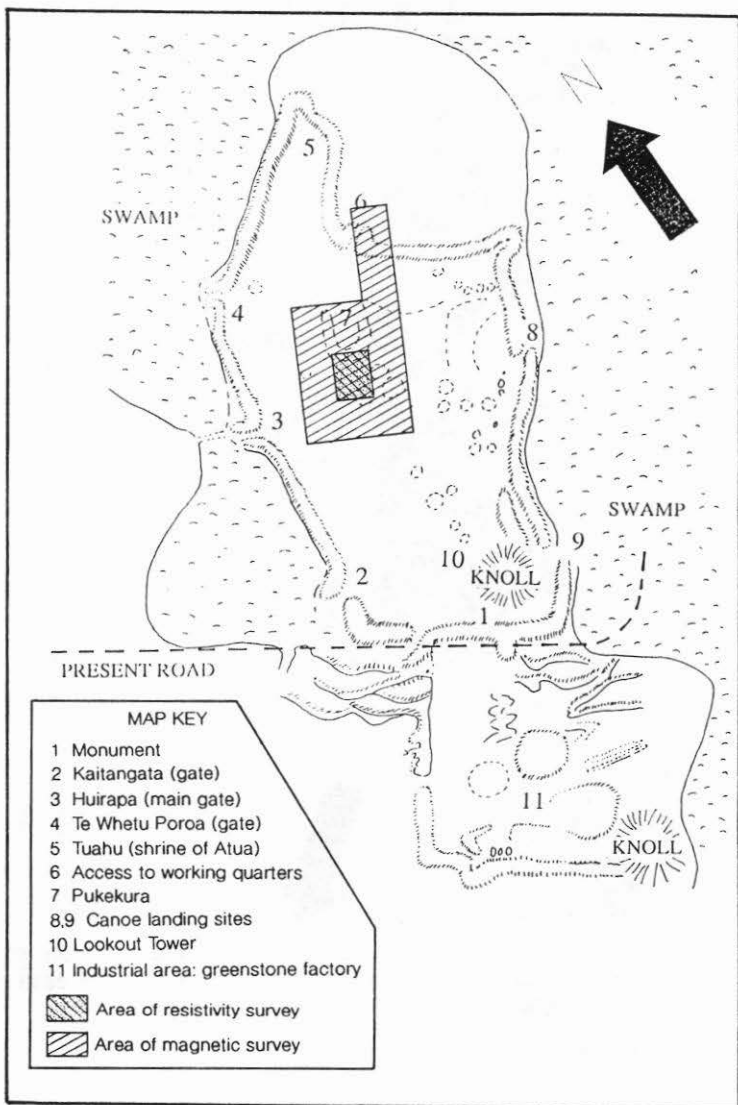


Figure 1. Map of Kaiapohia Pa (after England, 1989) showing magnetic and resistivity survey areas.

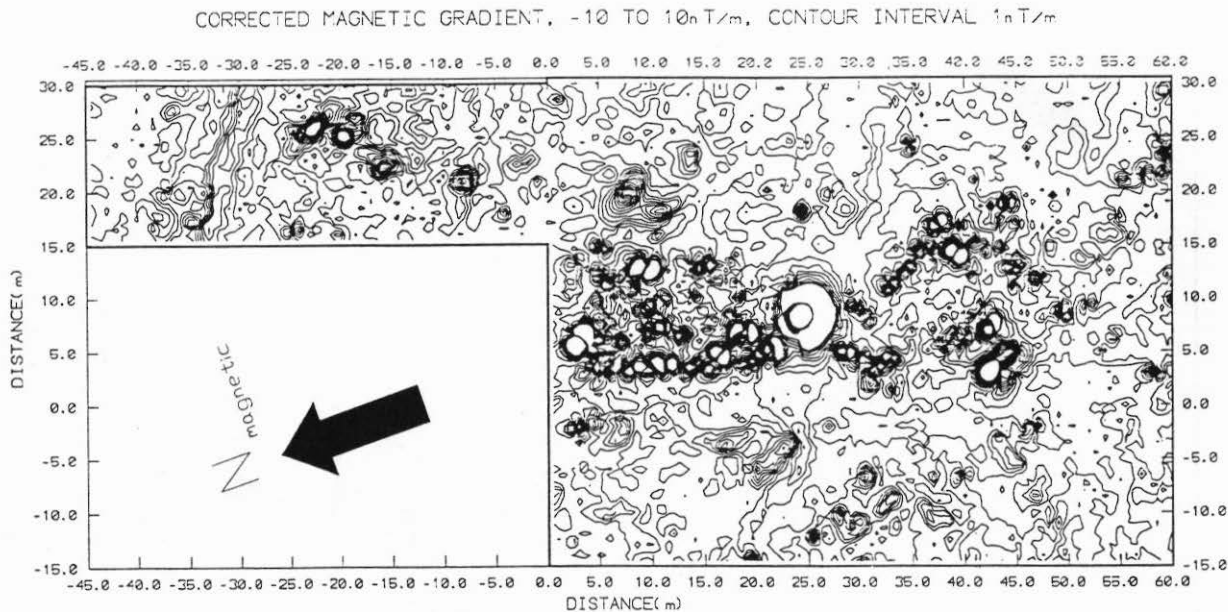


Figure 2. Contour plot of the corrected vertical gradients of the total magnetic field, Kaiapohia Pa site.

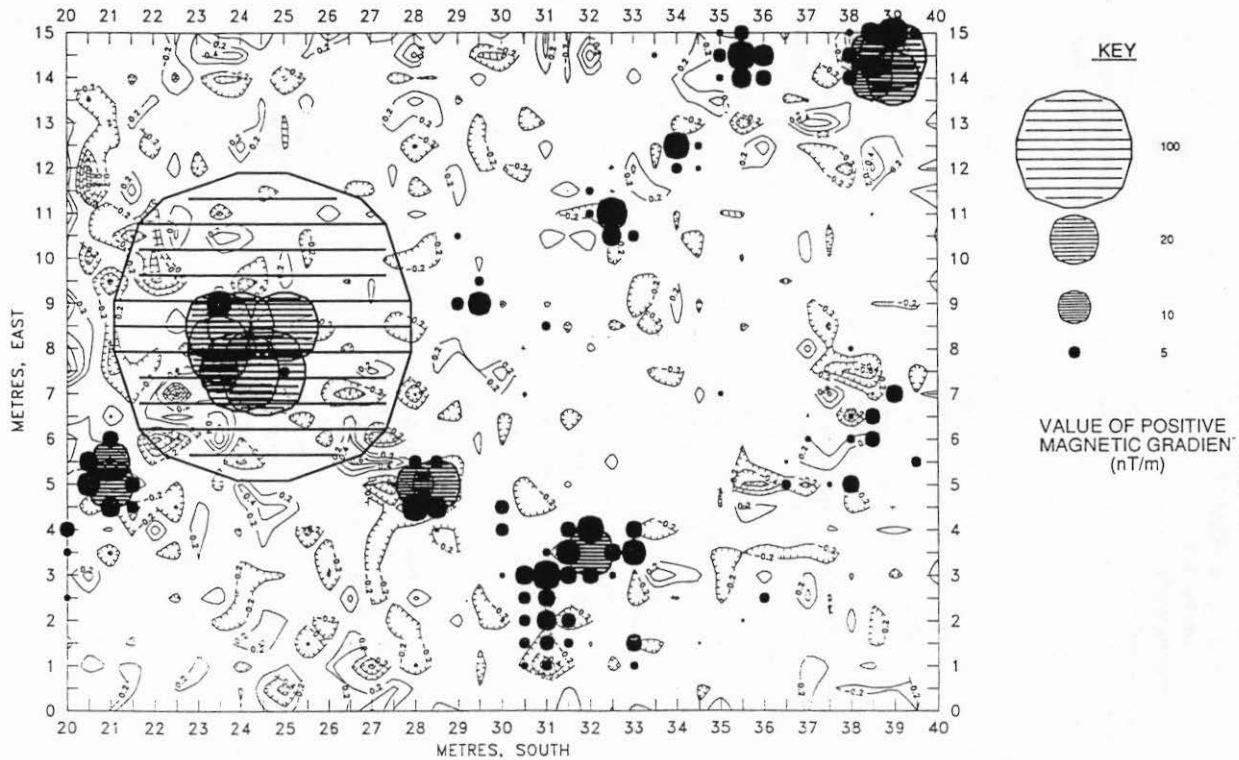


Figure 3. Plot of AIR data as contours and the magnetic gradient data as circles.

Magnetic measurements were made over a 3405m<sup>2</sup> area of the Kaiapohia Pa site in 1991/92 (Figure 1). The total magnetic field strength and its vertical gradient were recorded by a GSM-19 magnetometer. Data was collected at 0.5m intervals along survey lines. The survey lines were 0.5m apart and so magnetic measurements were made on a 0.5m grid. Magnetic vertical gradient data from the survey area are plotted in Figure 2. Figure 2 shows a clustering of anomalies around the central meeting house area. The largest anomaly is mapped at location 24m south, 8.5m east, i.e. (24,8.5). It has gradients from 650.2 nT/m to -60.1 nT/m associated with it.

To the north of that location, a rectangular area is defined by the magnetic anomalies. Anomalies tend to be larger on the perimeter of the rectangle than within it. Magnetic anomalies seem to identify boundaries to the north and south, at  $x = 5\text{m}$  and  $18\text{m}$ . Lineations of anomalies, which can be interpreted in terms of geometric shapes, occur to the south of the traditional location of the central meeting house. A magnetic gradient anomaly that is associated with a topographic feature is the anomaly running between the points (-28, 15) and (-30, 30). This linear anomaly corresponds with the outer bank of Kaiapohia Pa.

Resistivity measurements were made in 1991/92 at Kaiapohia Pa (Figure 1) using an ABEM SAS 300 Terrameter resistivity meter and a square array of electrodes of side 0.5m (Clark, 1990). An area of 300m<sup>2</sup> from which interesting magnetic data had been collected was chosen for the resistivity assessment. Resistivity measurements were made over the area with the centre of the electrode array located at 0.5 m intervals along lines spaced 0.5 m apart. The square array measured resistivity as well as azimuthal inhomogeneity ratio (AIR). The AIR value is an indicator of resistivity variability within the bounds of the square array and it can be used to detect small buried objects.

In a contour plot of AIR on which has been superimposed positive magnetic gradient data (Figure 3) the largest measured AIR value at (24, 8.5) is related to the largest magnetic anomaly. This magnetic anomaly is associated with resistivities that are high for the site. Two lines of AIR anomalies from (24, 8.5) to (28, 12.5) and (24, 7) to (28.5, 4.5) seem to be associated with the magnetic anomaly. Of the other magnetic anomalies, those around the following locations are associated with AIR anomalies: (22, 5), (29, 5), (33.5, 11.5), and (35, 13). Magnetic anomalies near the following locations are not associated with AIR anomalies: (30, 9), (32.5, 4.5) and (35.5, 14.5). Many AIR anomalies are not associated with magnetic anomalies. The diamond shaped area of magnetic anomalies centred at (41,5) has an edge defined by anomalies from (36.5, 5) to (39, 7) and this edge seems to be associated with anomalous AIR values.

A fuller account of the research work carried out in this project is contained in the report "Investigation of Maori archaeological site occupation patterns using geophysical techniques", which can be obtained from the authors.

## REFERENCES

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