

## Archaeological Sites Detecting using Underground Radar Images

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### ABSTRACT

It is more important for archaeologists, which any information will be got before excavations in archaeological sites. Archaeologists hope to get about underground data that were got from any methods. We developed two methods, and combined both. One is the Infrared air picture, and another is Underground Radar system. This underground radar system is able to catch until -5m depth, and almost Japanese archaeological sites are able to catch the underground data.

### 1, INTRODUCTION

More than 13000 archaeological sites were excavated every year, in Japan. And more than 5500 archaeologists were worked in these archaeological fields. But archaeologists must excavate less than any informations about underground information. So, they take more than time and tide to excavate at archaeological sites. If they get any under

ground information, they can excavate at archaeological sites so quickly, and can save money and time.

We developed and combined with the analysis of infrared air pictures and underground radar system. We get the plan data from infrared air picture, and also get the close-section data from underground radar system.

Combine with these two data, we can detect for underground information before archaeological excavations.



Fig.-1 Infrared Air Color Picture

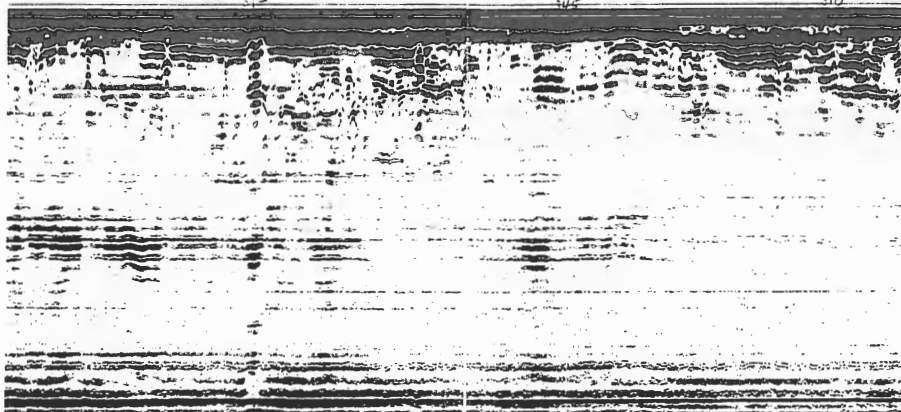
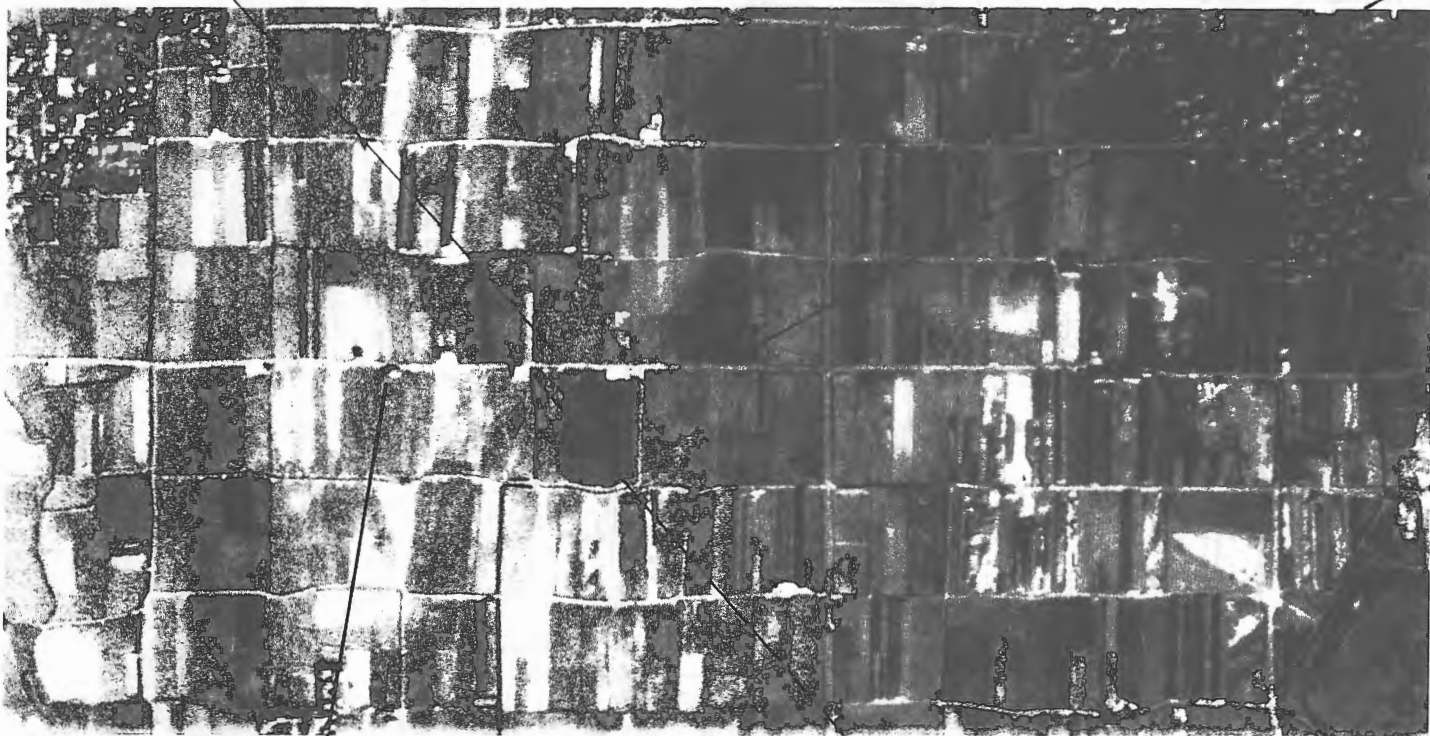
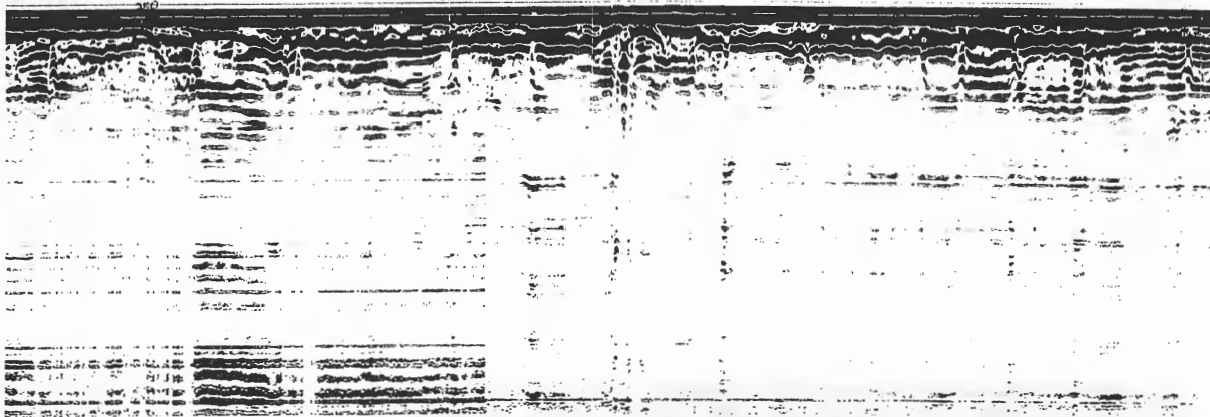


Fig.-2 Infrared Air Color Picture and Underground Radar Images



Fig.-3 Underground Radar of Ditches around the Village

## 2, INFRARED AIR COLOR PICTURE

### 2-1, Infrared Air Color Picture

Infrared air color pictures will show us the underground information (Fig.-1). In this case, we took air pictures from 600m above the ground level using infrared color film with RC-10 (23cm\*23cm). Original picture scale is 1/20000.

### 2-2, Interpretation for Old River Traces

Infrared color pictures show dark where including much waters, where are more humic soil, etc. At first, we put these images into the computer by 400-dpi scanner. And we miscued to digital whole images.

We picked up dark areas from these images in the computer using RGB analysis, for example, old river traces, old ponds, and lakes. These areas are more dark than another areas where are not river traces etc.,

In this area, the main river came from north to south. Older river flew west area, and newer river flew going to east. The west half of research areas are almost surrounded by old river traces.

## 3, UNDERGROUND RADAR SYSTEM

### 3-1, Underground Radar System

Almost river traces in Fig.-1 are flew looks like from north to south, we took underground radar research in direction east-west line. We took underground radar research from the top of roads, therefore the rice fields and were covered water. The radar, which we used, has the capacity to reach -5m, and to throw the hard constructions (Fig.-2).

This radar system can search 2-3 km line at one day using by car, but, can only 200-300m line at one day by manpower. If we research using mesh method, we can get the plan data from this underground system. In this time, we got the plan data from the infrared air pictures, and close-section data were got from this underground radar system.

### 3-2, Underground Radar Interpretation

Underground data shows that red or orange parts are high conduction, white and yellow parts are low conduction. High conduction part are considerable to be pebble or sand, low conduction part are also considerable to be silt or clay.

One more condition, we must be considerable. In this area, it is thinkable that river heaps were piled up by river flood last 4-5000 years. That start is 5500 years ago, in Jomon era, the seawater rises up 4-5m above from present time. And also, 2000 (+1m), 1000 (+1.5m) years ago, twice times, total 3<sup>rd</sup> times, seawater rises from the present time.

It can be considerable from the underground radar data that west part of the research area is deep and wide river traces were found, and east part of the same area is narrow and shallow ones were few found (Fig.-3). The areas were consisted archaeological remains are the high land and were not covered the river water.

Around the excavation area, we tested about the boundary of the archaeological remains. Fig.-4 shows the boundary of the ditches around the ancient village site.

## 4, CONCLUSION

Underground radar data and infrared air pictures are well combined each other. These GIS informations will help archaeologists when they excavate these areas. We will develop from 2D GIS informations to 3D GIS informations that are easy to understand.