Ground Penetrating Radar Survey Report:

Sha'ar HaGolan, Israel

Data Acquired September 23, 2005
Report compiled October 16, 2005

Artifacts near GPR survey area at Sha'ar HaGolan

Survey and Report Published by Mnemotrix Systems, Inc.

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On September 23, 2005 Mnemotrix Systems, Inc. was asked to acquire GPR survey data at the Neolithic Sha'ar HaGolan Archaeological Site. Chief Archaeologist Prof. Yosef Garfinkel of the Institute of Archaeology of Hebrew University served as the archaeological guide to the Geophysical Team of Mnemotrix Systems, Inc.

The main reason for the survey request was to see if archaeological remains could be non-invasively viewed sub-surface using GPR. If this would be successful, it is thought that much more of the site will be able to be mapped without the labor intensive investment of excavation. The site is located in the Jordan Valley SE of the Kinneret in what are now former fish ponds of the Kibbutz Sha'ar Hagolan.

Since the complete site is so large, a full non-invasive survey of the area could shed light on many questions, such as providing a better idea about the architecture and street system of the site as a whole. The full area of the site is recorded to be some 20 hectares, where to date only a tiny percentage of the area has been excavated. It is hoped that a full GPR study could give us a sub-surface map of the connecting mud-brick roads and walls which have been unearthed so far in only a few places, and answer a range of bigger questions that haven't yet been addressed.

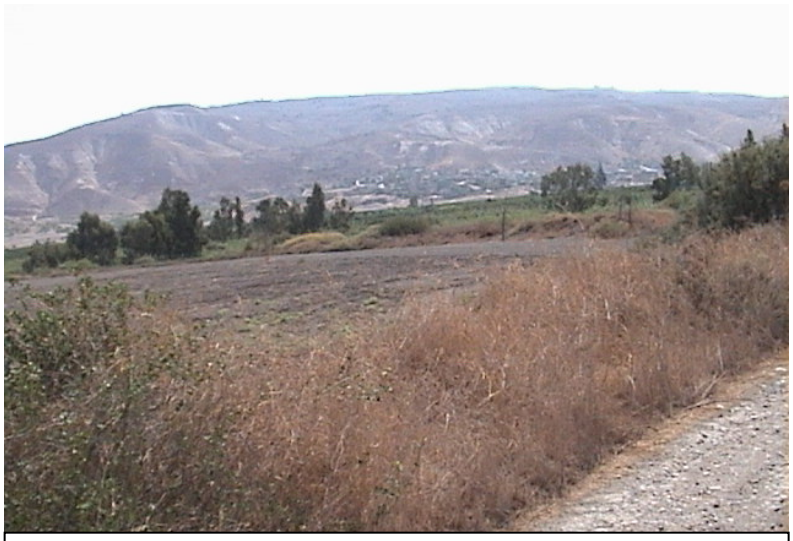

Figure 1: Partial view of fishpond area (generally looking West).

It was clear that the challenge to the survey would be the high basalt content at the site (many basalt stones and artifacts litter the site) and the high clay and sand content. Additionally, the material of the streets and structures were primarily of similar material to the ground itself, so any anomalies in the GPR reflections would be fairly subtle.

According to Dr. Garfinkel, the archaeological remains are within the first half meter, so a 400 MHz Shallow profile was used. This profile has a focus of the top few meters beneath the surface, so it was surmised that even an inhibited signal would be able to clearly image the depth of interest, which turned out to be true.

Work began in the SE corner of the 2nd fishpond to the east (see Figure 1). A 10 x 10 m grid was marked out for data acquisition.

Two interlocking grids of GPR data were completed (Dataset 1 E/W, Dataset 2 N/S). These grids were then joined (overlapped) in post-processing to give a denser view of the sub-surface. Data was collected every 1 m.

Figure 2: View of fishpond area looking South (person standing alone is in the survey area). Umbrella covers GPR controller during data acquisition.

Once in the lab, data was post-processed to give the clearest picture possible. To aid in the analysis of this area, we created an animation of the depth slices as they "move" down through the depth of the survey area, which can be seen at this Internet URL:

http://www.mnemotrix.com/geo/shgolan/shganm.gif

note: give the animation file enough time to download, and be sure you are viewing it with your web browser

An excerpt of the animation is seen in Figure 3 below. Here we have interpreted the data and labeled significant anomalies.

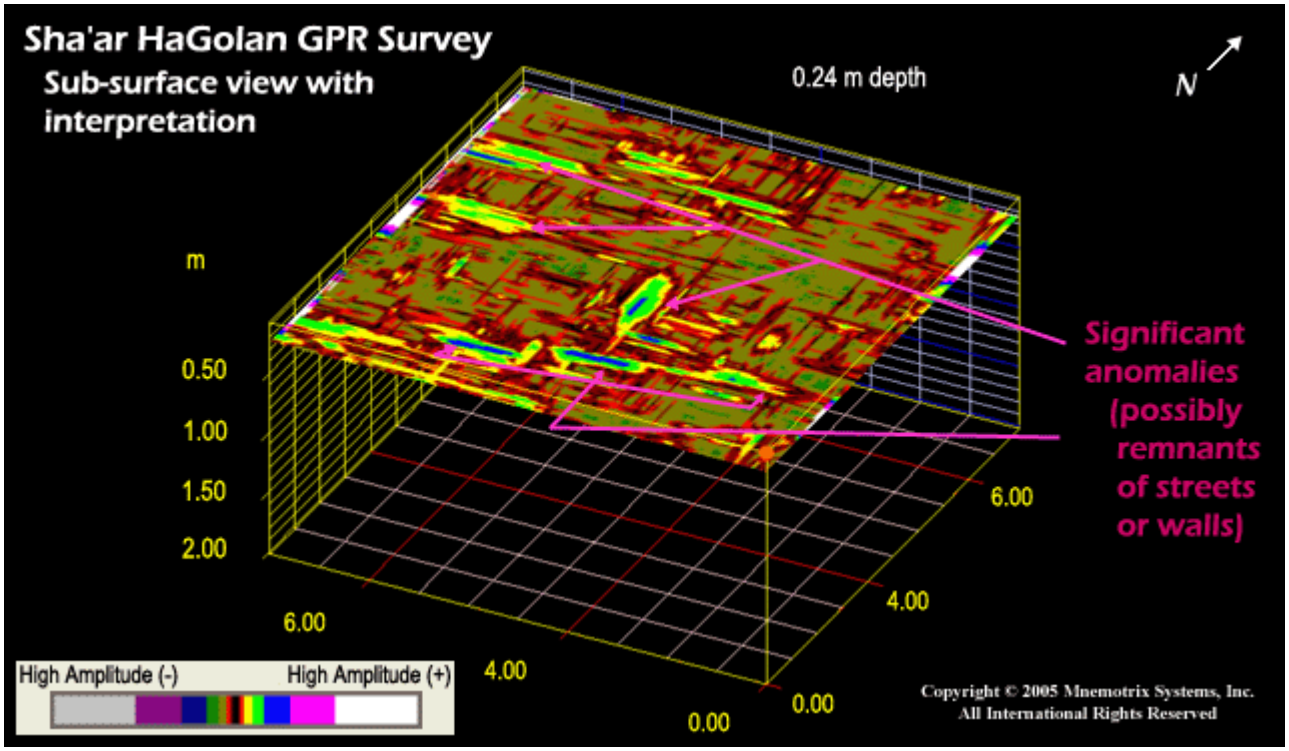

Figure 3: Sha'ar Hagolan GPR Survey excerpt with interpretation of significant anomalies.

Much attention was put into choosing a proper color table that would highlight the low to medium range anomalies that are present in the dataset. It is surmised that dry mud-brick in this type of clay/silt/basalt matrix would yield a low amplitude reflection as it is of the same material as the matrix, but formed more compactly without air. The same would be true for plaster, a substance which was found in some streets on the site. Therefore we chose a color table which would highlight these subtle changes, which can be seen above in the longish green and blue patterns above. The linear shape of these anomalies helps to strengthen our hypothesis that what we are seeing may be architectural remains of ancient mud-brick structures such as walls or streets, although GPR can only give clues to the hypothesis pending a ground truth study of the anomalies found. Valuable data was only seen until a depth of about 0.6 m. The depth range of the anomalies seen were from about 0.20 to 0.45 meters deep. What seemed to be visible is a mid-range set of anomalies marked by the arrows in Figure 3 above. Perhaps these outline ancient remains. The best view of the anomalies in question is seen at about 0.25 meter depth as shown in Figure 3.

Figure 4 shows the placement of these anomalies in the fishpond field as a kind of sub-surface map, where the anomalies are shown as a red line. Such a map can be used in the field to guide ground truth excavations as needed. Additionally if we were able to do a sub-surface map of this kind of the entire site, suppositions about similar connecting anomalies could be made.

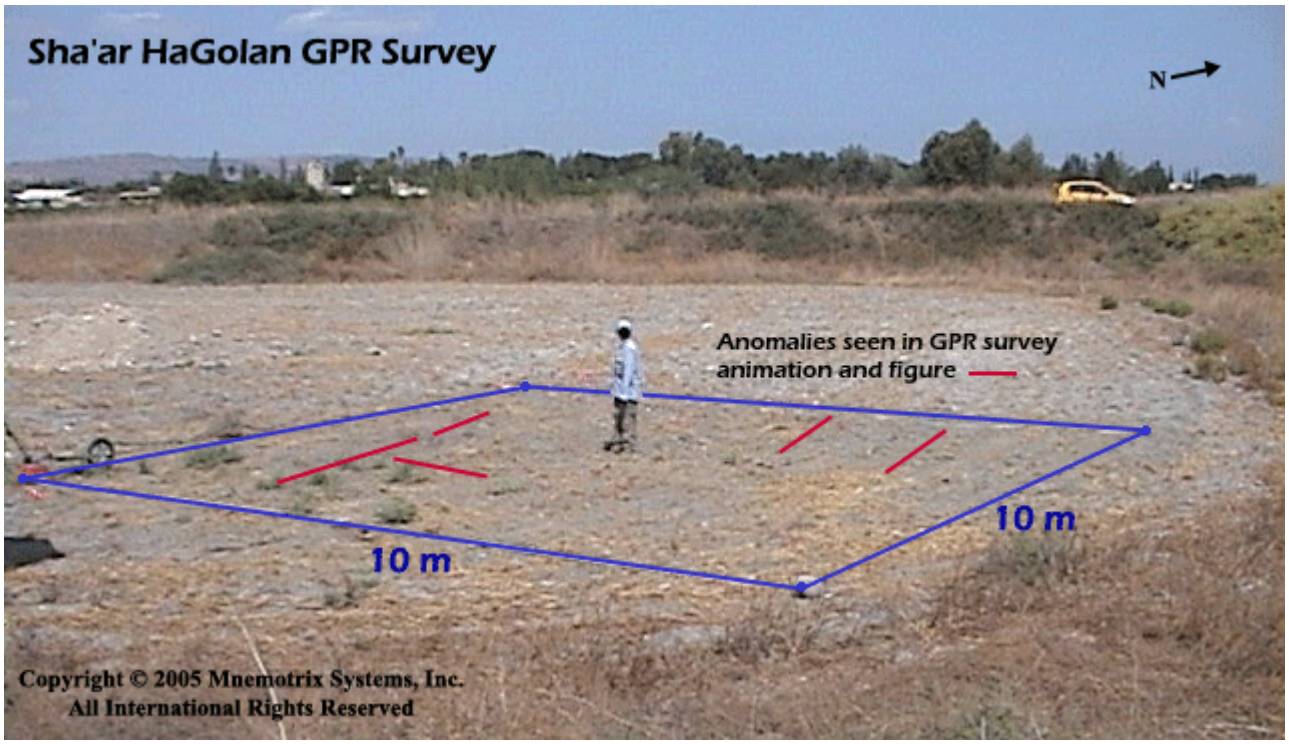

Figure 4: Placement of anomalies seen in Figure 3.

Since we have established that usable information was able to be acquired on the top half meter in relation to the questions posed by the chief archaeologist, we would suggest that continuing this type of study throughout a greater part of this huge Neolithic site could add greatly to the archaeological record and put the last eleven years of excavations and research into a larger context.