Ground Penetrating Radar Investigation at Kahal Grande Synagogue, Rhodes, Greece

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Abstract

Kahal Grande Synagogue, located in Rhodes, Greece, is thought to have been established in the late 1480s under Ottoman rule.

The subsurface of the floor of the synagogue was imaged through the collection of two grids using a Sensors and Software ground penetrating radar (GPR) system. The data was collected at frequency of 225MHz and a step size of 5 cm. The first grid was 12 m x 10 m with the starting point (0,0) at the synagogue's floor southwest corner. A total of 40 lines running south to north was collected every 0.25 m of the grid which covered the entirety of the exposed synagogue floor. The second grid, 16 m x 11 m, was shot with a starting point (0,0) in the northwest corner and ran from west to east. This grid consisted of 46 lines shot every 0.25 m.

Three-dimensional processing of the data showed several anomalies on plan views at approximately 0.25 – 1.0 m beneath the surface. Initially, several of these abnormalities were dismissed due to surface irregularities during data collection, most likely created during destruction. Other anomalies in the results reaffirm the location of a potential wall running the length of grid one in the western side of the synagogue. An anomaly located between what used to be the bemah and the torah ark, cannot be explained without further investigation. The interesting aspect of the anomaly is that it is located beneath a 1.75 m^2 tile pattern on the surface. The pattern leads to the interpretation that the area was meant to be marked and represents an important underlying feature. There are several theories as to what the subsurface feature is. It may be a temporary storage area for previously used Torah scrolls known as a *genizah* or an old *mikvah*, a bath for used for religious rituals. Only further investigation will tell what is beneath the synagogues floor.

Introduction

Built in the late 1480s, Kahal Grande is one of the oldest synagogues in the Medieval town of Rhodes (Figure 1). In its prime, Rhodes was once home to over 4,000 Jewish residents. Because of its prominent Jewish presence, Rhodes was often referred to as a "Little Jerusalem". However, when the Italian government became allies with Nazi Germany and implemented anti-Jewish laws 2,000 people relocated across Europe. In 1943, the Nazis took control of the island and less than a year later gathered the remaining Jewish residents and sent them to concentration camps. Tragically, only 151 Jewish Rhodians would survive. Today, less than 50 people make up the Jewish community.

During the time of German occupation, Kahal Grande was severely damaged by a bombing. All that remains of the once active synagogue are the remnants of two walls and a baron floor (Figure 2).

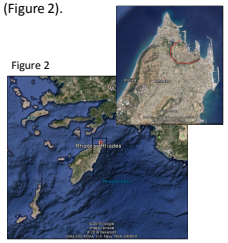

Figure 2

Figure 1

The purpose of this project was to noninvasively collect and analyze GPR data of the synagogues subsurface to look for evidence of past iterations of the synagogue and determine possible excavation locations. Hopefully, our findings can give the remaining members of the Jewish community an insight as to what the life was like for their families prior to World War II.

Methodology

The subsurface of the synagogue floor was investigated through the collection of two grids using a Sensors and Software ground penetrating radar (GPR) system. The GPR system used has two antennae a quarter meter apart. This one here closest to the user sends a high-frequency electromagnetic pulse into the ground. When that pulse comes into contact with something underground it is then reflected back to the surface where it is then received by the second antennae on the GPR. The receiving antennae then relays the information to the software program (Figure 3).

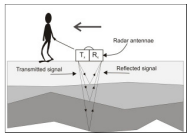

Figure 3

Recap of January 2015 investigation

In January of last year, a team of researchers began GPR work at Kahal Grande along with several other sites. The GPR grid collected ran 12 meters long and 4.25 meters wide (Figure 4). They shot the grid at 225 MHz. The data was then processed by Dean Goodman, president of GPR slice.

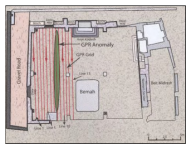

Figure 4

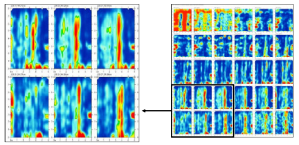

Figure 5

Results of the processed GPR data shows a subsurface feature roughly 4 meters below ground. This can be seen in the slice view of the data (figure 5). This feature is thought to be remnants of a wall from a former synagogue at this location.

January 2016 investigation

Over the course of 3 days, our team took GPR lines of 2 grids at a frequency of 225 MHz. Our plan was to first use this lower frequency to detect if there were any subsurface features. If there was and if time allowed, we would then shoot the areas of interest at a higher frequency to hopefully be able to recognize the subsurface features. The step size used for both grids was 5 centimeters, step size refers to the distance between collection points. So in this case every 5 centimeters the antenna sends out and then receives an electromagnetic pulse.

Grid 1

Grid one, which is a continuation of last year's grid, runs North to South (Figure 6). This grid was 12 by 10 meters with a starting point in the southwest corner. This grid had a total of 40 lines running every quarter meter.

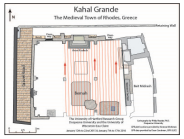

Figure 6

Grid 2

The second grid ran from west to east and began at the north west corner (Figure 7). With the dimensions of 16 by 11 meters, grid two consisted of 46 lines also at every quarter meter, covering the entirety of the exposed floor.

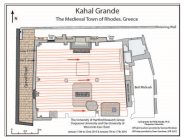

Figure 7

Results

Processing of the data was done by Dean Goodman. Three dimensional processing initially showed several new anomalies. As for new findings, grid 1 should some interesting results. Figure 8 shows a slice view of the data shows a feature located roughly 7-12 meters from the south wall and 1-2 meters below the surface.

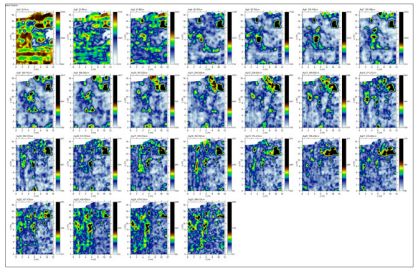

Figure 8

Processed with the pulseEKKO software program, GPR line 10 (Figure 9) shows two hyperbolic reflectance indicating a subsurface roughly 7-9 meters from the south wall then another feature is present roughly . Interestingly, the hyperbolic reflectance occurred directly underneath a 1.75 m^2 patterned tile on the surface (Figure 10).

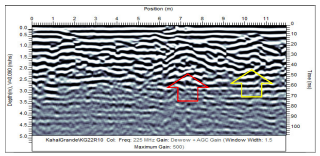

Figure 9

The patterned tile itself lies between where the bemah once stood and the former Torah ark (figure 11). In an active synagogue, the bemah is a platform in the center of the room where the rabbi would conduct the service. The Torah ark is an ornamental closet that holds the synagogue's Torah scrolls. Both of these are religiously important and are often the main focus of the service. This leads to the theory that the patterned tile and its subsurface feature is also of great significance.

Figure 10

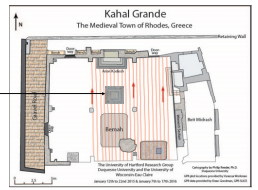

Figure 11

Theories on what this underlying feature include a genizah or possibly a mikvah. A genizah is a temporary storage for old Hebrew- writings. They are found in cemeteries, the synagogue's walls, in the basement, or buried underground. A mikvah, on the other hand, is a religious bath used during rituals. These are found in almost all synagogues. These are just two possibilities, further research would need to be conducted to know for certain.

Summary and future research

Ground penetrating radar is a noninvasive and nondestructive method for imaging the subsurface making it a great method when working at fragile archeological sites.
The interesting location of the subsurface feature that is seen in both the slice view of the data along with the processed lines leaves us with an idea to conduct further research. In the future we hope to conduct ground penetrating radar at a higher frequency to produce a higher resolution image of the area of interest. We also hope to conduct fiberscope analysis in the area. With the results from this research, we hope to present the information to the Department of Archeology of Rhodes and receive a permit to conduct pinpoint excavation which would allow us to preserve as much of the site as possible.

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