Rhodes, Greece Ground Penetrating Radar Surveys, Archaeological Probes and XRF

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GENERAL DIRECTORATE OF ANTIQUITIES AND CULTURAL HERITAGE
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ΥΠΠΟΑ/ΓΔΑΠΚ/ΔΒΜΑ/ΤΕΞΕΙ/278037/162382/9820/540

NOTIFICATION TO:

1) 4th Ephorate of Byzantine Antiquities, 85100 Rhodes

2) Israeli Community of Rhodes
Simiou & Dosiadou St., 851100 Rhodes

3) Professor Richard Freund,
Maurice Greenberg Center for Judaic Studies,
University of Hartford,
200 Bloomfield Avenue,
West Hartford CT 06117, USA

RE: Approval of pilot project concerning the study of four monuments in the Medieval Town of Rhodes in January 2015

DECISION

Taking into account the following

1. Presidential Decree 63/2005 (Government Gazette Issue 98/A/22-4-2005)
2. Presidential Decree 118/2013 (GGI 152/A/25-6-2013)
3. Presidential Decree 89/2014 (GGI 134/A/10-6-2014)
4. Joint Ministerial Decree YPPO/GNOS/49610/28-11-1990 (GGI 743.B/29-11-1990)
5. Law 3028/2002 (GGI 153/A/28-6-2002)
6. Presidential Decree 191 (GGI 146/A/13-6-2003)
7. Ministerial protective legislation 23084/737/25-8-1948 (General Administration of the Dodecanese Gazette Issue 10/23-9-1948), 94262/5720/28-12-1959 (GGI 24/B/22-1-1960), YPPO/ GDA/ARX/B1/F29/KHR/31095/942/7-8-2001 (GGI 1093/B/21-8-2001), YPPO/GDAPK/ARX/B1/F29/ 48764/2052/28-5-2009 (GGI AAP 277/15-6-2009)
8. The inclusion of the Medieval Town of Rhodes in the World Heritage List of UNESCO
9. The unanimous opinion of the Central Archaeological Council, as expressed in its 31/16-9-2014 Meeting

WE DECIDE

We approve the realization of the pilot project concerning the study of the following four listed monuments of the Medieval Town of Rhodes in January 2015:

1. Jewish “Kahal Shalom” Synagogne, on Dossiadou St.
2. Site of the “Kahal Grande” Jewish Synagogue, on Kisthiniou St.
3. Church of “Our Lady of the Castle”, at the east end of the medieval town of Rhodes
4. The open courtyard round the “Neoclassical School”, opposite the Palace of the Grand Master.

Permission is granted under the following conditions:

1. The research will be carried out in collaboration with the 4th Ephorate of Byzantine Antiquities and the representatives of the following American Universities: University of Wisconsin-Au Claire, Duquesne University – Pittsburgh, Pennsylvania and Hartford University – West Hartford, Connecticut.

2. Before the start of the work, a collaboration memorandum will be drawn and signed, which will name the representatives of either side, and set out in detail the terms and conditions of the said collaboration.

Internal distribution: 1. DBMA.B2
2. CCA Secretariat

THE MINISTER
KONSTANTINOS TASSOULAS

Exact Copy
The Secretariat Director

Figure 1-The research project investigated four selected research sites using GPR.

The GPR technique is based on the propagation and reflection of pulsed high frequency electromagnetic (EM) energy. This field technique can provide near surface, high resolution, near continuous profiles of archaeological sites. GPR has become a popular method for investigation of the shallow subsurface because of the above properties, and the availability of portable robust and digital radar systems.

Publications resulting from my past investigations, as well as others, have shown that GPR is a valuable, efficient and effective research methodology (Jol, 1995; Jol, 2009; Jol and Bristow, 2003; Jol and Smith, 1991;.

Figure 2-The Kahal Shalom January, 2015 GPR study

The GPR acquisition system, Sensors and Software pulseEKKO™ 1000 was used for the research projects. The GPR profiles with 225, and 450 megahertz antennae and 200 volt transmitters provided images of the subsurface. Step sizes and antennae separation varied from 0.03 m to 0.5 m depending on the site conditions (Jol, 1995; Jol and Bristow, 2003). To reduce data collection time, a backpack transport system was employed. Each trace was vertically stacked with an appropriate sampling rate. The digital profiles were downloaded, saved to an external hard drive, processed and plotted. Basic processing will include automatic gain control (AGC), signal saturation correction, trace stacking (horizontal averaging) and point stacking (running average) as well as other routines when necessary. Near surface velocity measurements were calculated. The profiles, where necessary, will be corrected for topography. The application of radar stratigraphic analysis (distinct signature patterns) on the collected data provides the framework to investigate both lateral and vertical geometry and stratification of the archaeological features being assessed (Jol and Bristow, 2003; Jol and Smith, 1991).

1) Kahal Shalom

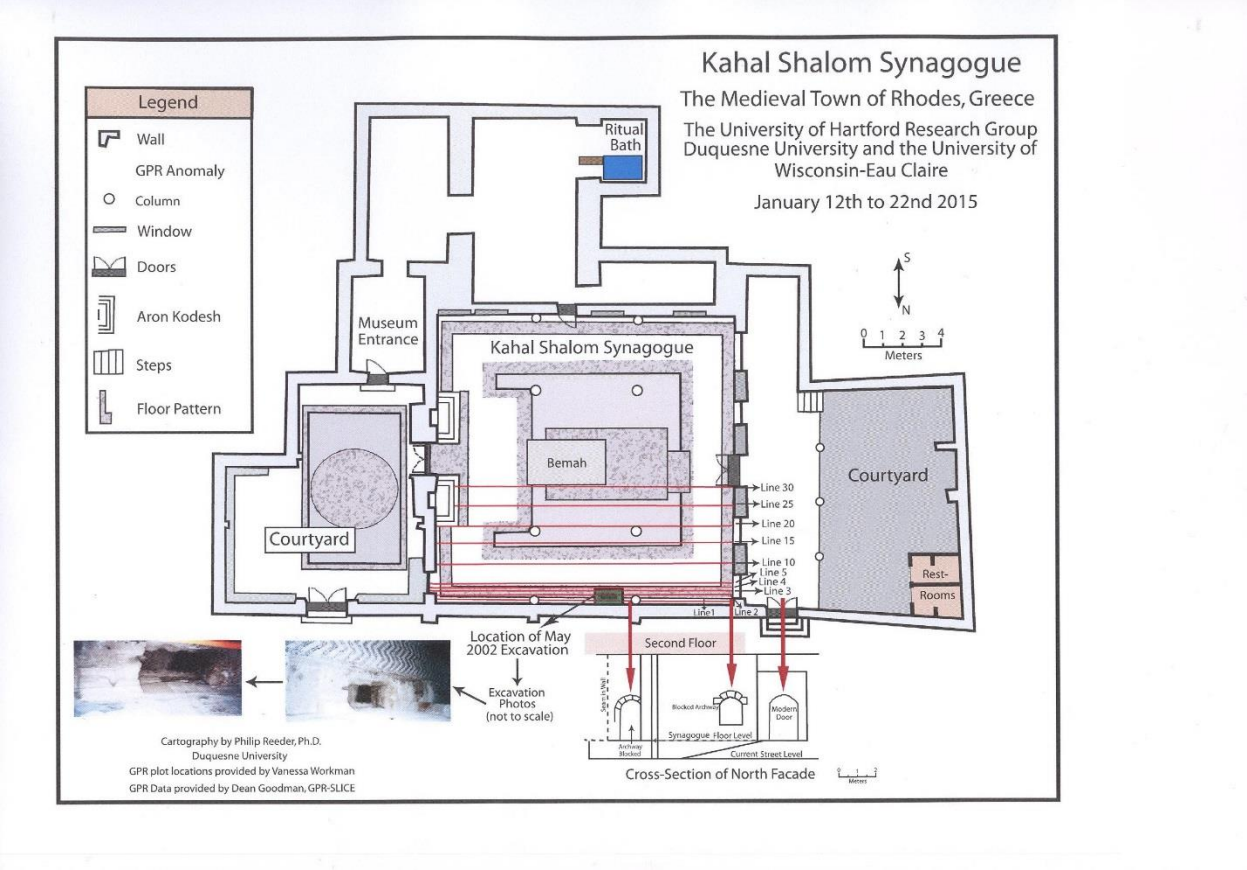


Figure 3-The Kahal Shalom area of GPR study (only the main synagogue area was done)

A grid x m by x m was was laid out in Kahal Shalom. Data was collected with 225 MHz (antennae separation: ; step size:) and 450 MHz antennae.

1. Kahal Shalom Synagogue-Preliminary Results and Continuation-we successfully mapped 1/3 of the subsurface of the entire synagogue complex in three days in January 13, 14, 15 2014 to test the feasibility of working in this environment and to provide information and a proposal for improvements to the site, providing historical data for the Ephorate and the Jewish community and provide Rhodes history of earthquake damage information.

The 2002 excavations revealed a distinct more ancient layer on the north wall.

Quoting the Ephorate report: page 16 “-Foundation

(3) On the base of the north front, along its total length, there is a more recent stone bench,

approximately 65 to 90 cm high and approximately 40 cm wide. Its role was tracked with an exploratory section in depth (III. 7). It was found that there is no broadened bedrock on the north wall and that the base of the latter does not have much depth, in fact it is at a level higher than the street.

Figure 4 is the 2002 photo of the area by the pillar.

At a depth of approximately 50 cm a layer of white clay was found, and it is followed by soft rock (virgin ground). Another section was made in the interior accordingly, from the south side of the northern wall, in the **area of the west semi-pillar (III. 8) revealing successive phases of the construction as well as traces of an older building, with a configuration unrelated to the present one**. The foundation appears normal from the interior side. One wonders whether the road was at some point higher than its current level, perhaps formed with a few steps. Then, the bench must have been constructed in order to support the wall on its base, following a possible modification of the road or following a discovery of instability problems or ascending humidity." PG 16/85, 2002 report of excavations and restoration of the Kahal Shalom Synagogue by the Rhodes Ephorate (translated from Greek).

Ground Penetrating Radar Scanning WNW -> ESE along the northern wall of synagogue gradually moving south to the center of the building using a Pulse Echo 1000 (GPR sensor and software). Recording 225 (megahertz) mhz every 20 cm, recording trace every 5cm. The 2 antennae separated by 50 cm. Prof Harry Jol and University of Hartford student Nicole Awad on device, Emily Galica and Vanessa Workman, Tel Aviv University measuring and documenting a limited space for testing.

Work done up to the 4 main pillars: two "semi-pillars" (to the central podium-bemah-section) built into northern wall 4.5 meters apart and two 4.45 meters apart 3.6 meters south from the wall. The southernmost pillars will interrupt the recording of GPR lines between the 3 and 4 meter markings. 30 lines were completed between northern wall and the bemah in the center of the synagogue at 225 mhz. Line 0 on the northern wall was not recorded, line 30 along the edge of the bemah was recorded. Lines

17-20 were affected slightly by the two pillars in the center of the surveyed space, as the GPR was not able to complete a direct path from wall to wall, but maneuvered around the two pillars in these lines.

GPR scanning the same area in the WNW -> ESE direction now using 450 mhz, recording lines every 10 cm, and recording trace every 3cm. This records the subsurface area at a higher resolution within a shallower depth. 31 lines of potential 60 lines of assessment and all 60 lines finished in three days with 1/3 of entire space being processed by our geophysicist in Los Angeles, Dr. Dean Goodman of GPR-Slice Software, Geophysical Archaeometry Laboratory, Los Angeles, CA USA January 13, 14, 15, 2015 data slices with the two clear layers below surface consistent with early floors of a building in the same location. The following are the depths of anomalies that we would be tracking in the next work we are proposing for January, 2016: RAW DATA

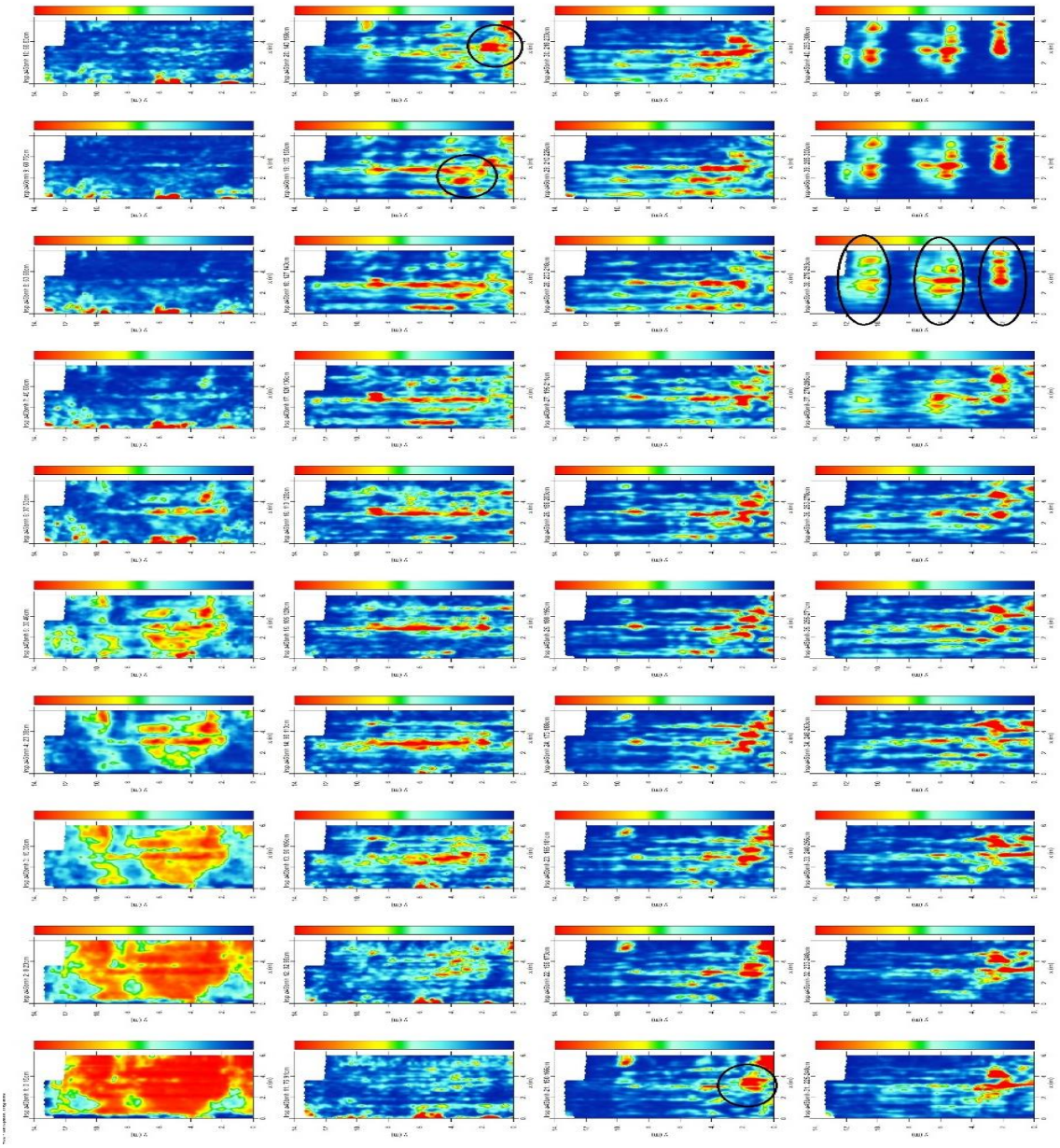


Figure 5-The Raw Data from GPR-Slice with indicated anomalies

The synagogue's present level is tied to the 1577 foundation stone date.

Anomalies and Areas of Interest for Coring, Sampling and Excavation in 2016:

Anomaly 1 at a depth of 135-150 cm below the present floor could be cored and sampled BUT only after the entire field of the main floor is GPR surveyed. It would, we think be easier to core and sample in a more obscure area and repair. The odd configuration of the anomaly may indicate that the door was oriented much differently than the later version.

Anomaly 2 at a depth of 140-160 cm appears to be from the same historical period, perhaps from the time before the 1481 earthquake.

Anomaly 3 at 270-290 cm appears to represent an even earlier stratum of the synagogue perhaps dating to a 14th century as do Anomaly 4 and 5.

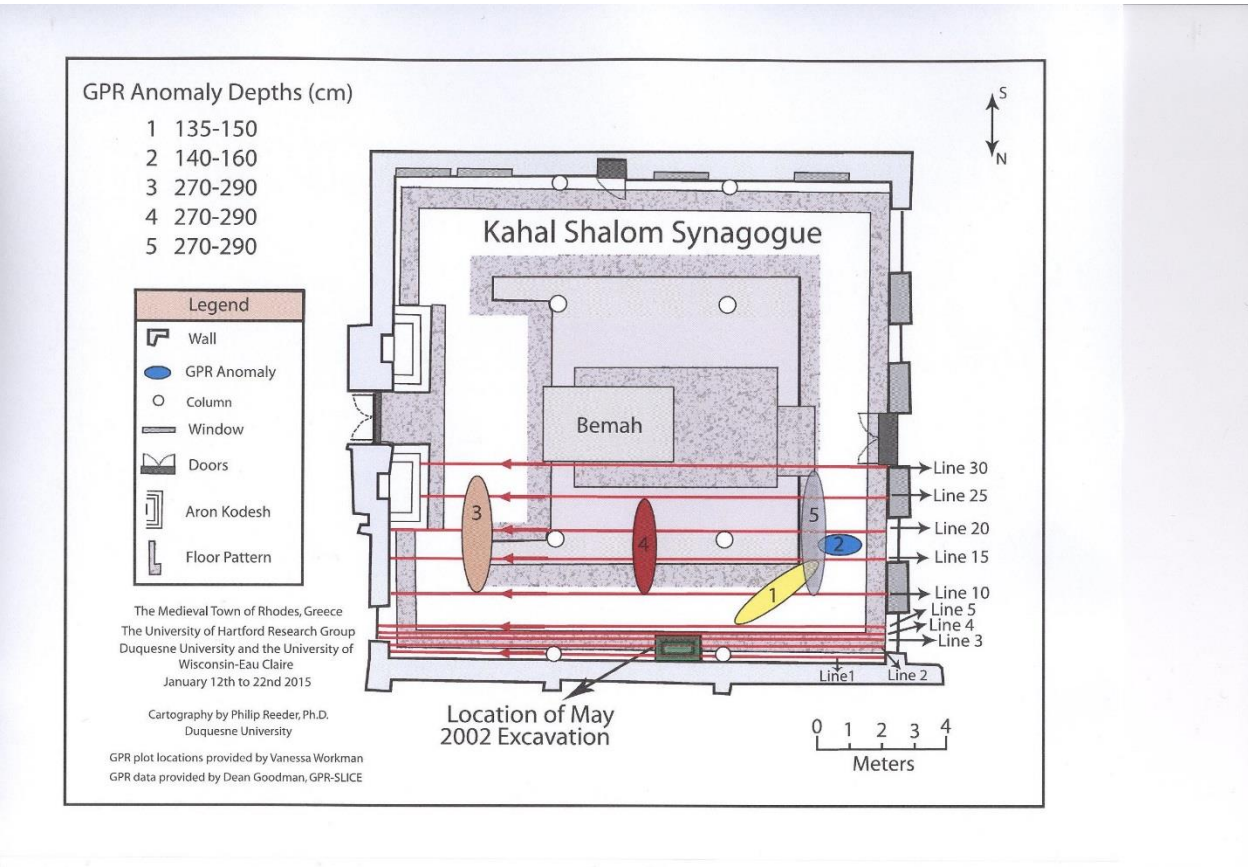


Figure 6-Map of all of the places of Interest

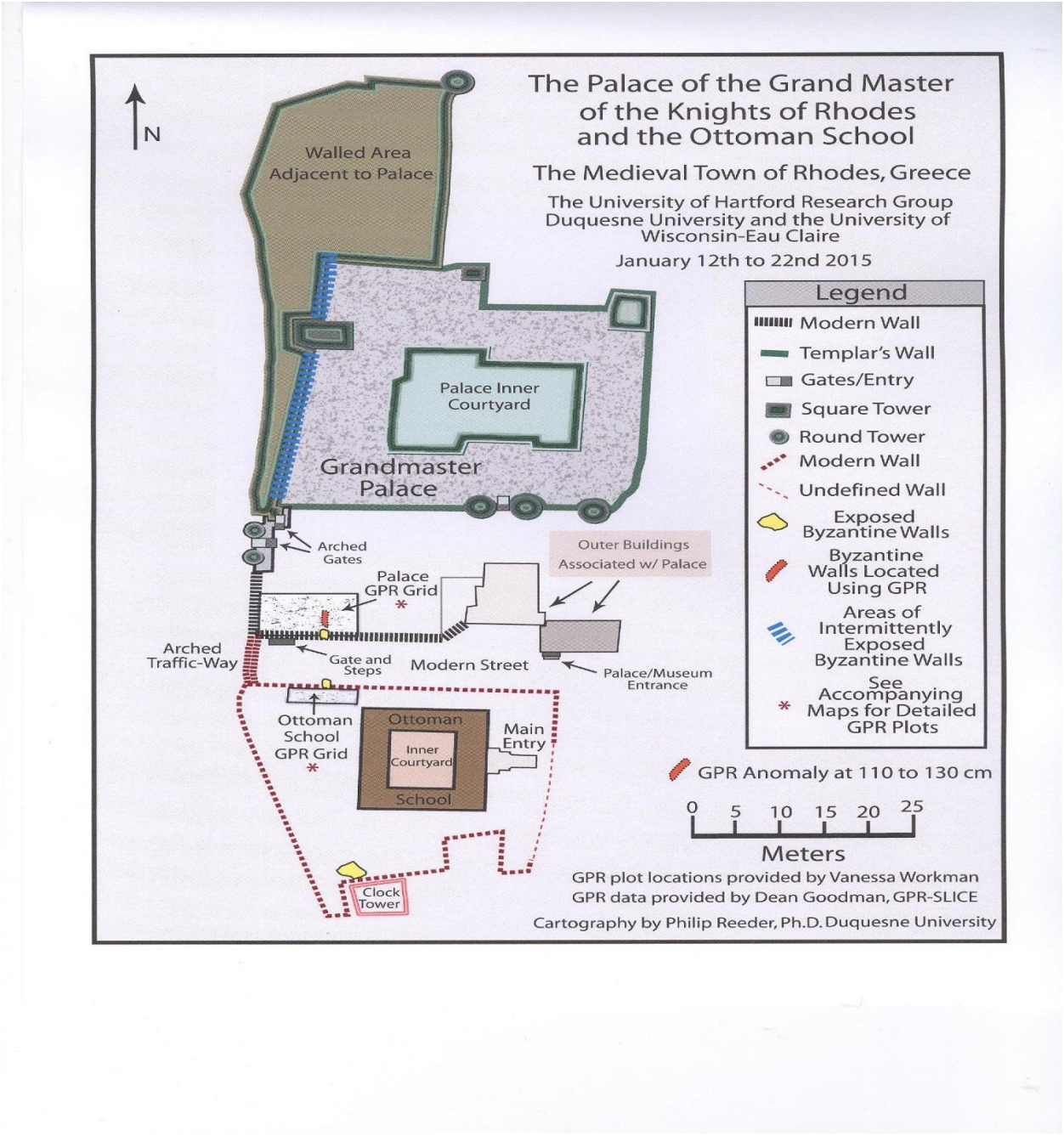
Proposal for January, 2016

Our proposal for 2016 will include finishing the synagogue with a full scan throughout the entire building. We would like to proposed supervised coring and sampling in small areas that would provide

meaningful and the least destructive means to determining the time periods of occupation of the synagogue there. Coring and carbon 14 testing a slice 19, for example. We also now know that this is an effective method to gain additional information without major excavation. Our project wanted to see the utility of the GPR project in a reconstructed site with a long history of earthquake damage and rebuilding.

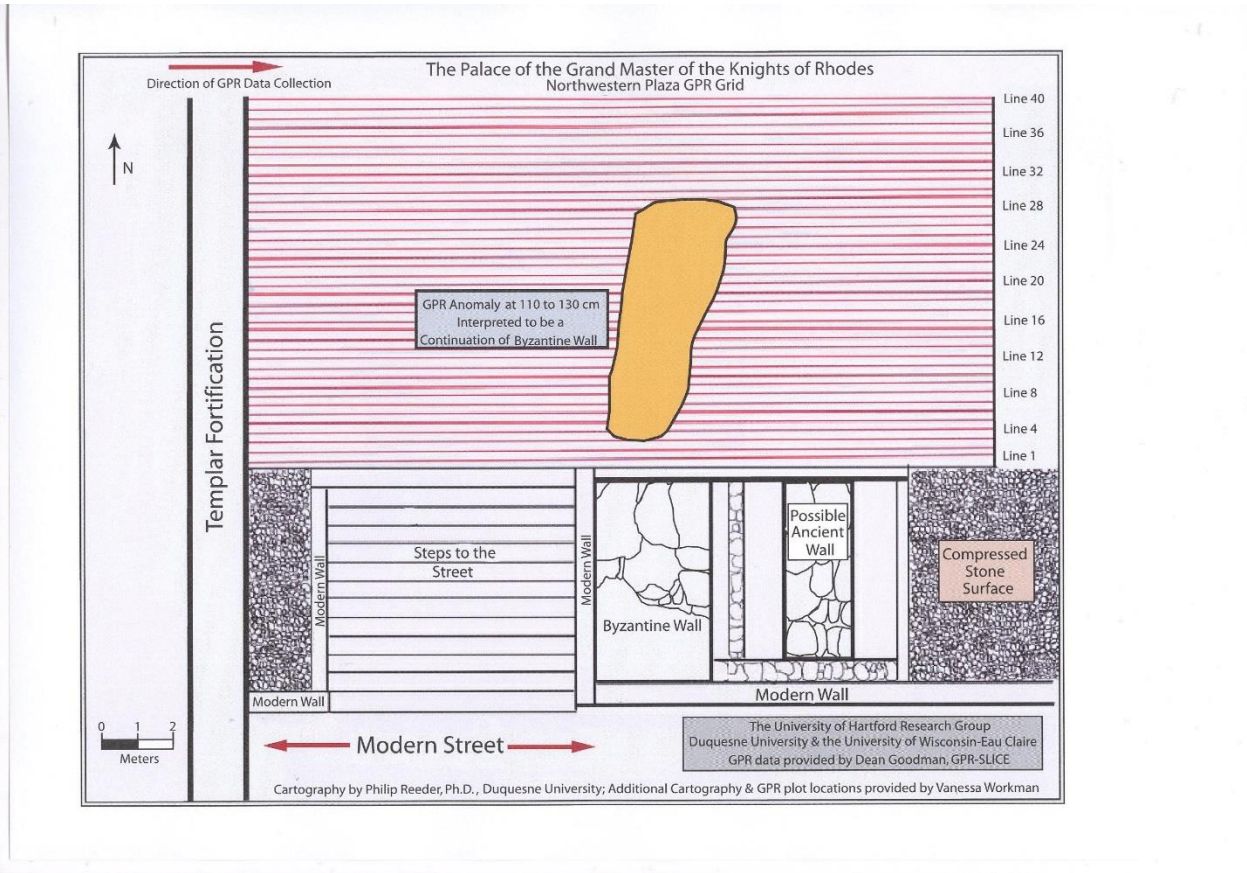
The next phase (Jan 2016) would be to map the courtyard, the museum area and perhaps the ancient cemeteries of the Jews. The cemeteries project is NOT for excavation, but for identification and if there are specific locations of tombstones or other distinguishing markers in the cemeteries, they can be GPSed in for future identification. All with GPR. Our recommendation is that we map the entire subsurface of Kahal Shalom to determine the size of the earlier structures in a new project and produce as full study of the subsurface and do sampling.

2) Grand Master Palace

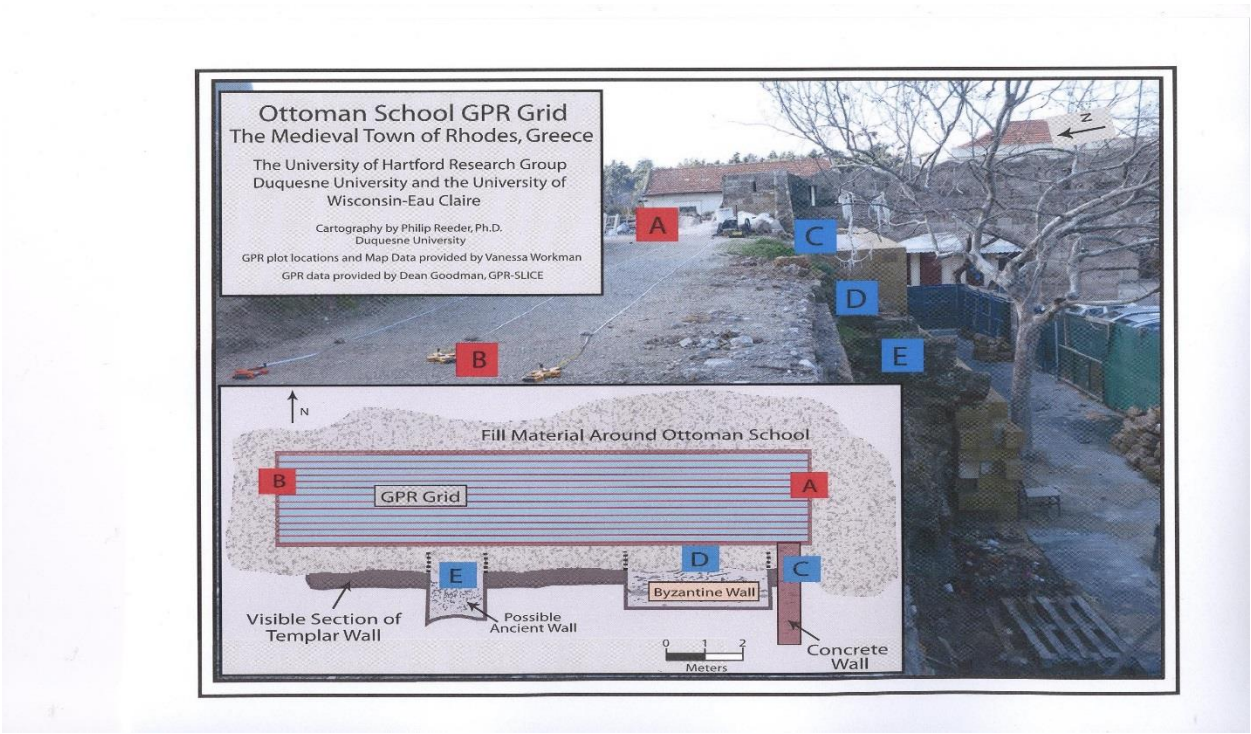


A grid x m by x m was was laid out at two locations at the Grand Master. Data was collected with 225 MHz antennae.

By far we documented the exposed walls of the Grandmaster Palace and the Ottoman school with the greatest detail. The Byzantine Wall sits only a 110-150 cm below the surface but extends down beyond the scope of the GPR. The depth of the wall was measured in varying parts of the wall to insure that we could carefully evaluate the wall's depth and width.



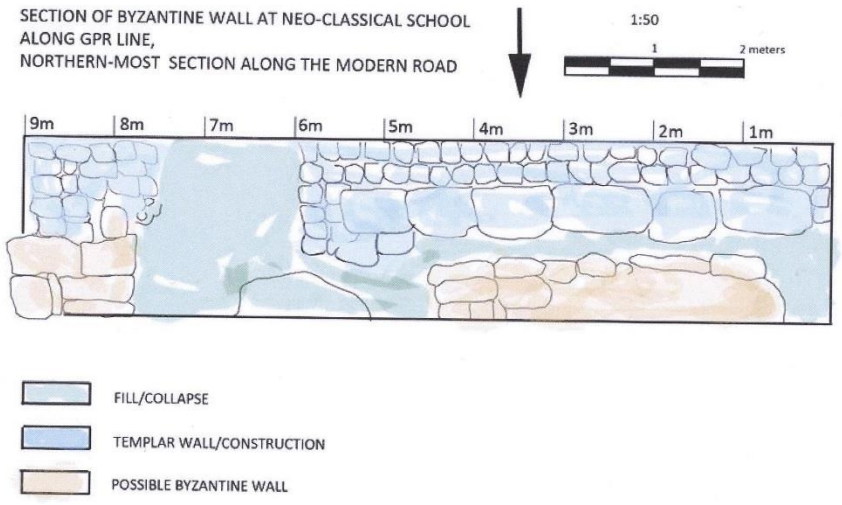
The Ottoman school where the wall continues had only one area where the GPR could work. The signal was at risk near all of the debris piles of equipment being used for the reconstruction project by the Ottoman school. But the signal of the area was clear and is consistent with the signal across the parking lot at the plaza of the Grandmaster Palace.



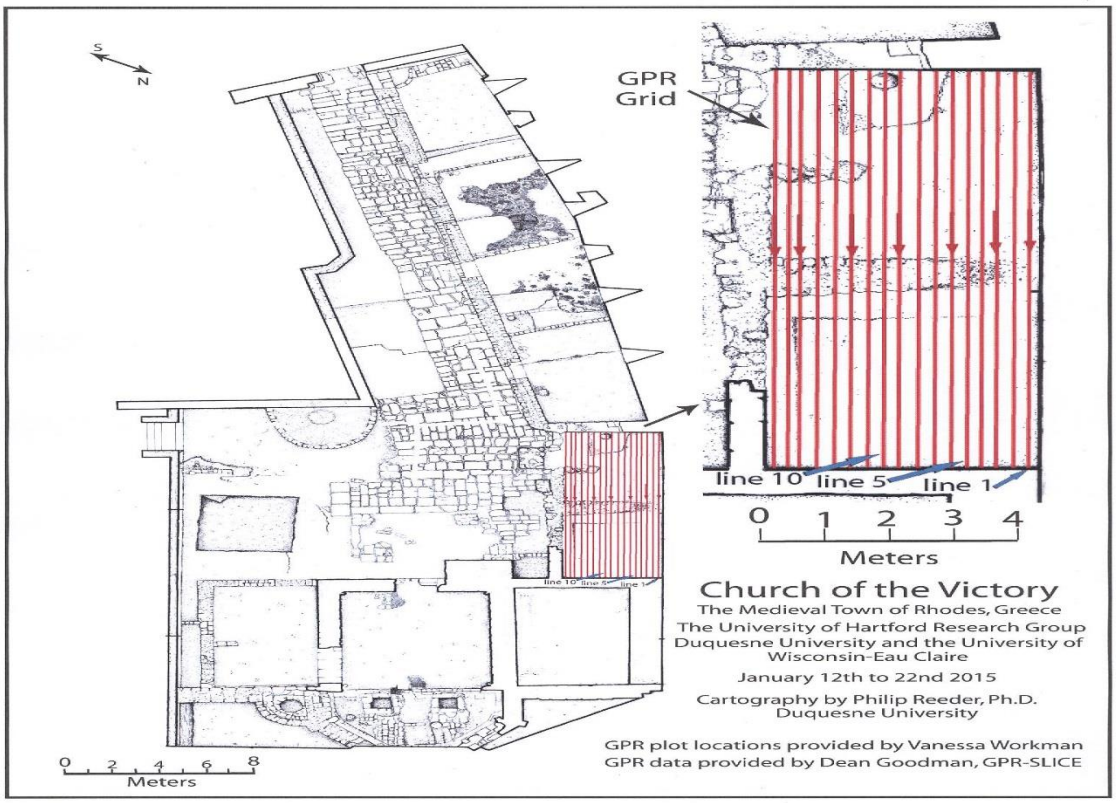
The debris piles would not be a problem for the proposed Electrical Resistivity Tomography equipment which can distinguish the modern metal from buried wall fragments.

Recommendation: The area of the Neo-Classical School Byzantine Wall Survey can be accomplished with the use of Electrical Resistivity Tomography equipment which we would like to propose for the continuation of the pilot project in January, 2016. The ERT equipment is very durable, can map through debris piles on top of the area (which GPR cannot), goes much deeper (up to 20 meters perhaps to identify the Hellenistic wall beneath the Byzantine Wall) and works in the rain (which GPR does not and very important for January weather).

Our recommendation is to follow the Byzantine Wall section through by the side of the Grandmaster Palace with the ERT to the farthest end of the section available for research.


SECTION OF BYZANTINE WALL AT NEO-CLASSICAL SCHOOL
ALONG GPR LINE,
NORTHERN-MOST SECTION ALONG THE MODERN ROAD
1:50
1
2 meters
9m
8m
7m
6m
5m
4m
3m
2m
1m
FILL/COLLAPSE
TEMPLAR WALL/CONSTRUCTION
POSSIBLE BYZANTINE WALL

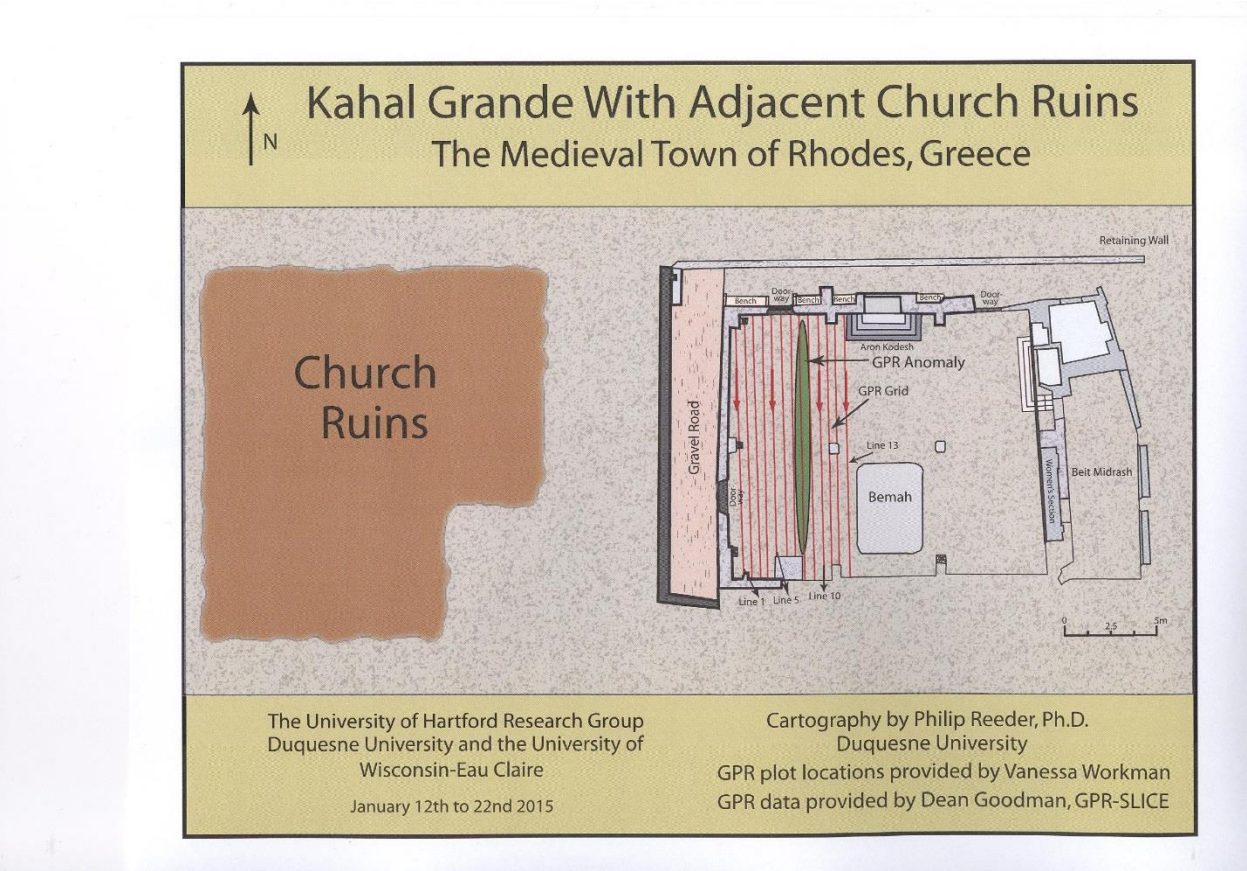
3) Church of the Victory



A grid x m by x m was was laid out in the Church of the Victory. Data was collected with 225 MHz. **Recommendation for the site in 2016** is to continue beyond the present GPR section to the west. George Ntellas recommendation was to continue and we would do a further section.

There is in an indication that there is just below the surface there is a different orientation of the architecture. We would like to continue one more section to the west.

4) Kahal Grande



A grid x m by x m was was laid out in Kahal Grande. Data was collected with 225 MHz.

Recommendations for 2016:

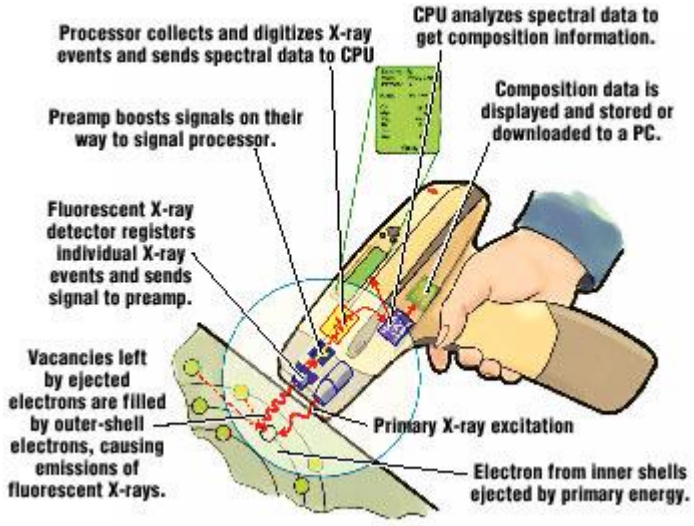
The most impressive part of the Kahal Gadol synagogue work involves the clear stratum of another floor at 4 meters below the surface. This area is in many parts intact and available for serious research. The finishing of the synagogue, up to and including the Bet Midrash area is the central recommendation. The second recommendation is to do a survey of the plaza in between the Church and the Synagogue to see if a street was located at the 4 meter level as well. Coring and Sampling at an appropriate area of the Synagogue at the anomaly identified. It would be suggested in the January, 2016 work that the GPR survey continue and sampling and coring be done at that time in an appropriate area. Sampling for C-14 testing.

Summary

The GPR investigations provided original datasets and valuable insights into the understanding of the complex subsurface of the selected archaeological sites.

XRF Work:

XRF Analysis of Pottery (especially ancient oil lamps) from the Ancient Port of Rhodes, Greece



In 1999, several companies produced handheld, lab-quality, isotope-based XRF analyzers. With an improved version of our patented Infiniton™ radioisotope source and the latest in advanced analog and digital electronics design, they combine industry-leading expertise in portable XRF analysis and applications development with the direct feedback from our users...providing the marketplace with the both the lightest weight and most ruggedly constructed handheld XRF analyzers worldwide.

For Archaeology, XRF has been a major step forward. The idea of doing petrographic and petrological studies of the pottery needed a full lab and required a chemist trained in archaeology and always damaged the item under study.

X-Ray Florescence is a hand-held non-invasive device that we will have access to in January, 2016 which identifies chemical signature of pottery (the most ubiquitous item in all archaeology is pottery) but we cannot always know where pottery comes from but its original provenance is important because it tells us very critical big issues like who is trading with whom. Two students will be working on the project; photographing the pottery and then cataloguing a baseline chemical signature of “known” pottery from known sites and then using the XRF to identify the unknown samples.

XRF

XRF uses x-rays and analysis of the x-rays data to determine the content of microscopic heavy metals (lead, for example-but many other chemical signatures of other elements) in the pottery made in certain areas of the world allowing us to assign a piece of pottery to a specific region. All other methods that identify the provenance of pottery is invasive and requires the small "destructive" sample being taken from often rare and irreplaceable pottery. To do this study requires a sub-set of materials available for checking (we have hundreds of oil lamps in Rhodes-a port city offered to us for checking from the Archaeological authorities of Rhodes) that come from many different areas of the Mediterranean and Middle East and North Africa but could be identified by the pottery make up.

Each area of the world has more or less a similar chemical signature for its pottery. There is more lead or iron in the clay in one place than in another. We take pottery that we know is from Egypt, Israel,

Libya, Greece etc. And establish a baseline chart and then compare all of the unknown pottery pieces that arrived in Rhodes. It is a great innovation. You would get the XRF training by Prof Harry Jol from the University of Wisconsin, Eau Claire maybe some skype interviews and in Rhodes. Work will be conducted in the museum of archaeology at the offices of the Archaeological Authority in Rhodes. Data will be processed during the semester following. Careful journaling will be important.

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