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#### 121.0.1 Continued:

#### Ground-truthing Magnetometry Results

Be these conditions as they may, slight variations in soils of low magnetic susceptibility and the possibility of undulation in the ancient landform mean that weakness and attenuation of magnetic contrast should not be regarded as directly proportional to paucity of subsurface remains. Ground-truthing is therefore imperative in fieldwork. To start, points where the extension of the reticulate pattern of negative anomalies or a corresponding field mark, or both, intersects the exposed section of existing modern irrigation ditches were chosen for cleaning and profiling drawing. The same was done for north-south linear bounding anomalies, as well as the likely east-west "connecting" anomaly between Glas and the reticulate pattern and its corresponding field mark. This method of ground-truthing of magnetometry results was realized in Areas I and J, though, unfortunately, in Transect G2, where the Steindamm is in question, the density of vegetation made profiling impracticable in 2011. (G2 will be revisited with a vengeance in 2012.) Points were firstly located with tape and backsight from grid square corner points. The horizontal center point of profiles was further recorded by stand-alone GPS receiver. The profiles are three meters wide, one standard deviation of the GPS's accuracy, to facilitate relocation from field records alone.

The discoveries are substantial and consistent. **Figure 32** shows a section of a feature corresponding in plan with field marks and linear negative anomalies of reticulate pattern in Transects G1 and I2 (profile 2011I2-P01). Here, as elsewhere, the negative component is represented by a lens of white to light gray firm silt loam, occasionally faintly mottled. The anomaly intersects the ditch at an angle of about 45 degrees, so the perpendicular width of the feature should be about 1.5 to 1.6 meters. To the left of the feature in 2011I2-P01 is faintly mottled dark grayish brown sediment. It is attractive to think that this is the fill of a channel accounting for the parallel positive anomaly. However, its lower boundary is indistinct, and it was not perceived in 2011I2-P02 opposite (**Figure 33**), where, if it exists, it may grade into the plow zone above. Given the caveat above about the relation of anomalies to preservation, it is noteworthy that Transects G1 and I2 exhibit some of the clearest field marks (**Figure 34**), yet I2 contains some of the weakest anomalies (see Figure 18), and these obviously correlate with substantial remains in the ground. Observation in the field, as well as information from local respondents, show there to be geomorphologically inexplicable concentrations of

limestone cobbles and boulders (Figure 35), suggesting former lateral revetment or upper pavement of some of these features.

**Figure 36** shows the profile corresponding in plan to the narrow bounding anomaly running through Area J (2011J1-P01). Given the angle of intersection, the perpendicular width of the lens should be between about 1.0 and 1.1 meters. Sediment appearing to abut each end of the gray/white lens may well correspond to adjoining parallel positive anomalies. The lens also appears in the uncleaned section opposite, and it finds a correlate in the thin A3 horizon of soil core 2010J1-01 (**Figure 37**), removed in 2010.

**Figure 38** shows the profile of one point where the linear east–west field mark, corresponding to the connecting anomaly, intersects the same ditch (2011J2-P01). It seems a distinctly white lens was just clipped on its left, grid south edge. It is also seen in the grid north edge of the opposite profile (2011J2-P03). While these features are rather less distinct than those observed in the ditch between Area G1 and Area I2, they do fall on the same alignment of as that of the field mark and corresponding anomaly.

Augering not only yielded soil profiles that are consistent and conformant with the ditch profiles but also demonstrated a clear contrast between cores removed from above anomalies and those removed from magnetic background areas. For example, profiles 2011I2-01 and 2011I2-02 are compared in **Figure 39**. The A3 horizon of the former has a color (light gray) and texture (silt loam) like that of the feature observed in the nearby ditch profile, while that of the latter is different (dark gray, clay loam). These are two of five profiles from in and around the reticulate pattern in Area I that confirm this correlation. Several cubic centimeters of sediment were taken for AMS radiocarbon dating from horizons in two of these cores thought to correspond with the anomalies.

#### The Vrystiká Katavóthra (Sinkhole)

Soil coring was used effectively in the entrance of the Vrystiká Sinkhole (Figure 40), into which, when it was engineered, the Late Helladic peripheral canal emptied (Lauffer 1986: 210–50). As expected, coring encountered beds of gravel and features on soil horizon boundaries (Figure 41) that suggest more or less rapid events of flooding and desiccation. Detailed geomorphological work on these sediments, possibly including soil micromorphology, will be conducted in 2012. A sediment sample was taken from the base of this column, about 267 centimeters below grade, to provide a radiocarbon terminus post quem for the sequence.

#### Aghía Marína Pýrghos (AMP)

Starting in 2011, AROURA began to investigate the site of Aghía Marína Pýrghos (AMP), about a kilometer and a half northeast of Glas (see Figure 2). It is named for the medieval watchtower, which sits inside a cyclopean enclosure (**Figure 42**). Known to have a Helladic component since Noack's exploration in the 1890s (Noack 1894: 444–8), it has often been characterized as a Mycenaean guard and signal post between Glas and the Megháli Katavóthra sinkhole into which the canalized Kephissos–Melas flowed (Fossey 1980; McConnell 1979). However, John Fossey has asserted that it must have been a considerable permanent settlement given its size and the quantity of Late Helladic

IIIB–C pottery on its summit and slopes (Fossey 1988: 283–6). Casual examination in 2010 confirmed his observations.

We decided to incorporate AMP into the Project Area because it appears to be a settlement site contemporary with Glas, yet a counterpoint to the latter's specialized nature, allowing us thereby to connect elements of a politico-economic landscape (fortress, hypothesized fields, hydraulic mechanisms, permanent settlements, etc.), and because the types and dates of the finds there might be linked to Glas and agricultural exploitation of the polder, especially since—as was expected of deeply buried remains agriculture that entailed little or no artificial manuring (see Halstead 1995, 2000)— collectible finds on the plain are scant.

The corner points of four blocs of six 30-meter sampling squares were staked out with differential GPS, and the squares within these staked out with the help of tape, compass, and trigonometry. Each grid square was divided into 2-meter square units for intensive surface collection. Every unit was first cleared of living or dead foliage, mainly with a small gardening rake, and then searched on hands and knees, by sight and with fingertips (**Figure 43**). All finds that might be of archaeological interest—ceramic, lithic, metallic, and so forth—that could be removed with just two fingers and fitted into a 15-by-30 cm field bag were collected. The label of the field bag for each unit bore, among other information, an estimate of surface visibility after cleaning.

Surface collection was done only of grid square AMP2c2. Three persons required about five eight-hour days to complete it. Finds are awaiting proper statistical analysis. The total number was 825, the great majority ceramic, either pottery sherds or fragments of roof tile. The greatest concentrations, especially of Mycenaean pottery, appear to be around animal burrows or where tree roots have brought material up through ruined wall courses. (One should bear in mind that this is not a plowed surface.) There is Early Geometric pottery, as has been previously observed, and probably medieval pottery, the latter represented by pieces vellow-glazed earthenwares. Most significant for our aims are sherds tentatively dated to Late Helladic IIIB2 Late or IIIC Early (Figure 44; S. Vitale, pers. comm. 2011). These are interesting because they suggest the settlement existed not just while Glas was inhabited but also after its final destruction, and they raise the question of how long the polder persisted thereafter. Survey also showed both the cyclopean and medieval fortifications to be larger than had previously been mapped. There appear to be several concentric cyclopean walls around the circuit wall Noack observed. Some of the wall foundations attached to the medieval tower are new discoveries too, and some appear to be built on the remains of Mycenaean walls (Figure **45**). This fact, along with the evident deep burial of Late Helladic pottery, bodes well for preservation beneath the extant ruins.

#### Provisional Results of Paleo-environmental Analysis

Evi Margaritis of the British School at Athens has provided very tentative results from the sorting of both the fine and coarse fraction of flotation of samples from soil cores removed in 2010. They are nonetheless worth remarking upon here. Especially noteworthy are the fragments of charcoal from the horizon in the profile of the core into the pit-like anomaly in Area B, which has already produced a radiocarbon date (see above), and the horizon in the profile of magnetic background in Transect E2 hypothesized to correspond to the ground surface in which the stone-revetted canal was constructed. The unusually high incidence of snail shell fragments (> 50) in the horizon in the profile of the core removed from Transect G1 that is thought to correspond to the magnetically negative linear feature (hypothetical levee) is also noteworthy. The high shell count is consistent with the observed composition of the gray / white lenses revealed in the ditch profiles (see above). The more complete specimens of gastropod shell have tentatively been identified as belonging to the freshwater genus *Lymnaea*. Dr. David Reese of the Peabody Museum of Yale University will analyze the shell remains in the summer of 2012. Finally, the hypothesized ditch fill from Area H produced seeds that appear to belong to the floral genus *Adonis* ("pheasant's-eye"), a ranunculal that is associated with cultivated field margins, though this remains to be proved definitively (E. Margaritis, pers. comm. 2012).

#### **Discussion and Conclusions**

The top priority in the fieldwork campaign of 2012 will be fixing absolute dates on the features discovered in 2011 that correspond to linear, magnetically negative anomalies, mainly those making up the reticulate pattern to the east of the polder dike, but also some of the bounding anomalies. The principal method to be employed to this end is optically stimulated luminescence dating, which will be carried out by Dr. Nikolaos Zacharias, an expert at the University of Patra. The plan at present is to install appropriate dosimeters for background dose versus sediment-intrinsic "paleodose" of radiation in ditch section profiles 2011I1-01 (or 2011I2-02), 2011J1-01, and a future third where one of the bounding anomalies crosses through Transect G2. Results, generally accurate to five percent of calendar date (e.g. 150 years in 3,000), should be available between the end of December 2012 and the end of January 2013. In addition, a sediment sample from the A3 horizon of core 2011I2-01, also corresponding with a linear features, and another from the A5 horizon (deepest point reached) in core 2011VK-01 are ready for dispatch in September 2012 to Beta Analytic's laboratories in Florida for AMS radiocarbon dating, now that transfer papers have been obtained from the Greek authorities. The charcoal samples from 2010B1-01 and 2010E2-01 will also be prepared for transshipment to Beta Analytic, Inc.

Even without these absolute dates, a strong circumstantial case can be made for the new discoveries in the polder dating to the LH III. All of the projects in Classical Antiquity to claim land from the Kopaic Lake—including Krates' canal across the middle of the Basin, ordered by Alexander, and the aqueducts Hadrian sponsored for the cities of the western shore—appear to have been at best short-lived and of limited success (Boatwright 2000: 116; Oliver 1989: 253–71; Str.9.2.40). None of them can be located in the northeastern bay near Glas. There are no records of harvests of rice or other typically wetland crops from any nearby towns between the end of the 13th century CE and the end of the Ottoman Period (Kiel 1997, pers. comm. 2011; Svoronos 1959), and the organization of features is not consistent with the design of Ottoman rice paddies, which are recorded near Livadheiá on the western side of the Basin, and which involve a system of sumps and locks (see Batakliev 1923: 150–4).

To this largely negative case, one can add evidence of the features' integration into the LH III drainage–irrigation system. The reticulate pattern appears not just to be arranged parallel and perpendicular to the polder dike, but it also appears to be centripetal to Glas, through a network of bounding and connecting anomalies, features, and field marks. The constituent features are consistent with one another in form and material, possibly including cyclopean stonework. They therefore appear to be part of the encompassing, planned Mycenaean hydraulic project.

AROURA intends to apply further methods during its 2012 campaign, equipment and funding permitting, including

• detailed geomorphological study of the accumulated sediments at the mouth of the Vrystiká Katavóthra (possibly soil micromorphology in particular)

• measurement of the magnetic susceptibility of sediments in and around newly discovered features, so as to refine the interpretation of relevant magnetometric data and to determine more precisely what methods might best be applied in similar geological and pedological circumstances, and

• possibly, pollen coring and stratigraphy.

Mr. Bittner, AROURA GIS Specialist, is carrying out a thorough statistical ("supervised") reclassification of eight-band multispectral satellite data (each banding containing 2,048 values), taking into account ground cover, in order to determine which spectral ranges correspond to magnetic anomalies of a certain type, thereby allowing their patterns to be traced throughout the landscape. The year 2013 will be devoted to analysis, cataloguing, recording, and publishing of finds, as well as to applying for a permit and funding to ground-truth features in the polder through focused excavation in plan, and for more extensive excavation at AMP.

-MFL

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Fig. 32a. Photograph of ditch profile 2011I2-P01 (grid N = NW to right; M.F. Lane).



Fig. 32b. Stratigraphic diagram of 2011I2-P01 (M.F. Lane).



Fig. 33a. Photograph of ditch profile 2011I2-P02 (grid N = NW to left; M.F. Lane).



Fig. 33b. Stratigraphic diagram of 2011I2-P02 (M.F. Lane).



Fig. 34. Histogram-equalized near infrared band of eight-band multispectral Worldview-2 satellite data (dated October 2010), showing prominent field marks in Area I (cf. Fig. 18).





Fig. 37. Soil profile 2010J1-01, showing thin A3 horizon corresponding to feature observed in 2011J1-P01 (M.F. Lane).

Fig. 36b. Stratigraphic diagram of 2011J1-P01 (M.F. Lane).

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Fig. 38a. Photograph of ditch profile 2011J2-P01 (grid N = NW to left; M.F. Lane).





Fig. 40. Co-Director M.F. Lane removing a soil core from near entrance of Vrystiká Sinkhole with handdriven auger (E.V. Iliopoulou).

Fig. 38b. Stratigraphic diagram of 2011J2-P01 (M.F. Lane).



Fig. 39. Soil profiles 2011I2-01 and 2011I2-02 (M.F. Lane).

### SOIL PROFILE 2011VK-01

v dk gr. br. (10783/2) Cl Lo c. 1% vf. f sh. frag. c. 1% fang. li nest. grav. (r. 15 cm below grade)	A1	∎ <sup>0</sup> cm - 20 - 40
v.ok.gr. (10°R3/1) C. Lo c. 10% st. or. (2.5°R5/8) c.Salcond, at bound, with A1 c. 10% vf limest, grav. x 10% vf sc. frag.	A2	¥ 100
dk gr. (10Y84/1) (11 n r. 108: st. hr. (77Y85/8) r. 198: st. fish. frag. r. 198: 1grav.	Λ3	
ek quan (10/17/2) (11 to c. 15% st. br. (2.5785/6) c. 15% of br. (2.5786) c. 3% p.y. (2.5777) c. 3% p.y. (2.5777) c. 15% f. 5% conc. (30 a 5 cm) c. 2% f. m. decemp. st.	Λ4	
gr. Lr. (2.5Y5/2) Si Lo c. 19% I. gr. Lr. (2.5Y5/4) c. 5% st. Lr. (7.5Y05/6) s 1% vf-fsht frag. <sup>14</sup> C sample <b></b>	A5	

× GGRS-87 E 0428590 N 4257834

Fig. 41. Soil profile 2011VK-01 (M.F. Lane).



Fig. 42. Inner cyclopean circuit wall at Aghía Marína Pýrghos (AMP), October 2010 (W.S. Bittner).



Fig. 43. S.C. Gammon and E.V. Iliopoulou collecting finds from the surface of AMP2c2 after clearing. Pin-flags are at corners of 2-meter square collection units (M.F. Lane).



Fig. 44. Rim of Type B deep bowl, dated to LH IIIB2 Late – IIIC Early (M.F. Lane).



Fig. 45a. Excerpt of field map of grid square AMP2c2 (M.F. Lane).



Fig. 45b. Plan of AMP2c2, showing architectural phasing (M.F. Lane).

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	144 (nos. 421-484), 145 (no. 488).
121 1 02	<b>B</b> A Cabriel Dhilin II of Mandonia Creator than Alexander

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