Junior Research Group Digital Humanities & Digital Cultural Heritage
Vossstraße 2,
69115, Heidelberg

Michelle Pfeiffer
michelle.pfeiffer@asia-europe.uni-heidelberg.de
Karl Hjalte Maack Raun
hjalte.raun@asia-europe.uni-heidelberg.de
Armin Volkmann
armin.volkmann@asia-europe.uni-heidelberg.de

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Prospection Report: "Digital mapping" - Detection and prospection through digital and physical landscapes at Koumasa, Crete

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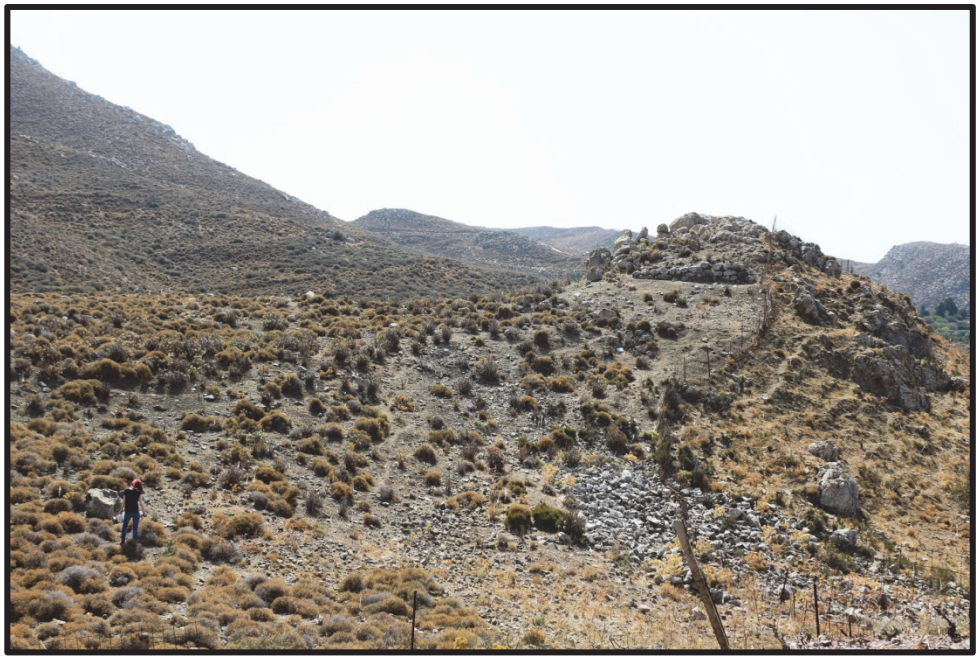

Koumasa excavation campaign **2014**

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1. Project

1.1. Project setting

The “Digital mapping” project was part of the excavation campaign 2014 in Koumasa. The fixed time slot for the project was five days. The statistical prospection was carried out in three days, between the 25th and the 27th of September. Statistical analysis and the digital mapping of the results were done in the remaining two days between the 29th and 30th of September in order to confirm and investigate details within the landscape. Further digital investigations were carried out as desk based investigations after the initial fieldwork.

1.2. Project aim

The aim of the project, “Digital mapping”, is a better understanding of the extent of the archaeological site of Koumasa located in Southern Crete. This is done in regards to future investigations allowing target specific excavations in response to specific archaeological research questions.

The investigations carried out, have been focused on statistical prospection for systematic assessment of potential target areas of excavation, but also as a systematic investigation of landscape in order to define settlement extent, areas and structures of particular interest for the Minoan settlement, sanctuary, and graveyard.

1.3. Geographical situation

The archaeological site of Koumasa (34°97’92’’ (N) 25°00’97’’ (E) (WGS 84)) is situated south of the Mesara plain, at the foothills of the Asterousia-Mountains. Koumasa is part of the regional unit Heraklion. The geological situation in the target area is characterized by flysch, a sedimentary rock deposited during the development of an orogeny (Faure, 1965). The vegetation at the site consists mainly of Euphorbio Verbascion phrygana, also known as Greek Spiny Spurge, but with the occasional inclusion of other dry soil plants. The soil is characterized by a significant erodibility (between 0.048 -0.06 t ha/h). The known archaeological settlement is situated east of the cemetery on a strategic hilltop overlooking the Mesara plain.

1.4. Historical background

The Minoan excavation site was discovered in 1904 (Xanthudides, 1924). The excavation revealed a pre-palatial cemetery composed of four graves, of which three where tholos graves. A settlement was discovered east to the tholoi.

In between 1904 and 1906 the first systematic archaeological investigations were carried out by Stéphanos Xanthoudides. A second excavation campaign followed between 1991 and 1992 under the supervision of Alexandra Karetsou und Athanasia Kanta. Since 2012 the University of Heidelberg is in charge of the archaeological investigations at the site of Koumasa under the supervision of Prof. Dr. Diamantis Panagiotopoulos.

2. Survey: methodological approach and conditions

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The methodological approach for the survey was focused on two approaches: A smaller intensive investigation, and a larger extensive investigation.
The two approaches are focused on numerical and spatial registration of finds. However, only the smaller intensive study is carried out as a systematic spatial investigation, and thereby making the quantifiable data possible for spatial statistical analysis. The smaller intensive investigation was initiated in order to understand activity and determine ceramic clusters, norms, and deviations. The larger extensive investigation was carried out in order to determine the archaeological extent of Minoan activity. The larger extensive survey was also carried out to investigate digital anomalies within the *Digital Elevation Models* (DEMs), and enhance our understanding between digital desk based landscapes contrasted with the real physical landscape surrounding the area of investigation.

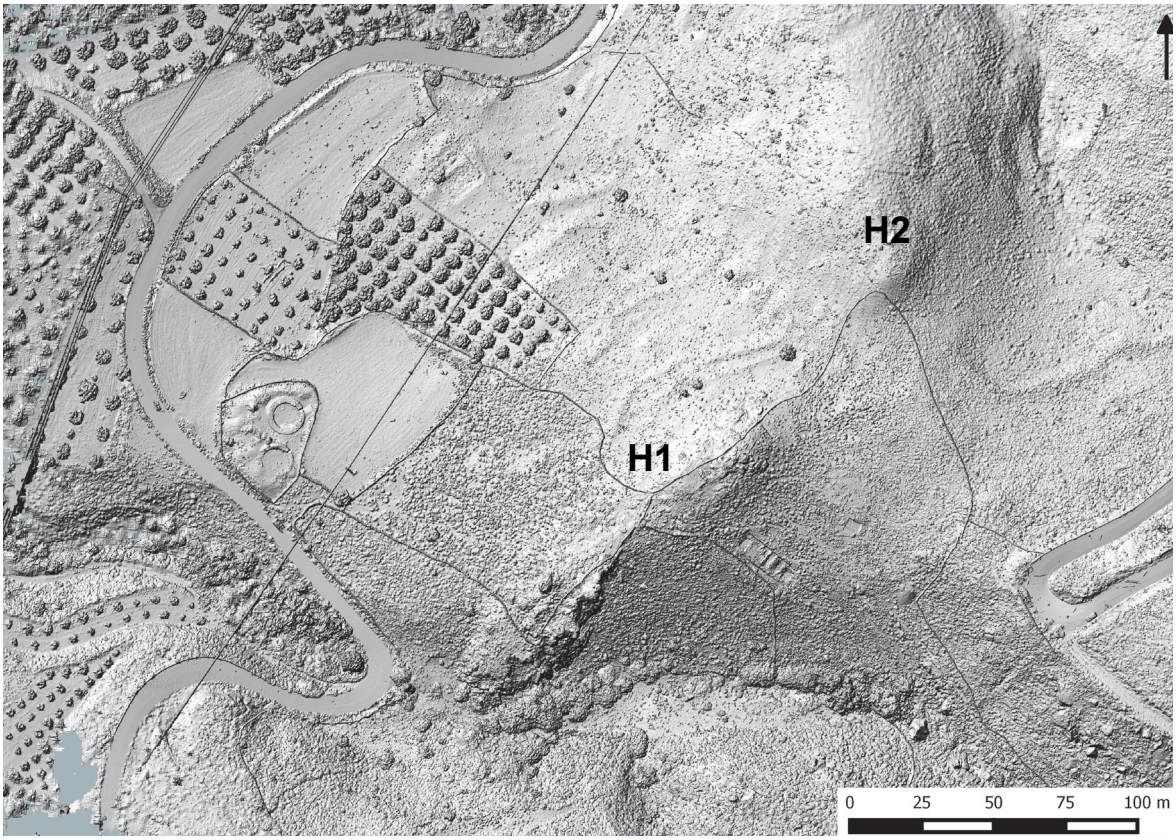

Fig. 1: *Digital Surface Model* (DSM) of the archaeological site of Koumasa and surroundings. Data source: LiDAR Research Group, University of Heidelberg

Almost the entire area within the area of investigation (fig.1) is covered with ceramics, but naturally some areas have more relevance then others. In order to understand the full complexity of the Minoan archaeological site of Koumasa, surface reconnaissance can help determine and define boundary and pattern of cultural activity. The DEM, used in this project, results of a scanning campaign of the Geographical Institute of the University of Heidelberg carried out in 2013. The data has been acquired with a full waveform laser scanner Riegel VZ-400. The DTM was calculated with a resolution of 0,1m (Profe et al., 2013).

The area chosen for a smaller intensive investigation and closer statistical prospection is defined by a concentration of ceramics of Minoan type dispersed over the entire area. The area extends (see also fig.2) from the known and defined area of archaeological investigation on the south and south-western hilltop with sanctuary and settlement activity (H1). The area of investigation extends to the north-eastern hilltop (H2), from where little information is determined as to cultural and temporal connection to the rest of the archaeological investigations. Further, the area chosen for statistical prospection lies at a topological interesting point of infrastructure with intersecting slopes and terraces potentially defining road- and pathways of historic

and prehistoric activity. In total, the area of statistical prospection covers some 3700 m^2.

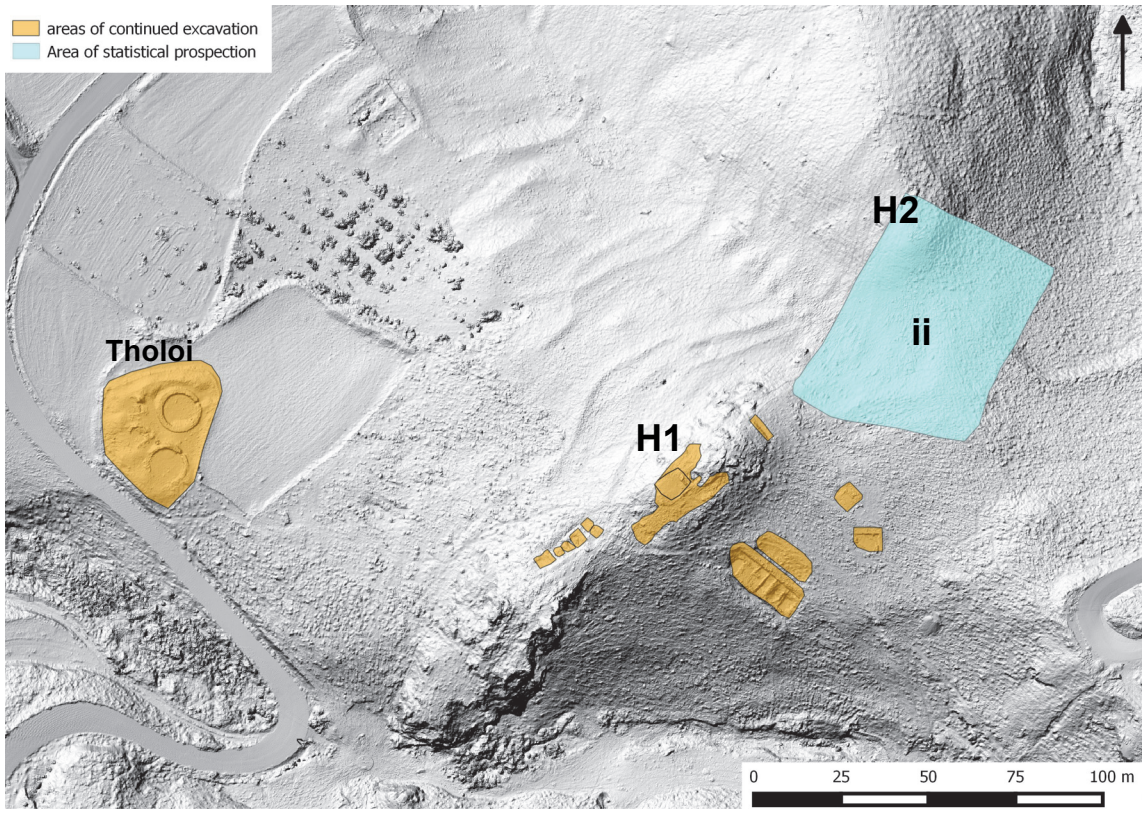

Fig. 1: *Digital Terrain Model* (DTM) showing area of continued archaeological excavation marked by orange, and extent of intensive statistic prospection marked by light-blue(ii). Data source: LiDAR Research Group, University of Heidelberg

The survey was carried out in a grid of 12 transects separated respectively by 4 m. Within these target areas, non-intrusive surveys were carried out. By transect definition, qualitative human investigation was carried out along the lines defined by 4 m with a buffer view of +1 m to each side of the transect line. The systematic survey, was hindered by vegetation and other canopy details hiding artefacts and obstructing pathways in the transect lines, and thus sometimes making the survey impossible to incorporate all ceramic shards, and/or changing the bounds of survey. However, as vegetation is more or less gradually dispersed, the statistical base for the survey is still compatible for analysis and comparison to neighboring clusters.

Further, erosion also affects the area of investigation due to sheep husbandry roaming the slopes, and grassing almost all vegetation that is not Greek Spiny Spurge. Thus the landscape is constantly changing by cultural and natural impact.

Artefact pollution by previous excavations is also a problem regarding understanding artefact distribution, because distribution should be understood by its prehistoric dispersal and not by modern intrusion by excavated soil and ceramics from other

areas. In order to compensate, the area for the smaller intensive study was situated with a safe distance to previous excavations, and thus minimizing cultural pollution by spatially re-dispersed artefacts.

The intensive systematic survey was undertaken in the time span of two days. Every single find was recorded and logged with a simple Garmin GPS with ±1 m accuracy. On balance, 396 records were created, documenting 1556 ceramic shards, and 1 stone tool. All artefacts were left on site.
The ceramic finds were classified by a simple color based classification. The classification was divided by distinction of being either red- or orange-ware, and in rare cases brown-ware. The simple classification is defined by material and production techniques according to its simple visual properties. Type definition is further recorded by the shard characteristics of being rim, body, handle, bottom, and with or without ornamentation. Lastly, numerical value is simply defined by count; hence size or weight of the shard gives no value to its schematic value. Due to amount of shards, 1556 pieces, the individual implications of shards is however statistically neutralized by amount of random significance. Larger pieces of ceramic are thus counteracted by the statistical presence of other large pieces of ceramic in other random areas within the site of smaller intensive investigation (cf. fig.4 & 5).

The larger extensive investigation into the landscape was followed by qualitative investigations focused on subjectively segmented terraces and slopes of interest within the DEM. Along the terraces, slopes and ridges east and northeast of the intensive study, transect lines was followed by inner and outer boundary along ridges and terraces. Due to limited time, an intensive investigation for statistical prospection was not feasible for the rest of the area to determine clusters of concentration and extent. In order to determine extent of archaeological settlement activity, the larger extensive investigations was based on determining absence or presence of Minoan ceramic in the landscape. By this larger extensive survey, a simple field investigation and reconnaissance was initiated to determine settlement boundaries, but without similar definition of cluster concentrations for areas of interest or specific purposes as within the intensive investigation. However, systematic investigation lines along the ridges and terraces east and northeast of the intensive investigations also revealed interesting results by clusters of ceramic concentration, specific type definitions and

potential special purpose areas for understanding the archaeological site of Koumasa. Meanwhile, the systematic ridge and terrace investigations also revealed clear boundary extent for the site. The entire extent of the archaeological site of Koumasa could benefit from such an analysis in between the intensive and extensive investigations in order to determine more site specific details and areas of potential interest by possible purpose analysis in relation to quantifiable statistical prospection, but also by large scale qualitative comparison.

3. Results and Interpretation

The open-source Geographical Information System QGIS was used for analysis and visualization.

In order to analyze the collected data, an Inverse Distance Weighting (IDW) interpolation based on the total amount of the ceramic finds was calculated.

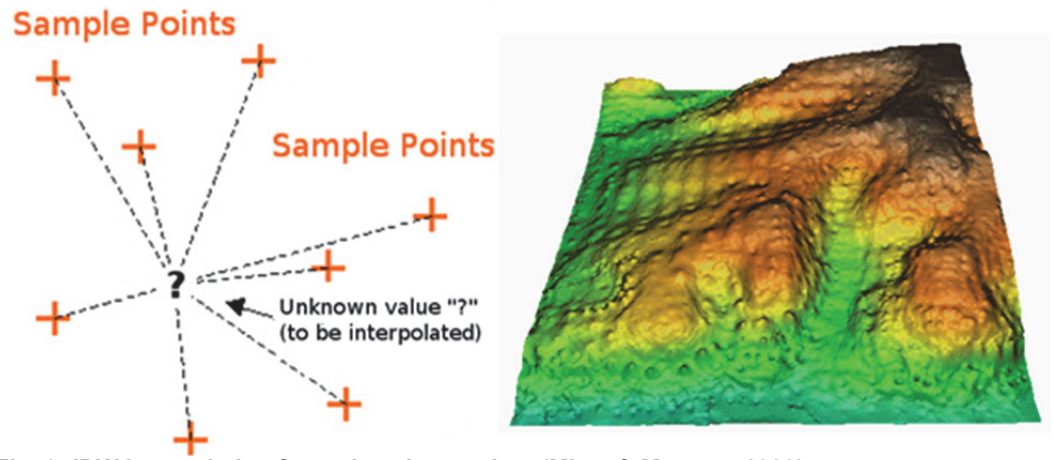

Fig. 3: IDW interpolation from elevations points (Mitas & Mtasova 1999)

Within this interpolation method, sample points are weighted during interpolation such that the influence of the point relative to another declines with distance from the unknown point of reference for the creation of new data (see fig.3) (QGIS Development Team, 2014). The weighing has been assigned by a weighting coefficient by the total amount of ceramics finds (see also app. 1).

The resulting outcome of the spatial-statistic investigation is exemplified in the interpolated raster in fig.5, visualizing the ceramic record by intensity and spatial orientation. The interpolated raster indicates three clusters (fig.4) of ceramic, but also a general presence of ceramics in the area of intensive investigation. However, one area, the northern hilltop (H2), is almost without ceramics, as can also be seen in the weighed interpolation. Only a few pieces were located from the foot of the hilltop to the hilltop plateau of H2, hence the calculated weight for interpolation does not substantiate a high enough amount to have influence on the interpolated raster.

The first cluster concentration, **C1** (fig.4), is situated on a slope just below the area of previous and present excavation. Thus a lot of soil comes from above with ex-situ dispersal of artefacts. All the ceramic registered is surface finds, and thus all registrations are ex-situ artefacts. However, the cluster concentration in C1 is mainly created by modern manipulation, and thus this area is deemed unsuitable as defining a potential area of interest by clusters of concentration. That the area is not potentially interesting, cannot be excluded, but also cannot be concluded by surface analysis.

The second cluster concentration, **C2** (fig.4), is situated on a northeast slope on the outer rim of the main plateau (cf. fig. 5). Generally ceramic shards are located above and below the slope on two different plateau plains. However, the largest concentration is located on the slope between the northwestern lower and upper plateaus. The cluster concentration of C2 clearly indicates dense Minoan activity, but not necessarily defining the area of potential interest to be pinpointed by the cluster concentration. The largest concentration of ceramics on a slope will almost always be

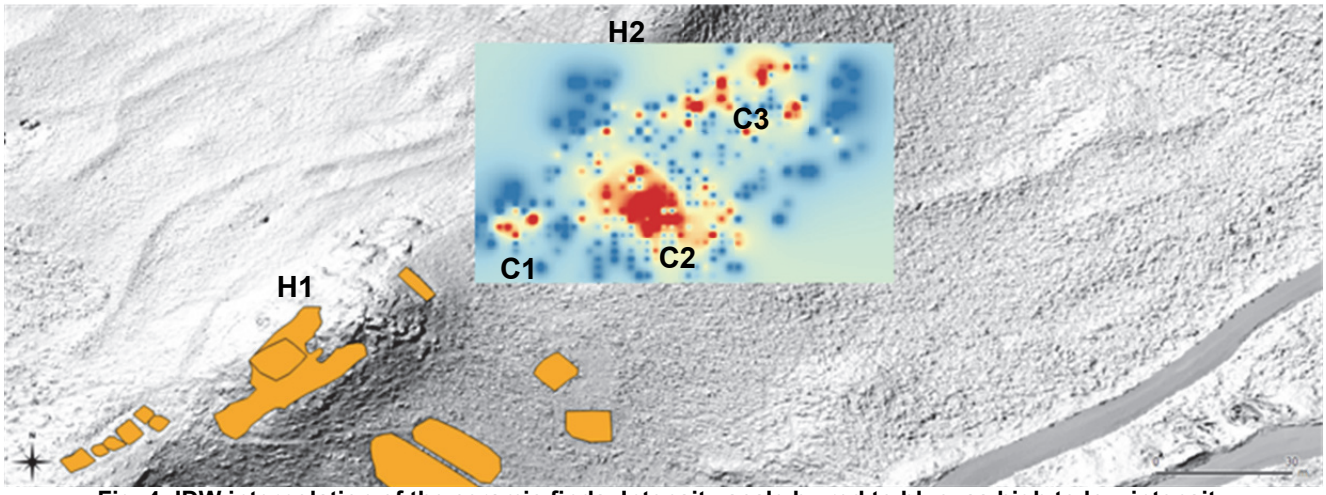

Fig. 4: IDW interpolation of the ceramic finds. Intensity scale by red to blue, as high to low intensity

located at the bottom of the slope. Ex-situ ceramics move around by natural and cultural factors affecting terrain changes. Subsequently, external factors and rules of gravity, enforces materials to travel towards the bottom of a slope. Thus, a concentration at the bottom of a slope is not uncommon. However, the concentration C2 is still visible on the slope, as well as on the upper ridge of the slope, consequently indicating that activity is either on the slope or above. The most likely situation is that the activity should be defined as being above the slope, and the ceramic concentration on the slope the consequence of waste deposition from the site, debris and erosion.

In result, settlement activity is present above the concentration on the slope, indicating that structures will be located above the slope, southeast of the ceramic concentration C2. It is difficult to conclude whether or not structures will also be found below the slope northwest of the ceramic concentration of C2. Settlement activity is

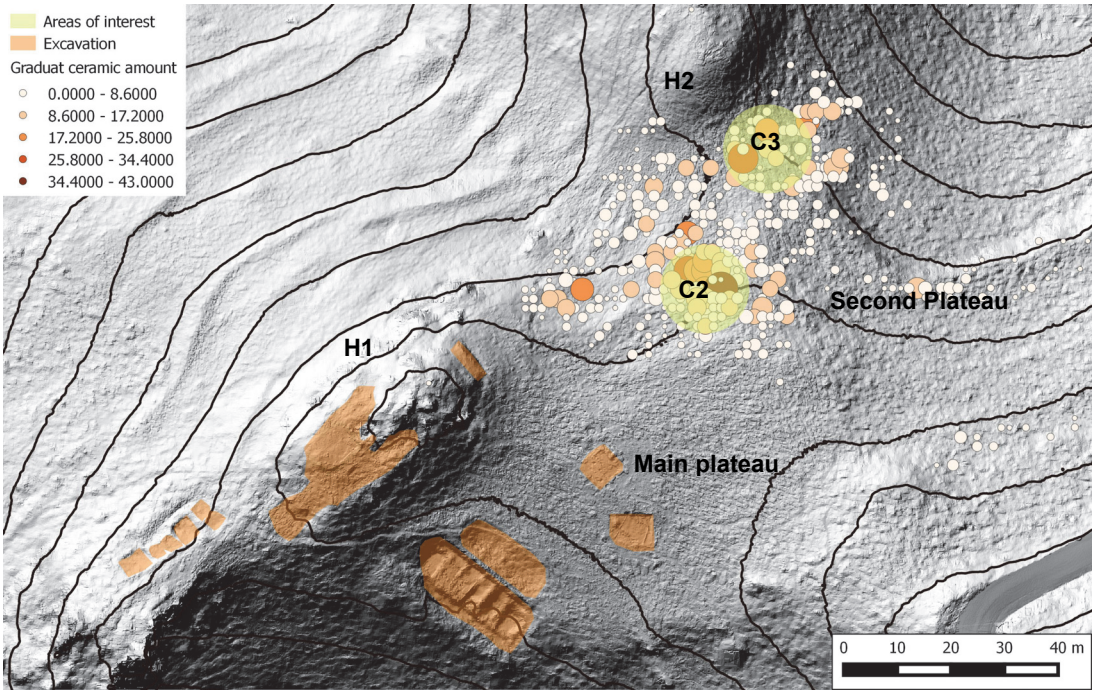

Fig. 5. Cluster concentrations with area of excavation and gradual amount of ceramics on a DTM with a 5 m contour indicating plateau levels

certain in the gully below the slope and C2 due to the general presence of ceramics in the entire area. Most likely this settlement activity is connected by the area being more of an infrastructural hub connection.

The third cluster, **C3** (fig.5), is situated on a minor plateau just on the other side of a ridge from the main plateau. The slope above C2 runs all the way from the main

plateau, circulating the channel running in between H1 and H2. The main area of infrastructure should therefore be located above C2 as the connection between the main plateau and the border cluster area of C3. Below C3, the landscape makes a step drop towards a small gully.

Ceramic pieces can be located well below concentration C3, and further running to the east along a minor ridge and plateau. The ceramic pieces located below the ridge of C3 towards northeast on the slope, are accounted for in the same manner as the situation of C2. Ex-situ ceramic pieces move around by natural and cultural factors affecting terrain changes. By external factors and rules of gravity, materials will therefore always move towards the bottom of a slope.

Erosion on the ridge of the plateau surrounding C3 also exposes in-situ ceramic pieces falling out of newly exposed areas. In one of the areas, half a pitcher was located by pieces fallen out of an area of erosion, and in-situ pieces exposed but still locked within the soil.

Below C3, the quantity of ceramic pieces gradually diminishes as we move further down the slope, but the area is also densely covered by vegetation of Greek Spiny Spurge, thus hindering a comprehensive survey. The collection method is therefore altered in comparison with the other areas, but attempts to compensate was initiated, and the result of quantity and spatial situation of ceramic pieces on the northern slope below C3, still seems possible to compare due to means of extended time of exploration. The picture painted in the statistical survey consequently still provides an assumed accurate picture of the connection and relative link with the main plateau of investigation. Moreover, the cluster of C3 defines some new connections regarding infrastructure and potential pathways, but also as the northern border of settlement activity. The amount of ceramic shards continues somewhat on the northern slope below C3, but diminishes as we get further and further away.

In the effort of locating a possible northern border, a further extensive survey was undertaken in the valley system northeast of H2, and north and northeast of C3 (see also fig. 6). In the minor gully at the bottom, no ceramic pieces were located. However, the dispersal of ceramic shards continued along the ridge extending from C3 to the east. The ridge consists of a 2-3 m wide plateau extending from C3 to the east, before slowly turning towards the northeast. Below the ridge, on the northern slope towards the gully, ceramic pieces were dispersed with gradual declination towards the north in similar pattern as around C3. In one area this pattern

differentiated somewhat, almost at the end of the ridge and plateau. A stone feature, F5, was located at the bottom of the northern slope, but not necessarily connected to the ridge and plateau. Despite its somewhat spatial difference, ceramic pieces were still located around the stone feature F5 (fig. 6.1). The ceramic pieces located define the local northern and eastern extent of ceramic presence around the stone feature.

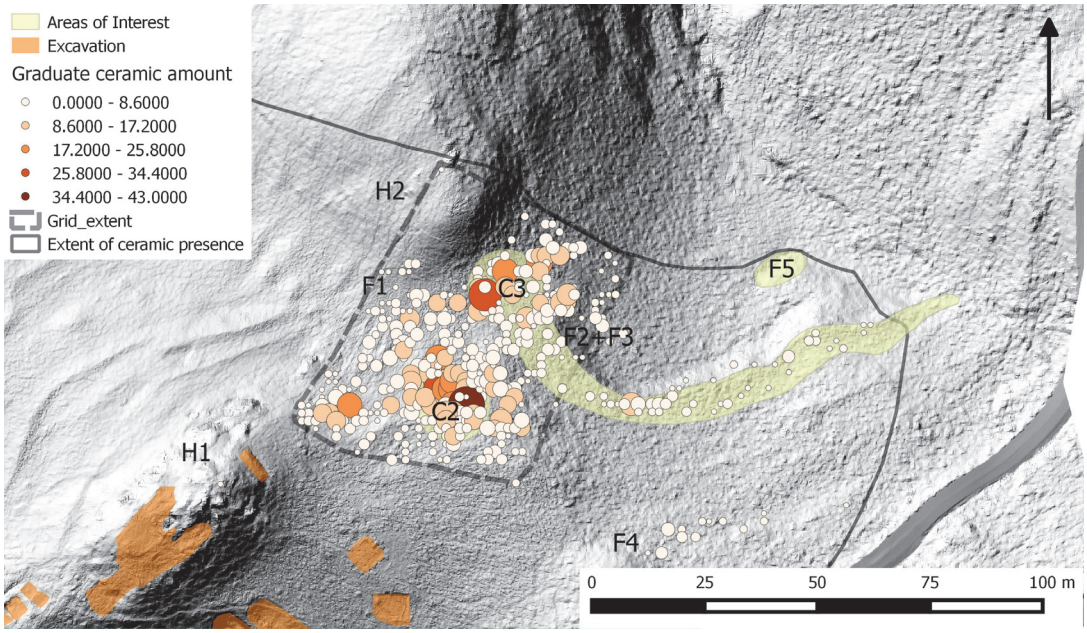

Fig. 6. Indication of the ridge and plateau extending from C3 with features marked, and the valley east and northeast of H2

The ridge and plateau extending from C3 contained dispersed ceramic pieces almost all the way to the upper gully. The search lines along the plateau were defined by exploring the inner and outer ridge of the plateau, and both lines provided similar patterns of ceramic density. As we walked along the lines towards east and northeast on the plateau extending from C3, ceramic pieces became more and more sparse, consequently defining settlement activity to be more concentrated towards the main plateau. However, the dispersal still indicates activity, but perhaps more likely as activity of general use and possible pathway infrastructure to and from the settlement. Smaller pathway terraces can likewise be seen towards the east of the ridge and plateau, leading further up the mountain until cut by modern road. Also terraces can be seen on both sides of the valley between H2 and the next hilltop towards northeast. Potentially a pathway could also be leading from the ridge and plateau extending from C3 towards the next northeastern hilltop. However, on the northern side of the valley gully and towards the next hilltop, no presence of ceramic pieces

could be located. Further, some 20 m before the southern upper gully along the ridge and plateau, no ceramic pieces could be located anymore.

The V-shaped valley is the natural drain of substantial water during rainfall, forming a small gully for transportation of water. Naturally, these areas are more prone to erosion, and the landscape has also changed a lot due to erosion near the valley gully. Ceramic pieces are therefore not necessarily present anymore because of the transportation of sediments and artifacts further away. However, since no ceramic pieces were located along the gully, it is most likely that settlement activity did not extend to this area. On the other side of the valley, no ceramic pieces were located either, likely indicating settlement extent to stop before the upper gully on the ridge and plateau extending from C3. Whether or not prehistoric pathways can be located on the other side of the gully, is more difficult to determine. Many of the pathways seen in the landscape are created by animal husbandry and human interference of both prehistoric and historic activity, but concluding whether pathways are of explicit origin is very difficult to determine. Because, pathways of the past will make logistical possibilities for a long time in the landscape, thus re-use of pathways throughout different ages can be extended to many minor potential activities of re-use outside of the point of origin. Consequently the determination of pathways will in this study be concluded upon regarding its potential logistical relevance to the archaeological Minoan site. But whether or not pathways are of Minoan activity, re-use, or later construction, is almost impossible to fully determine.

3.1. Features

In total, 5 different features of stone settings were located during the investigations (cf. fig. 5). Within the smaller intensive survey, 3 stone layers were located and defined (F1-3). The extensive survey revealed one more stone layer, and one stone wall dug into the slope (F5).

Dating the individual stone layers is a difficult matter, even though Minoan ceramics are located within and around the stone layers. However, all the stone layers described are definite anthropogenic, but can be of different time of origin with re-use activity a very likely scenario. All the stone layers are relatively deep, with stones going some 30-50 cm below in layers of c. 3-7 stones bundled together on top of each other. Consequently vegetation has problematic possibilities of growing in these areas. Vegetation thus grows in and around the stone layers, because the stones

hide most sunlight in areas where soil encounters the layer some 30-50 cm below. The result is that relatively little vegetation is found in the areas of these exposed stone layers, however, if the stone layers were not as dense, vegetation would have covered the area much easier, and thus making both analog or digital detection of these areas impossible. Defining the stone layers digitally, is very difficult due to the nature of local vegetation, and especially because of Greek Spiny Spurge. Greek Spiny Spurge is an extremely dense low lying plant, making it almost impossible for the infrared laser light to penetrate, and accordingly differentiate from terrain in areas where the vegetation has completely covered the area. Stone layers with a density composition lesser then F1-F4, might therefore be almost impossible to detect, both manually and digitally, because vegetation would quickly cover these areas, and accordingly sedimentation would slowly cover these features.

The first stone layer, **F1** (cf. fig.5), is situated north of the present excavation site, west of C2. F1 consist of c. 1 m thick stone wall, facing the western slope. A small plateau extends on the western slope by concentrations of stones, and in the beginning of the western slope a minor stone wall is erected. The entire plateau surrounding the feature with the stone wall has an oval extension by 4.7 m in length, and 3.5 m wide. The stones vary from 60x40 cm in size and below. Generally, the stones are large, rough natural stones. The entire feature is set within a larger stone layer encompassing the entire upper gully between H1 and H2. The stones within this larger concentration are similar to the ones within the feature.

Even though a dating is not possible, the outline of the feature gives clear resemblances to more modern construction, such as a sheep or hunting shelter (fig.7). Further, in direct western extension of this feature, several concentrations of stone layers were located below in the gully between H1 and H2 towards the foothill on the western. The stone concentrations below look more natural by layout, because the borders of the stone concentrations are more difficult to determine. The stone concentrations are however without a doubt anthropogenic, and likely to have been similar to the scenery of F1 (cf. fig. 7). Consequently, prehistoric activity is not necessarily present, and the most likely scenario being that of several more modern sheep shelters on the slope.

Whether or not it is re-use of old concentrations of stone slabs, cannot be determined. But it is most likely that the stones are from the direct spatial vicinity of the features, and thus very likely to have been part of older constructions at some point in time.

Fig. 7. Stone layer, F1, situated in the valley between hill tops H1 and H2

The second stone layer, **F2** (see fig.5 & fig. 8) is located on the northern border of settlement activity, just east of C3. The feature measures 6 x 2.7 m, and consists of densely distributed stones in an elongated shape. The stone setting seems rather deep, with sparse vegetation encompassing the central area, but with a lot of vegetation covering the border between soil and stones.

Fig. 8. Stone layer F2

F2's spatial position and dominant position on the second plateau, makes the feature very interesting. Within and around, several pieces of Minoan ceramics was likewise located, but as before, this does not necessarily date the feature in itself. Just below

the edge of the ridge, in between C3 and F2, the aforementioned in-situ pitcher was located.

Fig. 9. Stone layer, F3, situated at the northern border of settlement activity

Fig. 10. Stone layer, F4, situated north-east of the excavation site on a topographical dominant position

The third stone layer, **F3** (fig.5 & fig. 8), is situated in direct extension of F2, towards the northern slope of settlement activity, and below the ridge of the surrounding plateau. However, from C2 and towards F3, the area below the ridge is not as sloped as otherwise seen in the area. But at the northern edge of F3, the slope makes a steeper drop once again, and likewise towards the east, the leveled area seems to stop. Whether or not this small levelled area around F3 is natural or not, is difficult to say. But the inclination on the area does not make it unsuitable for settlement

activity, which also seems to be indicated by the amount of ceramics around F3 and the presence of F3.
F3 measures 5.5 x 4.5 m, and is densely covered by larger stones of some 30 x 20 cm in size and below. The stone layer, does however not seem as deep as that of F2, resulting in vegetation being able to grow in several different locations within the feature.

Stone layer **F4** (fig. 5 & fig.10) is situated north-east of the area of excavation on an elevated position overlooking the main and second plateau. Compared to the previous three stone layers, the border of F4 is more vaguely defined, but measures some 7 x 6.5 m. It has an almost rectangular shape, but with bulk on the south-western corner. Vegetation is dense within and outside of the feature, and the stone setting itself seems much less dense then the previous stone layers. The stones within are also covered by moss vegetation. Further, the stones within the feature are generally smaller compared to what seen at the three previous stone layers. By comparison, this stone layer consequently seems different than the previous, but also like the least disturbed stone layer. Within and around the feature, ceramic pieces of similar type as seen in the rest of the area were located.
The stone layer F4 could also be the most interesting one by its appearance of least modern manipulation and disturbance. Naturally, all the stone layers described, could easily originate or have relevance to Minoan activity. But F4 seems to be the most interesting one by its appearance and spatial setting in the landscape. The recommendation would therefore be that this feature would be the first one to be investigated. With its very dominant position on an elevation overlooking the two plateaus underneath, this structure could reveal to be a structure as more than simple housing. If the structure itself does not prove to be of Minoan activity, there is still ample settlement activity based on ceramic presence, that something of interest would be located on this dominant position overlooking the main areas of Minoan settlement. Focus should therefore not be on the feature only, but perhaps by a trench investigating activity on the entire plateau, with special attention around the feature F4. Modern construction has however changed the landscape in the area by a contemporary road running just above F4. Likely, the plateau surrounding F4 has also been covered by a lot of soil for leveling the area of the modern road, and thus

settlement activity is likely to continue underneath the contemporary road running up the mountain.

Lastly, the stone feature F5 needs to be described. F5 is not as the previous stone layers, distributed horizontally, but rather locked on a vertical axis within the slope. It is as such not a stone layer, but rather a stone feature, or stone wall face (fig. 5 & fig. 11). The stones within F5 are similar to the stones located at F4.

Fig. 11. Stone feature F5.

Ceramic pieces were located above and below F5. However, the ceramic pieces were mainly found above. The laws of gravity could explain the ceramic presence as displacement from the above lying ridge and plateau extending from C3. The ceramic activity stops both east and north of F5, but continues towards the west on the same topographical contour line towards H2.

The features consist of a simple wall face, with a minor leveled plateau below. The feature and plateau encompasses some 5 x 4 m.

Due to ceramic presence being very sparse, and not continuing towards east and north, it is very difficult to determine whether or not there is any relationship between this feature and the late Minoan archaeological site above. It is not unlikely, but presently there are not concluding evidence of such. Thus, the most likely scenario is that we are dealing with a feature of different temporal and cultural connectivity, and likely as that of a sheep or hunting shelter.

3.2. Findings

With the exception of one stone tool, registered nearby the cluster C2, the findings recorded during the intensive survey were exclusively ceramic shards. Even though only the shards in the intensive survey were numerically recorded and spatially analyzed, it has to be noted that the average size of the ceramic shards discovered in the gully between H1 and H2 was much larger (10-15 cm long and 2 to 3 cm thick) than the one recorded during the systematic survey, where the average size of the shards was about (2-5 cm long and 0,5–1 cm thick). Although differences in shard size were observed, they had no impact on the registration as the size of the single shards has not been used for the statistical analysis.

As the single ceramic shards were recorded by GPS (±1 m accuracy) the exact coordinates of the 396 records can be found under the following link (…). The registration of the 1556 ceramic shards was accompanied by a simple visual based classification. First a color based classification distinguishing between red- and orange-ware (fig. 12) and in rare cases brown-ware was performed.

Fig. 12 Sample of ceramic findings. Orange-ware (1) and red-ware (2)

Further classification criteria were the morphological characteristics. If any morphological distinction was possible, the shards characteristics of being rim, body, handle, bottom, and with or without ornamentation was registered. Only in 3% of the

records this characteristic was significant enough to be registered. Although differences in granularity between the different ceramic types were observed, they have not been registered due to a lack of time. A precise temporal classification was not possible due to a lack of knowledge regarding the Minoan pottery types.

4. Conclusion and outlook

By the investigations carried out, some general conclusions can be drawn on how to understand the archaeological activity on the Koumasa plain. A large area surrounding the known settlement, sanctuary, and graveyard, indicates cultural activity beyond present borders. Settlement activity is determined by ceramic presence and numerical frequency. These boundaries was concluded by the larger extensive survey previously mentioned, as well as in minor parts by the smaller intensive survey.

The suggested boundary of Minoan settlement activity encompasses 39.330 m^2. However, in total the area of settlement should also encompass some areas which were not possible to investigate due to it being private property. The additional areas not possible to investigate, but determined from the outside to also contain Minoan ceramics, cover 13.303 m^2. In total the likely area of Minoan activity on the Koumasa plain of investigation, encompass a minimum of **52.633 m^2** (see fig. 13).

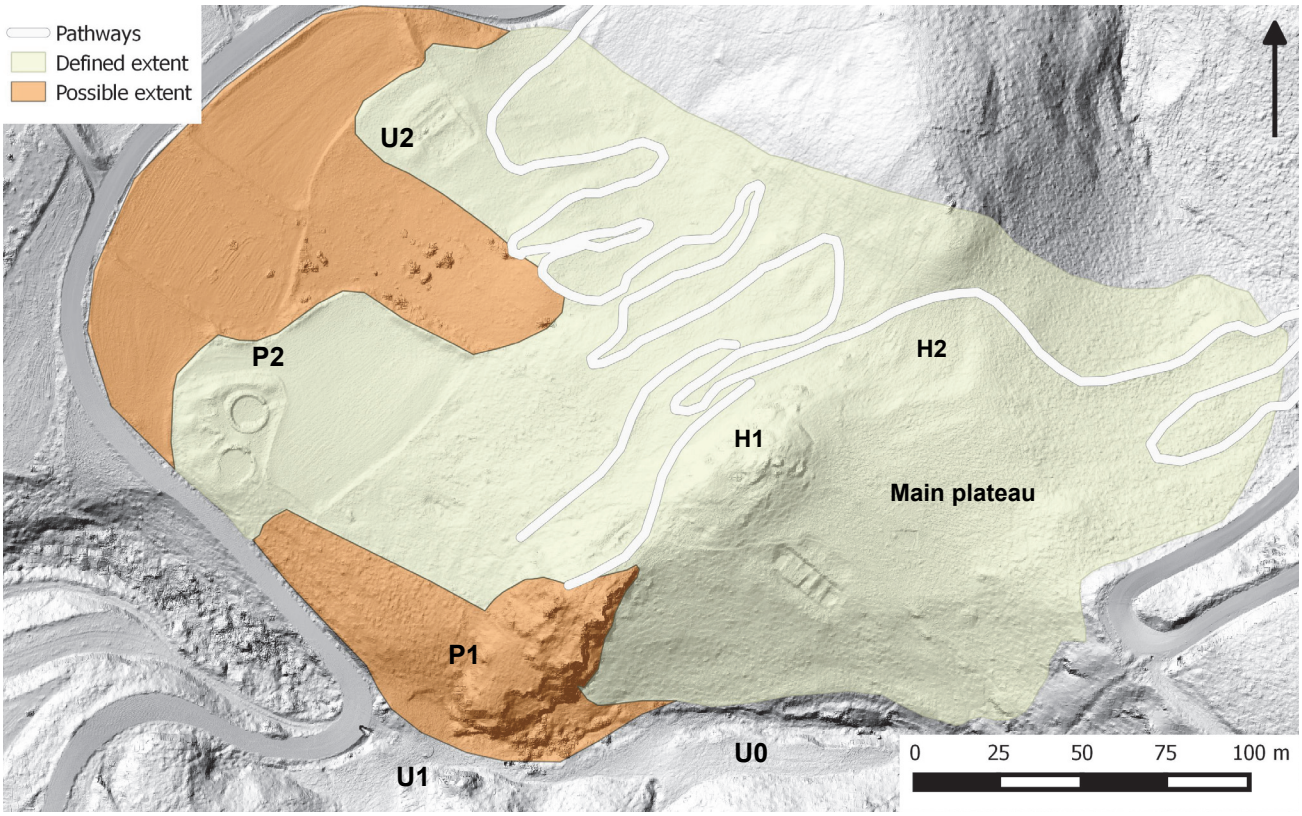

Fig. 13. Marked potential pathways of infrastructure. Further is defined boundary of cultural activity, with likely cultural activity into fields of private property.

South of H1 and the main plateau, the area is cut by a large gully. All the way towards the gully basin, ceramic pieces can be located on the northern slopes on the same side as settlement activity on the main plateau. On the other side of the gully, U0 (fig. 13), a few ceramic pieces were located at the basin. As we move up the southern slopes of U0, ceramic pieces become completely absent. Thus the southern border is defined by the gully basin.

At U1 (Undefined 1) on fig. 13, several pieces of Minoan ceramic were located, however, a lot of modern earthen work has been initiated in this area. The area seems to have been leveled with additional soil from other areas, and likely also surplus soil from previous archaeological investigations could have been used for this purpose. Another explanation is the displacement of soil in relation to modern road construction. Consequently, the area surrounding U1 does not seem to indicate Minoan activity despite the position of Minoan ceramic pieces.

U2 in fig. 13, indicates an area with a house foundation, and Minoan ceramic located adjacent and within the structure. The house foundation and remaining walls of approx. 0.5-1 m in height, is difficult to culturally and temporally place. The surrounding area, as well as the slope above, is densely covered by Minoan ceramic. Nevertheless, despite Minoan ceramics being located everywhere within and around the structure, it is not likely that we have a connection between the structure and the archaeological site of Late Minoan Koumasa. The architecture of the house is very different from that seen at the excavations carried out at the main plateau, and the proportions do not seem to be temporally nor culturally concurrent. The probable situation is thus, that the structure is of more modern activity and the inclusion of Minoan ceramics impossible to escape because of its spatial position on the plain and slope. Re-use of stones are a natural possibility, but more thorough investigations needs to be initiated in order to fully determine and understand the structure in U2. Activity is nevertheless still present on the plain surrounding U2, because Minoan ceramics is everywhere in the vicinity.

From the modern road near U2 following the slope towards H1, ceramic pieces are located as defining a border between north and south. The ceramic presence on the western side of the modern road near U2, is not certain due to absence of investigations by reason of private property regulations. Consequently, whether an extension of settlement activity can be followed into the western plain on the other side of the road is unknown. It is however also unlikely. The concentration of activity

is in the vicinity of H1, and the spatial distance between H1 and the plain west of the modern road, would define ceramic presence to be of new activity rather than directly relatable to the present investigations of settlement activity.
The settlement border near U2, as well as within private property P2, is defined to end at the modern road. As mentioned earlier, in order not to intrude on private property, the areas of P1 and P2 were not investigated. Further, areas of P1 and P2 are partly confined by modern fence. An overview from the outside indicates that ceramic presence continues in these areas. Hopefully future investigations can determine their relationship as being connected to settlement or burial ground activity. Between U2 and H2, a fuzzy border is defined by the diminishing presence of ceramics towards the north. South of the northern border between U2 and H2, ceramic presence is constant all the way towards the cemetery.

Within the defined borders of settlement activity, several elevations indicate usage of the landscape. Most importantly are the topographical elevations located on the western slope in the small gully system between H1 and H2 (cf. fig. 2 and fig. 13). These slight elevations on the slope are indications of previous structures of infrastructure, such as pathways between different plains. The temporal definition is of course difficult to determine, but it is very likely that some of the present elevations on the slope are indications of past Minoan pathways as well. Because, by logistical principle, pathways are naturally means of re-use for least-cost transportation in the landscape. Hence, it is very likely that the elevations located are in concurrence with the late Minoan activity on the Koumasa plain, but with re-use at different times as well. All the pathways indicated in fig. 13 are in relation with Minoan ceramic presence as well. The exact curves of the pathways are not necessarily absolute, because some means of elaboration has been taken in order to connect the different lines and indications of pathways in the landscape. That there is a pathway running up the western slope of H1 is without a doubt true, but the exact turns and changes could easily be a little bit different. The pathways are defined by digital interpretation of the DTM, with field estimation and ground truth comparison. But things change accordingly to natural and cultural manipulations in space and time, and the finale result is therefore also just an estimation and interpretation based on present spatial setting. Thus landscape deviates accordingly to context and the spatial setting changes at different intervals in the past.

This also gives some explanations to the western slope and the densely distribution of ceramic shards. Some of these are likely displaced from the main plateau and cultural activity at the hilltop of H1 by means of time and gravity. Likely, also archaeological displacements of soil by previous investigations are a possible causing factor. However, on the plain below the western slope, the ceramic presence continues towards the modern road and cannot only be explained by displacement of ceramics from the activity near H1.Thus some kind of cultural activity must also be present below the western slope. Whether or not this activity is related to ritual or residential activity is, nonetheless, difficult to determine by surface investigations.

In conclusion, several interesting parts of cultural activity should receive further investigation in the future. Further investigations on the pathways are of importance in order to potentially determine spatial and temporal connection between present detected linear structures and past activity. On this notion, there are also prospective areas of interest to be located in accordance with connected sites outside of the area of investigation. Results on understanding infrastructure will help understand the surrounding landscape of the Koumasa plain and hillside, and thus help to understand the importance of the ritual and residence activity in the area of investigation.

In order to understand the site of investigation, especially two specific minor parts seems to stand out as necessary areas to further investigate to understand the full potential and activity in the local vicinity of residency, sanctuary, and burial ground at Koumasa. These two areas are the previously mentioned as C3 and F4 within part 6 and 6.1 (cf. fig. 6).
The vicinity around F4 is likely to reveal structures very different from normal housing residency as otherwise seen on the main plateau. The area around F4 is the perfect spatial composition to overlook the settlement and potential market square on the main plateau. The ceramic presence in the area around F4 also indicates substantial cultural activity. However, the findings on the surface did not reveal special ware or types of ceramic, but rather completely similar ceramic goods as seen in the rest of the area of investigation. The only area where the ceramic presence was different than the rest of the area of investigation was on the western slope below H1 and H2. On this slope, especially a specific coarse thick ceramic shard was repeatedly

positioned, and much more densely than anywhere else within the area of investigation. These shards most likely belong to vessels described by Xanthudides as cylindrical clay figures (Xanthudides 1924, 50 & Plate XXXIII, 5002-5005). What the relationship between these findings and settlement activity, is difficult to say. However, there must be a special connection between these clay vessels and the temple on hilltop H1.

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