Built to Last – Middle Bronze Age Landscaping Development and Its Economic Implications in the Region of Agios Nikolaos, Crete

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Introduction

The mountain slopes west of Agios Nikolaos, settled more or less simultaneously in Minoan Protopalatial (PP) times (ca. 2000–1650 BC) with over 330 dispersed agricultural sites constructed in massive, unworked stone blocks, are situated far from known Minoan settlements and palaces. They present an otherwise unknown feature of Bronze Age (BA) landscaping, comprising not just of dwelling ruins, but also of ample traces of an intricate network of connecting paths/roads, small enclosures (pens, gardens), long enclosure walls (in sum over 150 km, originally probably up to 200 km, length) and a notable amount of round structures, probably for storage (water, grain). The enclosure walls attribute on average 3.5 ha of varying rocky and arable land to the sites, defining their function as 'mixed agriculture'. Due to the demanding investment of human resources needed to build these installations, the question arises if they were connected in some way with larger PP settlements of the wider area.

The massive architecture of the few known until recently preserved ruins and walls on the east- and south-facing mountain slopes west of Agios Nikolaos has led scholars

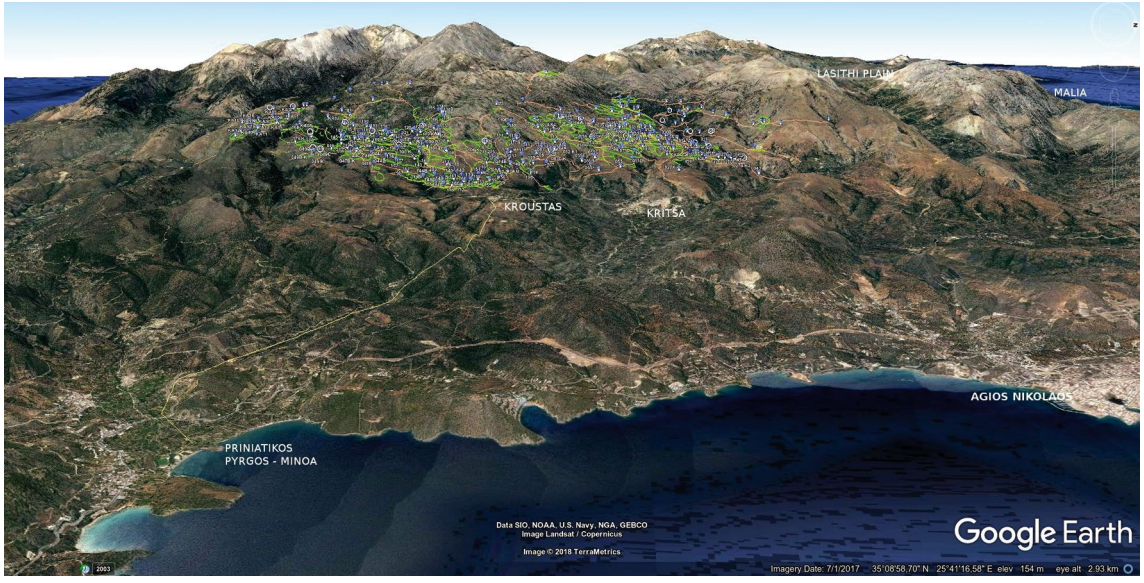

Fig. 1: Google Earth map of the studied area as seen from the East (orange lines Minoan paths/roads, blue dots sites, white circles round structures. Not all data are visible due to their dense positioning).

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Fig. 2: Two examples of oncolithic ruins (Beckmann Site 98, Kroustas Forest Park; Site 50, Kritsa mountains).

in the past to see them as military installations. Only due to the actually extant large number of dwellings with their enclosure walls and their mostly strategically unsuitable positioning in the landscape, it could be made clear[1] that these installations were not part of a defence system along a 'Mycenaean Military Road',[2] but rather of a well-organized hinterland landscape development. These installations would have been capable of providing the coastal urban settlements with a range of commodities needed to expand power structures and international trade. The sheer massiveness of the dwelling ruins' foundation constructions,[3] with their associated circular storage structures,[4] elsewhere named 'kouloures',[5] also show them to have been an effort appropriate for the first Cretan 'palatial' society's political economy. Still, in contrast to later Cyclopean or 'Megalithic' architecture, they were probably not built to impress, but 'built to last'.[6]

In numbers, and for comparison, the variety of BA structures in the area (ca. 32 km^2, fig. 1) can be detailed thus:

– 340 dwelling ruins (fig. 2) with built space in sum double the size of the Neopalatial (NP) palace of Knossos.

– ca. 150 km of enclosure walls (*perivoloi*) (fig. 3) that would have amounted to ca. 240,000 cubic metres of ancient walls in volume[7] (including many terraces in addition[8]).

– ca. 100 km of connecting paths/roads (fig. 4), partly cobbled and furnished with steps (none of them negotiable by wheeled vehicles).[9]

– over 60 round structures (fig. 5) with aboveground and underground architecture.[10]

While dwelling sites in the studied area were built with oncolithic architecture, they had still much smaller floor sizes than houses in NP towns: PP houses had between

Fig. 3: Examples of different Minoan enclosure walls (in the Kroustas and Kritsa areas).

25–50 m², NP townhouses had rather 50–100 m² or even more.[11] Together with the agricultural topography these differences give evidence for the vernacular character of the mountain installations. Also the surface pottery seen in the dwellings' surroundings does not indicate any of the 'riches' that could have been gained with the surplus of the larger arable plots in the region. Hence the situation suggests that at least the farmers of the latter did not work for their own gain, but either as dependent farmers (vel sim.) for someone else not present within the same area, or, in an imaginary world, were sharing their surplus with (or re-distributing it to) their poorer neighbors in times of need.

Fig. 4: Examples of BA paths/roads (in the Kroustas and Kritsa areas).

Fig. 5: Above ground and underground round structures, Kroustas Forest Park area (Beckmann site 189, 100).

Approaching Bronze Age Land Use

Usually the scholarly perspective on Minoan agriculture and its possible productivity is based on storage facilities found (or assumed[12]) at elite structures. Their function was for many decades seen as either (re-)distributive[13] or as centres for conspicuous consumption.[14]

Contrary to this centralized perspective, the Minoan mountain landscape with its *perivoloi* allows a focus on production rather than just storage. Regions[15] within the studied area were chosen where the enclosure walls are well enough preserved to allow a clear attribution to specific sites,[16] so as to estimate the actual arable surface according to the Minoan sites' clearly defined arable plots. (fig. 6). For these plots three categories of arability were established:

– Good fields: mostly alluvial/colluvial plots in small valleys or depressions with 85% and more arable[17] soil surface and very good soil.

– Medium fields: often plots on slopes, mostly terraced even in areas with very little gradient, 50–85% arable surface. The possible yield was calculated using factor ½ of the yield from good fields.

– Non arable spaces: with more than 50% rocky surfaces. They might have been used as spaces for grazing animals – as they are today.[18] That these spaces are not necessarily exclusively 'non-arable' is proven by the fact that some of them (e.g. the tiny soil patches of 2–10 m^2 just W of the ruin Beckmann site 33) were agriculturally used as hoed 'fields' (for barley[19]), as locals report.

Judging from the data provided by the Greek encyclopedia Ilios, 1000 m^2 of Greek field (before the time of artificial fertilizers) would have produced between 80–260 kg of barley per year.[20] Thus an amount of 8–26 kg per 100 m^2 of possible barley yield seemed

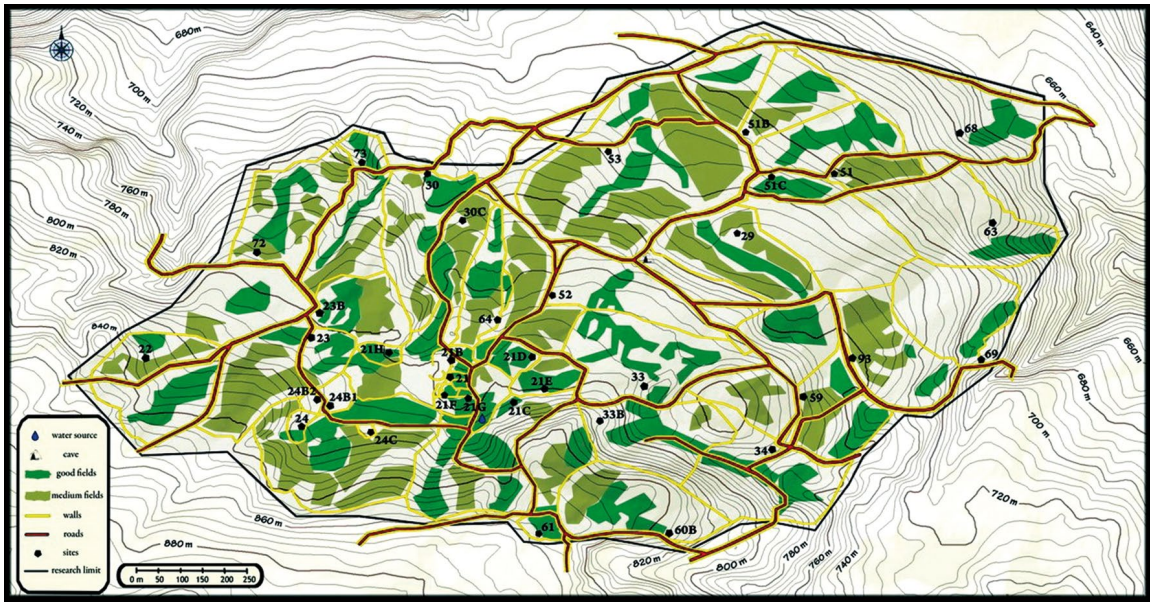

Fig. 6: Map of part of the studied region (Pateragiorgis, Kritsa) with good fields (green), medium fields (light green) and non-arable areas (uncoloured). Enclosure walls yellow, roads/paths red, dwelling sites at numbers. Data outside the land use study area not shown.

a reasonable computational foundation for the carrying capability of Minoan mountain fields in the author's calculations.[21] Note that the large range of possible yields also means an important *caveat* for anyone trying to define sizes of plots 'needed to feed a family'.[22]

The collected data result in a total of about 1500–2700 people that could have been fed by the studied area's yields. The accounts for the probable amount of barley cultivated on the enclosed fields per site[23] showed that most households would have been self-sufficient, while some must have produced a surplus that could possibly have been stored in the round structures. As a rule, the size of the main dwelling ruins is not proportional to other features, namely the extent of arable land, thus the size of groups inhabiting the sites may not have been related to the amount of its arable land or its possible yield.

Storing Spaces for Farms on Rocky Slopes?

Sites with larger plots at their disposal could have easily lived off their land while having extra space for raising animals, planting gardens, etc.[24] The by far largest site (as enclosed plot) in the region of Pateragiorgis, Beckmann site 53, with (good and medium) arable land of nearly 6 ha could have produced (following Ilios' amount of 8–26 kg per 100 m^2)

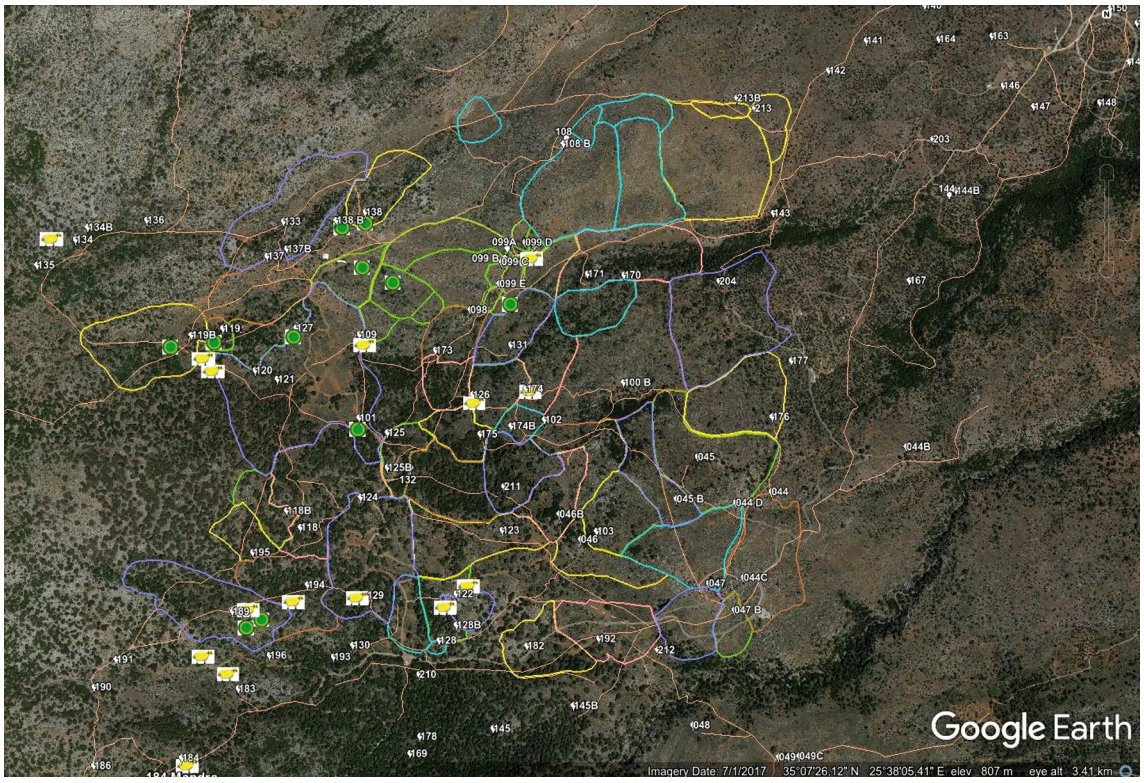

Fig. 7: Google Earth map of the Asfendamous/Kroustas Forest Park area with sites (numbered), above ground round structures (green dots), Minoan animal pens (sheep), Minoan roads/paths (light orange) and enclosure walls (multi-coloured, one colour per site).

2,800–9,100 kg,[25] a cereal surplus for 3–13 families (with Allbaugh's 640 kg/family/year, cf. note 31).[26] In this context it seems interesting that while e.g. the site's dwelling ruin (without its half-round extension[27]) very much resembles the simple rectangular McEnroe Type 3 Minoan NP house, the site's production capacity[28] could have exceeded the storage capacity of the much larger McEnroe Type 2 NP house type (that "does not exceed ca. 3,000 litres"[29]) or would possibly even have yielded amounts for the storage capacity range of McEnroe Type 1 NP houses of 5,000–14,400 litres.[30] Here we certainly deal with a serious possible surplus.[31] The amount of different pithos sherds visible on the slope below the half round structure might indicate its original use as storage area.

Site 53 might have used its half round extension as storage space for surplus, and there are other sites with similar extensions in the area. Possibly even some of the rectangular structures were storage spaces (e.g. what looks like a small house ruin, Beckmann Site 99B). Still the over 60 independent round structures (two architecturally different kinds[32]) detected[33] in the study region are of major interest here.

The two architectural variants are:

– Type 1. Constructed oncolithically and underground (probably cisterns[34]), dug out as a pit or vertical shaft/well with inner diameters up to 5 m and wall widths between

Fig. 8: Minoan animal pen at Beckmann Site 174 (Kroustas Forest Park area, dwelling ruin behind and right of girl).

0.7 and 1.3 m. The 22 of them with a well-visible shape might have contained ca. 460 m^3 of water.[35]

– Type 2. Built with mostly rubble and on slightly raised rocky positions. In diameter most popular sizes are between 3–4 m and wall widths 0.8–1.2 m (often difficult to judge because of fallen rubble). These are roughly comparable to a group of round structures at the Minoan 'palace' of Malia,[36] and interpreted by the author as probable granaries.[37] Those with clearly visible construction alone – 25 – have an estimated capacity of at least 565 m^3 (when computing with a height of 3 m)[38] and a maximum of ca. 900 m^3 when computing with a height of 1.5 times[39] the width but max. 5 m,[40] i.e. yearly rations for ca. 880–1400 people. If one compares these numbers with the storage capacity of the PP Knossos 'kouloures' with a capacity of 480–670 yearly rations,[41] it becomes clear that the current (re-)distribution theories concerning the 'palaces' (see above) should be reconsidered. Privitera's suggestion concerning a "high possibility that peripheral storehouses did exist"[42] (for Mycenaean times) could be seen as documented for PP times with the existence of the mountain round structures in the Agios Nikolaos area.

From these, albeit highly conjectural, computations it is still possible to say that, even if for modern eyes the studied region may not seem to be apt for farming, in a period when the 4.2 kiloyear aridification event[43] must have afflicted Minoan coastal settlements, the mountains with their larger rainfall amounts must have been important as hinterland even for cereal production,[44] and certainly for raising livestock – sheep, goats, bees (figs. 7–8). The possible surplus in barley is rather impressive in itself, when added to other resources that could have been gained in the surrounding mountainous landscape, from timber to animal products, the area can certainly be described as plentiful.

As it seems that urban (mostly coastal) areas in Minoan Crete are always also trading centres as well as elite settlements, it seems logical to look to the closest PP town/economical center for the predominant strata of Minoan society the mountain dwellers would have been subordinate to or trading with, in an imaginary world of independent Minoan farmers. In the case of the sites studied here, the ancient coastal settlement of Priniatikos Pyrgos[45] comes to mind, especially as some of the mountain paths/roads seem to be directed there.[46] Following the Istron river to the sea, ancient roads/paths provide the necessary connectivity from the mountains to the coast/urban settlement within a distance of ca. 10 km (following modern roads the two regions seem much further apart).

That the mountains were settled by an – imaginary – egalitarian community, peacefully sharing their crops and living in a proudly massive, self-constructed[47] landnam area off the reach of 'palatial' elites, sharing and exchanging (or 'redistributing') local products for non-local is theoretically just as possible as the area having been owned by a (topographically distant) elite who could "mobilize staple resources in return for access to the land by commoners"[48] – the material record visible in the landscape does not yield enough information for more.[49] Both horizontal (i.e. egalitarian) and vertical (hierarchical) models seem to fit the currently visible facts.

On the other hand, when applying Ockham's razor, one might suggest that a hierarchical model seems more logical for a conclusive explanation of such a well engineered 'project' as the PP landnam of the Agios Nikolaos mountains seems to have been.

While this is not the place to discuss the kind of possible local overlordship extant in PP times (secular or religious), it seems certain that a dynamic elite must have been interested in the agricultural and natural resources that could have been provided by the mountain dwellers in their hinterland. Thus the great investment that the installation of the many massive structures necessitated should also have come from this elite, with its administrative and technical know-how, thinking big enough to manage the topographically intricate and probably contemporary installation of the many kilometers of oncolithic dwellings,[50] enclosure walls, and roads – not as conspicuous architecture, but as a long-term investment, all built to last.

Notes

* Sabine Beckman died on 6th June 2019. She was a generous colleague and friend. She knew the Cretan terrain as no other as she walked it extensively for several decades. As a real fighter against illness, she passed away far too early. Her fresh and passionate input in Cretan archaeology will be sorely missed.

[1] Beckmann 2012a, 2012b.

[2] Evans – Myres 1895 in Brown 2001, 205.

[3] Named 'oncolithic' by the author for typological reasons; cf. Beckmann 2012a, 92–96; 2012b, 37.

[4] Beckmann 2012a, 137–144, Appendix E.

[5] Cf. most recently Keßler 2015 passim, with extensive bibliography.

[6] Hence many have been re-used in the recent past for mixed agriculture. It is unclear if the big foundation blocks were actually visible in the BA.

[7] Cf. the building volume of the Menkaure/Mykerinos pyramid, ca. 235,000 m^3.

[8] Hence Orengo and Knappett's (2018, 504) notion that there "has been little recognition of such systems" ("terraced fields") is clearly spurious. Also, their statement "there must be many other examples of Bronze Age terracing yet to be described as such" might be correct, but Beckmann 2012a (the existence of which they seem to have noticed without taking any of its data into account, ibid. 502) gives ample examples of well-documented enclosed (and often terraced) BA fields (regardless of the fact that due to centuries of re-use most of the terraces do not seem to be in their original BA structure any more, while the enclosure walls are mostly datable due to their characteristic oncolithic building style).

[9] Beckmann 2019.

[10] Beckmann 2012a, 251–260.

[11] Whitelaw 2001; Beckmann 2012a, 131.

[12] Cf. Privitera 2014, 430.

[13] E.g. Renfrew 1972, Halstead 1981; cf. the forum on Redistribution in Aegean Palatial Societies, AJA 115, 2011, 175–244.

[14] E.g. Schoep 2004.

[15] The areas of Pateragiorgis south of Kritsa and the area of what is now 'Kroustas Forest Historical Landscape Park' (cf. www.kroustas-park.gr), for one of its main toponyms called 'Asfendamous' in Beckmann 2012a, passim.

[16] Beckmann 2012a, 272–292.

[17] This is corroborated by recent land use. Being enclosed by Minoan walls preventing most erosion, it stands to reason that the fields' arable qualities were at least as good as they are now (for the geo-archaeological basics of this cf. Beckmann 2012a, 18–20).

[18] During the rainy seasons (winter-spring) spaces between rocks are especially green and fertile (cf. already Sieber 1823, 53). For the geo-physical background of this phenomenon, cf. Krusche et al. 1982, 52 f.

[19] For the reasons for barley as main crop see Beckmann 2012a, 72. Note also Halstead's (1987, 84) comments on the better seed:yield ratios in hoed agriculture.

[20] Ilios 1941/52, vol. 11, 551, lemma >κριθή<.

[21] Yield amounts accordingly calculated per m^2 of the studied area's good fields plus half of the amount per m^2 of medium fields. Allbaugh (1953, 379) refers to an average yield of ca. 74 kg per 1,000 m^2 in post WWII Crete. The 'in situ' data of experimental yields (Beckmann 2012a, 75–79) are similar.

[22] Here taken to be an average 5 (adult) persons as usual in such computations. A good size of family has always been desirable in agricultural societies if only for economical/practical reasons.

[23] Beckmann 2012a, 313; Ch.II,d 4.

[24] Studying in a similar way the possible amount of animals that can be raised by natural means – i.e. no added fodder – on the Agios Nikolaos mountain slopes (in keeping with modern local information), approximately 50 sheep and goats could have constituted the livestock per site and household (cf. Beckmann 2012a, 291–293 and fig. 206; 313)

[25] I.e. ca. 1,900–6,100 litres of local Cretan barley weighing 0.67 kg/litre. Judging from Keßler's computations (Keßler 2015, 145–148, citing Christakis 2005), when accounting with the largest PP pithos size of 300 litres, 6 to 20 pithoi could house this amount, even if stored in a different containing object (sack, bulk) in the ca. 30 m^3 (30,000 litres) space the half round structure could have provided if built 3 m high.

[26] I agree with Keßler's statement (2015, 138) as for the possible 'precision' and use of such computations: only "to determine an order of magnitude of the people that could at most have been subsidized with the storage capacities present" (Keßler's italics). Note that there is a mistake in Beckmann 2012a, 285, giving an amount of 4–14 families' supply as surplus, not taking into account the family of the dwelling.

[27] Cf. Beckmann 2012a, fig. 200.

[28] Judging from the possible revenue from its plot of arable land within its well-preserved enclosure.

[29] Christakis 1999, 10.

[30] McEnroe 1982.

[31] Based on Allbaugh's data (Allbaugh 1953, 107), who measured an actual average need of 128 kg of cereals per person (i.e. 640 kg for a whole hypothetical household of 5) per year in a household. Note that there is an important element of uncertainty in these computations for various reasons: Keßler differentiates between cereals, but due to this very approximate approach that seems to be too much detail here. The same has to be said for caloric needs of BA people that probably can only be guessed at as a very vague amount. Keßler assumes 1.23 litres of husked barley as average daily need, i.e. nearly 280 kg/year (following his calculations in Keßler 2015, 143, applying 20% of the caloric need covered by olive oil). I assume that Allbaugh's lower cereal data are probably closer to the BA reality, even though he gives a rather large amount of olive oil (29% of the caloric need, Allbaugh 1953, 126) as part of the post WWII Cretan diet. This, as well as the legumes omnipresent in the modern Cretan diet, would in modern times not be produced in the studied mountain region as it is supposed to be situated too high for most of the olive species to bring optimal yield, while legumes were recently only grown in the lowlands because they needed more tending than cereals but could have been grown in the mountains if people lived in the dwellings during winter (for the probability of winter use, cf. Beckmann 2012a, 291). For the BA, facts like these show that there would have been an exchange in goods that cannot be taken into account here, as other products of the mountains – timber, honey, herbs etc. – plus the animal products – meat, wool, cheese etc. – cannot be quantified.

[32] cf. Beckmann 2012a, 137–144.

[33] As especially the underground structures could have been buried under colluvium easily, there may have been many more.

[34] In rainy winters e.g. the large cistern at site 100/100B still fills temporarily with ca. 1 m of water.

[35] For an example, see Beckmann 2012a, 300 f. The region has relatively few springs (cf. Beckmann 2012a, 249), so cisterns must have been very useful.

[36] The 'kouloures' at Knossos and Phaistos are underground constructions and their function is still unclear (Strasser 1997, Keßler 2015, Privitera 2014).

[37] Cf. Strasser 1997 and Keßler 2015 with extended bibliographies.

[38] Cf. Keßler 2015, 161.

[39] For the reasons, cf. Beckmann 2012a, 300.

[40] Examples from the Levant and Egypt seem to suggest for height ca. 1.5 times the width (cf. Currid 1985), but it seems improbable they could have been higher than 5 m.

[41] Keßler 2015, 161.
[42] Privitera 2014, 437.
[43] Kaniewski et al. 2008.
[44] Beckmann 2012a, 20, 314.
[45] At Kalo Chorio/Istron, currently excavated under the auspices of the Irish Institute of Hellenic Studies at Athens, a site probably mentioned as Minoa by Strabo, Geographica 10.4.5; cf. Boyd-Hawes et al 1908, 20.
[46] Beckmann 2012a, 312; Beckmann 2019.
[47] Modern examples show that the local oncolithic BA architecture could easily have been done by clans vel sim.; Beckmann 2012a, 95.
[48] Earle 2011, 242.
[49] This is the necessary place for assuring that future excavations might provide more detailed information.
[50] Even if their 'built big' foundations were probably embedded in mortar and plastered (if only to prevent mice and scorpions from getting in) and thus invisible.

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