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# Potential location of early Neolithic sites in Crete and Cyprus: A GIS-based regional potamological approach

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**Abstract:** This study aims to identify key locations for the potential unearthing of Early Holocene archaeological sites in the interior of Cyprus and Crete, two large islands in the Eastern Mediterranean. We apply geographic information system (GIS) methods, based on assumptions of environmental suitability and geographical accessibility. The core assumption is that the first farmers colonizing almost pristine islands had a fair empirical knowledge of morphopedological conditions suitable for their Mediterranean farming practices. Here we use the SRTM digital elevation model (DEM) to establish the primary factor of access to water resources calibrated on the hydrogeomorphological context of known archaeological sites on the two islands. Test zones on the central part of Crete (pre-ceramic Knossos, 9000-6500 BP) and the foothills of the Troodos mountains in Cyprus (Khirokitia culture) suggest potential suitable localities situated on specific terraces, ledges or footslopes perched above the flood plains of major rivers or smaller streams. The final aim is to establish a methodology for the discovery of new archaeological sites that is expected to contribute new data to the fragmented archaeological record of both islands. Although this study focuses on bridging existing gaps in the early Neolithization processes in the Eastern Mediterranean, our "potamological" (Pardé, 1949) approach is of value for any mountainous region where hydrological resources are a key factor at the early stage of neolithization.

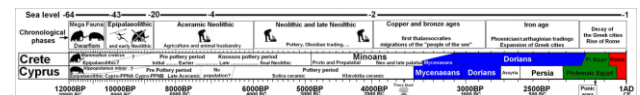
**Keywords:** Aceramic Neolithic, Cyprus, Crete, GIS, hydrogeomorphology

## 1. Introduction

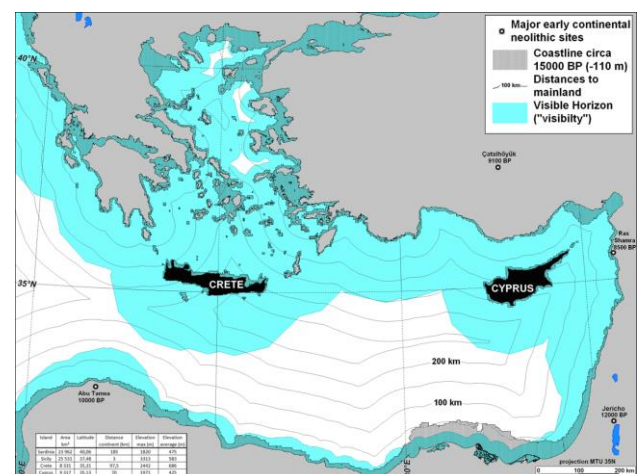
Following previous studies on coastal (Ammerman 2020) and hinterland areas (Mertel et al. 2018), a predictive approach based on the location and geomorphology of known archaeological sites is applied to Early Holocene in the island contexts of Cyprus and Crete (table 1) close by the original cradle of agriculture with the purpose of providing potential locations of other inland sites of the same periods (Map 1). The colonization and settlement of true islands, such as

Cyprus and Crete, demonstrates definite naval capabilities as well as deliberate choices and forward planning linked to migration dispersals from the terrestrial continuum of continental zone. The continental diffusion of agriculture along the Danube within the European mainland has its counterpart in the maritime context of the Mediterranean where the process of Neolithic dispersal took specific characteristics with islands being a case on their own. In the Eastern Mediterranean, population genetics suggest that the first seafaring peoples came mostly from the Anatolian or other coastal communities.

**Table 1.** Timeline and chronogrammes of Crete and Cyprus from 12,000 BP to 1 AD (from Dawson, 2014 and Depraetere and Meichsner, 2016).



**Map 1.** Location of Crete and Cyprus within the context of the Eastern Mediterranean Sea.

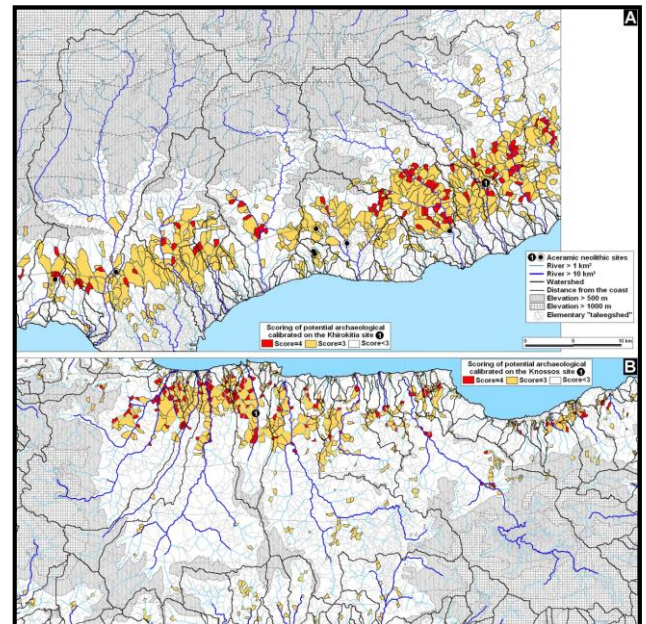


## 2. Hypothesis and method

The central hypothesis is that access to water resources is a key factor in the location of archaeological sites especially for sedentary Neolithic populations, who would require a consistent and abundant source of fresh water for their crops and animals. Priority will be given to a hydrogeomorphological approach using the homogenous SRTM DEM suitable for regional survey and comparative studies of hydrological processes related to landforms. We have selected the following hydrogeomorphological criteria based on geographical and topographical features:

1. Dc: distance from the present coastline (km): depending of coastal bathymetry, the distance was greater than today: i.e. 1.5 km (-62 m) for Akamas *Aspros* in Cyprus 12,000 BP (Ammerman 2020), 1.5 km (-30 m) Knossos in Crete 9,000 BP.
2. Em: Elevation (metres): according to present sea level (about + 62 metres compared to 12,000 BP).
3. Sg: Slope gradient (%): maximum gradient in the 8 directions (3x3 pixels window);
4. R1: River bed: area of upstream catchment basin > 1 km<sup>2</sup> computed from SRTM monodirectional flow direction (method D8).
5. Dr: Distance to river beds (3) in metres.
6. PSSR: Potential Surface and Sub-surface Runoff and percolation index: PSSR=number of pixels upstream. (PSSR from Depraetere (2013), variant of Topographic Wetness Index of Beven and Kirkby 1979).
7. MEP/MEU: Minimal Elevation Passage and Max Elevation Units, variant of topographical "lowest cost" paths (Depraetere and Riazanoff, 2004).

**Map 2.** Scorings of potential archaeological sites calibrated from two reference sites (Khirokitia and Knossos). A. Compared to the site of Khirokitia in the Southeast part of the Troodos mountains in Cyprus. B. Compared to the site of Knossos within the Northern part of the central plain of Crete (processed from the SRTM DEM at 1 arc second resolution).



In this preliminary study, one known archaeological site from each island has been chosen to test the index of similarity. Khirokitia, a Late Aceramic Neolithic sites on Cyprus (Figure 2A) and Knossos on Crete (Figure 2B) comprise two well-established archaeological sequences and are, thus, ideal case studies to test the validity of our model.

### 3. Conclusion

From an archaeological perspective, the present study aims to develop a systematic methodology to facilitate the discovery of new archaeological sites on two key insular landscapes in the Eastern Mediterranean. Despite recent advances, the archaeological record of both Cyprus and Crete regarding this key transition period (Early Holocene) remains fragmented. Our study aims to be a useful tool in archaeological enquiry expected to contribute new data on each of the selected islands. Moreover, our approach allows for a comparative analysis between Cyprus and Crete as a means of investigating patterns of location selection by farming populations per island. This study is envisaged as the basis for a wider application of the methodology to other islands in the Mediterranean and elsewhere.

## References

- Adam M. , Ondrejka P. and Šabatová K., (2018), Spatial predictive modeling of prehistoric sites in the Bohemian-Moravian Highlands based on graph similarity analysis, *Open Geosciences*, Volume 10 Issue 1, July 20, 2018
- Ammerman A.J. (2020), Cyprus. The Submerged Final Palaeolithic of Aspros Dive Site C. In: Bailey G., Galanidou N., Peeters H., Jöns H., Mennenga M. (eds) *The Archaeology of Europe's Drowned Landscapes*. Coastal Research Library, vol 35, pp 429-442.
- Button, S.L. (2010), *Resource Stress and Subsistence Practice in Early Prehistoric Cyprus* PhD Thesis, Classical Art and Archaeology, The University of Michigan, 2010, 452 pages
- Cheng-Zhi Qin et al. (2013). Quantification of spatial gradation of slope positions. January 2013 *Geomorphology* 110:152-161
- Dawson, H. (2014). *Mediterranean Voyages The Archaeology of Island Colonisation and Abandonment*. Routledge, 324 Pages.
- Depraetere, C. and Riazanoff, S., (2004). The new Digital Elevation Model data set from the Shuttle Radar Topography Mission: Hydrogeomorphological applications in the Ohrid region (Albania, Greece and Macedonia). *Systèmes d'observation et d'information sur l'eau pour l'aide à la décision BALWOIS*, Ohrid, République de Macédoine, 25-29 Mai 2004.
- Depraetere, C. and Meichsner, M. (2016), Geohistorical perspective on the islands of the Mediterranean and the Baltic Sea. Editions Wilhem Fink and Ferdinand Schöningh, Band 11, 2016 ; *Konstruktionen mediterraner Insularitäten, Mittelmeer Studien*, edited by Reinhard von Bendemann, Annette Gerstenberg, Nicolas Jaspert and Sebastien Kolditz., pp. 225-264 .
- de Faucamberge, E. (2010), Abou Tamsa : étude d'un nouveau site néolithique en Cyrénaïque (Libye), *Afrique : Archéologie & Arts*, 6, 2010, pp. 101-102.
- Flannery, K.V. (1972), The origins of the village as a settlement type in Mesoamerica and the Near East: a comparative study, in *Man, Settlement and Urbanism*, edited by P.J. Ucko, R. Tringham, and G.W. Dimbleby, pp. 23-53. London: Duckworth.
- Held, S. (1989). *Early prehistoric island archaeology in Cyprus: Configuration of formative culture growth from the Pleistocene/Holocene boundary to the mid-3rd millennium B.C.* PhD Dissertation (Archaeology), University of London 1989, 784 pages.
- Le Brun A. and Daune-Le Brun O. (2009), Khirokitia (Chypre). la taille et les pulsations de l'établissement néolithique pré-céramique, nouvelles données. In: *Paléorient*, 2009, vol. 35, n°2. pp. 69-78.
- Moutsiou T. (2018), The Obsidian Evidence for Trans-maritime Interactions in the Eastern Mediterranean: The View from Aceramic Neolithic Cyprus. *Journal of Mediterranean Archaeology*, Vol 31, No 2 2018.
- Moutsiou T. and Agapiou A. (2019), Least Cost Pathway Analysis of obsidian circulation in Early Holocene–Early Middle Holocene Cyprus, *Journal of Archaeological Science: Reports*, Volume 26, 2019.
- Nougier, L.-R. (1988), *L'essor de la communication: colporteurs, graphistes, locuteurs dans la préhistoire*. Lieu Commun, 350 pages.
- Pardé, M. (1949), *Potamologie. École Nationale Supérieure de l'Énergie, l'Eau et l'Environnement (Grenoble)*. Éditeur scientifique, 2e édition, 2 vol. (IV-336 p.)
- Thiébault, S. (2003), Les paysages végétaux de Chypre au Néolithique: premières données anthracologiques, pp. 221-230 in J. Guilaine and A. Le Brun, eds., *Le 447 Néolithique de Chypre*. Athens: École Française d'Athènes.
- Todd Whitelaw (2004), Estimating the population of Neopalatial Knossos. *British School at Athens Studies* Vol. 12, Knossos: Palace, City, State (2004), pp. 147-158
- Tomkins, P. (2008), Time, space and the reinvention of the Cretan Neolithic, in Isaakidou, V. & Tomkins, P. (ed.) *Escaping the labyrinth: new perspectives on the Neolithic of Crete (Sheffield Studies in Aegean Archaeology 8)*: 22–51.
- Vigne, J-D et al. (2011), A New Early Pre-Pottery Neolithic Site in Cyprus: Ayios Tychonas – Klimonas (ca. 8700 cal. BC). *The Newsletter of Southwest Asian-Neolithic Research Neo-Lithics* 1/11, January 2011, pp 3-18
- Waltz, Pierre (1934), *Le monde égéen avant les Grecs*. Collection Armand Colin, Sélection d'Histoire et Sciences économique, 1934, 206 pages (page 27);

## Related websites:

- University of Cyprus, Nicosia, Cyprus: Project PLEICY: Water Routes in Human Island Dispersals: Modeling the Pleistocene Exploitation of Cyprus (<https://ucy.ac.cy/pleicy/>).
- University of Tübingen, Germany. ResourceCultures: Interdisciplinary DFG Network on 'Insular Dynamics' (<https://uni-tuebingen.de/en/universitaet/aktuelles-und-publikationen/attempto-online/newsfullview-attempto/article/sfb-1070-resourcecultures-interdisciplinary-dfg-network-on-insular-dynamics-is-founded/>)
- Institut de Recherche pour le Développement, Marseilles, France: Base de données Insulaires Mondiale (BIM) (doi:10.23708/T37S0K)