# Obsidian Maritime Interconnections in Early Holocene Eastern Mediterranean

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## Introduction

Although archaeological evidence has provided a relatively clear picture of when the island of Cyprus was inhabited, there is still considerable debate as to where these inhabitants originated from, as well as the routes they most likely followed to reach the island. Based purely on similarities of the material record, e.g. architecture, lithic technology, fauna, between Cyprus and its surrounding mainland (e.g. Vigne et al. 2011), research has suggested Anatolia and/or the Near East as the original homelands of the first Cypriot settlers (Peltenburg et al. 2001). Obsidian is a common feature of the material culture of the broader region, with material from Anatolian sources traversing the Near East (Figure 1) as far south as Israel (Ibáñez et al. 2015). Obsidian artefacts are also found on the neighbouring island of Cyprus. No geological sources of obsidian occur on the island (Figure 2), which has never been connected to the continent with any form of land bridge. This indicates that obsidian could have only reached Cyprus via seafaring (Moutsiou 2018). Determining the most likely routes for these mainland-island maritime crossings can provide significant information about the Eastern Mediterranean 'socialscape' at the transition from the Pleistocene to the Holocene.

## The consumption of obsidian on the island of Cyprus

The island of Cyprus in the Eastern Mediterranean is rich in good quality raw material resources for human exploitation, such as chert, but obsidian is not one of them. Nevertheless exotic obsidian appears in lithic assemblages of Early Holocene (8900-6400 cal BC) sites across the island (Figure 3).Obsidian artefacts are mostly in small quantities (20-50 pieces), although larger assemblages are also known, such as Parekklisia *Shillourokambos* (~600) and Akanthou *Arkosyko* (~5000). Unretouched blades and bladelets dominate the assemblages, formal tools are extremely rare and no evidence for in situ tool manufacture has been unearthed anywhere on the island (Moutsiou 2018). Complete obsidian assemblages were elementally characterised using X-ray Fluorescence Spectrometry (XRF) and demonstrated the dominance of central Anatolian obsidian sources in the Cypriot archaeological assemblages (Figure 4).

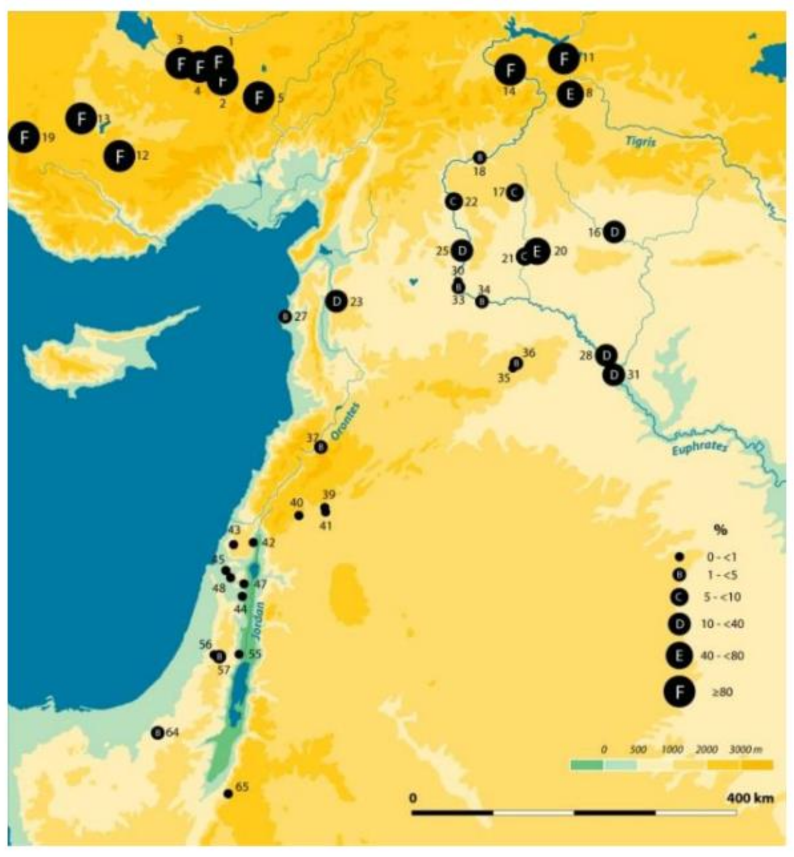

Figure 1. Obsidian distribution in the Near East during the Pre-Pottery Neolithic B (PPNB), 8,500-6,400 cal BC (from Ortega et al. 2016).

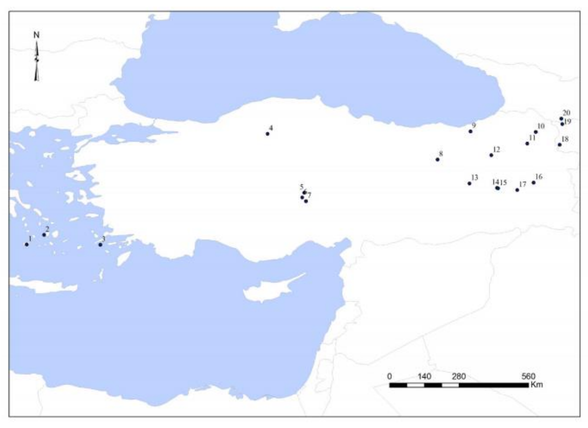

Figure 2. Map showing the location of the main geological sources of obsidian in the eastern Mediterranean region neighbouring the island of Cyprus. [Note: 1=Melos, 2=Antiparos, 3=Giali, 4=Sakaeli, 5=Acigöl, 6=Nenezi Dag, 7= Göllüdağ, 8=Erzincan, 9=Ikizdere, 10=Kars, 11=Sarikamis, 12=Erzurum, 13=Bingöl, 14=Mus, 15=Meydan Dag, 16=Suphan Dag, 17=Nemrut Dag, 18=Arteni, 19=Ashotsk, 20=Chikiani]. From Moutsiou 2019.

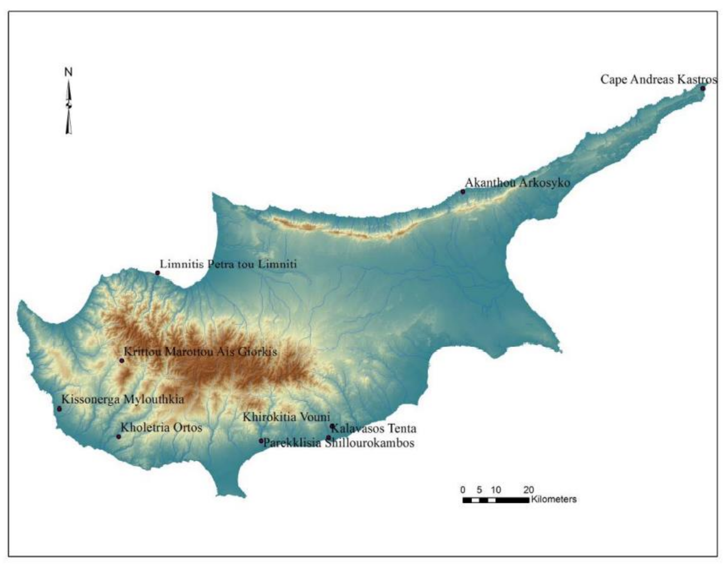

Figure 3. Map showing the main Aceramic Neolithic (8900-6400 cal BC) sites on Cyprus with documented presence of obsidian.

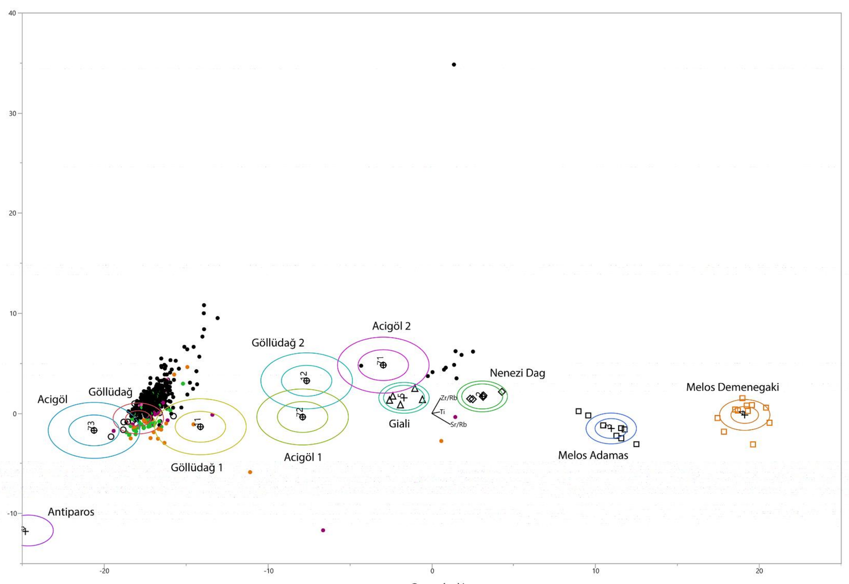

Figure 4. Discriminant Function Analysis (DFA) comparing pXRF data on obsidian from Aceramic Neolithic Cyprus with the main Eastern Mediterranean geological obsidian sources. The figure shows that based on Sr/Rb and Zr/Rb ratios and Ti absolute values, the majority of the Cypriot obsidian can be attributed to the central Anatolian source of Göllü dağ. Colours: black=*Shillourokambos*, green=*Ais Giorkis*, orange=*Mylouthkia*, pink=*Arkosyko* (covered by the *Shillourokambos* main cluster), purle=*Tenta* (Moutsiou 2018).

In Aceramic Neolithic Cyprus, obsidian—when not a surface find—usually derives from contexts that represent everyday activities. Most of the obsidian pieces found across Cyprus (Figure 5) are associated with living floors or fills interior or exterior to building structures. In fact, in all documented instances, there are only two occasions where obsidian artefacts are found within 'special' contexts, although the notion of their association with activities such as feasting or grave goods remains weak. Although the stratigraphic association of obsidian artefacts with domestic rather than religious or other ritual contexts is usually taken to mean that obsidian had no significant value in Aceramic Neolithic Cyprus, it is argued that objects can accrue special value beyond their original functionality, especially when made of materials that are rare, visually distinctive and found at great distances from their source (Saunders 2001, Moutsiou 2018).

Figure 5. Obsidian artefacts from Early Holocene (Aceramic Neolithic) Cyprus.

## Obsidian distribution on Cyprus

Least Cost Pathways (LCP) analysis of obsidian distribution across the island (Moutsiou and Agapiou 2019) demonstrates that water played an important role in facilitating obsidian movement on Early Holocene Cyprus. Specifically, our models suggest that (a) riverine and (b) coastal waterways were commonly exploited by the early inhabitants of the island in the context of social exchanges (Figure 6). Moreover, the analysis suggests that not all insular communities were involved in the social exchanges delineated by obsidian circulation. The LCP model clearly shows a fragmentation between north and south. A possible explanation could be that in the division between coastal obsidian-bearing sites and inland sites with no obsidian we are, in fact, observing two distinct (contemporaneous but separated) social territories. In this context, the north and south coastlines experience an influx of new populations from the mainland, who settle themselves along the coast as a first stage in the colonization process. During this initial exploration phase, humans are more likely to be risk-averse and obsidian objects would enable the maintenance of social ties as an adaptive strategy in the new conditions.

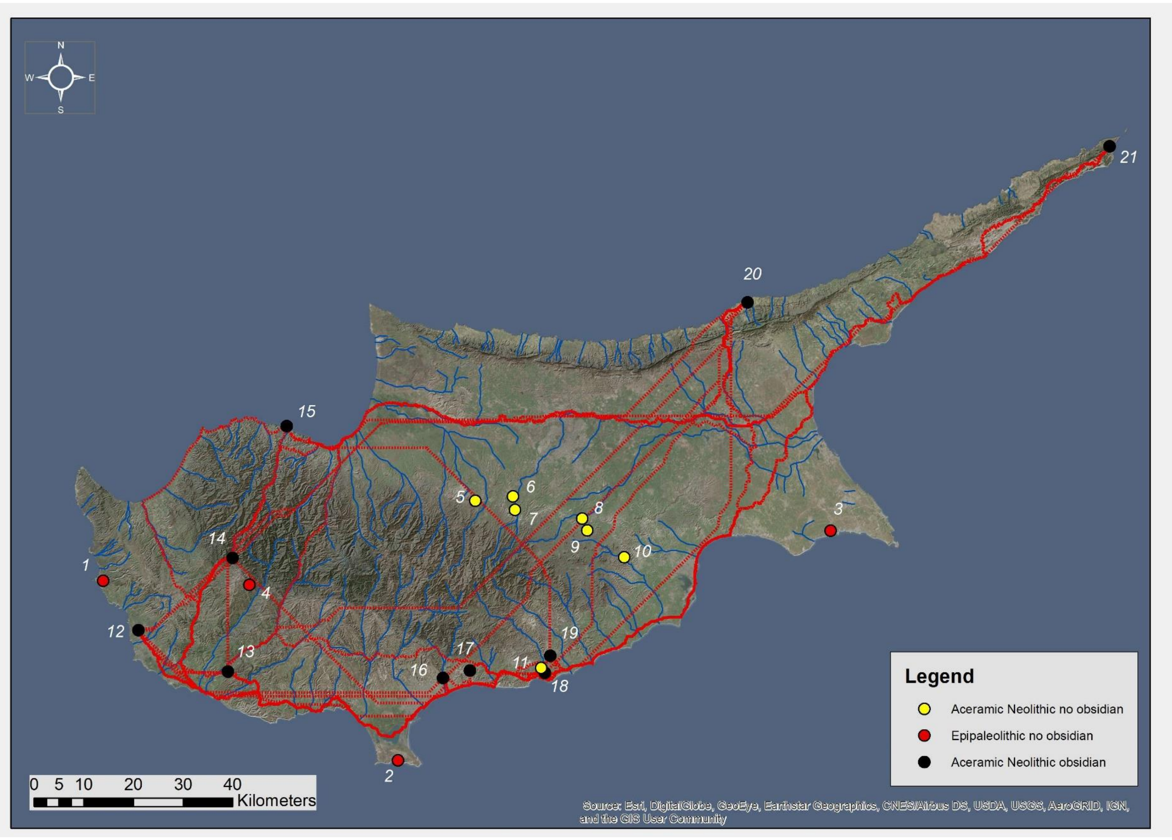


Figure 6. Least Cost Paths Analysis (LCPA) of Aceramic Neolithic sites on Cyprus. The analysis has shown that not all contemporary sites use obsidian. On most occasions sites that do not use obsidian are located at a distance from the least cost routes. However, on some occasions, such as Agrokipia Paleokamina and Pera Chorio Moutti, obsidian is absent from the lithic assemblages even though the sites fall on the least cost route. The image also illustrates that obsidian circulation is fragmented with exploitation restricted along the north and south coasts and a major gap in the interior of the island. Sites: 1=Akamas Aspros, 2=Akrotiri Aetokremmos, 3=Nissi Beach, 4=Vretsia Roudias, 5= Agrokipia Paleokamina, 6=AVA Asprokremmos, 7=Politiko Kelaidoni, 8=Pera Chorio Moutti, 9=Alambra Spileos and Koudourka, 10=Ayia Anna Perivolia, 11=Mari, 12=Kissonerga Mylouthkia, 13=Choletria Ortos, 14=Krittou Marottou Ais Giorkis, 15=Limnitis Petra tou Limniti, 16=Parekklisia Shillourokambos, 17=Ayios Tychonas Klimonas, 18=Kalavasos Tenta, 19=Khirokitia Vouni, 20=Akanthou Arkosyko, 21=Cape Andreas Kastros. [Note: sites 2 and 4=Epipalaeolithic, 1 and 3=Epipalaeolithic?, 5-11=Aceramic Neolithic with no obsidian, 12-20=Aceramic Neolithic with obsidian]. (Moutsiou and Agapiou 2019).

## Modeling maritime connectivity in the Eastern Mediterranean

To support archaeological inquiry and inference regarding prehistoric seagoing to/from Cyprus, this project employed Lagrangian-based simulation algorithms for modelling the drift-induced, as well as directed sea-borne movements, based on data and assumptions regarding the prevailing paleo-environmental conditions and vessel characteristics. Although directed seaborne movements are still under investigation, preliminary drift-induced simulation results indicate that there exist at least two periods, during winter for South to North routes (south coast of Anatolia - Cyprus and vice versa), and during summer, for East to West routes (eastern coast of Levant – Cyprus and vice versa), whereby the sea state is favourable to drifting vessels, especially for shorter distances. During almost all the time, departures from the southern side of the Levantine mainland are blocked by currents flowing almost parallel to the coast (Nikolaidis et al. 2020, Figure 7).

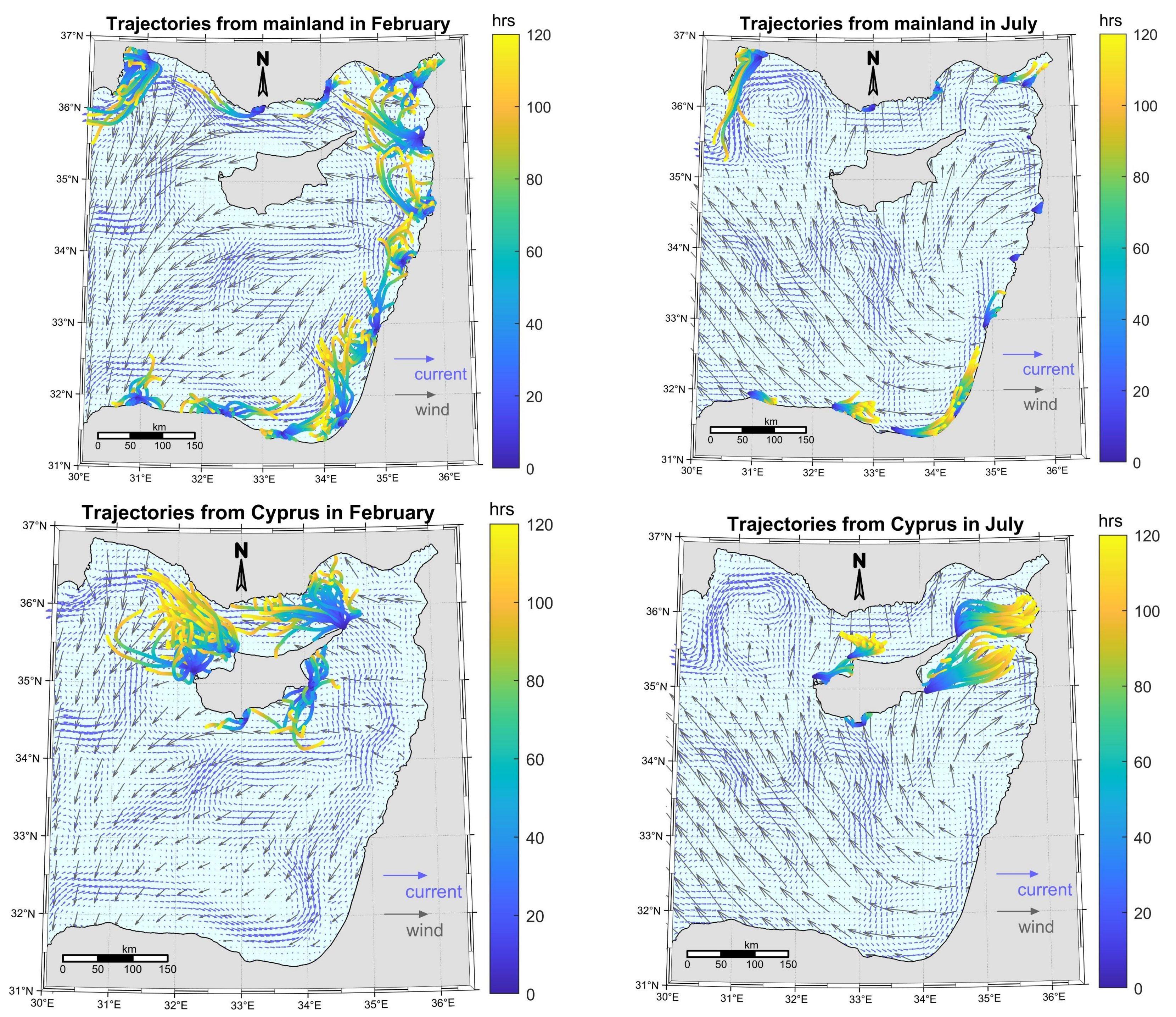


Figure 7. Simulations of prehistoric seagoing to/from Cyprus based on drift-induced modelling (Nikolaidis et al. 2020).

## Maritime obsidian networks in the Eastern Mediterranean

The location of Early Holocene obsidian-bearing sites along the north and south coasts of the island and the apparent obsidian gap between the two regions likely support two different mainland routes for the introduction of obsidian to Cyprus: (a) Levant and south coast of Cyprus, and (b) Turkey (Anatolia) and north coast of Cyprus. The application of simulation-based modelling of sea-borne movement in the Eastern Mediterranean allows us to test these hypotheses and determine the most realistic routes for obsidian maritime movement between the island of Cyprus and its surrounding mainland. Work so far points supports both scenarios as likely. The lack of obsidian-bearing sites on the southern coast of Turkey contemporaneous with those found on Cyprus may point towards a closer link with the Levantine mainland.

## Conclusions

Complex networks of exchange, where some long distance links between non-neighbouring villages were present (Ortega et al. 2016) in the mainland from the PPNA, with settlements able to develop and maintain distant exchange links that connected different regional exchange networks. The subsequent PPNB period sees an increase in obsidian consumption and longer-distance networks. The detailed analysis of obsidian on Cyprus demonstrates similar patterns were taking place on Cyprus too. The island across the sea was an active participant in this broader 'socialscape' that joined mainland and insular prehistoric communities together. Obsidian exchange (Figure 8), in particular, facilitated the creation and maintenance of long-distance maritime networks. Social networks are a valuable asset crucial for the sharing of information, resources and genes.

Figure 8. Obsidian artefacts from Early Holocene/Aceramic Neolithic Cyprus.

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