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Exotic or Eccentric Exchange?

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4. Obsidian Finds on the Fringes of the Central Mediterranean: exotic or eccentric exchange?

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Summary

Long-distance trade is typically associated with rare or exotic materials, which naturally have different prestige values than at locations closer to their origins. In the prehistoric Mediterranean, obsidian is the best documented material, and shown to have been traded extensively from sources on the central Mediterranean islands of Lipari, Palmarola, Pantelleria, Sardinia. But relatively little study beyond sourcing has been done on obsidian artifacts found at archaeological sites far from these sources. Obsidian has been found hundreds of kilometers away, at many Neolithic sites around the Adriatic; in northern Italy, southern France, northeastern Spain, and the Balearics; and in Algeria, Tunisia, and Malta. In the Copper and Bronze Ages, however, obsidian from the central Mediterranean sources has only rarely been found at faraway sites, suggesting a change in its symbolic value with the introduction of metals.

This paper focuses on exotic obsidian finds, how such dispersals were related to economic and political changes over time, their overall sociocultural significance, and how they may be related to the exchange of other exotic or eccentric materials. In addition to integrating previous data with current research, suggestions are made for future studies on this topic.

Introduction

Obsidian is a volcanic glass, widely used for stone tools in antiquity, and often transported over great distances because its physical properties made it superior to the local lithic material available. In the central Mediterranean area, workable obsidian exists only on the Italian islands of Lipari, Palmarola, Pantelleria, and Sardinia (Fig. 4.1). Further away, there are obsidian sources on the Greek islands of Melos, Antiparos, and Giali; in central and eastern Anatolia, and in the Carpathians of central Europe. So the findings of obsidian artifacts at mainland sites in the central/western Mediterranean immediately indicate maritime transportation, most likely as an accompaniment to other materials, with those that were

perishable not being recorded at all in the archaeological record. Unfortunately, the earliest sea-going vessels found in the Mediterranean, at Uluburun and Cape Gelidonya, are considerably later, from the Late Bronze Age. The discovery and analysis of obsidian artifacts therefore has been widely used to represent trade and contact between different regions in the Neolithic period (ca. 6000–3000 BC).

There was much early work done on sourcing obsidian by Cann and Renfrew (1964), Hallam *et al.* (1976), Williams-Thorpe *et al.* (1979, 1984), Bigazzi and Radi (1996), and others. But the data from these studies are limited in several ways, and do not address many of the questions we have now about ancient societies in this region. While it is not a new idea that obsidian studies could be used to address the socioeconomic patterns of ancient cultures, e.g. down-the-line vs. more complex exchange systems (Sidrys 1977; Renfrew 1969, 1977, 1993), until the mid-1990s there was relatively little done with obsidian artifacts in the central Mediterranean, and the “interaction zone” model proposed by Hallam *et al.* (1976) was still widely referred to as a description of the overlapping distribution of obsidian in this region (see e.g. Williams-Thorpe 1995). This model was actually based on the analysis of few samples from any one site, and in many cases without a specific chronological context.

It is only in the last 15 years that enough artifacts began to be scientifically tested to enable quantitative evaluation of obsidian trade (Tykot and Ammerman 1997). Much of this is due to the development of analytical methods for sourcing obsidian, at relatively low per sample costs, and in particular, the use of non-destructive XRF (X-ray fluorescence spectrometer) instrumentation (Tykot 2002a, 2003, 2004a; de Francesco *et al.* 2008). Along with detailed studies of the actual geological sources and subsources of obsidian in the central Mediterranean (Sardinia – Tykot 1996a; Palmarola and Tykot, Setzer *et al.* 2005; Lipari – Tykot, Iovino *et al.* 2006; Pantelleria – Tykot *et al.* nd), and the survey and excavation of a major obsidian workshop at Sennixeddu in Sardinia (Tykot, Lugliè *et al.* 2006), large-scale analyses of

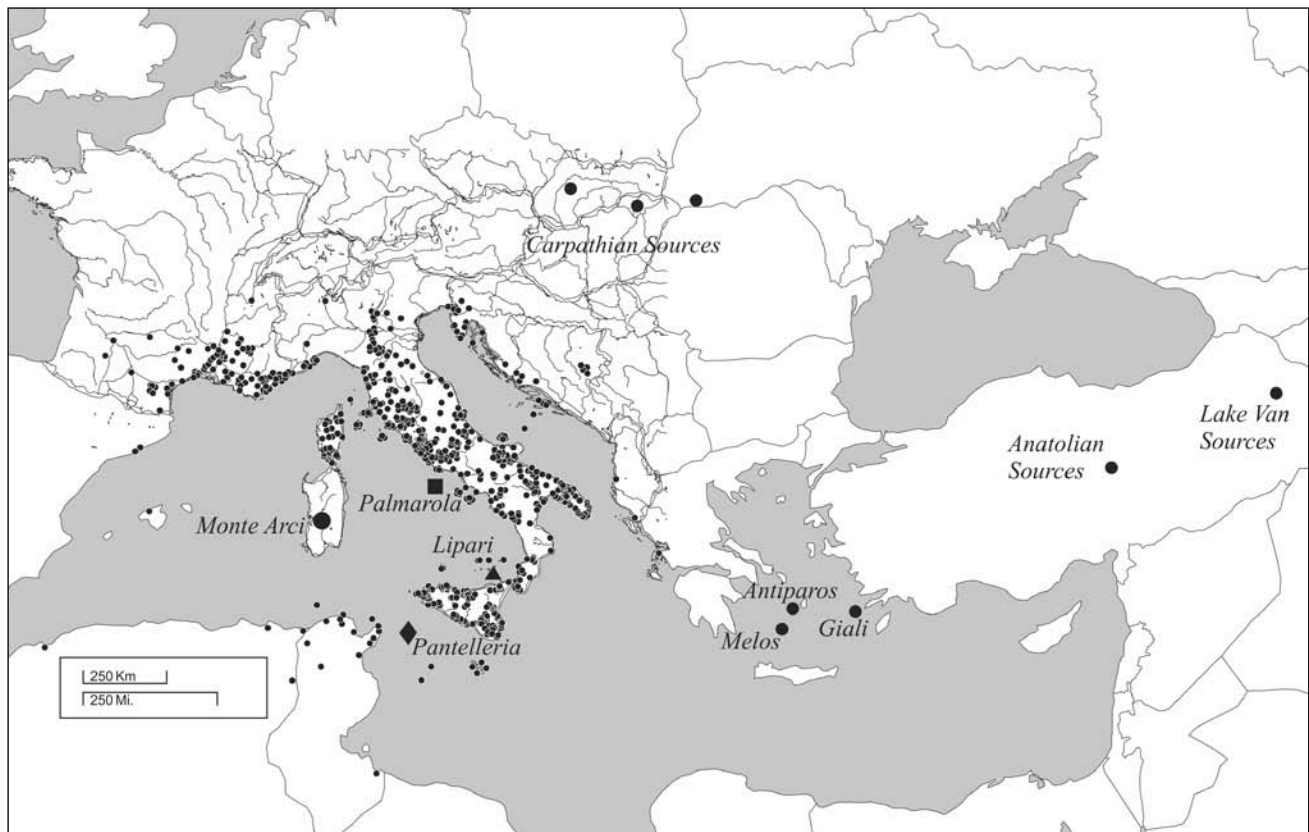


Figure 4.1. Map of geological sources and sites in the central Mediterranean where obsidian has been found. Sites in Sardinia not shown.

obsidian artifacts from individual archaeological sites have now been conducted (e.g. Barca *et al.* 2008; de Francesco and Crisci 2000; Le Bourdonnec *et al.* 2010; Lugliè *et al.* 2007; Tykot 2010; Tykot *et al.* 2010; Tykot *et al.* 2008).

The overall data now available allow us to discuss in greater depth the acquisition, spread, and use of obsidian in both core and peripheral regions. When obsidian is found far from its geological source, is it treated as *exotica* or is it just an eccentric item? How do we address this from the archaeological record? Our definition of *exotica* is something non-native or foreign which has been imported and appreciated by the receiving culture, while *eccentric* means unusual, deviating from the usual pattern, especially in odd or whimsical ways. But to describe and interpret obsidian finds requires information about distance from source, the context where it was found, information from other sites to compare with, and the overall cultural settings in which obsidian use was embedded.

Archaeological Sites with Obsidian

In the central Mediterranean region, obsidian artifacts are now known from many archaeological sites not only close to the source islands, but throughout the Italian

peninsula and into southern France, the Dalmatian side of the Adriatic Sea, and in the northern parts of Tunisia (Fig. 4.1). A few samples have been identified in northeastern Spain, the Balearic islands, and Algeria. Perhaps most surprising – but perhaps explained simply by the location of other obsidian sources – is the absence (at present) of artifacts from central Mediterranean sources found east of the Italian peninsula, suggesting little direct trade or communication with cultures based in the Balkans or Aegean, at least in the Neolithic period. While seafaring was capable and regular enough by the beginning of this period to transport not only people but also domesticated animals (sheep, goat, cattle, pig), establishing hundreds of sites just in Sardinia (Tykot 1999), there was little economic or political reason for super-long-distance trade and exchange, definitely not on a dependency basis. In most regions, other lithic material (e.g. chert/flint, jasper, quartzite) was much more readily available for everyday stone tools.

In part due to the large number of Bronze and Iron Age sites (Nuragic, Etruscan, Roman, etc.) in the central Mediterranean with major architectural remains, the overall amount of archaeological work on the Neolithic and Copper Age is far less, especially in certain regions, and this must be considered when examining the periphery of obsidian exchange. The absence of obsidian finds does not

necessarily imply that obsidian was not used or available, and that the region was beyond the boundary of exchange networks. More significant is that for certain regions where only very small quantities of obsidian had been found, they were initially thought to have been exotic/eccentric finds, but further excavations have produced much greater quantities, requiring a reevaluation of their significance. One example of this is in Dalmatia, starting near Trieste (Italy) and continuing thru Slovenia, Croatia and Bosnia and Herzegovina. Until a decade ago, there were about 25 sites where obsidian had been found, all with just a few pieces each. Since then, more than 30 pieces of obsidian have been found at newly discovered sites in Istria (Komšo 2007); more than 60 at the site of Danilo (Moore *et al.* 2007); and about 50 from the tiny islands of Palagruža and Sušac in the middle of the Adriatic (Forenbaher 2007; Bass 2009).

What parameters does one use to start describing obsidian finds as exotic or eccentric? The answer to this question will depend in part on the type and extent of survey/excavation at a particular site, whether the context is residential or ritual/mortuary, and the total amount of lithic material recovered. In general, if obsidian is a low percentage (<5%) of the lithic assemblage, it is not likely to be an important part of everyday life. But what if the finds at one site include obsidian from two or more sources, in disproportionate amounts? Is one type more exotic or eccentric? To address this, there are many factors that need to be taken into consideration.

Patterns of Obsidian Dispersal

The discovery of a piece of obsidian at an archaeological site is just one part of the artifact's *chaîne opératoire* (Fig. 4.2). While its typology, size, and context provide information on what it was used for, in most cases

scientific analysis is necessary to identify its geological source, i.e. where it was acquired from. One must also consider the accessibility of that source (e.g. near the coast, in a mountainous area, etc.), and the quantity and quality of the raw material; whether the obsidian artifact was produced there, or if a core was knapped and transported, with the tool produced later at the site where it was found; and what kind of transportation and exchange was involved for the artifact to end up far from its source. By studying large collections of obsidian samples, these fundamentals may be used to address questions about the economic, social, and political circumstances for the cultural period involved.

Using our definitions for exotica and eccentricism, one must be careful first with the distance between island obsidian sources and the archaeological sites in question. While islands have natural boundaries and maritime transport was necessary for interaction with the mainland, the relatively short distances between Lipari and northeastern Sicily, or between Sardinia and Corsica should not be considered very much different than distances traveled on land for neolithic period cultures.

An obsidian artifact would be eccentric, however, only if one or more of the following cases were met:

- obsidian is a small or tiny percentage of the overall lithic assemblage at the site;
- its type or style is different from the norm for that region and time period;
- the context in which it was found does not have other lithic artifacts, e.g. as a grave offering;
- it is associated with other unusual materials (e.g. jewellery, toys);
- the particular obsidian artifact originates from a source different from the one regularly used;
- obsidian of that type is mostly associated with higher status individuals, but not in great quantities.

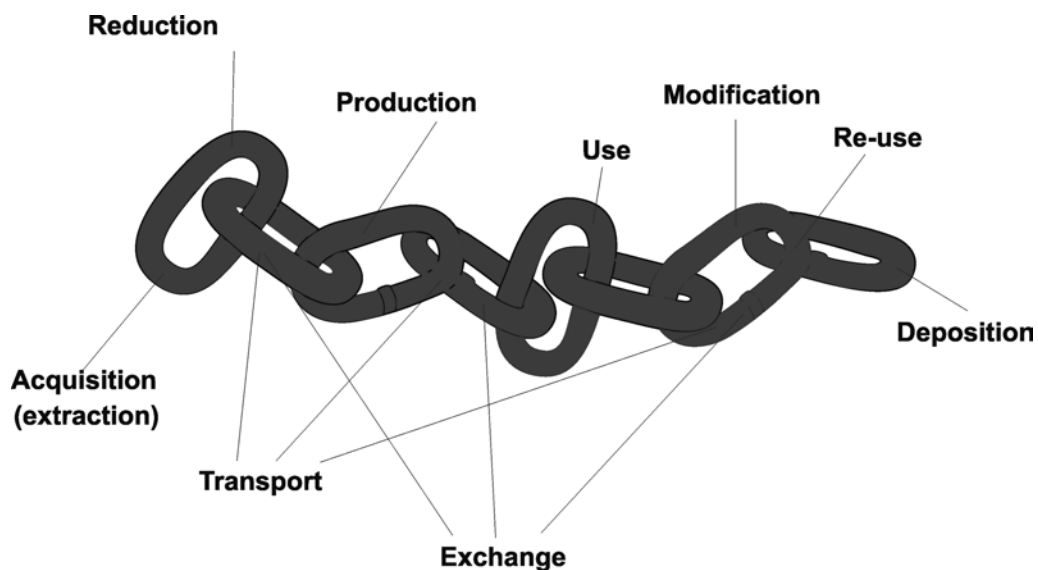


Figure 4.2. The *chaîne opératoire* (operational sequence)



Figure 4.3. Map showing archaeological sites with 10 or more obsidian artifacts tested. Site names in bold analyzed by Tykot; in italics analyzed by Tykot and others.

At least one study of eccentric obsidian has been done in other regions, e.g. for “trinket trade” in the Early Bronze Age in the southern Levant (Rosen *et al.* 2005).

Quantitative Analysis

Over the past fifteen years, the analytical sourcing of obsidian artifacts from the central Mediterranean has increased exponentially, with thousands of results now available. While some are from older museum or survey collections (e.g. Tykot 2010), with less contextual information than from modern excavations, they contribute to the general information about dispersal of obsidian from specific geological sources. Figure 4.3 shows the many sites where 10 or more pieces of obsidian have been analyzed, so that comparisons may be made

in the percentage of each source that was present, and patterns established for different time periods. Published elsewhere is the clear change in the use of the Monte Arci (Sardinia) subsources, with all three major groups (SA, SB, SC) well represented at Early Neolithic sites not only in Sardinia but also in Corsica, the Tuscan archipelago, and the northern Italian mainland, along with the disappearance of type SB by the Late Neolithic and general domination of the SC subsurface (Tykot 1996; 2002b; 2004b). The similarity in the overall pattern, however, in both Early and Late Neolithic periods strongly suggests that down-the-line trade is still the best explanation for exchange in those periods. Artifact studies still in progress may reveal whether similar patterns existed and changes occurred with the other central Mediterranean obsidian sources. Relatively

few sites have been tested in Sicily and southern Italy, so caution is necessary for making interpretations for those regions.

Long-Distance Trade and Contact

Courtin (1967, 105, fig. 5) implied long ago that Sardinian obsidian reached southern France directly and independently of Tuscany and Liguria, while Camps (1976a; 1976b) specifically indicated that Monte Arci obsidian probably passed along the west Corsican coast and then across the open sea to Provence, near St. Tropez. The presence of Pantellerian obsidian in Early Neolithic levels at Grotta dell'Uzzo in northwestern Sicily is direct evidence of open-water crossings of at least 100 km, to a small island destination, and attests to the navigational skills of early seafarers (Francaviglia and Piperno 1987). The open-water distance between Corsica and southern France is of the same order of magnitude (150 km), indicating that such trips could well have taken place on a regular basis during the Neolithic. Phillips (1986; 1992) more reasonably suggests that obsidian probably reached southern France by several routes, including directly from Sardinia, but also by cabotage along the Ligurian coast and overland from the Po Valley.

Since mostly type SA obsidian is found in southern France, and the current in the Ligurian Sea runs counterclockwise (i.e. northern Italy would probably have been visited before southern France by Sardinian/Corsican sailors), it is more likely that French merchants specifically selected type SA obsidian over the other varieties available, whether that was at ports of call in Liguria, Corsica, or even Sardinia. Lipari obsidian, when available so far from its source, was also apparently acceptable, but Palmarolan obsidian – even though it is well attested at Arene Candide – was not. Differences in obsidian selection criteria between southern France and northern Italy may also be related to the availability of alternative lithic materials, and thus obsidian type selection based on its visual or physical properties. This geographic variation could also be due in part to evolutive cultural preferences or ethnic ties dating from the beginning of the Early Neolithic; in southeastern France, neolithization involved the acculturation of Cardial impressed ware ceramic characteristics by Castelnovian peoples, whereas in Liguria there seem to have been no Late Mesolithic antecedents, so that the new settlers expanded an already existing socioeconomic networks (Binder 1987; Vaquer 1990; Biagi *et al.* 1990).

The limits of obsidian distribution probably also applied to the movement of other materials and ideas, and may reflect cultural or ethnic boundaries. It should also be understood that these distribution patterns represent cumulative actions over long periods of time; it may have taken generations for some obsidian to travel from

its geological source to its findspot (Williams-Thorpe 1995). For the central Mediterranean, obsidian did not simply travel “as the crow flies” from geological source to archaeological site (Fig. 4.4), so that other studies besides sourcing are necessary to fully understand obsidian usage in antiquity.

In reconstructing prehistoric exchange systems, Renfrew (1993) has emphasized the consideration of the full range of human interactions, and the possibility that these interactions may have been characterized by “communication” rather than “trade” if the acquisition of goods played a secondary or minor role. In extant traditional societies, lithic raw materials are often acquired in the course of other activities such as seasonal transhumance, in other words as an embedded strategy (Binford 1979). What has become strikingly clear for Neolithic Mediterranean societies is that multiple, distinct systems of production and exchange operated simultaneously, pertaining to different categories of material goods (Perlès 1992; Skeates 1993).

We must therefore consider that the distribution of obsidian not only is linked to the circulation of other material goods of similar utilitarian, social, and/or symbolic significance, but that the particular exchange system it belongs to probably depends upon local custom and the availability of the material, and these are likely to change over time. In the central Mediterranean, obsidian was not used during the Upper Paleolithic or Mesolithic, despite the likelihood that its sources were known to the Preneolithic residents of Corsica, Sardinia, and Sicily, and its use falls off sharply in the Chalcolithic. This situation parallels the use of amber in Britain, which was a high prestige item in the Early Bronze Age Wessex culture, but is almost archaeologically invisible in the preceding Neolithic and the succeeding Middle Bronze Age (Beck and Shennan 1991).

In the central Mediterranean obsidian distribution coincides with the expansion of village farming, and is more likely the consequence of this new sedentism. The dramatic shift in the subsistence economy is accompanied by the development of craft specialization – evident not only in the skilled knapping of obsidian and flint tools but also in ceramic production and other activities – but craft specialization is certainly not a prerequisite for obsidian exploitation, particularly near its source. In its “supply zone” obsidian was likely to have been primarily utilitarian in function, whereas at greater distances its diminished availability added a social component to its use, thus acquiring exotic and eccentric qualities. Jadeite and eclogite axes found in northern Italy and southern France appear well used and less perfectly finished than more finely made, lightly used axes found in southern Italy which probably served a non-utilitarian or ornamental purpose (Leighton 1992). While it would be tidy to link the southward distribution of “jadeite”

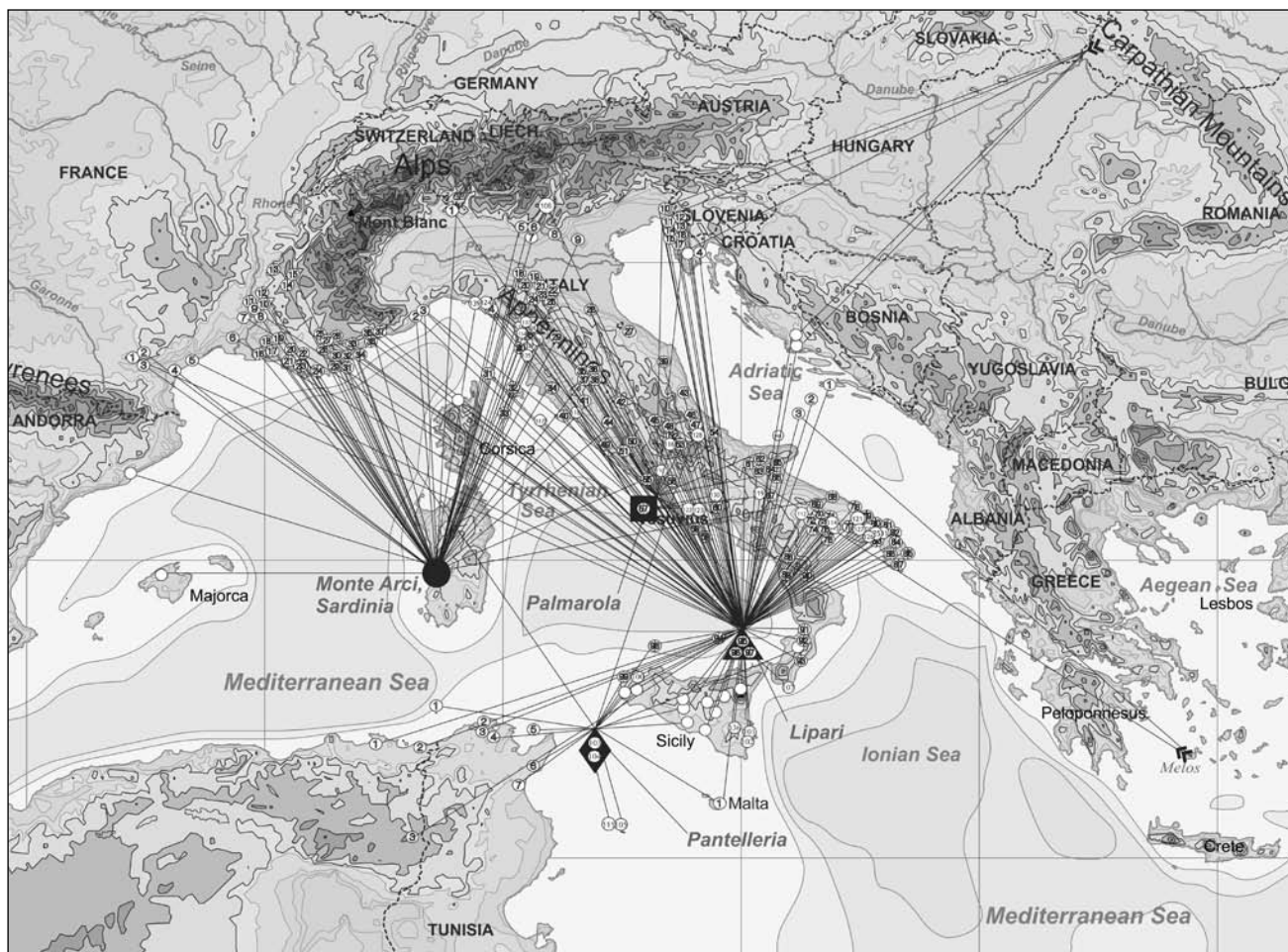


Figure 4.4. Map showing links between archaeological sites in the central Mediterranean and the geological sources represented.

from the western Alps to the northward dispersion of Lipari and Sardinia obsidian, this cannot be assumed since they may have belonged to different exchange system categories depending on a site's location relative to the two opposing sources, and because interaction between groups may not have been symmetrical (cf. Renfrew 1986; Champion 1989).

Just like in the central Mediterranean, obsidian in the Aegean is thought to have been distributed through simple reciprocal exchange mechanisms (Renfrew 1972; Renfrew *et al.* 1965; Torrence 1986). Binder and Perlès (1990; Binder 1987; Perlès 1992; cf. also Demoule and Perlès 1993) indicate, however, that obsidian tools were knapped by highly-skilled workers during the Neolithic in Greece and elsewhere, and that even though the open-water distances involved in travel to Melos (with many other islands inbetween) were substantially less than for the central Mediterranean obsidian sources, maritime travel also involved considerable technical skill. Perlès (1990; 1992) argues convincingly that itinerant knappers performed cores while on Melos, and subsequently produced blades from a single core at several mainland villages.

Some Exotic and Possibly Eccentric Obsidian Finds

At this point, there has been sufficient archaeological survey and excavation of prehistoric sites in the central Mediterranean to identify regions or subregions where obsidian was a regular part of the everyday lithic assemblage, found in substantial quantities at most if not all Neolithic sites. Likewise, there are other regions where obsidian has not been found at any sites. It is those areas inbetween where obsidian was by definition exotic, but only *possibly* may be considered eccentric (Fig. 4.5). Some examples include:

Northernmost Italy

There are a large number of Neolithic sites in the Lombardy, Veneto, and Friuli-Venezia Giulia regions of northern Italy where a very small number of obsidian artifacts have been found, and analyzed (Hallam *et al.* 1976; Williams Thorpe *et al.* 1979; Randle *et al.* 1993). Obsidian found at the Lombardy sites (Isolino di Varese; Monte Covolo-Brescia, Rocca di Manerba,

Riparo Valtenesi-Manerba) is mostly from Sardinia, with one piece from Lipari. In contrast, obsidian from the Veneto and Friuli-Venezia Giulia regions (Bellori-Grezzana-Verona; Grotta G. Perrin-Sengia Bassa di San Cassiano; Sammardenchia di Pozzuolo; Grotta della Tartaruga, Vlasca Jama, Riparo di Monrupino, and San Quirino-Trieste; Grotta degli Zingari-Sgonico; Grotta Lonza-Monrupino; and Grotta dell'Ansa-San Pelagio) is mostly from Lipari, with just 1 piece from Sardinia and 2 each from Palmarola and Carpathian sources. While these sites range over time, and the obsidian finds often have little context, obsidian is a minimal part of the lithic finds at these sites, while its presence at so many sites supports an interpretation of its exotic but perhaps not eccentric value. The difference in which sources are present most likely reflects the general down-the-line trade routes that existed.

Southern France

Similar to northernmost Italy, obsidian artifacts have been found and analyzed at a very large number of Neolithic sites in southern France (Crisci *et al.* 1994; Poupeau *et al.* 2000). More than 40 pieces were found at La Cabre/Le Grenouiller (Saint-Raphaël, Agay), in the Var province, and more than 20 at Sainte Catherine (Trets), in the Bouches-du-Rhône. Ten or more were found at Giribaldi (Nice, Alpes-Maritimes), Les Terres Blanches (Menglon, Drôme), and Station des Combes (Piolenc, Vaucluse). While Lipari obsidian appears to dominate the Early/Proto Chasseen sites, Sardinia A (SA) obsidian was most widely used overall. Given the pattern in Corsica and northern Italy for the greater relative use of Sardinia C (SC) obsidian, this suggests actual selection of obsidian material, rather than end-of-the-line eccentric usage. No Palmarola obsidian has been found in France, but two pieces of dark-green Pantelleria obsidian were found at the final Neolithic site of San Sebastien (Hallam *et al.* 1976), with these definitely falling into the eccentric category.

Spain and the Balearics

A large obsidian blade has been found at a Neolithic site in Gavà in northeast Spain, while a substantial sized chunk of Sardinia obsidian was excavated at the Copper Age site of Son Muleta in Mallorca (Waldren 1982). At the funerary site in Gavà, the obsidian blade was found along with flint tools, stone hatches, a pottery vessel, a coral collar, and a collar of variscite, a green mineral from a nearby mine known to have been exploited in the Neolithic (Bosch 2001). Along with the one piece reported from Bobila Padro (Ripollet, Barcelona), this area could be considered the end-point of down-the-line obsidian exchange thru southern France, with these pieces being eccentric. The later period find on Mallorca



Figure 4.5. Example of potential exotic obsidian artifacts, from sites (in Corsica and northern Italy) far from the geological sources.

might also be considered eccentric, given the changes in stone tool use by that time, and that this piece was unworked.

Malta

Despite being a small island, at a significant distance south of Sicily and east of Pantelleria, a considerable amount of obsidian artifacts have been found in the excavations at the Neolithic residential site of Skorba, and at the mortuary site of Xaghra (the Brochtorff Circle). While all of the obsidian comes from Pantelleria and Lipari (Trump 1966; Tykot and Trump 2010; Tykot, Stoddart *et al.* 2010), it cannot be directly determined whether obsidian from Pantelleria (or Lipari) reached Malta directly, or via Sicily. Considering that no raw material for making stone tools was available on Malta, and the relatively large quantities of obsidian present, signify that it was not in the eccentric category.

Tunisia and Algeria

In Tunisia and Algeria, relatively little archaeological research has been done on pre-Phoenician sites. A substantial amount of obsidian has been found at an Early Neolithic site on the small island of Zembra, while smaller numbers have been found at several other sites. Visual and chemical analyses identify nearly all

as coming from Pantelleria, with a few from Lipari (Vargo *et al.* 2005; Tykot, unpublished). Based on the currently available data, at least the small number of finds in Algeria and inland/southern Tunisia should be considered as eccentric.

Croatia

As mentioned above, owing to recent fieldwork small amounts of obsidian have been found at a number of sites in Istria, resembling in general the pattern observed for the sites in Trieste (Komšo 2007). The small number of objects, mostly from Lipari but at least one from Carpathia, categorizes these as both exotic and probably eccentric. Further down the Adriatic, significant numbers of obsidian artifacts have been found during excavations at Danilo and Pokrovnik (Moore *et al.* 2007), and on the islands of Palagruza and Sušac (Forenbaher 2007; Bass 2009). So the presence of Lipari obsidian at these sites is only exotic, while the few pieces of obsidian from Carpathian sources may be considered eccentric. The recent identification of a few obsidian artifacts from a Copper Age site on one of the Adriatic islands as coming from Melos (Tykot *et al.*, unpublished data) is especially exceptional, considering the distance involved. Given the overall context and time period, and probable result of down-the-line type exchange, these pieces were probably just eccentric to the people using them.

Other

The only other obsidian from Melos found in the central Mediterranean are a few pieces from unstratified layers at Grotta del Leone (La Croce di Agnano, Pisa) (Bigazzi *et al.* 1986). While most likely Copper Age or later, I would still categorize these finds as eccentric. In recent years, some Lipari obsidian has been identified at A Fuata in Corsica (Le Bourdonnec *et al.* 2010), and a piece of Monte Arci (Sardinia) obsidian found at Pulo di Molfetta (Bari) in southern Italy (Acquafredda and Muntoni 2008). Overall, these eccentric oddities to the regular distribution networks support the hypothesis of non-systematic, down-the-line type exchange systems in the Neolithic central Mediterranean.

Discussion

The relative quantity of obsidian found at sites of differing distances from its source has been used to define fall-off curves which may be characteristic of certain exchange mechanisms of sociopolitical systems. The quantification of obsidian frequency, by number or mass of tools, debitage, and cores relative to other chipped stone tools or other measures of site size, is still theoretically desirable (Ericson and Baugh 1994), although often difficult to apply given the considerable variation in reported

excavation data in the last century (cf. Guidi 1987). Such systematic data is necessary for diachronic and spatial analysis of obsidian use, and an admirable effort has been made for the central Mediterranean by Pollmann (1993) who confirms the empirical hypothesis that obsidian use was greatest during the Middle Neolithic and the early part of the Late Neolithic, with presumed transportation routes and geographic barriers significantly influencing the quantities found.

The identification of centers of redistribution should be made cautiously, however, since the quantity of obsidian found at Pescale in northern Italy (950 pieces) is no longer unusual, or surprising. Hundreds of obsidian artifacts have been found at Fornace Cappuccini-Faenza (Montanari *et al.* 1994), Podere Oliveto and La Puzzolente-Coltano (Cocchi Genick and Sammartino 1983), and extrapolation of the surface finds from Gaione suggest that thousands may be present there in just the plough zone levels (Ammerman *et al.* 1990; Tykot *et al.* 2005).

While privileged access to non-local goods may have enhanced the prestige of local elites, by both the exotic nature of the material and any accompanying exotic or secret knowledge (Renfrew 1993; Helms 1988), there is little evidence at present to indicate that obsidian fulfilled such a role in the prehistoric central Mediterranean. According to the structuralist, prestige-goods economy model, elite sociopolitical status is characterized by control of commodities which are scarce, require specialist production, and/or are associated with more powerful social systems (Baugh and Ericson 1992, 10). During the Early and Middle Neolithic, however, social differentiation within culture groups was minimal, as was any political hierarchy between groups, and it is only in the Late Neolithic – after the zenith of obsidian distribution – that agricultural intensification and an increase in the variety and quantity of material goods in circulation signify the growth of ranking and increased emphasis on prestige goods (Phillips *et al.* 1977; Barker 1981; Shennan 1982; Phillips 1993).

Conclusion

I argue that in the central Mediterranean the presence of obsidian should be interpreted as primarily utilitarian in function, even when found at sufficient distances and in small enough quantities to be considered both exotic and eccentric. The movement of obsidian over great distances resulted from social and multi-level economic interactions, both of which probably had particular local characteristics. The basic exchange systems that existed may be understood as intertwined local networks rather than as a whole world system (cf. Renfrew 1993, 7), and in combination with some direct long-distance contacts – mostly via coastal maritime routes – resulted in the

distribution of mainly raw materials and utilitarian products, although their symbolic value would have been enhanced at great distances from their source. In the Neolithic, domesticated sheep, goat and cattle, and their secondary products, were among the most likely commodities exchanged, especially for Sardinia, Corsica, Malta and other islands, where they must have been intentionally introduced and were a necessary dietary supplement to the limited indigenous fauna (cf. Lewthwaite 1981).

Simultaneously, ethnicity and the maintenance of kin connections are likely to have been significant factors in the creation of preferential social exchange partners, and the importance of alliances and ceremonial behavior in the functioning of exchange networks cannot be underestimated. Fine ceramics, shell and other exotic materials are commonly found in ritual or ceremonial contexts, and these are just the Neolithic commodities that are archaeologically visible (Skeates 1993; Malone 1985). Such occasional ceremonial events may also have provided the main context for repetitive social exchange of obsidian, ground stone axes and other less spectacular materials. Group identity and the maintenance of kin relations would have become important social issues with the changes in mobility due to agricultural sedentism in the Early Neolithic, and widespread exchange networks would have integrated dispersed communities through the common behaviors associated with the exchanged items, especially decorated ceramics and the eating and drinking habits associated with them (Chapman 1988).

In modeling distribution and exchange systems and their endpoints where the objects would be considered exotic or eccentric, it is necessary to go beyond the simple dispersion diagrams showing the geographic extent of a single material's distribution. We must consider the chronology, quantity and quality of the material circulated, the economic and social context(s) in which obsidian and other products were acquired or exchanged, and the particularistic factors of transportation methods and routes, differential use-function and value pertaining to individual prehistoric communities. I agree entirely with Renfrew (1993) and others, who have noted that archaeological artifacts may have a symbolic meaning more significant than their economic value: "La voie de l'obsidienne ainsi repérée sera celle des produits divers, mais également des idées, des hommes" (de Lanfranchi 1987a, 441).

As a pertinent example, in some cases obsidian may have also served an ornamental and even magico-religious function in addition to being used for stone tools. Even in the last century, amulets (*pinnadellu*) that offered protection from the evil eye (*s'ogu*) were commonly worn in Sardinia, some with obsidian incorporated in their design known as *sa perda de tronnu* – rock of thunder (Cabiddu 1965, 248; Tavera 1987, 170–171;

Contu 1990–91, 248; Liori 1992, 246–247). It is, of course, impossible to project such a use backward several thousand years in time, without archaeological finds in an appropriate context followed by reduction, typology and use-wear analyses, but it is not unreasonable to suppose that sometimes obsidian was used for symbolic or ornamental purposes, including jewellery that might have been worn only on special occasions.

We must therefore be cautious in our extraction of economic and social information from lithic distribution patterns, but it is certainly a worthwhile endeavor. Characterization alone is not enough; the derivation of structured models that integrate social and utilitarian function within specific exchange systems are necessary to fully interpret "trade" in ancient societies. The extent and significance of obsidian distribution to the perimeters of the central Mediterranean sources are still being refined, but it is clear that comprehensive sourcing of obsidian assemblages provides a different yet clearer picture of source exploitation, production and exchange than does selective analyses of small numbers of artifacts, especially at great distances from their origins. Analyses of large numbers of artifacts permits control at least at the site level, and therefore insight into dynamic changes in obsidian source selection. Provenance studies continue, therefore, to make significant contributions to our understanding of Neolithic economic and sociobehavioral systems, especially when obsidian artifacts found far from their geological source may be considered exotic or eccentric in nature.

Bibliography

- Acquafredda, P. and Muntoni Italo, M. 2008. Obsidian from Pulo di Molfetta (Bari, Southern Italy): Provenance from Lipari and first recognition of a neolithic sample from Monte Arci (Sardinia). *Journal of Archaeological Science* 35, 947–955.
- Ammerman, A.J., Cesana, A., Polglase, C. and Terrani, M. 1990. Neutron activation analysis of obsidian from two neolithic sites in Italy. *Journal of Archaeological Science* 17(2), 209–220.
- Barca, D., de Francesco, A. M., Crisci, G. M., Tozzi, C. and Bucci, Ponte P. 2008. Provenance of obsidian artifacts from site of Colle Cera, Italy, by LA-ICP-MS method. *Journal of Archaeological Science* 35, 41–52.
- Barker, G. 1981. *Landscape and Society. Prehistoric Central Italy*. London, Academic Press.
- Bass, B. 2009. Early Neolithic communities in southern Dalmatia: Farming seafarers or seafaring farmers? *European Journal of Archaeology* 11(2–3), 245–265.
- Baugh, T. G. and Ericson, J. E. 1992. Trade and exchange in a historical perspective. In J. E. Ericson and T. G. Baugh (eds), *The American Southwest and Mesoamerica. Systems of Prehistoric Exchange*, 3–20. New York, Plenum.
- Beck, C. and Shennan, S. 1991. *Amber in Prehistoric Britain*. Oxbow Monograph 8. Oxford, Oxbow Books.

- Biagi, P., Maggi, R. and Nisbet, R. 1990. Liguria: 9,000–5,000 BC. In C. Bonsall (ed.), *The Mesolithic in Europe*, 533–540. Edinburgh, IIIrd International Symposium on the Mesolithic.
- Bigazzi, G. and Radi, G. 1996. Prehistoric exploitation of obsidian for tool making in the Italian peninsula: a picture from a rich fission-track data-set. In Arias, C., Bietti, A. Castelletti, L. and Peretto, C. (eds), *XIII International Congress of Prehistoric and Protohistoric Sciences-Forlì-Italia-8/14 September 1996*, 1, 149–156. Forlì, A.B.A.C.O.
- Bigazzi, G., Meloni, S., Oddone, M. and Radi, G. 1986. Provenance studies of obsidian artifacts: trace elements analysis and data reduction. *Journal of Radioanalytical and Nuclear Chemistry* 98(2), 353–63.
- Binder, D. and Perlès, C. 1990. Stratégies de gestion des outillages lithiques au Néolithique. *Paléo* 2, 257–283.
- Binder, D. 1987. *Le Néolithique Ancien Provençal. Typologie et Technologie des Outillages Lithiques*. Gallia Préhistoire Supplement 24. Paris, C.N.R.S.
- Binford, L. R. 1979. Organization and formation processes: looking at curated technologies. *Journal of Anthropological Research* 35(3), 255–273.
- Bosch, J. 2001. Unes ofrenes funeràries neolítiques excepcionals trobades a Gavà. *La Plana del Baix Llobregat. Museu de Gavà* 25, 1.
- Cabiddu, G. 1965. *Usi, Costumi, Riti, Tradizioni Popolari della Trexenta*. Cagliari.
- Camps, G. 1976a. La question des navigations préhistoriques dans le bassin occidental de la Méditerranée. *Comptes Rendus, Congrès Préhistorique de France* 20, 53–65.
- Camps, G. 1976b. La navigation en France au Néolithique et à l'âge de Bronze. *Archéologia Corsa* 1, 113–130.
- Cann, J. R. and Renfrew, C. 1964. The characterization of obsidian and its application to the Mediterranean region. *Proceedings of the Prehistoric Society* 30, 111–133.
- Champion, T. C. 1989. Introduction. In T. C. Champion (ed.), *Centre and Periphery: Comparative Studies in Archaeology*, 1–21. London, Unwin Hyman.
- Chapman, J. C. 1988. Ceramic production and social differentiation: the Dalmatian neolithic and the western Mediterranean. *Journal of Mediterranean Archaeology* 1(2), 3–25.
- Cocchi Genick, D. and Sammartino, F. 1983. L'ossidiana utilizzata nelle industrie preistoriche del livornese. *Quaderni del Museo di Storia Naturale di Livorno* 4, 151–161.
- Contu, E. 1990–91. L'ossidiana e la selce della Sardegna e la loro diffusione. *Origini* 15, 241–253.
- Courtin, J. 1967. Le probleme de l'obsidienne dans le Néolithique du Midi de la France. *Rivista di Studi Liguri* 33, 93–109.
- Crisci, G. M., Ricq-de Bouard, M., Lanzaframe, U. and de Francesco, A. M. 1994. Nouvelle méthode d'analyse et provenance de l'ensemble des obsidiennes néolithiques du Midi de la France. *Gallia Préhistoire* 36, 299–309.
- de Lanfranchi, F. 1987. Le néolithique de Curacchiaghiu. Position chronologique et culture matérielle. Son importance dans l'ensemble corso-sarde. In J. Guilaine, J. Courtin, J.-L. Roudil and J.-L. Vernet (eds), *Premières Communauté Paysannes en Méditerranée Occidentale. Actes du Colloque International du C.N.R.S., Montpellier, 26–29 avril 1983*, 433–442. Paris, C.N.R.S.
- de Francesco, A. M. and Crisci, G. M. 2000. Provenienza delle ossidiane dei siti archeologici di Pianosa (Arcipelago Toscano) e Lumaca (Corsica) con il metodo analitico non distruttivo in fluorescenza X. In C. Tozzi and M. C. Weiss, (eds), *Il primo popolamento Olocenico dell'area corso-toscana*, 253–58. Pisa, Edizioni ETS.
- de Francesco, A. M., Crisci, G. M. and Bocci, M. 2008. Non-destructive analytic method using XRF for determination of provenance of archaeological obsidians from the Mediterranean area: a comparison with traditional XRF methods. *Archaeometry* 50(2), 337–350.
- Demoule, J.-P. and Perlès, C. 1993. The Greek Neolithic: a new review. *Journal of World Prehistory* 7(4), 355–416.
- Ericson, J. E. and Baugh, T. G. 1994. Systematics of the study of prehistoric regional exchange in North America. In T. G. Baugh and J. E. Ericson (eds), *Prehistoric Exchange Systems in North America*, 3–15. New York, Plenum Press.
- Forenbaher, S. 2007. Adriatic offshore islands and long-distance interaction in prehistory. Presented at the 13th Annual Meeting of the European Association of Archaeologists, Zadar, Croatia.
- Francaviglia, V. and Piperno, M. 1987. La repartition et la provenance de l'obsidienne archéologique de la Grotta dell'Uzzo et de Monte Cofano (Sicile). *Revue d'Archéométrie* 11, 31–39.
- Guidi, A. 1987. The development of prehistoric archaeology in Italy: a short review. *Acta Archaeologica* 58, 237–247.
- Hallam, B. R., Warren, S. E. and Renfrew, C. 1976. Obsidian in the western Mediterranean: characterisation by neutron activation analysis and optical emission spectroscopy. *Proceedings of the Prehistoric Society* 42, 85–110.
- Helms, M. W. 1988. *Ulysses' Sail. An Ethnographic Odyssey of Power, Knowledge, and Geographical Distance*. Princeton, Princeton University Press.
- Komšo, D. 2007. Changes in seafaring and use of the sea from Paleolithic to Neolithic: a view from Istria. Presented at the 13th Annual Meeting of the European Association of Archaeologists, Zadar, Croatia.
- Le Bourdonnec, F.-X., Bontempi, J.-M., Marini, N., Mazet, S., Neuville, P. F., Poupeau, G. and Sicurani, J. 2010. SEM-EDS characterization of western Mediterranean obsidians and the Neolithic site of A Fuata (Corsica). *Journal of Archaeological Science* 37, 92–106.
- Leighton, R. 1992. Stone axes and exchange in south Italian prehistory: new evidence from old collections. *Accordia Research Papers* 3, 11–40.
- Lewthwaite, J. 1981. Plain tails from the hills: Transhumance in Mediterranean archaeology. In A. Sheridan and G. Bailey (eds), *Economic Archaeology*. BAR International Series 96, 57–66. Oxford, British Archaeological Reports.
- Liori, A. 1992. *Demoni, Miti e Riti Magici della Sardegna. Un Viaggio Affascinante e Singolare tra i Misteri Millenari di una Regione Straordinariamente Ricca di Tradizioni*. Roma, Newton Compton.
- Luglie, C., Le Bourdonnec, F.-X., Poupeau, G., Congia, C., Moretto, P., Calligaro, T., Sanna, I. and Dubernet, S. 2008. Obsidians in the Rio Saboccu (Sardinia, Italy) campsite:

- Provenance, reduction and relations with the wider Early Neolithic Tyrrhenian area. *C. R. Palevol* 7, 249–258.
- Luglie, C., Le Bourdonnec, F.-X., Poupeau, G., Atzeni, E., Dubernet, S., Moretto, P. and Serani, L. 2007. Early neolithic obsidians in Sardinia (western Mediterranean): the Su Carroppu case. *Journal of Archaeological Science* 34, 428–439.
- Malone, C. 1985. Pots, prestige and ritual in Neolithic southern Italy. In C. Malone and S. Stoddart (eds), *Papers in Italian Archaeology IV: The Cambridge Conference. 2: Prehistory*. BAR International Series 244, 118–151. Oxford, British Archaeological Reports.
- Montanari, G., Bermond, Massi Pasi, M. and Mengoli, D. 1994. L'insediamento neolitico di Fornace Cappuccini di Faenza (Ravenna). Campagna di scavo 1990. *Preistoria Alpina* 27(1991), 173–195.
- Moore, A., Smith, J., Mendusic, M. and Podrug, E. 2007. Project “Early Farming in Dalmatia”: Danilo Bitinji 2004–2005. *Vjesnik Arheoloskog muzeja u Zagrebu [Journal of the Zagreb Archaeological Museum]* XL, 15–24.
- Perlès, C. 1990. L'outillage de pierre taillée néolithique en Grèce: approvisionnement et exploitation des matières premières. *Bulletin de Correspondance Hellénique* 114, 1–42.
- Perlès, C. 1992. Systems of exchange and organization of production in neolithic Greece. *Journal of Mediterranean Archaeology* 5, 115–164.
- Phillips, P. 1993. Produzione e commercio nell'Europa del Neolitico. In J. Guilaine and S. Settis (eds), *Storia d'Europa. Volume Secondo: Preistoria e Antichità*, 249–279. Torino, Giulio Einaudi.
- Phillips, P. 1986. Sardinian obsidian and neolithic exchange in the west Mediterranean. In M. S. Balmuth (ed.), *Studies in Sardinian Archaeology, Volume II*, 203–209. Ann Arbor, University of Michigan Press.
- Phillips, P. 1992. Obsidian distribution and the European neolithic. In R. H. Tykot and T. K. Andrews (eds), *Sardinia in the Mediterranean: A Footprint in the Sea. Studies in Sardinian Archaeology Presented to Miriam S. Balmuth*. Monographs in Mediterranean Archaeology 3, 71–82. Sheffield, Sheffield Academic Press.
- Phillips, P., Aspinall, A. and Feather, S. 1977. Stages of ‘neolithisation’ in southern France. *Proceedings of the Prehistoric Society* 43, 303–316.
- Pollmann, H.-O. 1993. *Obsidian im nordwestmediterranean Raum. Seine Verbreitung und Nutzung im Neolithikum und Äneolithikum*. BAR International Series 585. Oxford, Tempus Reparatum.
- Poupeau, G., Bellot-Gurlet, L., Brisotto, V., and Dorigel, O. 2000. Nouvelles données sur la provenance de l'obsidienne des sites néolithiques du sud-est de la France. *Sciences de La Terre et des Planètes* 330, 297–303.
- Randle, K., Barfield, L. H. and Bagolini, B. 1993. Recent Italian obsidian analysis. *Journal of Archaeological Science* 20, 503–9.
- Renfrew, C. 1965. Obsidian in the Aegean. *Annual of the British School at Athens* 60, 225–247.
- Renfrew, C. 1969. Trade and culture process in European prehistory. *Current Anthropology* 10, 151–160.
- Renfrew, C. 1972. *The Emergence of Civilisation*. London: Methuen.
- Renfrew, C. 1977. Alternative models for exchange and spatial distribution. In T. E. Earle and J. E. Ericson (eds), *Exchange Systems in Prehistory*, 71–90. New York, Academic Press.
- Renfrew, C. 1986. Introduction: Peer polity interaction and socio-political change. In C. Renfrew and J. F. Cherry (eds), *Peer Polity Interaction and Socio-political Change*, 1–18. Cambridge, Cambridge University Press.
- Renfrew, C. 1993. Trade beyond the material. In C. Scarre and F. Healy (eds), *Trade and Exchange in Prehistoric Europe*. Oxbow Monograph 33, 5–16. Oxford, Oxbow Books.
- Renfrew, C., Cann, J. R. and Dixon, J. E. 1965. Obsidian in the Aegean. *Annual of the British School at Athens* 60, 225–247.
- Rosen, S. A., Tykot, R. H. and Gottesman, M. 2005. Long distance trinket trade: Early Bronze Age obsidian from the Negev. *Journal of Archaeological Science* 32, 775–784.
- Shennan, S. J. 1982. The emergence of hierarchical structure. In C. Renfrew and S. J. Shennan (eds), *Ranking, Resource and Exchange: Aspects of the Archaeology of Early European Society*, 9–12. Cambridge, Cambridge University Press.
- Sidrys, R. 1977. Mass-distance measures for the Maya obsidian trade. In T. K. Earle and J. E. Ericson (eds), *Exchange Systems in Prehistory*, 91–107. New York, Academic Press.
- Skeates, R. 1993. Neolithic exchange in central and southern Italy. In C. Scarre and F. Healy (eds), *Trade and Exchange in Prehistoric Europe. Proceedings of a Conference held at the University of Bristol, April 1992*. Oxbow Monograph 33, 109–114. Oxford, Oxbow Books.
- Tavera, A. 1987. La gioielleria. Ornamento, magia, devozione. In *Il Museo Etnografico di Nuoro*, 131–182. Sassari, Banco di Sardegna.
- Torrence, R. 1986. *Production and Exchange of Stone Tools: Prehistoric Obsidian in the Aegean*. Cambridge, Cambridge University Press.
- Trump, D. H. 1966. *Skorba and the Prehistory of Malta*. Oxford, England, University Press.
- Tykot, R. H. 1996a. Obsidian procurement and distribution in the central and western Mediterranean. *Journal of Mediterranean Archaeology* 9, 39–82.
- Tykot, R. H. 1996b. The geological source of an obsidian Ear (04.1941) from the Museum of Fine Arts, Boston. *Revue d'Égyptologie* 47, 177–179.
- Tykot, R. H. 1999. Islands in the stream: Stone age cultural dynamics in Sardinia and Corsica. In R. H. Tykot, J. Morter and J. E. Robb (eds), *Social Dynamics of the Prehistoric Central Mediterranean*. London: Accordia Research Institute, University of London. Accordia Specialist Studies on the Mediterranean 3, 67–82.
- Tykot, R. H. 2002a. Chemical fingerprinting and source-tracing of obsidian: the central Mediterranean trade in black gold. *Accounts of Chemical Research* 35, 618–627.
- Tykot, R. H. 2002b. Geochemical analysis of obsidian and the reconstruction of trade mechanisms in the Early Neolithic period of the western Mediterranean. *American Chemical Society Symposium Series* 831, 169–184.
- Tykot, R. H. 2003. Determining the source of lithic artifacts and reconstructing trade in the ancient world. In P. N.

- Kardulias and R. W. Yerkes (eds), *Written in Stone: The Multiple Dimensions of Lithic Analysis*, 59–85. Maryland: Lexington Books.
- Tykot, R. H. 2004a. Scientific Methods and Applications to Archaeological Provenance Studies. In M. Martini, M. Milazzo and M. Piacentini (eds), *Physics Methods in Archaeometry. Proceedings of the International School of Physics "Enrico Fermi" Course CLIV*, 407–432. Bologna, Italy, Società Italiana di Fisica.
- Tykot, R. H. 2004b. L'esatta provenienza dell'ossidiana e i modelli di diffusione nel Mediterraneo central durante il Neolitico. In *L'ossidiana del Monte Arci nel Mediterraneo: recupero dei valori di un territorio* (a cura di P. Castelli, B. Cauli, F. Di Gregorio, C. Lugliè, G. Tanda and C. Usai), 118–132. Tipografia Ghilarzese, Ghilarza.
- Tykot, R. H. 2010. Sourcing of Sardinian obsidian collections in the Museo Preistorico-Etnografico 'Luigi Pigorini' using non-destructive portable XRF. In C. Lugliè (ed.), *L'ossidiana del Monte Arci nel Mediterraneo. Nuovi apporti sulla diffusione, sui sistemi di produzione e sulla loro cronologia*. Atti del 5° Convegno internazionale (Pau, Italia, 27–29 Giugno 2008), 85–97. NUR, Ales.
- Tykot, R. H. and Ammerman, A. J. 1997. New directions in central Mediterranean obsidian studies. *Antiquity* 71(274), 1000–1006.
- Tykot, R. H., Ammerman, A. J., Bernabò Brea, M., Glascock, M. D. and Speakman, R. J. 2005. Source analysis and the socioeconomic role of obsidian trade in northern Italy: new data from the Middle Neolithic site of Gaione. *Geoarchaeological and Bioarchaeological Studies* 3, 103–106.
- Tykot, R. H., Glascock, M. D., Speakman, R. J. and Atzeni, E. 2008. Obsidian subsources utilized at sites in southern Sardinia (Italy). In P. B. Vandiver, B. McCarthy, R. H. Tykot, J. L. Ruvalcaba-Sil and F. Casadio (eds), *Materials Issues in Art and Archaeology VIII*. Materials Research Society Symposium Proceedings 1047, 175–183.
- Tykot, R. H., Iovino, M. R., Martinelli, M. C. and Beyer, L. 2006. Ossidiana da Lipari: le fonti, la distribuzione, la tipologia e le tracce d'usura. *Atti del XXXIX Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria: Materie prime e scambi nella preistoria italiana, Firenze, 25–27 November 2004*, 592–597. Firenze.
- Tykot, R. H., Lai, L. and Tozzi, C. 2010. Intra-site obsidian subsurface patterns at Contraguda, Sardinia (Italy). *Proceedings of the 37th International Symposium on Archaeometry, Siena, Italy, May 12–16, 2008*.
- Tykot, R. H., Lugliè, C., Setzer, T. and Tanda, G. 2006. A Preliminary Report on the Survey and Excavations (2002–2006) of the Obsidian Workshop at Sennixeddu (Sardinia, Italy). Presented at the XVth Congress of the International Union for Prehistoric and Protohistoric Sciences, Lisboa, Portugal.
- Tykot, R. H., Setzer, T., Glascock, M. D. and Speakman, R. J. 2005. Identification and characterization of the obsidian sources on the island of Palmarola, Italy. *Geoarchaeological and Bioarchaeological Studies* 3, 107–111.
- Tykot, R. H., Stoddart, S., Malone, C., Trump, D. S. and Bonanno, A. 2010. Analysis of obsidian from the Brochtorff Circle (Malta): Contacts and trade in the central Mediterranean islands. Presented at the 111th Annual Meeting of the Archaeological Institute of America, Anaheim, CA, January 6–9, 2010. Abstract published in *Archaeological Institute of America 111th Annual Meeting Abstracts* 33, 23.
- Tykot, R. H. and Trump, D. 2010. Subsource specific sourcing of Skorba (Malta) obsidian. Presented at the 38th International Symposium on Archaeometry, Tampa, Florida.
- Vaquer, J. 1990. *Le Néolithique en Languedoc Occidental*. Paris, C.N.R.S.
- Vargo, B., Tykot, R. H., Glascock, M. and Speakman, R. J. 2005. Source analysis of obsidian artifacts from Pantelleria (Italy) and Tunisia. Presented at the 70th Annual Meeting of the Society for American Archaeology, Salt Lake City, Utah. Abstract published in *International Association for Obsidian Studies Bulletin* 33 (2005), 14.
- Waldren, W. H. 1982. *Balearic Prehistoric Ecology and Culture: The Excavation and Study of Certain Caves, Rock Shelters and Settlements*. BAR International Series 149. Oxford.
- Williams-Thorpe, O. 1995. Obsidian in the Mediterranean and the Near East: a provenancing success story. *Archaeometry* 37, 217–248.
- Williams-Thorpe, O., Warren, S. E. and Barfield, L. H. 1979. The distribution and sources of archaeological obsidian from Northern Italy. *Preistoria Alpina* 15, 73–92.
- Williams-Thorpe, O., Warren, S. E. and Courtin, J. 1984. Sources of archaeological obsidian from Southern France. *Journal of Archaeological Science* 11, 135–146.