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EARLY PREHISTORIC NAVIGATION IN THE WESTERN MEDITERRANEAN: IMPLICATIONS FOR THE NEOLITHIC TRANSITION IN IBERIA AND THE MAGHREB

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Abstract

Early Neolithic sea voyaging and organized colonization of large islands involving crossings in the range of 100 km are well documented in the Eastern and Central Mediterranean. In the west, the distribution of obsidian from Tyrrhenian sources and the lack of human settlement in the Balearic archipelago until later prehistoric times suggest a pattern of contact, exchange and dispersal where navigation would have been restricted to small-scale, in-sight-of-land crossings and cabotage journeys. For the spread of farming into Iberia to have followed a North African route, the path of entry must therefore have been the Straits of Gibraltar, which presupposes an earlier emergence of the Neolithic in the Maghreb, where the associated impressed ware material culture in turn implies an ultimate origin in southern Italy and, therefore, the crossing of the Siculo-Tunisian Strait. In North Africa, however, the earliest directly dated domesticates post-date by several centuries similar evidence from Valencia, Andalucía and Portugal, while the presence of Pantelleria obsidian in the nearest mainlands substantiates prehistoric navigation between Europe and Africa in the central Mediterranean after ~7000 cal BP, only at a time when farming economies were already several centuries old in Iberia. The material culture similarities perceived in the Early Neolithic of southern Iberia and the Maghreb may indicate a North-to-South diffusion of farming across the Straits of Gibraltar but not the reverse.

Key words: Obsidian, Mesolithic, Cardial, Impressa, Sheep, Lentils, Radiocarbon

INTRODUCTION

The geographic location of Iberia means that it represents the westernmost cul-de-sac for any historic process involving the diffusion, trade or migration of ideas, objects and people with ultimate origin in Southwest Asia. As such, Iberia plays per force a key role in the testing of models related to the corresponding rhythms and mechanisms. Where the emergence of farming economies in Europe is concerned, this was well apparent in the debate that followed the proposition of Ammerman and Cavalli-Sforza’s (1973) Wave of Advance. Initially, the discussions implicitly or explicitly assumed an essentially land-based process, even though, in at least the case of Britain, Ireland and the large Mediterranean islands, sea crossings were evidently implicated and, for southern France and Iberia, the possibility of a maritime spread was envisaged early on (e.g., Lewthwaite, 1986).

In recent years, it has become clear that sea voyaging may well have deep pre-Neolithic roots in the Eastern Mediterranean (for a review, cf. Ammerman, 2010). Were the same to be true in the West, ponderous consequences would ensue for models of the emergence of farming, given that (a) diffusion and migration can occur much more rapidly over open water than across mountain ranges and closed forests, (b)
the precision of radiocarbon dating in this time range implies that regional time lags below the one hundred year threshold are unlikely ever to be resolved, and (c) apparent synchronicity and overall similarity in material culture can lead to issues of equifinality when assessing specific historical scenarios concerning the origins of and the routes followed by the domesticates and the diagnostic artifact categories first encountered in the archeological record of a given time/place. For Iberia in particular, the hypothesis of pre-Neolithic sea voyaging in the Gulf of Lyon and the Alboran Sea opens the possibility that the novel resources associated with the emergence of farming economies were introduced through a Northern African pathway.

Based on a review of the relevant evidence, namely the distribution of the obsidian from island sources in mainland sites either side of the Western Mediterranean, it is the odds that this “African Mirage” (Manen et al., 2007) can be turned into a valid working hypothesis that this paper will address. The implications are important, and not just for the Iberian process: if the answer is yes, new light will also be shed on the possibility of a precocious acquisition of “Neolithic” innovations by “Mesolithic” peoples along the islands and coasts of the Tyrrhenian and Ligurian Seas, a possibility that has long been the backdrop for adoptionist views of the spread of farming across the European continent as a whole.

THE TERMS OF THE IBERIAN DEBATE

Where Iberia is concerned, indigenist/adoptionist views of the spread of farming economies have tended to assume that the implicated innovations emerged among, or were acquired by local Mesolithic people in the context of trans-Pyrenean networks of contact, exchange and diffusion uniting the peninsula to France and beyond. Such an overland dispersal of farming would be the parsimonious reading of the evidence under certain empirical settings. For instance, if (a) the Neolithic were as early in the interior as in the littoral areas of Iberia, (b) elements of its artifactual and/or subsistence package were diffused to the Mesolithic populations of the interior at the same time as, if not even earlier than the time of establishment of the first agricultural settlements of the Mediterranean coast (which current evidence places in the middle of the eight millennium cal BP), and (c) a Mesolithic occupation of Iberia’s hinterland existed to begin with.

That these conditions are verified in the archeological record has indeed been claimed, most recently on the basis of the putative presence of pottery and/or domesticates around or prior to 8000 cal BP in a few sites of the upper Ebro valley, namely, Mendandia (Euskadi), and La Lámpara and La Revilla (Soria) (Alday, 2007; Rojo et al., 2008). This evidence, however, is controversial, and the indigenist/adoptionist interpretation of the archeological patterns observed at these sites has been questioned by critical reviews (e.g., Zilhão, 2011).

The mechanism supported by migrationist views is instead one whereby Mediterranean sea routes play a key role in the encroachment of groups of farmers that create from scratch new village settlements in Mesolithic territory. In one such model, Maritime Pioneer Colonization (Zilhão, 2001), the process advances via the leap-frog dispersal of farming groups into empty areas located between the nodes of Mesolithic occupation known along the northern shores of the Western Mediterranean. Alternatively, it has been hypothesized that the farming economies of southern and Western Iberia originate in South-North crossings of the Straits of Gibraltar, which, in turn, presupposes an earlier emergence of the Neolithic in the Maghreb, where, given perceived similarities in ceramic typology, it would have arrived from Sicily (Manen et al., 2007; Marchand and Manen, 2010). Taking the argument one step further, one might then suggest that such Early Neolithic crossings used sea paths first tread during the preceding Mesolithic, thus opening an escape route for indigenist/adoptionist views of the process — instead of arriving first in the upper Ebro through Pyrenean bypasses, innovations could have made their way up the valley from sources along the Catalanian coast, to where they would have been brought by local fisher-hunter-gatherers that had acquired them in the context of a Western Mediterranean-wide network of Mesolithic sea trading.
Support for maritime dispersal and/or exchange in any of these flavors requires evidence that navigation capabilities both existed and were called upon as part of the process, with the nature of the specific sea route or routes in operation being a subordinate issue. Thus, in the following, I will begin with a review of the evidence concerning navigation in the Western Mediterranean, and will then return to Iberia and the Maghreb to consider the implications of that evidence for the neolithization of the peninsula and the other side of the Straits of Gibraltar.

**EARLY NEOLITHIC NAVIGATION IN THE MEDITERRANEAN**

As recently reviewed by Ammerman (2010, 2011), the presence of obsidian from Melos in Mesolithic sites from other Aegean islands (e.g., Youra and Kythnos) and also from mainland Greece (Franchthi) implies routine navigation across open seas in pre-Neolithic times, possibly as early as the 12th millennium cal BP. The settlement of Cyprus and Crete shows that, soon after, navigation skills had already improved to the point of enabling eastern Mediterranean early farmers to undertake colonizing expeditions involving deep planning and the transportation of groups of people and cargo over maritime crossings in the range of 50 to 100 km (Broodbank and Strasser, 1991; Vigne and Cucchi, 2005). Moreover, on Cyprus, the populations of domestic mice introduced alongside the Neolithic package maintained morphological similarity with those from the Levant over the subsequent millennia, indicating sustained genetic flow and, therefore, a pattern of regular boat traffic with the mainland. The navigation knowledge and equipment documented in the Aegean must also have been a prerequisite for the colonization of Malta (Evans, 1977; Robb, 2001; Malone, 2003) in the Central Mediterranean. Here, the decorative patterns of the impressed ceramics from the earliest Neolithic (as documented at the key cave site of Ghar Dalam) allow us to trace the island’s initial settlers to the Stentinello culture of Sicily and Calabria, implying a sea crossing of ~80 km.

Further to the West, however, the pattern is different. Firstly, no obsidian from the Tyrrhenian islands has ever been found in Mesolithic sites of mainland Italy (Ammerman, 2010). Secondly, such large islands as the Balearics remained uninhabited during the Neolithic (Ramis et al., 2002). This is despite the distance between Ibiza and the adjacent Spanish coast being similar to that separating Crete from the southern tip of the Peloponnese and the sea crossing from Ibiza to Mallorca being about the same. On the other hand, the coastal location of the earliest Neolithic settlements and the presence in sites from mainland Italy, southern France and Catalonia of island resources, namely obsidian from Lipari and Sardinia (Tykot, 1996, 1997), are consistent with colonization via sea routes.

Clarification of this apparent conundrum comes from consideration of the spatial and economic properties of the distribution of the Lipari material. In the Early Neolithic, its obsidian is ubiquitous around the coasts of the Tyrrhenian Sea, but has never been found in the coeval sites of Sardinia and Corsica, and is absent from the corresponding levels of the Arenes Candide stratigraphic sequence (where, in contrast, it becomes dominant in the Late Neolithic; Tykot and Ammerman, 1997; Ammerman 2010). Moreover, the amounts recovered and the parts of the chaîne opératoire represented in the French sites indicate that it circulated by down-the-line exchange and/or the movement of persons transporting individual toolkits (Tykot, 2002; Lugliè, 2009). Combined, this evidence suggests that, in the Western Mediterranean, the maritime dispersal of farming and farmers was effected by cabotage over coastal waters and involved short mainland-island or island-island crossings but not targeted landfalls in previously reconnoitered territories located across significant expanses of open sea.

Direct evidence that vessels sufficiently seaworthy for such a navigation existed at this time is provided by the >10 m–long dugout canoe found in 1993 in the submerged lakeside dwelling of La Marmotta, near Rome, where coupled tree-ring and radiocarbon dating of house posts places the occupation in the middle of the 6th millennium BC (Fugazzola-Delpino et al., 1993; Fugazzola-Delpino and Mineo, 1995; Kromer, 2009). In 1998, a replica built by Czech archaeologists was navigated from Sicily to
By fastening two such canoes with planks to form a catamaran akin to those used a few millennia later by the Stone Age farmers who colonized islands of the Pacific (separated by sea crossings several times longer than those involved in the Western Mediterranean story; Irwin, 1992), substantial amounts of cargo could have been effectively transported over cabotage routes. Moreover, many ethnographic examples exist to show that, in calm seas, rafts capable of transporting 150 to 200 kg of cargo suffice to move around over short distances the number of humans and the amount of grain and live animals necessary to form a pioneer agricultural settlement (Vigne & Cucchi, 2005).

If we bear in mind the archaeological evidence from the Languedocian site of Pont de Roque-Haute, strongly suggestive of it having been a beachhead for people coming directly from Italy (and where the obsidian finds have been traced to Palmarola), these pioneer colonists may have enhanced the chances of success by travelling as light as possible, namely, by reducing the range of initially transplanted animals to only sheep and goats (Guilaine and Manen, 2007; Tresset and Vigne, 2007).

Bearing the above in mind, Neolithic agriculturalists of the coastal Maghreb undergoing expansion to adjacent areas, namely Iberia, would have found the 10-15 km of the Straits of Gibraltar to be a trivial distance. However, as currently formulated, the hypothesis that the Iberian Neolithic spread northward across the Straits is based on the notion that a crossing of a different order of magnitude, that from Sicily to Tunisia and Sicily, whence it would have spread as far from its source as the islands of Malta and Lampedusa (Vargo, 2003). If such claims could be verified, we would be forced to conclude that Central Mediterranean sea crossings between Europe and Africa did occur at this time, and the littoral Maghreb would indeed have to be considered as a possible route for the spread of the Neolithic, or of its technological and economic novelties, into Southern and Western Iberia.

With current evidence, Pantelleria does not seem to have been settled before the Bronze Age. It is often assumed, however, that quarrying of its obsidian must have begun much earlier, as the stuff is reportedly represented in stone tool inventories from the Epipaleolithic and the Early Neolithic of Tunisia and Sicily, whence it would have spread as far from its source as the islands of Malta and Lampedusa (Vargo, 2003). If such claims could be verified, we would be forced to conclude that Central Mediterranean sea crossings between Europe and Africa did occur at this time, and the littoral Maghreb would indeed have to be considered as a possible route for the spread of the Neolithic, or of its technological and economic novelties, into Southern and Western Iberia.

The imprecision of the data, however, makes it difficult for an independent observer to assess the validity of the association of the items made of Pantelleria obsidian with the contexts where they are supposed to come from and/or the dates obtained for such contexts. Where Sicily is concerned, the evidence consists entirely of material from the Grotta dell’Uzzo (Tykot, 1996; Malone, 2003). Well known for its Early Mesolithic habitation and burial contexts, the upper reaches of this site’s stratigraphy are, however, controversial. It is claimed that, after a “transitional” Mesolithic-Neolithic level dated to between 7000 and 6600 BC and characterized by the presence of decorated pottery in an otherwise purely Mesolithic hunter-gatherer context, two Early Neolithic occupation horizons exist—the earliest ranging from 7800 to 7600 cal BP and the youngest from 7650 to 7500 BC (much of this has been questioned in the more recent literature; Mannino et al. 2007). It is further claimed that obsidian is present throughout the Neolithic levels and that 40% of the 152 items analyzed are from Pantelleria.
The presence of Cardial pottery in the Mesolithic levels of Uzzo, however, indicates that the sequence underwent unrecognized post-depositional disturbance at the Mesolithic-Neolithic interface. This fact casts doubt (a) on the extent to which the recovered obsidian is associated with the Neolithic from its beginnings or only with the youngest occupation horizons, and (b) on the reliability of the charcoal dates used to establish the chronology of the site’s Geometric Cardial facies (P-2733, 6750±70 BP or, at 2σ, 7717-7480 cal BP; P-2734, 7910±70 BP or, at 2σ, 8992-8592 cal BP). Moreover, the Early Neolithic culture-historical sequences of Sicily and Southern Italy follow in parallel (Malone, 2003), and the obsidian from Lipari is widespread in mainland Italy. From this ubiquity, one can infer the existence of extensive networks of raw-material circulation encompassing both sides of the Strait of Messina; therefore, if obsidian from Pantelleria had made its way into Sicily at the time indicated by the Uzzo dates above, one would expect it to have been distributed into (and to have been found on) the mainland side too, even if in small amounts. However, that is not the case. The earliest recorded occurrence of Pantelleria obsidian in continental Italy is at the site of Villa Badesso, in the province of Pescara (Tykot, 1996), which belongs to the Catignano culture dated to the 7000-6500 cal BP interval.

Along the coast and adjacent hinterland of Valencia and Andalucía, however, agro-pastoral economies are securely documented from ~7500 cal BP (Bernabeu et al., 2009). Therefore, by the time when the presence in Italy of obsidian from Pantelleria (and, by implication, sea crossings to the island and, possibly, beyond it to North Africa) are ascertained, farming had already existed in Eastern and Southern Iberia for more than half a millennium, making the establishment
of a route of diffusion and/or migration between Sicily and Tunisia irrelevant to explain its emergence. However, the notion that Pantelleria obsidian is present in Epipaleolithic sites of the Eastern Maghreb (Camps, 1964) could still salvage the African hypothesis for the emergence of the Neolithic in Iberia under scenarios of independent invention or local adoption. For instance, maritime hunter-gatherer societies from around the shores of Cape Bon possessing the advanced navigation skills proved by the capacity to acquire that obsidian could likewise have obtained domesticates and pottery from distant sources at a relatively early date, spreading them westward and, eventually, northward too, across the Straits of Gibraltar.

A recent study of the prehistoric obsidian from Tunisia (Mulazzani et al., 2010), however, sheds considerable doubt on the reliability of the evidence, consisting for the most part of surface finds, upon which hangs the archeological reality of the pre-Neolithic quarrying of Pantelleria obsidian by people coming from Northern Africa. There are only three instances where that obsidian has been found in stratified archeological contexts. One is Doukanet el Kouïfa, where the context is described as Neolithic and three out of four radiocarbon dates on charcoal place it in the 7300-6700 cal BP interval (i.e., in the time range of the first occurrence of Pantelleria obsidian in mainland Italy). The other is Kef Hamda, where the obsidian is associated with dates in the 9000-7000 cal BP range. In both cases, however, the finds were made in escargotières that, as cautioned by Mulazzani et al., (2010, p. 2534), had “complex post-depositional/working histories, so that their 14C ages do not necessarily correspond to that of the obsidian’s deposition.” The other instance is site SHM-1, located on the western edge of the retro-coastal lagoon of Sebkhet Halk el Menjel in the Hergla coast. Extensive testing carried out here in 2002 revealed a 1.5 m-deep sequence with seven occupation levels described as Epipaleolithic on the basis of material culture and subsistence evidence. Eleven obsidian pieces were recovered in the three uppermost levels, dated to the 8150-7450 cal BP interval, but all are very small, <2.5 cm items, mostly fragments, and they are associated with pottery that the authors describe as “relatively abundant” and accompanied by “other elements of material culture traditionally associated to the Neolithic” Mulazzani et al., (2010, p. 2530).

The SMH-1 stratigraphic pattern suggests that (a) the ceramics and the obsidian form an integrated artifact package and (b) they indicate Neolithic activity in the area rather than local hunter-gatherers having possessed such items of material culture. Taking place on the surface of areas intensively occupied by Epipaleolithic hunter-gatherers at a previous time, such Neolithic activity would have left remains that, inevitably, through ordinary soil formation processes, would have penetrated subsurface to eventually produce an apparent stratigraphic association with the remains of the earlier Epipaleolithic occupations. Such site formation processes are well known in open air sites of Portugal (e.g., Vale Pincel) and Western Andalucía (e.g., El Retamar) located in similar settings and featuring both Mesolithic and Neolithic occupations (Zilhão, 1998, 2011). That such is the case at SMH-1 too is additionally shown by the presence of ceramics in the site’s four oldest levels (Mulazzani et al., 2010, p. 2530). The potsherd fragments found in these deeper deposits are rare and small, as one would expect in a scenario where the ceramics (and, by inference, the obsidian) are post-depositional Neolithic intrusions in a previously accumulated Epipaleolithic sequence—as they must be, given that the pottery-bearing basal layers of the SMH-1 sequence date to ~8700 cal BP (i.e., to several centuries before the emergence of the Pottery Neolithic in the Near East itself; Maher et al., 2011).

From the above, we can conclude that no secure evidence exists for the settlement of Pantelleria, or for the quarrying of its obsidian, in the Early Neolithic or before that. In addition, no other sources of evidence support the notion that the stretch of sea between Italy and Tunisia was navigated in Epipaleolithic and Early Neolithic times: no African raw-materials (e.g., ostrich egg-shell) have been found in coeval sites of Sicily and southern Italy, and no Italian raw-materials (e.g., Lipari obsidian) have been found in coeval sites of Tunisia. A spread of the Neolithic into the latter directly from the northern Mediterranean landmass or any of the other islands of the Central Mediterranean with a documented Early
Neolithic settlement would involve distances of at least \(~150\) km (if from Sicily), \(~200\) km (if from Sardinia) or \(~300\) km (if from Malta); however, we have no evidence for crossings of such magnitude occurring at this time anywhere in the Mediterranean.

THE ARCHEOLOGY OF EARLY FARMING IN SW IBERIA

The notion of a North African route for the spread of farming across the Western Mediterranean and, eventually, into Iberia, has a long history. For instance, it featured prominently in Lewthwaite’s (1986) “island filter” model, which sought to explain the putative early appearance of pottery and domesticates in Andalucian sites, namely the Cueva de la Dehesilla (Acosta and Pellicer, 1990): as such an appearance seemed to predate the first occurrence of similar material along the shores of the Gulf of Lyon, it was suggested that the phenomenon related to a dispersal from Southern Italy and Sicily via the Maghreb littoral. More recently, this hypothesis was resurrected by Manen et al. (2007) and Marchand and Manen (2010) to explain two features that they perceive in the Early Neolithic of Portugal: the predominance of segments, instead of trapeze, among geometric microliths; and the limitation of decorative patterns (mostly featuring a horizontal disposition and simple, linear motifs) to the upper third of the vessels.

The fundamental problem with Lewthwaite’s model was that the archeological reality of the patterns it sought to explain was questionable to begin with (Zilhão, 1992, 1993). As is nowadays widely acknowledged, the percolation of elements of the Neolithic package, namely sheep, into hunter-gatherer contexts of France and Eastern Iberia reflects not the “neolithization” of ancient people but either (a) the “neolithization” of archeological deposits (that is, the presence, in Late Mesolithic levels from cave and rockshelter sequences, of material post-depositionally intruded from overlying Early Neolithic occupation horizons), or (b) more simply, the misidentification of the bones of wild caprines as belonging to domesticated animals. Likewise, there is little question that the early dates obtained for the “Early Neolithic” of Cueva de La Dehesilla, including results as early as \(~9200\) cal BP, reflect the mixed, Paleolithic and Neolithic composition of the deposits, not the appearance of the Neolithic package in Andalucia hundreds of years before it is first recorded elsewhere in the Western Mediterranean (and, where pottery is concerned, almost a millennium before its first appearance in the Near East).

The more recent versions of the African route are not immune to similar problems of relation between reality and model. For instance, the notion that the microliths of the initial phase of the Portuguese Early Neolithic tend to be segments instead of trapeze cannot be supported with the evidence currently available, as shown by the nature of the only three sealed, dated contexts that can be considered in the discussion of this issue (Carvalho, 2007): (a) horizon NA2 of Gruta do Caldeirão, a cave burial context with Cardial ceramics, which contained a single microlith, and that microlith is a trapeze; (b) layer Eb-base of the Abrigo da Pena d’Água, a rockshelter settlement context with Cardial ceramics, which also contained a single complete microlith, in this case a segment (but where two items classified as “truncated bladelets” probably correspond to broken trapeze); and (c) Cabranosa, an open air settlement site where the lithic assemblage is reported to lack microliths (although the original publication—Zbyszewski et al., 1981—mentions that the Cardial ceramics recovered therein were associated with a few trapeze).

Given these counts and the very small size of the lithic assemblages concerned, the relative importance of trapeze and segments in the initial phase of the Portuguese Early Neolithic remains a moot point -- a conclusion that does not change even if we also consider the Early Neolithic burial context of Galeria da Cisterna (Almonda). This context featured three microliths, all segments indeed, but corresponds to a palimpsest where, on typological grounds and by comparison with French and Spanish sequences, three different moments of Early Neolithic occupation can be differentiated: Early Cardial, Late Cardial and Epicardial (Zilhão, 2009; Figs. 2-3). Although commentators have linked the segments with the earlier styles, they are, in fact, more likely to relate instead to the Late Cardial or the Epicardial...
episodes, to which belong some 90% of the 40 decorated Early Neolithic vessels represented in the collection.

On the other hand, the stylistically early pottery from the Galeria da Cisterna makes it clear that unwarranted generalization also underlies the other argument upon which the African route has been put forth—that the Late Cardial decorative styles characterized by rows of impressions limited to the upper third of the vessel (well exemplified by the ceramics from horizon NA2 of Gruta do Caldeirão, dated to the 7250-7050 cal BP interval) are representative of the initial phase of the Portuguese Early Neolithic in its entirety. However, Vessels I and II from Galeria da Cisterna (Fig. 2), dated to ~7350 cal BP (on the basis of their probable association with the two directly dated beads identified in Fig. 3; Zilhão, 2001), show that the Early Cardial of Portugal was no different in this regard from that of Valencia, as both vessels are extensively decorated from rim to bottom (in one case with the edge of a Cardium shell and in the other with a comb).

Fig. 2. Early Neolithic ceramics from Galeria da Cisterna (Almonda): vessel IV, Ligurian Impressa (impressed groove) style; vessel I, early Cardial style; vessel V, late Cardial style; vessel VIII, Epicardial style
Fig. 3. Early Neolithic ornaments from the Galeria da Cisterna (Almonda). Top row, left to right: oval pendant made on cuttlefish shell (*Sepia officinalis*); seven oval pendants made on *Glycymeris* sp. shells; discoidal limestone beads. Middle row, left to right: *Theodoxus fluviatilis* shell beads; pierced wolf canine. Bottom row: pierced red deer canines and bone pendants imitating their shape (the two radiocarbon-dated specimens are indicated by the corresponding inventory numbers). [photos - J. P. Ruas (top and middle rows) and F. d’Errico (bottom row); all scale bars = 1 cm]
The only thing special about the Portuguese Early Neolithic when seen in its European context is, therefore, the dearth of sites and the extensive lacunae that remain in our knowledge of it. No explanation other than the hazards of research history is necessary to account for this situation—an African route is no more required to understand the emergence of farming in Portugal than it would be for the understanding of the process in France or Spain. Showing that the hypothesis is unnecessary does not, however, suffice to refute it—a significant level of cultural interaction could nonetheless have existed across the Strait of Gibraltar at this time, and it could have been indeed via such exchanges of people, ideas and/or technologies that pottery and domesticates first entered Southwestern Iberia.

Assessing this possibility on its own merits begs the question to which I now turn. Although a Sicilian source can be excluded on the basis of the evidence on early navigation and the distribution of obsidian in the Central and Western Mediterranean, did farming emerge in the Maghreb earlier than on the opposite shores of the Mediterranean—perhaps as a result of diffusion along strictly African routes (that is, from the Nile valley to the East or from the then fertile Sahara to the South)?

THE EARLY NEOLITHIC OF THE MAGHREB

The dearth of stratified sequences and of reliable radiometric redeterminations makes it very difficult to reach a consensus on the nature of the North African process (cf. Linstädter, 2008, for a recent review). The situation at the key site of Kef Taht el Ghar suffices to illustrate the problem. Three different varieties of domestic wheat were reported from layer G, in association with charcoal dates ranging between 11,000 and 12,000 cal BP, although sheep and goats only appear in overlying level F and in association with Cardial pottery. A cereal grain from this level yielded a direct date of ~7250 cal BP that is consistent with the nature of the ceramic assemblage. But the main lesson from this site is that the Maghreb sites are not immune to the same problems of post-depositional disturbance that afflict the Mesolithic-Neolithic sequences from cave and rockshelter sites of Mediterranean Europe. Likewise, the presence of inherited charcoal in Early Neolithic deposits is also a major problem in the Maghreb, explaining the very early results obtained for some pottery-bearing deposits. A good example is Ifri Armas, in the Eastern Rif, where a result on bone dates its Neolithic with impressed and incised pottery to ~6850 cal BP, in line with the ages obtained for the stylistically equivalent Epicardial of west Mediterranean Europe; two results on charcoal, however, yielded much earlier ages, in the 7550-7950 cal BP interval (Linstädter, 2008, Fig. 5).

As argued by Linstädter, there is therefore every reason to be extremely wary of interpretations of (a) the presence of ceramics in Epipaleolithic contexts as documenting an early invention/adoption of the technology, or (b) the association of impressed, non-Cardial wares with early radiometric results as documenting a pre-Cardial spread of the Neolithic into the region. Similar claims were made in the 1970s and 1980s for a number of contexts located on the Iberian side of the Mediterranean (e.g., Vale Pincel, in Portugal, or Cova Fosca, in Spain). All were eventually shown to be either specific manifestations of a process of “neolithization” of deposits, not of people, or instances of palimpsest formation related to Early Holocene sedimentation hiatuses (Zilhão, 1993, 1998).

Recent work at the site of Ifri Oudadane has exposed a consistent stratigraphic sequence where, despite some disturbance, the separation between Epipaleolithic and Neolithic levels is supported at the sedimentological and micromorphological level: namely, by the “fumier”-like features of the latter, akin to those seen around the Mediterranean in deposits related to ovicaprid penning (Linstädter and Kehl, 2012). Such features (e.g., calcite spherulites, which are components of ovicaprine coprolites) appear in thin sections IO 1 to IO 4, that is, in the so-called Early Neolithic B deposit, but not in the underlying Early Neolithic A. However, the latter contained Cardial-decorated pottery in association with the bone remains of ovicaprids and a stone tool assemblage markedly distinct (namely, by the presence of large notched blades) from that found in the basal Epipaleolithic levels of the site. These associations warrant assignment of the
site’s Early Neolithic A deposits to the activity of people with a full agro-pastoral economy.

The chronology of Ifri Oudadane’s Early Neolithic A is bounded by two termini: the ante quem is provided by a ~7050 cal BP result (OxA-23528, 6136±34 BP, or, at 2σ, 7160-6941 cal BP) obtained on a domestic goat sample from the overlying Early Neolithic B; the post quem is provided by a ~7595 cal BP result (Beta-295779, 6740±50 BP, or, at 2σ, 7678-7511 cal BP) obtained on a lentil sample from the interface with the underlying Epipaleolithic. Linstädter and Kehl (2012), who assign this lentil sample to the Early Neolithic, assume that it is a domesticated species and, hence, take its age as marking the beginnings of the Neolithic at the site. Several facts, however, invite caution in the acceptance of this interpretation:

(a) The exact provenience of the sample is ambiguous, as based on the published description, it could well relate to the latest Epipaleolithic: “the lower boundary [of the Early Neolithic A deposit] is marked by a massive ash lens at about 8.10 m well visible in the centre of section CE. From the surroundings of the lens [my emphasis, that is, not from the lens itself] a domesticated lentil was recovered”( Linstädter and Kehl 2012, p. 3316-3317).

(b) Morales et al. (2013) argue that the specimen is likely to be *Lens culinaris* on the basis of size and shape, but acknowledge that the determination is open to question; as wild varieties of the genus exist in the Maghreb (namely, *L. nigricans*; Ladizinsky, 1979; Sonnante et al., 2008), it cannot be excluded that, instead of representing the consumption (and inferred cultivation) of a domesticated pulse, this seed stands for exploitation of the plant by Epipaleolithic groups (given the ambiguity in provenience), or is simply part of the natural background of the site’s Neolithic occupation.

(c) Besides this problematic lentil, the Early Neolithic A of Ifri Oudadane yielded only one other seed identified as from a cultivated plant, in this case *Triticum* sp.; directly dated to 6140±30 BP (Beta-318608; 7157-6950 cal BP; Morales et al., 2013), this sample post-dates the lentil by half a millennium and falls in the time range of the goat bone from the overlying Early Neolithic B dated by Linstädter and Kehl (2012).

(d) The other seven direct dates on cultivated plants from the site reported by Morales et al. (2013) are even later, falling between 5980±40 BP (Beta-295773, on *Hordeum vulgare*) and 5590±40 BP (Beta- 295772, on *Triticum aestivum/durum*). This dating evidence strongly suggests that it was only after ~7200 cal BP that cereals and domesticated pulses began to be stored, processed or consumed at the site, as is otherwise indicated by the fact that, in the Early Neolithic B, the number of cultivars is 54 (49.5/m³) and their percentage over the total macrobotanical remains recovered in the level is 0.9%, the corresponding values for the Early Neolithic A being 2 (5.3/m³) and 0.2%.

(e) On the basis of a large number of results on short-lived samples, including cereal grain and bone samples from sheep, buried humans and artifacts (Bernabeu et al., 2009), the beginning of the Cardial culture in the Western Mediterranean post-dates by more than two centuries the Ifri Oudadane lentil date; the result of ~7330 cal BP (KIA-39299, 6400±90 BP, or, at 2σ, 5550-5209 BC) obtained for a sample of *Juniperus communis* charcoal from an ash lens clearly in the main body of the Early Neolithic A deposit (Linstädter and Kehl, 2012) is more in keeping with the style of the associated ceramics and, as the life span of this species is, on average, one hundred years, the result, bearing in mind the associated uncertainty, is only marginally affected by old wood issues and, therefore, represents the best estimate of the age of the site’s Early Neolithic A.

That the Cardial culture extended into the Maghreb shores has long been known (Gilman, 1975), and the findings from Ifri Oudadane confirm this in a context that features significant stratigraphic integrity, assemblage coherence and consistent dating. By the same token, this site provides no evidence that a pre-Cardial Neolithic existed in the region. Therefore, we must conclude that, with present evidence, the earliest
Neolithic of the Western Maghreb is of Cardial affiliations and post-dates by a couple of centuries the emergence of farming in Iberia, now firmly set at ~7500 cal BP (Bernabeu et al., 2009). In this context, if stylistical similarities do exist in decorative style between the two sides of the Straits of Gibraltar, and if they are to be interpreted indeed as documenting the diffusion of people or ideas, then the inescapable conclusion is that such a diffusion occurred from North to South rather than from South to North.

CONCLUSION

The geographic distribution and mode of circulation of the obsidian from Lipari indicate that Early Neolithic navigation in the Western Mediterranean was a cabotage affair, effected over coastal waters and mostly within sight of land. This evidence is consistent with the fact that such large islands as the Balearics remained uninhabited until the fifth millennium cal BP.

There is no evidence that obsidian from Pantelleria was being quarried and distributed to neighboring territories before 7000 cal BP, which implies that no evidence exists for Mesolithic or early Neolithic sea crossings between Sicily and Tunisia. A littoral Maghreb route for the spread of the Neolithic into the southern tip of Iberia ahead of its arrival in Southern France and Eastern Spain is therefore unsupported. The notion of a precocious emergence of the Neolithic in the westernmost Mediterranean, around 8000 cal BP if not before, cannot be supported either, thus making the hypothesis of a Siculo-Tunisian connection unnecessary to begin with.

By the time, ~7350 cal BP, when the Neolithic is securely documented in the Maghreb, it had already spread across most of Iberia, the Cantabrian strip excepted. At this time, ceramic styles on both sides of the Straits of Gibraltar are consistent with their inclusion in a common Cardial culture area. This culture lacks any antecedents in Northern Africa but is preceded in the Northern Mediterranean by well dated farming/herding contexts featuring Impressa wares of Ligurian affinities. If anything, these chronological and material culture patterns indicate that, after diffusing from the Gulf of Lyon to Western Andalucía and Southern Portugal via cabotage along the northern shores of the Mediterranean, the Neolithic then spread via the same mechanism from these areas into the Western Maghreb, rather than the other way around.

It has been argued (Özdogan, 1997) that the westward spread of the Anatolian Neolithic was triggered by the collapse of the Levantine Pre-Pottery Neolithic B, for which there is significant evidence of social stratification and strongly developed cult practices. This is conspicuously lacking from the earliest Neolithic of Southeastern Europe, where no evidence exists for specially built temples or for ranking in settlement and burial. A corollary of these observations is that an ethos of fissioning before groups became too large and severe conflict or social inequality developed may have characterized the expansion of Neolithic groups across Europe. Along the northern shores of the Mediterranean, such a tendency to fission and move on would have been reinforced further because opportunities for settlement and expansion around initial enclaves were limited by physical geography and the presence of hunter-gatherer groups (Zilhão, 2001).

In this context, the difference between East and West in the Early Neolithic navigation of the Mediterranean may well relate to the social fabric of the societies involved. Dense, tightly-knit, probably hierarchical in the East, farming societies of the PPNA and PPNB would have been capable of operating such large-scale processes of colonization as those involved in the settlement of Cyprus and Crete. Scattered, family-based, easy-fissioning and non-hierarchical in the West, farming societies of the Impressa and Cardial cultures would have lacked the scale and level of social organization required to put together expeditions involving targeted landfalls in previously reconnoitered territories located across significant open sea expanses. This hypothesis is consistent with the Western Mediterranean pattern of pioneer colonization inferred from the leap-frog pattern of dispersal suggested by the location of the earliest Neolithic settlements currently known along the Mediterranean and southern Atlantic coasts of Iberia.
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