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The Results of the Excavations of the Regione Siciliana
Soprintendenza ai Beni Culturali ed Ambientali Provincia di Palermo
in collaboration with Brown University
in 1990 and 1991

by

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ERRATA

Page 87:

Last reference should read: R.H. Tykot, Prehistoric Trade in the Western Mediterranean: The Sources and Distribution of Sardinian Obsidian, diss., Harvard University, 1995.

Page 88:

Last sentence should read: Furthermore, two pieces of obsidian from Ustica have already been reported to be from Lipari.[7]

Note 5 should include also: Crisci et al. 1994, cit. in note 2.

Note 7 should include also: Hallam et al. 1976, cit. in note 2.

APPENDIX I: OBSIDIAN PROVENANCE

R. H. Tykot

Obsidian is formed only in restricted volcanic circumstances, with just 6 sources in the Mediterranean area, all located on islands: Melos and Giali, in the Aegean; Monte Arci, in western Sardinia (with several distinguishable sub-sources); Palmarola, in the Bay of Naples; Lipari, in the Aeolian Islands; and Pantelleria, southwest of Sicily (with 3 sub-sources). Other sources exist in central and eastern Anatolia, and in central Europe.

Despite the limited number of geological sources, flake and blade tools of obsidian are well-known from neolithic contexts throughout the Central Mediterranean, and are commonly found at chalcolithic and bronze age sites as well.[1] Obsidian's glassy composition makes it superior to other rock types for cutting animal and plant materials.

Considerable effort has been expended to characterize each Mediterranean obsidian source, with the greatest success coming from trace element studies.[2] Fission-track dating has also been extensively used to source artifacts based on the different geological ages of the obsidian sources,[3] although the Sardinian and Pantellerian sub-sources cannot be distinguished by this method. Several other methods of analysis have proven useful in distinguishing at least some of the Mediterranean obsidian

[1] H.-O. Pollmann, Obsidian im nordwestmediterranen Raum. Seine Verbreitung und Nutzung im Neolithikum und Äneolithikum. BAR International Series 585, 1993.

[2] The seminal papers on western Mediterranean obsidian provenance are: J.R. Cann & A.C. Renfrew, "The characterization of obsidian and its application to the Mediterranean region," Proceedings of the Prehistoric Society 30, 1964, p. 111–133; and B.R. Hallam, S.E. Warren & A.C. Renfrew, "Obsidian in the western Mediterranean: Characterisation by neutron activation analysis and optical emission spectroscopy," Proceedings of the Prehistoric Society 42,1976, p. 85–110. More detailed chemical characterization studies of individual sources may be found in M. Mackey & S.E. Warren, "The identification of obsidian sources in the Monte Arci region of Sardinia," in A. Aspinall & S.E. Warren,eds., Proceedings of the 22nd Symposium on Archaeometry, University of Bradford, Bradford, U.K. March 30th – April 3rd 1982, 1983, p. 420–431; V. Francaviglia, "Characterization of Mediterranean obsidian sources by classical petrochemical methods," Preistoria Alpina 20,1984, p. 311–332; G. Herold, Mineralogische, chemische und physikalische Untersuchungen an den Obsidianen Sardiniens und Palmarolas. Grundlagen zur Rekonstruktion Prähistorischer Handelswege im Mittelmeerraum. Unpublished PhD dissertation, Universität (TH) Fridericiana Karlsruhe (1986); V. Francaviglia, "Ancient obsidian sources on Pantelleria,Italy," Journal of Archaeological Science 15,1988, p. 109–122; R.H. Tykot, "The sources and distribution of Sardinian obsidian," in R.H. Tykot & 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, 1992, p. 57–70; G.M. Crisci, M. Ricq-de-Bouard, U. Lanzaframe, & A.M. de Francesco, "Nouvelle méthode d'analyse et provenance de l'ensemble des obsidiennes néolithiques du Midi de la France, Gallia Préhistoire 36 (1994): 299–309; R.H. Tykot, Prehistoric Trade in the Western Mediterranean: The Sources and Distribution of Italian Obsidian diss, Harvard, 1995.

sources, but have not been widely applied to archaeological materials.[4]

In recent years, a number of chemical characterization studies of archaeological artifacts have been completed,[5] so that the distribution patterns for each source are known in a general way. More research is necessary on chronological changes in obsidian distribution patterns, artifact typology and function, particularly at the site level. Only in this manner can we examine the underlying procurement and exchange mechanisms responsible for obsidian distribution, and the social and economic significance of obsidian being found at such great distances from its geological source.

In many cases, an experienced analyst may confidently assign an artifact to a single island source based strictly on its visual characteristics. Pantellerian obsidian is green in transmitted light, but is nearly opaque; Liparian obsidian is grey to brown and quite transparent; Palmarola obsidian is black and mostly opaque; Monte Arci obsidian is black, and ranges from virtually transparent to totally opaque. Although visual identification allows entire assemblages of artifacts to be studied, chemical analysis is a widely accepted, secure method of provenance determination, and should at minimum be used on a subset of an assemblage, to blindly test the success rate of the visual analyst.

The most likely source of obsidian artifacts found on Ustica would be Lipari, because of its geographic proximity and the already-known wide distribution of high-quality Lipari obsidian to sites all over the Italian peninsula, Sicily, Malta, and even North Africa.[6] Furthermore, at least one piece of obsidian from Ustica has already been reported to be from Lipari, although no details have been published.[7]

[3] G. Arias-Radi, G. Bigazzi, & F.P. Bonadonna, "Le tracce di fissione. Un metodo per lo studio delle vie di commercio dell'ossidiana," Origini. Preistoria e Protostoria delle Civiltà Antiche 6,1972, p. 155–169; G. Bigazzi & G. Radi, "Datazione con le tracce di fissione per l'identificazione della provenienza dei manufatti di ossidiana," Rivista di Scienze Preistoriche 36:1–2,1981, p. 223–250; C. Arias, G. Bigazzi, F.P. Bonadonna, M. Cipolloni, J.C. Hadler, C.M.G. Lattes, & G. Radi, "Fission track dating in archeology. A useful application," in P.L. Parrini,ed., Scientific Methodologies Applied to Works of Arts,Montedison Progetto Cultura 1984, p. 151–159; G. Bigazzi, S. Meloni, M. Oddone, & G. Radi, "Nuovi dati sulla diffusione dell'ossidiana negli insediamenti preistorici italiani," in E. Herring, R. Whitehouse, & J. Wilkins,eds., Papers of the Fourth Conference of Italian Archaeology 3. New Developments in Italian Archaeology Part 1, 1992, p. 9–18.

[4] G. Longworth & S.E. Warren, "Mössbauer spectroscopy and the characterisation of obsidian," Journal of Archaeological Science 6,1979, p. 179–193; N.H. Gale, "Mediterranean obsidian source characterisation by strontium isotope analysis," Archaeometry 23,1981, p. 41–51; J. McDougall, D. Tarling, & S.E. Warren, "Magnetic sourcing of obsidian samples from the Mediterranean," Journal of Archaeological Science 10,1983, p. 441–452; E. Mello, "Indagini scientifiche per l'individuazione della provenienza dei manufatti di ossidiana," in S. Tinè, Passo di Corvo e la civiltà neolitica del Tavoliere, 1983, p. 122–124.

[5] O. Williams Thorpe, S.E. Warren, & L.H. Barfield, "The distribution and sources of archaeological obsidian from Northern Italy," Preistoria Alpina 15,1979, p. 73–92; O. Williams Thorpe, S.E. Warren, & J. Courtin, "Sources of archaeological obsidian from Southern France," Journal of Archaeological Science 11,1984, p. 135–146; J. Michels, E. Atzeni, I.S.T. Tsong, & G.A. Smith, "Obsidian Hydration Dating in Sardinia," in M.S. Balmuth & R.J. Rowland, Jr.,eds., Studies in Sardinian Archaeology, 1984, p. 83–114; J.G. Crummett & S.E. Warren, "Appendix I. Chemical analysis of Calabrian obsidian," in A. Ammerman, ed., The Acconia Survey: Neolithic Settlement and the Obsidian Trade. Institute of Archaeology Occasional Publication 10, 1985, p.107–114; G. Bigazzi, S. Meloni, M. Oddone, & G. Radi, "Provenance studies of obsidian artifacts: trace elements and data reduction," Journal of Radioanalytical and Nuclear Chemistry, Articles 98,1986, p. 353–363; V. Francaviglia & M. Piperno, "La repartition et la provenance de l'obsidienne archeologique de la Grotta dell'Uzzo et de Monte Cofano,Sicile," Revue d'Archéométrie 11,1987, p. 31–39; A.J. Ammerman, A. Cesana, C. Polglase, & M. Terrani, "Neutron activation analysis of obsidian from two neolithic sites in Italy," Journal of Archaeological Science 17,1990, p. 209–220; G. Bigazzi, S. Meloni, M. Oddone, & G. Radi, "Study on the diffusion of Italian obsidian in the neolithic settlements," Atti del VIII Convegno Nazionale sulla Attività di Ricerca nei Settori della Radiochimica e della Chimica Nucleare, delle Radiazioni e dei Radioelementi, Torino, 16–19 Giugno 1992, p. 243–247; A.J. Ammerman & C. Polglase, "The exchange of obsidian at Neolithic sites in Italy," in F. Healy & C. Scarre, eds., Trade and Exchange in European Prehistory, 1993, p. 101–107; K. Randle, L.H. Barfield, & B. Bagolini, "Recent Italian obsidian analyses," Journal of Archaeological Science 20, 1993, p. 503–509; Tykot 1995, cit. in note 2.

[6] For the most recent overviews of Liparian obsidian distribution, see Bigazzi et al. 1992, cit. in note 3, p. fig. 2; and Crummett & Warren 1985, cit. in note 5, fig. A1.2.

[7] J.E. Dixon, J.R. Cann & C. Renfrew, "Obsidian and the origins of trade," Scientific American 218:3,1968, p. 38–46.

Table A1.1: Composition (in weight percent oxide) of twelve obsidian artifacts from Ustica, measured by wavelength dispersive spectrometry using an electron microprobe.

Findspot	Lab. No.	Description	Attrib.	SiO_2	Al_2O_3	TiO_2	Fe_2O_3	MgO	CaO	Na_2O	K_2O	BaO	Total
Ustica	1715	flake	Li	74.55	12.77	0.08	1.61	0.03	0.71	4.10	5.16	0.00	99.00
Ustica	1716	small flake	Li	74.59	12.70	0.07	1.63	0.02	0.71	4.11	5.16	0.01	99.00
Ustica	1717	small blade	Li	74.25	12.64	0.08	1.60	0.05	0.87	4.30	5.22	0.00	99.00
Ustica	1718	blade	Li	74.40	12.81	0.09	1.57	0.05	0.73	4.13	5.20	0.02	99.00
Ustica	1719	small chunk	Li	74.71	12.75	0.08	1.51	0.03	0.69	3.96	5.26	0.02	99.00
Ustica	1720	blade fragment	Li	74.37	12.75	0.09	1.80	0.04	0.81	4.01	5.13	0.01	99.00
Ustica	1721	core trim?	Li	74.69	12.74	0.08	1.57	0.03	0.70	4.04	5.16	0.00	99.00
Ustica	1722	small blade	Li	74.70	12.61	0.08	1.68	0.03	0.69	4.03	5.18	0.00	99.00
Ustica	1723	blade	Li	74.63	12.77	0.07	1.58	0.03	0.70	4.05	5.16	0.00	99.00
Ustica	1724	small chunk	Li	74.64	12.71	0.07	1.62	0.02	0.70	4.09	5.17	0.00	99.00
Ustica	1725	chunk	Li	74.78	12.62	0.08	1.65	0.02	0.69	4.04	5.12	0.01	99.00
Ustica	1726	arrowhead	Pa2	66.17	10.89	0.61	8.35	0.17	0.57	7.49	4.73	0.03	99.00

Obsidian from Pantelleria was also used in Sicily, at both neolithic (Grotta dell'Uzzo) and bronze age (Monte Cofano) sites,[8] as well as in Malta[9] and North Africa[10]. Two arrowheads of Pantellerian obsidian have even been found in a Copper Age dolmen at San Sebastien in southern France.[11] Only in North Africa, however, is Pantelleria ever the most common obsidian source represented in a site assemblage. Monte Arci obsidian is found at sites throughout Sardinia, Corsica, northern Italy and southern France, but not in southern Italy or Sicily. Obsidian from Palmarola appears to be restricted to central and northern Italy.

Twelve obsidian samples from Ustica, collected on the surface outside the archaeological site, were visually examined. Although without stratigraphic context, the pieces may be attributed to the period 1500–1200 BC. None of the pieces are more than 2.5cm in length: a few are blades or blade fragments, one is a small arrowhead, and the rest appear to be debitage from the lithic reduction process. The geological origin of these samples was determined on the basis of their color, transparency, and appearance in transmitted light. Eleven of the twelve are of typical Liparian type; one is certainly from Pantelleria. This visual assessment was then confirmed by chemical analysis of all twelve specimens.

Fragments 1 mm. in size were removed from the Ustica artifacts, mounted in 1-inch diameter epoxy disks, and polished flat using successively finer grinding compounds. The major/minor element composition of the samples was then determined by electron probe microanalysis with wavelength dispersive spectrometers, using the facilities of the Department of Earth & Planetary Sciences at Harvard University. Extensive analyses of geological source material have already demonstrated that all of the Mediterranean sources (and nearly all sub-sources) can be distinguished on the basis of their major/minor element composition.[12]

The data in Table 1 represent the average of two analyses per sample, normalized to 99% (water content was not independently measured). Simple comparison of the elemental values for the archaeological samples with the geological data in Table 2 is sufficient to confirm that the first 11 artifacts are Liparian obsidian, and the twelfth ar-

[8] Francaviglia & Piperno 1987, cit. in note 5.

[9] Cann & Renfrew 1964, cit. in note 2; Hallam et al. 1976,cit. in note 2.

[10] G. Camps, Les Civilisations Préhistoriques de l'Afrique du Nord et du Sahara, 1974; R.H. Tykot & J.-D. Vigne, unpublished analyses of obsidian from Zembra Island, Tunisia.

[11] Williams Thorpe et al. 1984, cit. in note 5.

[12] Francaviglia 1984, cit. in note 2; Tykot 1995, cit. in note 2.

Table A1.2: Average composition of geological obsidian sources in the western Mediterranean, measured by wavelength dispersive spectrometry using an electron microprobe.

		SiO_2	Al_2O_3	TiO_2	Fe_2O_3	MgO	CaO	Na_2O	BaO	Total
Lipari	Ave.	74.51	12.75	0.08	1.63	0.03	0.72	4.03	0.01	99.00
	Std. dev.	0.22	0.14	0.01	0.08	0.01	0.04	0.10	0.01	
	n = 20									
Pantelleria 1 – Balate dei Turchi	Ave.	70.78	7.47	0.22	8.50	0.01	0.26	7.16	0.03	99.00
	Std. dev.	0.10	0.03	0.01	0.05	0.00	0.00	0.11	0.01	
	n = 3									
Pantelleria 2 – Gelkhamar	Ave.	66.23	10.17	0.61	8.90	0.15	0.53	7.56	0.02	99.00
	n = 2									

tifact is Pantellerian obsidian, specifically the Gelkhamar sub-source.

In conclusion, it was anticipated that obsidian artifacts found on Ustica would be mostly, if not entirely, of Liparian origin; the discovery that one of twelve artifacts derives from Pantelleria is not surprising. These findings augment our knowledge of prehistoric obsidian distribution in the central Mediterranean, and reaffirm the multi-dimensional nature of the sea-borne traffic in material goods characteristic of the Late Bronze Age.