OBSIDIAN FINDS FROM THE EARLY NEOLITHIC SITE AT GRUMĂZEȘTI – *DELENI*, NEAMȚ COUNTY

Adina BORONEANȚ[a], Vasile DIACONU[b], Clive BONSALL[c]
[a] *"Vasile Pârvan" Institute of Archaeology, Romanian Academy; e-mail: boro30@gmail.com*
[b] *History and Ethnography Museum, Târgu Neamț; e-mail: diavas_n82@yahoo.com*
[c] *University of Edinburgh, School of History, Classics and Archaeology; e-mail: Clive.Bonsall@ed.ac.uk*

Keywords: *pXRF, obsidian sourcing, Early Neolithic, Romania*
Abstract: *The site of Grumăzești – Deleni (Neamț County) was excavated by Silvia Marinescu-Bîlcu during the late 1960s and 1970s. The excavations unearthed the remains of an Early Neolithic (Starčevo-Criș) settlement, as well as traces of occupation during the Bronze Age (Komariv and Noua cultures) and the 3rd–4th centuries AD. The excavator's field notes mention abundant obsidian finds associated with the Early Neolithic occupational layer. However, these original obsidian finds have been mislaid and were not available for analysis. During field surveys undertaken in the general area of the site in 2011 and 2017–2018, a further ten obsidian artefacts were recovered. Non-destructive Energy Dispersive X-ray Fluorescence (EDXRF) analysis of these new obsidian finds was undertaken using a Niton 'XL3t ultra' handheld portable XRF analyzer. Based on their geochemical and macroscopic characteristics they likely all originated in the Carpathian 1 source area.*

Cuvinte-cheie: *pXRF, surse de obsidian, neolitic timpuriu, România*
Rezumat: *Situl arheologic de la Grumăzești – Deleni (județul Neamț) a fost cercetat de Silvia Marinescu-Bîlcu la finalul anilor '60 și pe durata anilor '70 ai secolului trecut. Cercetările au pus în evidență existența unui sit neolitic timpuriu atribuit culturii Starčevo-Criș și urme de locuire asociate epocii bronzului (culturile Komariv și Noua) precum și secolelor III–IV p. Chr. Notele de șantier ale Silviei Marinescu Bîlcu menționează numeroase piese de obsidian asociate nivelului neolitic timpuriu, care, din păcate, nu au putut fi regăsite. Perieghezele desfășurate în 2011 și 2017–2018 au dus la recuperarea a 10 piese de obsidian. Pentru analiza EDXRF a acestor piese a fost utilizat un XRF portabil Niton 'XL3t ultra'. Pe baza caracteristicilor macroscopice și geo-chimice, obsidianul din care au fost făcute piesele provine din sursa carpatică C1.*

INTRODUCTION

The site of Grumăzești – *Deleni* (Neamț County, 47°09'19" N, 26°24'42" E) is situated on the left bank of the Netezi creek, a tributary of the Topolița River (Fig. 1). The site was discovered in 1966, excavations started in 1968 and continued intermittently until 1978. During five field seasons nine trenches (SI–SIX) with four extensions (Cas 1 - Cas 4) were excavated (Fig. 2). The excavations unearthed the remains of an Early Neolithic (Starčevo-Criș) settlement, as well as traces of occupation during the Bronze Age (Komariv and Noua cultures) and the 3rd–4th centuries AD (Marinescu-Bîlcu 1975; 1993; Marinescu-Bîlcu, Beldiman 2000). A field survey undertaken by Vasile Diaconu aimed at establishing the full extent of the site took place in 2011 (Diaconu 2012), followed in 2017–2018 by further fieldwork with emphasis on geomagnetic survey carried out in collaboration with Regensburg University.

The archaeological evidence relating to the Early Neolithic settlement has been summarized in previous publications: Marinescu-Bîlcu (1975; 1993) and Dumitrescu *et alii* (1983) provided brief descriptions of the site, the general chronology and the Early Neolithic pottery finds; A. Boroneanț (2012) presented a detailed account of the excavations with descriptions of the Early Neolithic features; while V. Diaconu (2012) reviewed the evidence from all the archaeological sites in the area, and the main categories of (published) Early Neolithic finds.

The general stratigraphy of the site (Fig. 3), which slopes from west to east, may be summarized as follows:

1. Vegetal topsoil containing a mixture of finds from different periods, resulting from plough disturbance;
2. Dark brown soil with very few features/finds, mostly dating to the 3rd–4th centuries AD;
3. Light brown soil containing mainly Early Neolithic and some Noua culture features and finds;
4. Yellow clayey soil, archaeologically sterile.

Most of the Early Neolithic material came from the 12 features that were clearly identified as Early Neolithic[1], and many fewer finds from the supposed 'cultural layer' (Boroneanț 2012). According to S. Marinescu-Bîlcu's field notes, the dwellings appeared as spatial concentrations of

[1] For a detailed description of the Early Neolithic features, see Boroneanț 2012, p. 27–32.

pottery sherds (in some instances including fragmented vessels), daub fragments with wattle impressions, a significant number of polished stone tools (axes, adzes, chisels), coarse stone tools (grinders, punches and hammers), chipped stone artefacts (made of flint, chert, obsidian and quartzite), and ceramic loom weights.

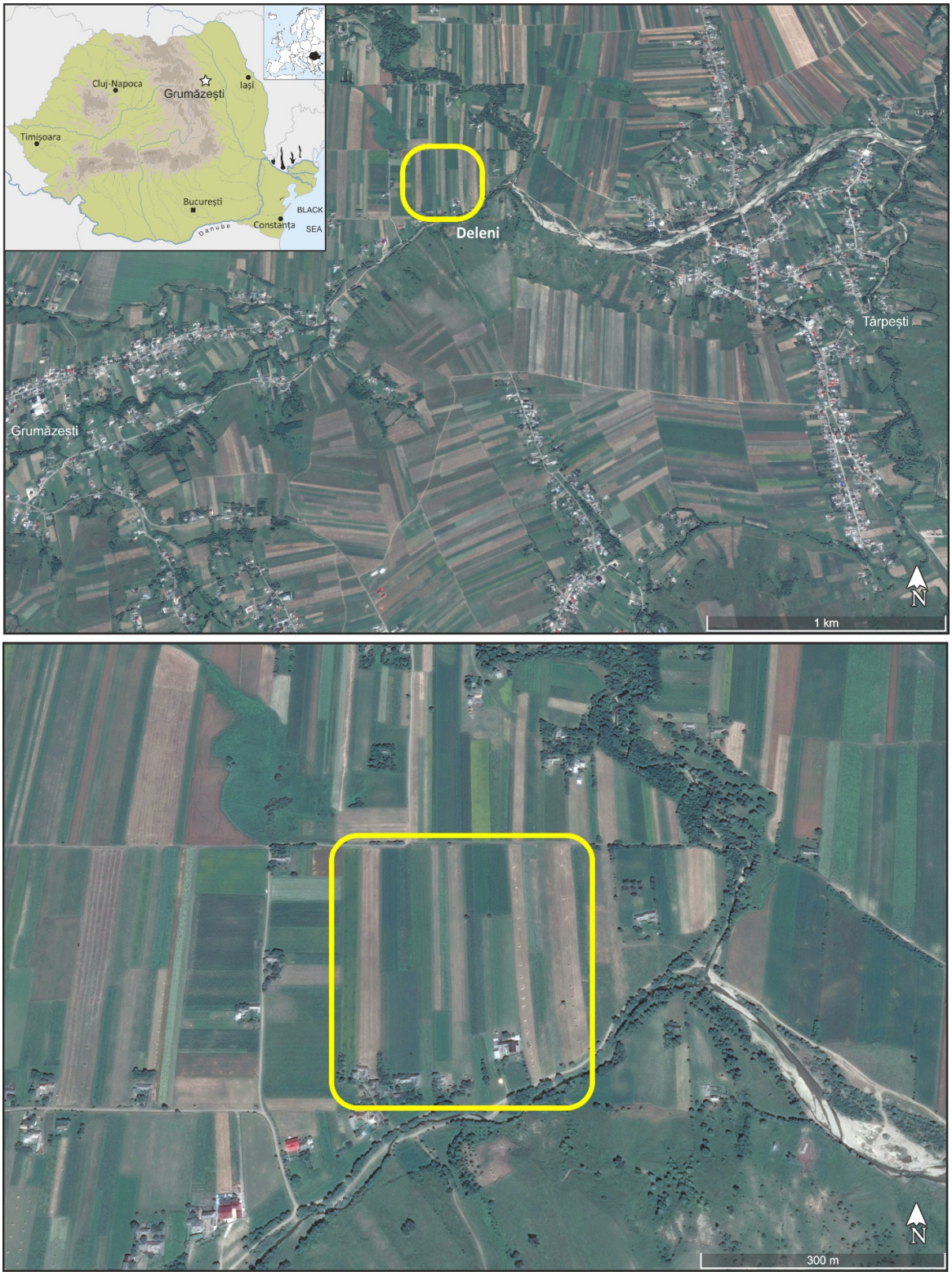

Figure 1. *Location of the Grumăzești – Deleni site. Google Earth imagery 21/10/2017 (accessed 14/03/2018).*

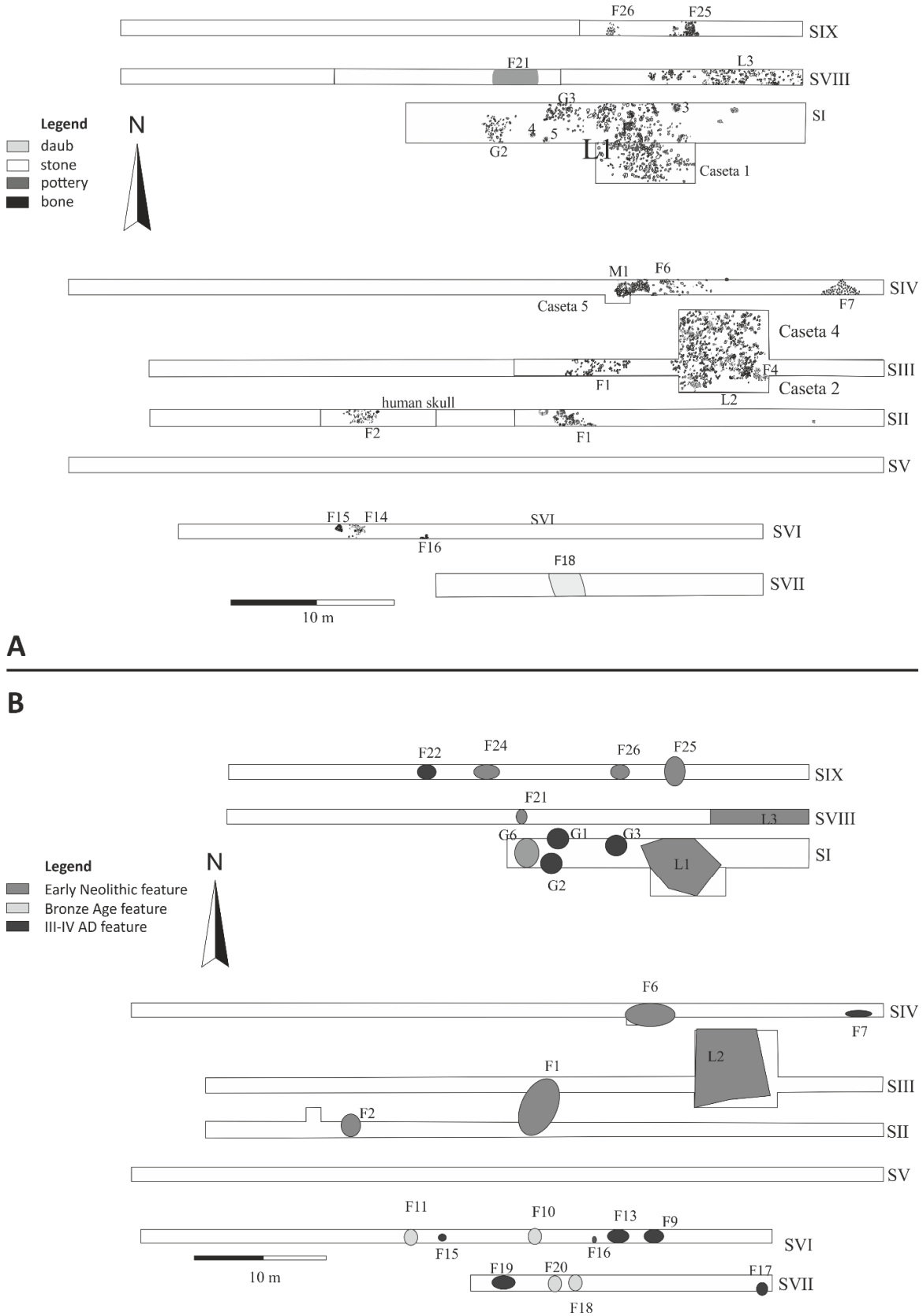

Figure 2. *Grumăzești – Deleni 1968–1978: A. Plan of trenches showing the principal archaeological features (after Boroneanț 2012). B. Separation of archaeological features by period (after Boroneanț 2012).*

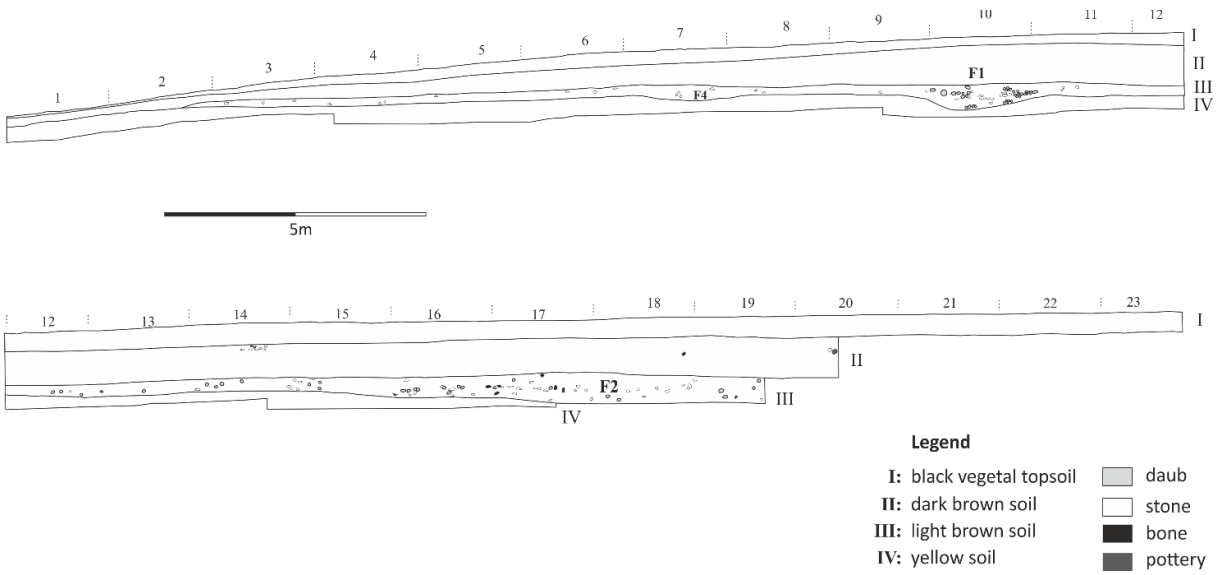

Figure 3. *Grumăzești – Deleni 1968–1978: South profile of trench SII (after Boroneanț 2012).*

OBSIDIAN FINDS

A summary of the obsidian finds from S. Marinescu-Bîlcu's excavation, as described in her field notes, is presented in Table 1, where contexts L1, L2 and L3 were interpreted as dwellings and F18 as a large pit. Unfortunately, these original obsidian finds have been mislaid and so were not available for XRF analysis.

During the field surveys undertaken in the general area of the site in 2011–2017, a further ten obsidian artefacts were recovered. These ten pieces were described, measured and photographed (Table 2, Fig. 4) prior to XRF analysis. One (**Grm.004**) is a thick flake with cortex over the whole of the dorsal surface. The other pieces are interior flakes and blades with no traces of cortex. Two of these are retouched: **Grm.007** is a mesial fragment of a blade, partially backed on one lateral margin, while **Grm.002** has partial light retouch on one lateral margin. The obsidian is highly translucent with distinctive light and dark bands and has a strong, glassy lustre (best seen in Fig. 4/1–3).

XRF ANALYSES

Non-destructive Energy Dispersive X-ray Fluorescence (EDXRF) analysis of the ten new obsidian finds from Grumăzești – *Deleni* was undertaken using a Niton 'XL3t ultra' handheld portable XRF analyzer. Two sets of measurements were taken on each piece – with the instrument operated in 'mining mode' and 'soil mode', respectively (for an explanation and discussion of these two matrix correction methods, see Frahm *et alii* 2014). For both sets of analyses, 'spot size' (the diameter of the analysis area) was set to 8 mm, and the measurement time per sample to 180 seconds. Elemental concentrations were measured for a range of minor and trace elements including Ti, Fe, Zn, Rb, Sr, Y, Zr, Nb, Pb, Th and U. The same instrument (with the identical settings) was previously used to measure geological samples from known obsidian sources in the Carpathians, the Aegean, Central Anatolia and the Central Mediterranean curated at the Vienna-Lithotek (VLI) managed by Dr. Gerhard Trnka and the Lithoteca of the Hungarian National Museum in Budapest (Biró, Dobosi 1991; Biró *et alii* 2000; Biró 2014).

DISCUSSION AND CONCLUSIONS

XRF provides a quick, accurate and non-destructive means of analyzing the chemical composition of obsidian, and the introduction of portable handheld analyzers (pXRF) has enabled measurements to be taken 'in the field', i.e. on site or in a museum. By using pXRF it is often possible to analyze all artefacts from a site whereas studies done using laboratory-based instruments have tended to be restricted to a small subset of artefacts from a site (for curatorial reasons, presumably) which may not reflect the full range of sources represented within the total assemblage.

Obsidian sources in Europe and neighbouring parts of Southwest Asia (Anatolia) are few and relatively well studied. Each source has a unique chemical signature, which allows for the provenance of archaeological obsidian pieces to be determined by comparing their elemental

compositions to those of geological samples collected from known sources.

Context	Trench	Square	Depth (m)	Type	Quantity
L1	SI/Cas I	3–5	0.55–0.65	unknown	several fragments
	SII	?	0.75–0.80	flake	one fragment
L2	SIII/Cas 2/Cas 4	4–6	0.65	unknown	several fragments
	SIV	7–15	1.10?	unknown	several fragments
L3	SVIII	1–5	0.50–0.60	fragments of small blades, blade-like flakes	many fragments
	SIX	?	?	unknown	large number of fragments
F18	SVIII	9–10	1.05–1.75	unknown	several fragments

Table 1. *Summary of Early Neolithic (Starčevo-Criș culture) obsidian finds from Silvia Marinescu-Bîlcu's excavations at Grumăzești – Deleni (adapted after Boroneanț 2012).*

Sample ID	Type	Blank	Dimensions (mm)			Wt (g)	Cortex	Remarks
			Max L	Max B	Max Th			
Grm.001		F	14.2	13.5	3.1	0.47	0%	Snap fractures (natural) along one lateral edge
Grm.002	ER	B	-17.9	10.0	2.5	0.42	0%	Distal mesial break, possibly accidental during retouching
Grm.003		B	18.6	9.6	2.1	0.34	0%	
Grm.004		F	34.1	40.9	6.0	5.90	>90%	
Grm.005		B	-25.6	11.5	2.9	0.90	0%	Faceted butt; distal mesial break; ED
Grm.006		F	19.3	10.7	4.3	0.92	0%	
Grm.007	BB	B	-19.6	10.0	3.0	0.85	0%	Mesial fragment of a blade, partially backed
Grm.008		F	14.0	7.9	3.9	0.41	0%	
Grm.009		F	12.4	9.6	2.5	0.26	0%	ED
Grm.010		B	-9.3	7.5	2.3	0.22	0%	Mesial fragment of a blade; ED on left lateral margin

Table 2. *Details of obsidian artefacts discovered in field surveys in 2011–2017 at Grumăzești – Deleni and analyzed by pXRF (cf. Figure 6). Key: B – blade, F – flake, BB – backed blade, ER – edge-retouched piece, ED – macroscopic edge damage; a minus sign before a measurement indicates that the dimension is affected by a break.*

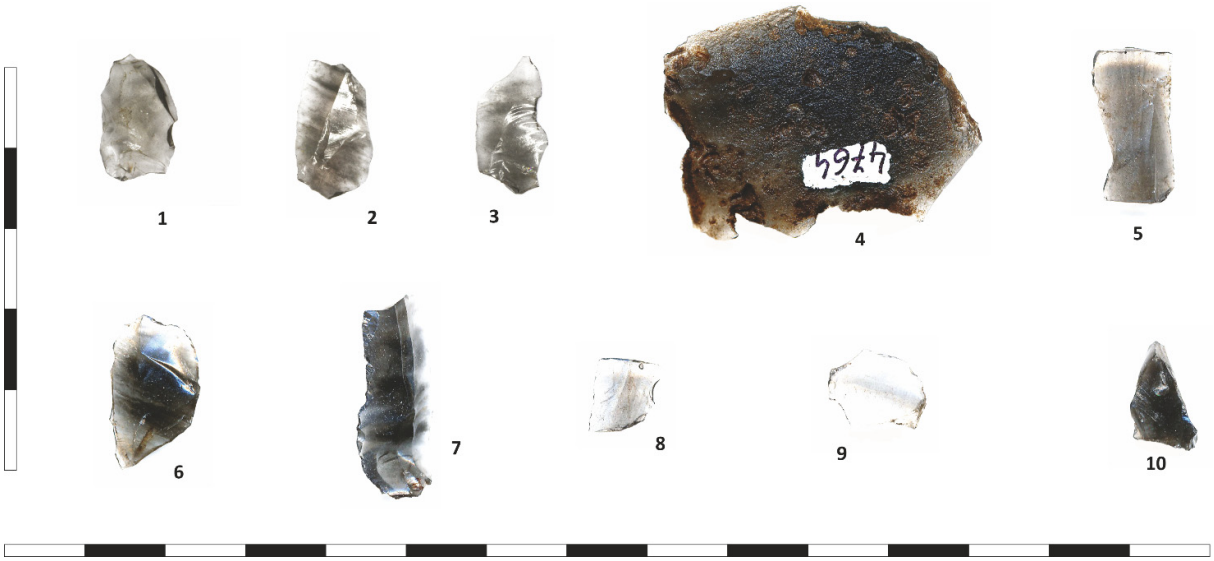

Figure 4. *Photographs of obsidian artefacts (Grm.001–010) measured by pXRF. Scale in cm. Grm.001–003 were photographed against a white background with a DSLR camera, while the images of Grm.004–010 were created using a flatbed scanner.*

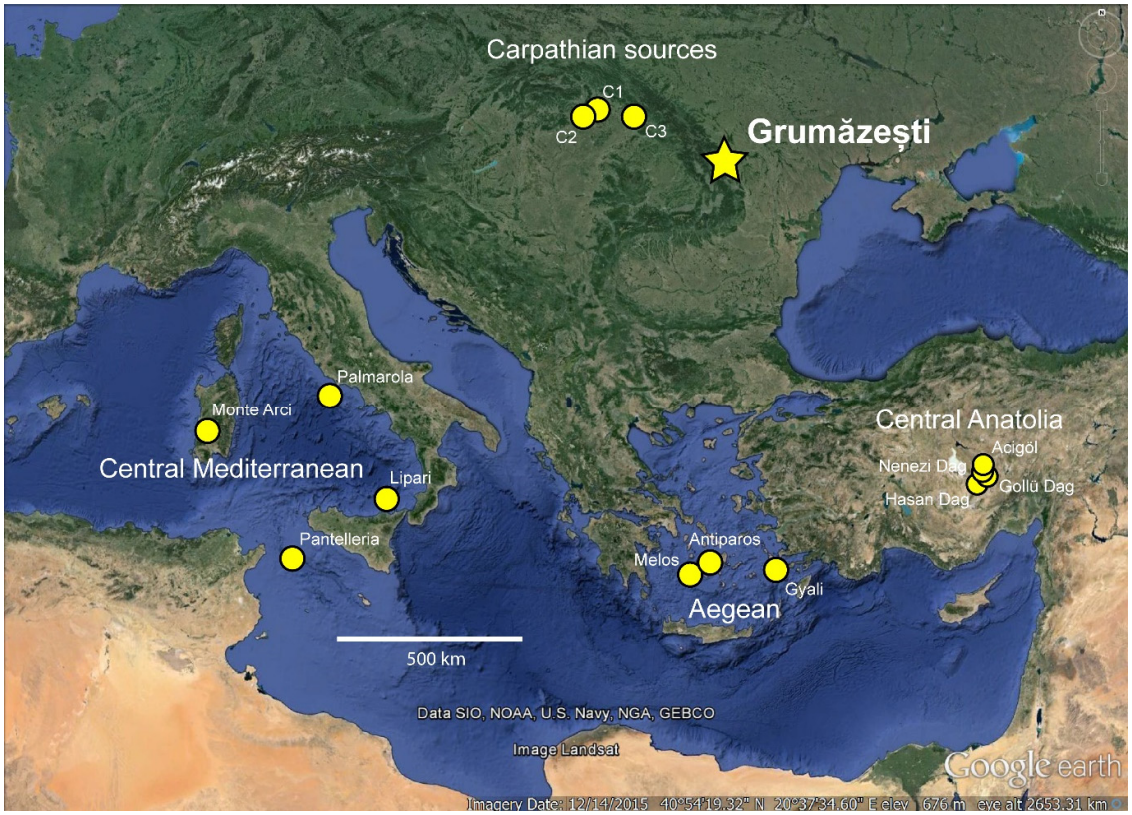

Figure 5. *Location of Grumăzești – Deleni and major obsidian sources in Europe and central Anatolia. Google Earth imagery, 14/12/2015 (accessed 7 June 2016).*

The nearest geological sources of obsidian to Grumăzești – *Deleni* are in the Carpathian Mountains to the west-northwest, where three main source areas have been identified (Biró 2006; 2014; Rosania *et alii* 2008). The site lies *c*. 270 km straight-line distance from the Carpathian 3 (C3) source area in the Transcarpathian region of southwest Ukraine, *c*. 380 km from the C1 source area in the Zemplín Hills of eastern Slovakia, and *c*. 400 km from the C2 source area in the Tokaj Mountains of northeast Hungary (Fig. 5). However, the Aegean Islands have also been suggested as the source of some of the obsidian found in Neolithic contexts in Romania (Vlassa 1965; Maxim 1995; Constantinescu *et alii* 2014).

The elemental concentrations of zirconium (Zr), strontium (Sr) and rubidium (Rb) have been found to be particularly useful for discriminating between the different European and Anatolian obsidian sources. Fig. 6 plots the Zr-Sr-Rb coordinates of the Grumăzești – *Deleni* finds against the distributions of geological samples from the various Carpathian sources (C1, C2E, C2T, C3) and from the island of Melos in the Aegean, represented on the graph by ellipses. The Zr-Sr-Rb profile of the Grumăzești – *Deleni* finds corresponds very closely with that previously determined for the Carpathian 1 source in eastern Slovakia, although several archaeological pieces have coordinates that fall at or just outside the boundary of the C1 ellipse. These pieces are all relatively small and thin, which tends to reduce measurement accuracy. The ternary plot provides a means of visualizing the data in a way that allows such archaeological samples to be confidently attributed to their geological source.

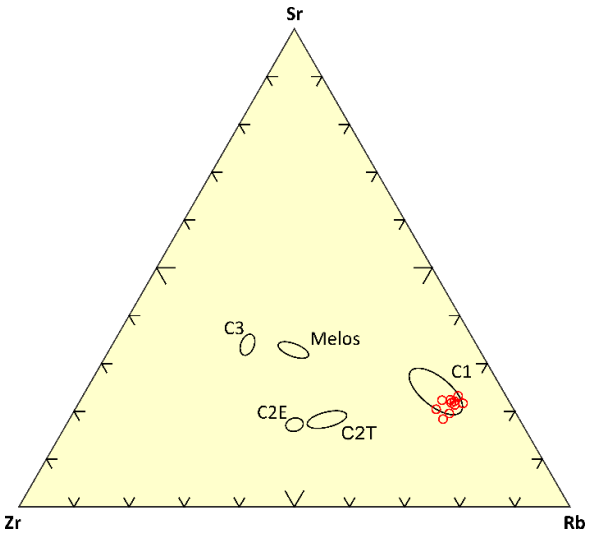

Figure 6. *Ternary diagram of Zr-Sr-Rb data for 10 obsidian artefacts from Grumăzești – Deleni (red circles) plotted against the compositional ranges of infinitely thick samples from geological sources in the Carpathians and on Melos (grey ellipses) – all measured by pXRF.*

In summary, based on their geochemical and macroscopic characteristics (*cf.* Biró 2006), the obsidian pieces from Grumăzești – *Deleni* found in 2011–2017 likely all originated in the Carpathian 1 source area. Further research is planned on the Neolithic obsidian assemblages from Moldova, which will include techno-typological analyses of the obsidian artefacts and, we hope, the acquisition of new AMS radiocarbon dates. This research will be the subject of future publications.

REFERENCES

Biró 2006 – K. T. Biró, *Carpathian obsidians: myth and reality*, in: J. Pérez-Arantegui (ed.), *Proceedings of the 34th International Symposium on Archaeometry, 3–7 May 2004, Zaragoza, Spain*, Zaragoza, 2006, p. 267–278.

Biró 2014 – K. T. Biró, *Comparative raw material collections in support of petroarchaeological studies: an overview*, in: K. T. Biró, A. Markó, K. P. Bajnok (eds.), *Aeolian Scripts. New Ideas on the Lithic World Studies in Honour of Viola T. Dobosi*, Budapest, 2014, p. 207–224.

Biró, Dobosi 1991 – K. T. Biró, V. T. Dobosi, *Lithoteca. Comparative Raw Material Collection of the Hungarian National Museum*, Budapest, 1991.

Biró *et alii* 2000 – K. T. Biró, V. T. Dobosi, Zs. Schléder, *Lithoteca II. Comparative Raw Material Collection of the Hungarian National Museum 1990–1997*, Budapest, 2000.

Boroneanț 2012 – A. Boroneanț, *The archaeological excavations at Grumăzești – Neamț County. Part 1 – refitting the puzzle*, SP 9, 2012, p. 25–47.

Constantinescu *et alii* 2014 – B. Constantinescu, D. Cristea-Stan, I. Kovács, Z. Szőkefalvi-Nagy, *Provenance studies of Central European Neolithic obsidians using external beam milli-PIXE spectroscopy*, Nuclear Instruments and Methods in Physics Research B 318, 2014, p. 145–148.

Diaconu 2012 – V. Diaconu, *Depresiunea Neamț. Contribuții arheologice*, Piatra Neamț, 2012.

Dumitrescu *et alii* 1983 – V. Dumitrescu, A. Bolomey, F. Mogoşanu, *Esquisse d'une préhistoire de la Roumanie*, Bucureşti, 1983.

Frahm *et alii* 2014 – E. Frahm, R. Doonan, V. Kilikoglou, *Handheld portable x-ray fluorescence of Aegean obsidians*, Archaeometry 56, 2014, p. 228–260.

Marinescu-Bîlcu 1975 – S. Marinescu-Bîlcu, *Asupra unor probleme ale culturii Criș*, SCIVA 26, 1975, 4, p. 487–506.

Marinescu-Bîlcu 1993 – S. Marinescu-Bîlcu, *Les Carpates Orientales et la Moldavie*, in: J. K. Kozłowski, P.-L. van Berg (eds.), *Atlas du Neolithique Europeen, vol. 1, L'Europe Orientale*, Liège, 1993, p. 191–243.

Marinescu-Bîlcu, Beldiman 2000 – S. Marinescu-Bîlcu, C. Beldiman, *Industria materiilor dure animale în cadrul culturii Starčevo-Criș pe teritoriul României. Așezarea de la Grumăzești, județul Neamț*, MemAnt 21, 2000, p. 273–295.

Maxim *et alii* 1995 – Z. Maxim, L. Mogos, L. E. Lakó, *Prelucrarea arheomagnetică a obsidianului de la Zăuan*, ActaMP 29, 1995, p. 11–16.

Rosania *et alii* 2008 – C. N. Rosania, M. T. Boulanger, K. T. Biro, S. Ryzhov, G. Trnka, M. D. Glascock, *Revisiting Carpathian obsidian*, Antiquity 82, 318, 2008 (http://www.antiquity.ac.uk/projgall/rosania/).

Vlassa 1965 – N. Vlassa, *Quelques problèmes de chronologie du Néolithique de la Transylvanie à la lumière de la stratigraphie de l'établissment de Tărtăria*, in: M. Pallottino, R. Peroni, M. Corona (eds.), *Atti del VI Congresso Internazionale delle Scienze Preistoriche e Protostoriche, Roma, 29 Agosto – 3 Settembre 1962, II. Comunicazioni sezioni I–IV*, Firenze, 1965, p. 267–269.

ABRÉVIATIONS / ABBREVIATIONS / ABREVIERI

AA – Archäologischer Anzeiger. Deutsches Archäologisches Institut, Darmstadt, München, Tübingen–Berlin
ACMI – Anuarul Comisiunii Monumentelor Istorice, Bucureşti
ActaMN – Acta Musei Napocensis, Cluj
ActaMP – Acta Musei Porolissensis, Zalău
ActaTS – Acta Terrae Septemcastrensis, Universitatea Lucian Blaga, Sibiu
Acta Siculica – Acta Siculica. Anuarul Muzeului Naţional Secuiesc, Sfântu Gheorghe
l'Anthropologie (Paris) – l'Anthropologie, Paris
Antiquity – Antiquity. A Quarterly Review of Archaeology, University of York
Anuarul MJIAP – Anuarul Muzeului Județean de Istorie și Arheologie Prahova, Ploiești
ARA – Annuaire Roumain d'Anthropologie
Archaeometry – Archaeometry, Research Laboratory for Archaeology and the History of Art, Oxford University
ArchBulg – Archaeologia Bulgarica, Sofia
Area – Area, Royal Geographical Society, London
ArheologijaKiiv – Arheologija. Nacional'na akademija nauk Ukraini. Institut archeologii, Kiiv
ArheologijaSSSR – Arheologija SSSR. Svod Archeologičeskih Istočnikov, Moskva
ArhMold – Arheologia Moldovei, Iaşi
BA – Biblioteca de Arheologie, Bucureşti
BARIntSer – British Archaeological Reports. International Series, Oxford
BiblThrac – Bibliotheca Thracologica, Bucureşti
BMC – *Coins of the Roman Empire in the British Museum*, London. I, *Augustus to Vitellius*, 1923; II, *Vespasian to Domitian*, 1930; III, *Nerva to Hadrian*, 1936; IV, *Antoninus Pius to Commodus*, 1968; V, *Pertinax to Elagabalus*, 1950 (H. Mattingly); VI, *Severus Alexander to Balbinus and Pupienus*, 1962 (R.A.G. Carson)
BMJT – Buletinul Muzeului Judeţean Teleorman, Alexandria
BMJTAG – Buletinul Muzeului Județean „Teohari Antonescu", Giurgiu
BSNR – Buletinul Societății Numismatice Române, București
Bull. et Mém. de la Soc. d'Anthrop. de Paris – Bulletins et Mémoires de la Société d'Anthropologie de Paris
CA – Cercetări Arheologice, Bucureşti
Caiete ARA - Caietele ARA, Revistă de Arhitectură, Restaurare şi Arheologie, Asociaţia ARA, Bucureşti
CCA – Cronica Cercetărilor Arheologice din România, Bucureşti
CercNum – Cercetări Numismatice, București
Dacia / Dacia NS – Dacia / Dacia Nouvelle Série. Revue d'archéologie et d'histoire ancienne. Académie Roumaine. Institut d'archéologie « Vasile Pârvan », Bucarest
DOW, I – Dumbarton Oaks Catalogues. A. Bellinger, Ph. Grierson (eds.), *Catalogue of the Byzantine coins in the Dumbarton Oaks Collection and in the Whittemore Collection*, I, *Anastasius to Maurice (491-602)*, Washington, 1966 (A. Bellinger)
EAIVR – C. Preda (ed.), *Enciclopedia Arheologiei și Istoriei Vechi a României*, vol. I-III (1994, 1996, 2000), București
EphemNap - Ephemeris Napocensis. Academia Română, Institutul de Arheologie şi Istoria Artei, Cluj-Napoca
Estiot, TM 5 – Sylviane Estiot, *Le trésor de Maravielle (Var)*, în Trésors Monétaires, V, 1983, p. 9-115
Estiot, *Venèra* – Sylviane Estiot, *Ripostiglio della Venèra. Nuovo Catalogo Illustrato* II/1, *Aureliano*, Roma, 1995
Fl – File de Istorie, Bistriţa
FolArch – Folia Archaeologica, Budapest
Giard, *Venèra* – J.-B. Giard, *Ripostiglio della Venèra. Nuovo Catalogo Illustrato*, III/1, *Gordiano III-Quintillo*, Roma, 1995
Göbl – R. Göbl, *Die Münzprägung der Kaiser Valerianus I. / Gallienus / Saloninus (253/268), Regalianus (260) und Macrianus / Quietus (260–262)*, Viena, 2000
IJO – International Journal of Osteoarchaeology
IstMitt – Istanbuler Mitteilungen, Istanbul
Istros – Istros, Muzeul Brăilei, Brăila
JAS – Journal of Archaeological Science, London
JEA – Journal of European Archaeology
JFA – Journal of Field Archaeology

KSIA (Kiiv) – Kratkije Soobščenija Instituta Arheologij Akademij Nauk SSSR, Kiiv
KSIA (Moskva) – Kratkije Soobščenija Instituta Arheologij Akademij Nauk SSSR, Moskva
Ktèma – Civilisations de l'Orient, de la Grèce et de Rome antiques, Strasbourg
MCA – Materiale şi Cercetări Arheologice, Bucureşti
MemAnt – Memoria Antiquitatis, Piatra Neamţ
MIAR – Materialy i issledovanija po arheologii Rossii
MIBE – W. Hahn, M.A. Metlich, *Money of the Incipient Byzantine Empire (Anastasius I – Iustinian I, 491–565)*, Viena, 2000
Mousaios – Mousaios. Buletinul Ştiinţific al Muzeului Judeţean Buzău
MuzNaţ – Muzeul Naţional, Bucureşti
NZ – Numismatische Zeitschrift, Viena
Peuce – Peuce, Studii şi cercetări de istorie şi arheologie, Institutul de Cercetări Eco-Muzeale, Tulcea
Pick, Regling – B. Pick, K. Regling, *Die antiken Münzen Nord-Griechenlands*, I, *Die antiken Münzen von Dacien und Moesien*, Berlin, 1, 1898 (B. Pick), 2, 1910 (B. Pick, K. Regling)
Pink, NZ – K. Pink, *Der Aufbau der Römischen Münzprägung in der Kaiserzeit*. VI/1, *Probus*, NZ, 71, 1946, p. 13-74
Pontica – Pontica. Studii şi materiale de istorie, arheologie şi muzeografie, Muzeul de Istorie Naţională şi Arheologie Constanţa
PZ – Prähistorische Zeitschrift, Berlin-Mainz
RA – Revue Archéologique, Paris
Radiocarbon – An International Journal of Cosmogenic Isotope Research, Cambridge
REA – Revue des Études Anciennes, Bordeaux
RevBistr – Revista Bistriței. Complexul Muzeal Bistriţa-Năsăud, Bistriţa
RevMuz – Revista Muzeelor, Bucureşti
RIC III – H. Mattingly, E.A. Sydenham, *The Roman Imperial Coinage*, III, *Antoninus Pius to Commodus*, London, 1930
RIC IV, 1 – H. Mattingly, E.A. Sydenham, *The Roman Imperial Coinage*, IV, 1, *Pertinax to Geta*, London, 1968
RIC IV, 2 – H. Mattingly, E.A. Sydenham, C.H.V. Sutherland, *The Roman Imperial Coinage*, IV, 2, *Macrinus to Pupienus*, London, 1938
RIC IV, 3 – H. Mattingly, E.A. Sydenham, C.H.V. Sutherland, *The Roman Imperial Coinage*, IV, 3, *Gordian III – Uranius Antoninus*, London, 1949
RIC V, 1 – P.H. Webb, *The Roman Imperial Coinage*, V, 1, London, 1927 (retipărit 1968)
RIC V, 2 – P.H. Webb, *The Roman Imperial Coinage*, V, 2, London, 1933 (retipărit 1968)
RIC VI – C.H.V. Sutherland, *The Roman Imperial Coinage*, VI, *From Diocletian's reform (A.D. 294) to the death of Maximinus (A.D. 313)*, London, 1967
RIC VII – P.M. Bruun, *The Roman Imperial Coinage*, VII, *Constantine and Licinius A.D. 313-337)*, London, 1966
RIC IX – J.W.E. Pearce, *The Roman Imperial Coinage*, IX, *Valentinian I-Theodosius I*, London, 1933 (retipărit 1968)
Ruzicka, *Inedita* – L. Ruzicka, *Inedita aus Moesia Inferior*, NZ, 50, 1917, p. 73–173
Quaternary International – Quaternary International. The Journal of the International Union for Quaternary Research
SAA – Studia Antiqua et Archaeologica, Iaşi
SCA – Studii și Cercetări de Antropologie, București
SCIV(A) – Studii şi Cercetări de Istorie Veche (şi Arheologie), Bucureşti
SCN – Studii şi Cercetări de Numismatică, Bucureşti
SNG IX, BM – Silloge Nummorum Graecorum, IX, The British Museum, I, *Black Sea*, London, 1993
SNG XI, *Stancomb* – Silloge Nummorum Graecorum, XI, *The William Stancomb Collection of coins of the Black Sea Region*, Oxford, 2000
SovArh – Sovetskaja Arheologija, Moskva
SP – Studii de Preistorie, Bucureşti
Stratum(Plus) – Stratum (Plus), Şcoala Superioară de Antropologie, Chişinău, Sankt Petersburg, Bucureşti
StudCom Satu Mare – Studii şi comunicări Satu Mare
StudCom Sibiu – Studii şi Comunicări, Sibiu
Th-D – Thraco-Dacica, București
Tyragetia – Tyragetia. Anuarul Muzeului Naţional de Istorie a Moldovei, Chişinău
Vărbanov – I. Vărbanov, *Greek Imperial Coins and their Values (The Local Coinage of the Roman Empire)*, I, *Dacia, Moesia Superior, Moesia Inferior*, Burgas, 2005
Verh.Naturforsch.Ver. – Verhandlungen des naturforschenden Vereines in Brünn, Brünn (Brno)