



pXRF analysis of obsidian artifacts from Albania: Crossroads or cul-de-sac?

Rudenc Ruka^{a,*}, Michael L. Galaty^b, Danielle J. Riebe^c, Robert H. Tykot^d, Ilir Gjipali^e,
Georgia Kourtesi-Philippakis^f

^a Academy for Albanological Studies, Institute of Archaeology, Department of Prehistory, Sheshi Nënë Tereza, Tirana, Albania

^b University of Michigan, Museum of Anthropological Archaeology, 3025 School of Education, 610 E. University Avenue, Ann Arbor, MI 48109-1259, United States

^c Field Museum of Natural History, 1400 S. Lake Shore Drive, Chicago, IL 60605, United States

^d University of South Florida, Department of Anthropology, 4202 East Fowler Ave, SOC107, Tampa, FL 33620-7200, United States

^e Academy for Albanological Studies, Institute of Archaeology, Department of Prehistory, Sheshi Nënë Tereza, Tirana, Albania

^f National and Kapodistrian University of Athens, Faculty of Philosophy, Department of History and Archaeology, University Campus Zografou, 15874 Athens, Greece

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ABSTRACT

Archaeologists first identified obsidian artifacts in Albania in the early 20th century, but their numbers were small and the contexts insecure. Their source was never determined. Nor was it clear why, given the large numbers of obsidian artifacts recovered in regions to the south and north, in areas like central and southern Greece and Croatia, more obsidian artifacts were not found in Albania. In an attempt to address these problems in Albanian prehistoric archaeology, we analyzed eight obsidian artifacts from six sites – out of a total of only 16 known pieces from the entire country, many of which are now lost – using portable X-ray fluorescence spectroscopy (pXRF). One of these, from the Putanja site, is from Lipari, Italy. The other seven are from Melos, Greece. All eight appear to date from the Middle/Late Neolithic to Late Bronze Age (5500–1050/25 BCE). The absence of obsidian in Albania is not the result of poor archaeological sampling; several, recent intensive surface surveys and excavations in south and north Albania produced no obsidian. Rather, it may be that obsidian was not imported to prehistoric Albania due to the presence of abundant, accessible, very fine flint sources, located in particular in the southwest of the country. Consequently, the prehistoric inhabitants of Albanian were out of the loop or otherwise uninterested in obsidian during those periods of Mediterranean prehistory, specifically from the Late Neolithic to the Bronze Age, when it was traded most extensively.

1. Introduction

Archaeologists first identified obsidian artifacts in Albania in the early 20th century, however their numbers were few and the contexts of their recovery were insecure. Their source was never determined and it remained unclear why, given the large numbers of obsidian artifacts recovered in regions to the south and north, in areas like central and southern Greece and Croatia, more obsidian artifacts were not found in Albania. To address these problems in Albanian prehistoric archaeology, we analyzed eight obsidian artifacts from six sites – out of a total of only 16 known from the entire country, many of which are now lost – using portable X-ray fluorescence spectroscopy (pXRF). One of these, from the Putanja site, is from Lipari, Italy. The other seven are from Melos, Greece. All eight appear to date from the Middle/Late Neolithic to Late Bronze Age (5500–1050/25 BCE).¹

In this article we review the archaeology of obsidian in Albania, present the results of pXRF analysis, and discuss the reasons why Albania was not better integrated into widespread, prehistoric obsidian interaction spheres centered on Greece, Italy, Turkey, and the Carpathians. The absence of obsidian in Albania is most certainly not the result of poor archaeological sampling; several, recent intensive surface surveys and systematic excavations in south and north Albania produced no obsidian. Rather, it appears likely that obsidian was not imported to prehistoric Albania due to the presence, particularly in the southwest of the country, of abundant, accessible, very fine flint sources (Ruka et al., 2014: 102; Perhoč and Ruka, 2017). Prehistoric inhabitants of Albania were out of the loop or otherwise uninterested in obsidian during those periods of Mediterranean prehistory, such as the Late Neolithic to the Bronze Age, when it was traded most extensively.

* Corresponding author.

E-mail addresses: rudenci@gmail.com (R. Ruka), mgalaty@umich.edu (M.L. Galaty), driebe@fieldmuseum.org (D.J. Riebe), rtykot@usf.edu (R.H. Tykot), igjipali@gmail.com (I. Gjipali), gkphil@arch.uoa.gr (G. Kourtesi-Philippakis).

¹ Preliminary results of this research were first reported in Ruka and Galaty (2017).

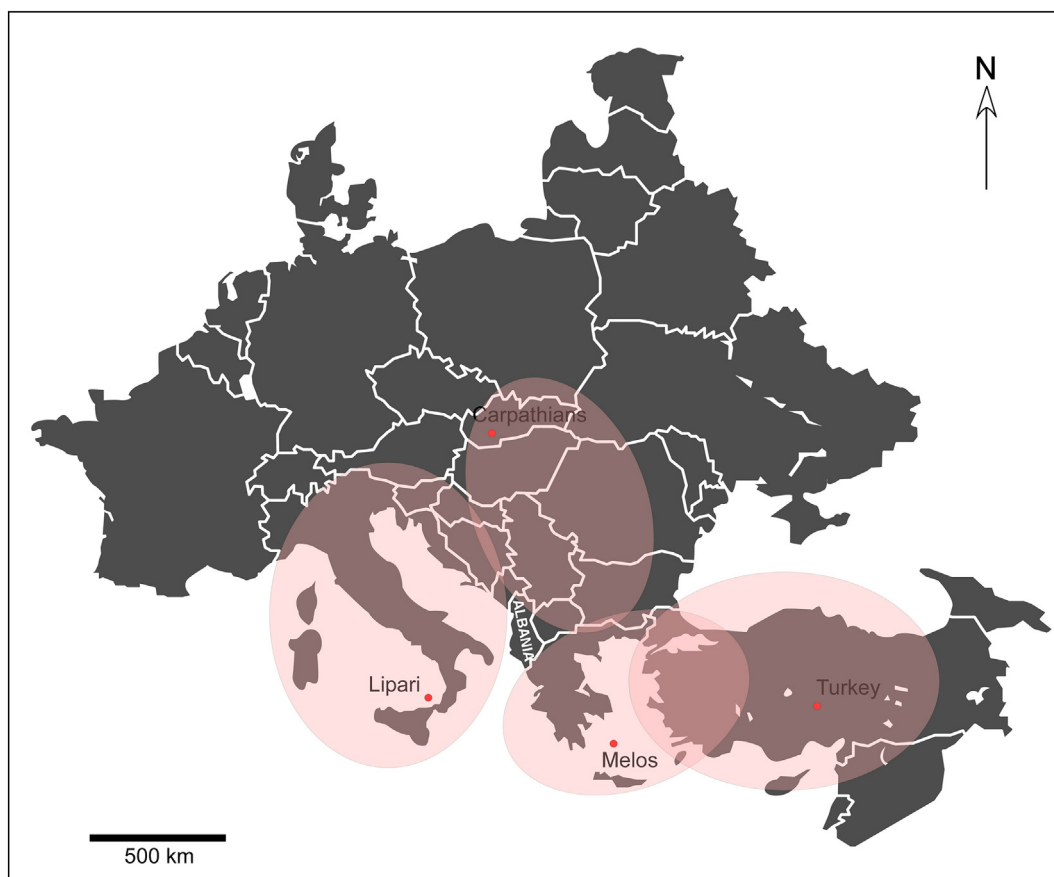


Fig. 1. Map of the Eastern Mediterranean showing obsidian sources and distribution spheres. M. Galaty, based on Milić (2014: 286, fig. 1).

2. Mediterranean obsidian sources

Most Eastern Mediterranean obsidian derives from four primary source zones in Italy, Greece, Turkey, and the Carpathians. Chemical sourcing of Mediterranean lithic materials began with research on Melian obsidian in the 1960's by Cann and Renfrew (1964), acting as a catalyst for the analysis of other, known sources in other parts of the Mediterranean and Eastern Europe. Consequently, we now understand relatively well where and how Mediterranean obsidian was acquired and subsequently traded. In this section, we briefly describe each source zone in turn and then consider Albania's position within and between the Mediterranean's prehistoric obsidian distribution spheres (Fig. 1).

2.1. Greece

In Greece, there are two main island sources of obsidian, Giali in the Dodecanese and Melos in the Cyclades. Some exploitation may have also occurred on the island of Antiparos, but the material is considered to be of lower quality (Renfrew et al., 1965: 232; Williams-Thorpe, 1995: 231). Melos is the best-studied obsidian source in the Mediterranean, and has been exploited since early prehistoric times. Melian obsidian artifacts were recovered, for example, from Upper Paleolithic and Mesolithic levels at Franchthi Cave in the Argolid, demonstrating the existence of early marine exchange networks (Perlès, 1987, 1990; Perlès et al., 2011). Obsidian trade in the Aegean continued through the Neolithic and climaxed during the Bronze Age. Though the other sources were known and occasionally used, the majority of obsidian found at sites in Greece comes from Melos and access to the quarries might have been open, not restricted (Torrence, 1986).

On the island of Melos, two quarries are known: Demenegaki and

Sta Nychia (the latter has also been referred to as Adhamas, Agia Nychia, or Bombarda) (Francaviglia, 1984; Renfrew et al., 1965; Torrence, 1986). They are located on opposite sides of the island and exploit flows formed by two different volcanic events (Acquafredda and Paglionico, 2004: 422; Fytikas et al., 1976; Fytikas et al., 1986). Though dating the flows using fission track analysis produced controversial results (Arias et al., 2006), compositional analysis of samples from the two quarries clearly demonstrates that they are chemically distinct (using INAA: Aspinall et al., 1972; Aspinall and Feather, 1978; Bigazzi et al., 1986; Williams-Thorpe, 1978; OES: Cann and Renfrew, 1964; and XRF: Frahm et al., 2014; Liritizis, 2008; Molloy et al., 2014; Riebe, 2018; Tykot, 2002). Seven of the obsidian artifacts we analyzed in Albania were from Melos and though we did not aim to identify subsources, most of them would appear to be from Demenegaki.

Melian obsidian artifacts are found throughout Greece, from Thrace and Greek Macedonia in the north to the Peloponnese and the Ionian islands in the south, and at many sites in western Anatolia (Kourtessi-Philippakis, 2014; Milić, 2014: 288, fig. 2; Sørensen, 2010: 158, fig. 1). Generally speaking, numbers fall off with distance (Sørensen, 2010: 171, table 1), however, and as recent field research (Middle Kalamas Archaeology Project in Thesprotia, Sidari excavations, etc.) has demonstrated, there is clearly less Melian obsidian in northwestern Greece and the Adriatic as compared to northern Greece and Asia Minor (Kourtessi-Philippakis, 2009a, 2009b). To the best of our knowledge, Melian obsidian has not been identified along the east Adriatic coast north of southern Albania and in Italy, with the exception of Grotta del Leone near Pisa (Tykot, 1996: 54). Melian obsidian accounts for approximately 10% of the total from the prehistoric site of Salamandrija on the island of Palagruža, while the rest is from Lipari (Forenbaher, 2013: 94; Tykot, 2011, 2014).

Table 1
All obsidian artifacts from Albania, along with pXRF data, calibrated in ppm.

Albanian obsidian artifacts analyzed by p-XRF (results in ppm)								
Element	Putanja	Dalani i Vogël	Bishti i Pallës	Maliq	Kallamas	Kamnik	Kamnik	Kamnik
	Medial blade fragment	Core bladelet fragment	Secondary flake	Retouched blade fragment	Chip	Crested blade	Blade	Flake
	Neolithic?	Late Neolithic-Bronze Age	Late Neolithic-Bronze Age	Late Neolithic	Middle-Late Neolithic	Late Neolithic	Late Neolithic	Late Neolithic
Mn	420	439	335	354	514	178	229	206
Fe	11,552	7367	6984	7990	10,901	8175	8401	7737
Zn	49	35	27	26	110	< LOD	7	< LOD
Ga	21	12	11	12	16	9	9	7
Th	41	14	9	10	10	8	5	7
Rb	292	110	97	101	116	87	81	86
Sr	12	84	82	82	111	80	78	80
Y	46	20	17	18	18	16	15	12
Zr	176	105	99	96	122	96	92	95
Nb	36	8	7	7	8	6	6	6
Source	Lipari	Melos	Melos	Melos	Melos	Melos	Melos	Melos

Albanian obsidian artifacts analyzed by p-XRF (results in ppm)				
Site	Form	Date	Source	Location
Kallamas	Blade fragment	Middle-Late Neolithic	Not obsidian	Korça
Kryegjata B	Rectangular microlith	Mesolithic	Not obsidian	Apollonia

Albanian obsidian artifacts not analyzed by p-XRF				
Site	Form	Date	Source	Location
Phoinike	“Knife”	Prehistoric	Unknown	Lost
Butrint	Scrapers (n = 3)	Late Bronze Age	Unknown	Lost
Dhiapori	Chunk	Unknown	Unknown	Unknown
Konispol	Blade fragment	Middle-Late Neolithic	Melos?	Lost
Ripësi	Axe	Unknown	Not obsidian	Lost
Apollonia	Unknown	Neolithic	Unknown	Lost

Total no. = 16 (eight certain, one probable, seven uncertain).

Lipari = 1 certain.

Melos = 7 certain, 1 probable.

2.2. Italy

Italian obsidian comes from sources on four islands: Lipari, Palmarola, Pantelleria, and Sardinia. Of these four, Lipari obsidian is the most widely distributed, with substantial amounts found throughout Italy and in Croatia, near the coast in Istria and in central Dalmatia (e.g., Danilo, n = 54), and inland as well, at a few sites in north Croatia (Bass, 1998; Kaiser and Forenbaher, 1999; Tykot, 2011, 2014, 2017a; Tykot et al., 2013). Obsidian from the other Italian sources has not been identified in the Adriatic, with the exception of two pieces of Palmarola obsidian from Sušac (versus 56 from Lipari; Tykot, 2014: 178), one each at two mainland sites in Croatia (Tykot, 2017b), and Sardinian obsidian at Brindisi in the heel of Italy (De Francesco et al., 2011). One Albanian obsidian artifact from the Putanja site is from Lipari.

2.3. Turkey

There are many sources of obsidian known in Turkey, primarily located inland in central Turkey (Carter, 2006; Carter and Shackley, 2007; Chataigner et al., 1998). Small numbers of central Anatolian obsidian artifacts are found in western Anatolia and in Crete and the Cyclades (Milić, 2014: 287, 288, fig. 2). No Anatolian obsidian has been identified in Albania.

2.4. The Carpathians

As is the case in the Mediterranean, Eastern Europe has a limited number of obsidian sources from which materials could be obtained in prehistoric times (Biro, 1984, 1998a, 1998b). The obsidian sources are located in several locations within the Tokaj-Eperjes Mountains in northwestern Hungary and in southeastern Slovakia. To date, relatively few compositional studies have been carried out on Eastern European obsidian materials (Biagi et al., 2007; Biagi and Starnini, 2013; Constantinescu et al., 2002; Riebe, 2016; Williams-Thorpe and Nandris, 1977; Williams-Thorpe, 1978; Williams-Thorpe et al., 1984). Small numbers of Carpathian obsidian artifacts are found as far south as Greek Macedonia, e.g., from the sites of Dispilio and Mandalo (Kilikoglou et al., 1996; Milić, 2014: 288, fig. 2), and in northern Italy (Kilikoglou et al., 1996: 347). Carpathian obsidian has been recovered from Neolithic archaeological sites in northern, continental Croatia and Bosnia (Tykot, 2011), as well as recently from the Dalmatian coast (D. Riebe, personal communication). No Carpathian obsidian has been identified in Albania, but there are several pieces from the site of Žitkovac, Kosovo (Tripković and Milić, 2008: 80 citing Chapman, 1981: 302–303, fig. 98).

2.5. Summary

When Mediterranean obsidian distribution spheres are mapped (as described by Robb and Farr, 2005: 37 and done by Milić, 2014: 286, fig.

1), Albania falls into a gap between them, even during the Late Neolithic-Bronze Age, when these spheres were at their largest and most active (Fig. 1). As discussed below, the lack of obsidian in Albania is not mainly a sampling problem; there must have been other factors at play.

With regard to the Neolithic Mediterranean obsidian trade, Broodbank (2013: 233) describes the existence of: “unusual specialist individuals or groups moving over much longer distances than most of their contemporaries.” Just what motivated these traveling specialists – and why they skipped Albania – remains unclear, but obsidian does not appear to have been circulated for utilitarian purposes only; rather there seems to have been deeper social needs driving early trade contacts. It may be that prehistoric inhabitants of Albania eschewed obsidian because they had access to excellent local flints. But another intriguing possibility is that, at least during the Bronze Age, the prehistoric inhabitants of Albania did not adopt the Aegean social practices that accompanied obsidian, such as scarification, the cutting and shaving of hair, and various mortuary rituals, and so did not acquire it (Broodbank, 2013: 231; Carter, 1994, 1997; Nakou, 1995: 22–23). However, before addressing this hypothesis, we catalog and describe all of the obsidian artifacts found to date in Albania, followed by descriptions of methods and results.

3. Obsidian in Albania

The list of obsidian artifacts discovered in Albania is short and confined to twelve sites in southern Albania (Table 1): 16 total artifacts, of which eight are certainly obsidian (as determined by pXRF analysis), one may be obsidian (visually inspected, but not available for pXRF analysis), and six were probably obsidian (not visually inspected by the authors or subjected to pXRF analysis), but are now lost. One reported obsidian axe, now lost, was almost certainly not obsidian. Of the 16, six are blades or blade fragments, three are “scrapers,” three are flakes, and two are chips/chunks. Of the three flakes, one may indicate rejuvenation of a core, and of the blades, one preserves a secondary crest, indicating that prepared cores were occasionally imported to Albania. Of those artifacts that could be dated, by form and/or context, the majority date to the Neolithic-Bronze Age, with most of those probably dating from the Late Neolithic to Bronze Age (5500–1050/25 BCE).

3.1. Albanian obsidian artifacts not subjected to pXRF analysis

The first archaeologist to identify obsidian in Albania was Luigi Maria Ugolini, the head of the Italian archaeological mission to Albania. In the early 20th century, he published sporadic prehistoric finds that he claimed ranged in date from the Eneolithic through the Bronze Age (circa 4500–1050/25 BCE; Ugolini, 1932, II: 216–217). These were reported in the context of excavations undertaken in the classical city of Phoinike in southwest Albania, 1926–1927 (De Maria, 2002: 21–22). The accounts describe several prehistoric artifacts, among them two fragments of polished stone hammers, flint tools, and a small obsidian knife, most of which were discovered in the central part of the Phoinike plateau close to the treasury (Ugolini, 1932, II: 139–142). That this knife was in fact obsidian has never been confirmed, and no other finds from these periods have been reported from more recent excavations (Budina, 1971a: 295–299, 1974: 235–244, 1986: 113–121; Çondi, 1977: 343–344, 2004: 35–48; Nanaj, 1989: 272–273, 1990: 256–266; De Maria and Gjongecaj, 2002, 2003, 2005), but we may assume that the knife was prehistoric.

Ugolini also identified two pieces of obsidian from the acropolis of the classical city of Butrinti. From excavations beginning in 1928, he recovered a few prehistoric artifacts, of which two are identified as small obsidian scrapers. Ugolini indicated that these materials were of late prehistoric date (Ugolini, 2000: 115–116), while Mustilli was of the opinion that the lack of context made dating them (and those from Phoinike) impossible (Mustilli, 1943: 138). More obsidian was collected at the site in Ugolini's excavation back dirt during a visit in 1937 by the

Swedish archaeologist Natan Valmin (1939: 77). In fact, unlike Phoinike, later work at Butrint has revealed possible Late Neolithic and mostly Late Bronze Age and Early Iron Age finds in the area of the acropolis (Budina, 1988: 25–27, 30–31, 34–37; Haxhis, 1998: 223–224, 227–228; Lima, 2013: 32; Nanaj, 1985: 306, 311, 1986: 255; Prendi, 2008), suggesting that Ugolini's obsidian scrapers perhaps did date to late prehistory.

One more obsidian chunk was discovered as a surface find at Dhiapori in the vicinity of Butrinti during survey work in 1999. The piece has not been published and lacks any obvious association with other finds (I. Gjipali, personal communication). We could not confirm that it was in fact obsidian.

An obsidian blade fragment was discovered during the 1993 excavations at Konispoli Cave in the far south of Albania near the ancient city of Butrinti. Based on visual inspection of the piece, the authors of a preliminary report of the 1992–1994 excavations suggested a Melian origin (Korkuti et al., 1996: 183, 192, 216; see also Petruso et al., 1994). Unfortunately, the piece could not be relocated in the store rooms of the Institute of Archaeology in Tirana for pXRF analysis. Nevertheless, given that the excavators are experienced Mediterranean archaeologists, the piece seems almost certainly to have been of Melian origin, as originally identified. According to the report, it was recovered from a Middle-Late Neolithic stratigraphic context in Trench XXI, unit 23 (Korkuti et al., 1996; K. Petruso, personal communication).

Another stray surface find – a grey obsidian pierced axe, 12 cm long, broken longitudinally – was recovered during the 1962 excavation campaign at the IVth century BC hilltop fortification of Ripësi in the Finiqi district of southern Albania (Budina, 1971b: 69, 79). Despite efforts to relocate the object, its whereabouts remain unknown. However, based on the information provided in the publication and given the axe's form, we can infer an approximate date in the Albanian Late Neolithic to Middle Bronze Age. Given that there are no other comparable or existing examples of polished obsidian axes from the Mediterranean basin of which we are aware, this particular object was probably misidentified and was most likely a polished stone axe, not obsidian.

An attested obsidian find comes from the classical Corinthian colony of Apollonia in the Fier district, but it also could not be relocated. It was discovered during the 1951 excavations in the area delimited by the temenos wall and the site's deposit of sacred amphorae, between the gate of the temenos wall and the odeon. The author of the excavation report maintains that even though the obsidian piece was found in a historic stratum it was of prehistoric date, and would have been imported from either Hungary or Melos in Greece (Ceka, 1951: 3–4; we consider the latter a much more likely point of origin). While Anamali (1956: 8) points to a possible Neolithic date for the obsidian, artifacts of Bronze and Iron Age date have been found occasionally both within the city and in its necropolis (Anamali, 1956, 8; Bejko and Aliu, 2010, 1–2, 23–24), which could indicate that the piece was a late prehistoric, rather than Neolithic, import.

3.2. Albanian obsidian artifacts subjected to pXRF analysis

Recently, an obsidian piece from Maliq was identified in the Institute of Archaeology store rooms in Tirana (Fig. 2). The site is located in the Korça basin in southeast Albania, on the north side of the current bed of the Devolli River, in close proximity to the town of Maliq. The settlement, discovered in 1948 during drainage work at Maliq Lake (Ceka and Adam, 1949: 95), was excavated from 1961 to 1966 and 1973 to 1974 (Andrea, 1983–1984: 114, 1991–1992: 84–85; Prendi, 1966, 1974), revealing Late Neolithic, Eneolithic, Bronze Age, and Iron Age phases. The piece was originally excavated in 1966, bears the inventory number 5869, square K13, spit 20, and is described as a blade fragment, bilaterally retouched on black flint belonging chronologically to the Late Neolithic. PXR analysis of the artifact indicated instead that it is Melian obsidian.

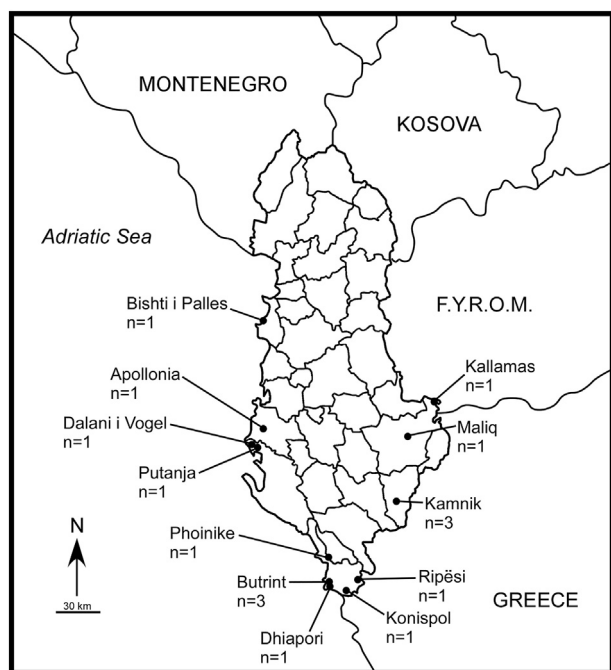


Fig. 2. Map of Albania showing sites mentioned in the text from which obsidian was analyzed by pXRF. M. Galaty.

Two purported obsidian artifacts were found at the large (8 ha) Middle (5400–5200 BCE)–Late Neolithic (4800–4500 BCE) lakeside settlement of Kallamas, located on the northern shore of Greater Prespa Lake in the Korça district of southeast Albania. The site represents a particularly large specialized workshop for the production of polished stone implements. It was first identified by an Albanian-French team in 2007. Systematic test excavations followed (2008–2011) in order to determine the extent and the chronology of the site. Each season surface finds were collected, producing a relatively large sample of lithic artifacts, including two possible obsidian pieces (Lera and Touchais, 2008, 897–900; Lera et al., 2009; Mulliez, 2009, 969–970; Lera et al., 2010, 618–626, 647; Lera et al., 2011, 661–675; Lera et al., 2012; Oberweiler et al., 2014, 83–89). The first is a blade fragment found in 2009 (“Rapport Sur La Campagne de 2009”, 2009: 8, 10, 37). It was analyzed by pXRF and is made from black flint, not obsidian. The other is a small chip found in 2011. The pXRF analysis indicated a Melian origin.

Another obsidian find derives from the site of Bishti i Pallës, discovered during survey and rescue excavations from 2002 to 2005 at Archaic sanctuaries in the territory of the ancient Corinthian colony of Epidamnos. The site is situated north of the modern city of Durrës, on the southern part of the Bishti i Pallës peninsula, and is being eroded by wave abrasion. Initially, the very large number of lithics made exclusively from honey-brown flint suggested a Paleolithic or Mesolithic age (Gjipali, 2006: 37). But later work, including trial excavations in

2007, revealed at least two major chronological phases: the Late Neolithic and Early Bronze Age. Unfortunately, the sea water level did not allow for additional deeper excavations at what once might have been an island, leaving room for further interpretation as regards date and site function (Požani et al., 2013: 133–134; Gjipali, 2012: 231, 2014: 61; Ruka et al., 2014: 103). Mixed in with the particularly large quantities of surface-collected honey-brown flint finds was a single obsidian flake, possibly a core tablet. The piece is rather worn due to wave action but remnants of flake scars can still be detected on the dorsal side, which might suggest the presence of at least one obsidian core, the platform of which was maintained by detaching core tablets. The flake was analyzed by pXRF and it is from Melos, the northernmost example of Melian obsidian discovered to date along the eastern Adriatic coast.

The sites of Putanja and Dalani i Vogël were discovered in 2010 by local amateur lithic collectors and are situated north of the city of Vlora, on the bay, at the far southern end of the eastern Adriatic coast (Ruka et al., 2014). Each produced one obsidian artifact. Putanja and Dalani i Vogël are two of several prehistoric archaeological sites located close to the southern extent of a sandstone and sandy hill-range molasse that extends for ca. 4.6 km northwest-southeast between the sea and Narta Lagoon. The important late prehistoric and Classical site of Treporti is also situated nearby, but until recently the overall archaeological potential of the wider region, for early prehistory in particular, had not been fully realized. The hill range is comprised of a series of depressions and peaks that are being continuously eroded by the sea on the southwest. Like Putanja and Dalani i Vogël, the rest of the sites are situated in depressions that are relatively flat. The many recently-identified open-air sites along the range contain mostly different early prehistoric components at each of the various locations.

In the assemblage of Putanja, one obsidian medial blade fragment with very regular parallel ridges and lateral margins was identified and recovered during a brief visit to the site in 2012 (Fig. 3). The pXRF analysis indicated that the obsidian is from Lipari, Italy. Given its form and the lack of pottery at the site, we initially dated the piece to the Mesolithic. However, Lipari's obsidian sources were not formed until the late Mesolithic and exploited prior to the Neolithic period (Tykot, 2017a). They generally were not exported outside Italy after about 3000 BCE, so the artifact may well date to the Neolithic (Freund, 2017: 5–6).

The second obsidian artifact derives from the site of Dalani i Vogël and is a core bladelet fragment. The site includes finds that range from the Middle Paleolithic to perhaps the Bronze Age, with one of the most significant components being the Early Neolithic (Andoni et al., 2016: 121–123, 125; Ruka et al., 2014). The obsidian originated from Melos and the artifact is probably of Middle/Late Neolithic-Bronze Age date, given that most Melian obsidian artifacts found in the nearby Ionian Islands date to this period.

Three obsidian artifacts were discovered at the Late Neolithic-Eneolithic site of Kamnik, a hilltop settlement situated in the Kolonja district of southeast Albania. The site was first identified in 1967 and was excavated from 1968 to 1970 by a local archaeologist, Skënder Aliu

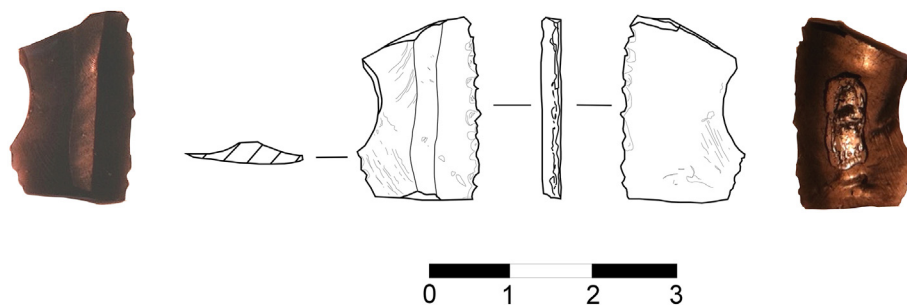
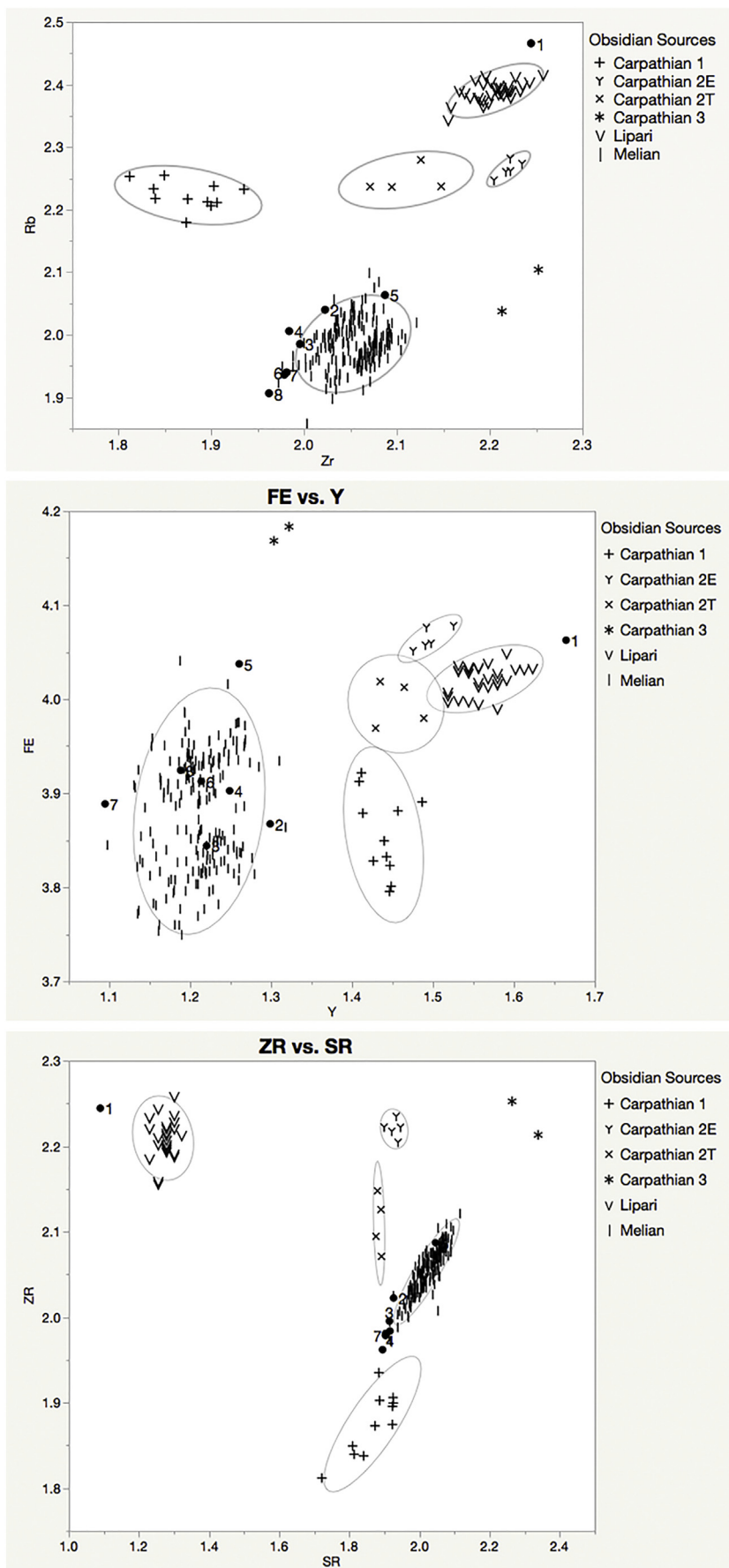


Fig. 3. Drawing and photograph of the Lipari obsidian artifact from the Putanja site, Albania. Scale in centimeters. D. Karges and M. Galaty.



(caption on next page)

Fig. 4. a, b, c. Bivariate plots of logged pXRF data for Albanian obsidian artifacts with logged Melian, Italian, and Carpathian data. The ellipses represent 90% confidence intervals. a) Rb versus Zr; b) Fe versus Y; c) Zr versus Sr. 1) Dalani i Vogel, 2) Bishti i Palles, 3) Maliq, 4) Kallamas, 5) Kamnik 1 (K74955), 6) Kamnik 2 (K7499), 7) Kamnik 3 (KAMB), and 8) Putanja. D. Riebe.

(1969), in collaboration with Bep Jubani (Aliu and Jubani (1969)) and Frano Prendi (Prendi (1971) and Prendi and Aliu (1971)). The pieces were recently relocated in the store rooms at the Institute of Archaeology in Tirana and identified as obsidian. All three were excavated during the 1969 campaign from Late Neolithic contexts, with two bearing the inventory numbers 7495/5 and 7499/15, and the third without a number. Of particular interest is 7499/5, a blade which preserves a secondary crest. The other two pieces are a blade and an accidental flake fragment.

Finally, a recent systematic survey conducted in the vicinity of Apollonia, the Mallakstra Regional Archaeological Project (MRAP; additional discussion below), recovered numerous early prehistoric artifacts, including a single, small obsidian piece, a rectangular microlith, from the site of Kryegjata B (Runnels et al., 2004: 13–17). Our pXRF analysis of the artifact indicates that it is not obsidian, rather it is made from black flint.

4. pXRF analysis of obsidian: materials and methods

A Bruker Tracer III-V+ portable X-ray fluorescence spectrometer, owned by the Department of Anthropology and Middle Eastern Cultures at Mississippi State University, was used to analyze Albanian obsidian artifacts. Over the last decade the use of pXRF has become widespread in archaeological obsidian studies due to its being non-destructive while providing quantitative measurements of many of the same trace elements used in obsidian sourcing studies by ED-XRF, INAA, and LA-ICP-MS. The pXRF model used is equipped with a high resolution, Peltier cooled, Silicon PIN diode detector. The instrument was set to 40 kV and 33 μ A and each sample was analyzed for 300 s. A filter (76 μ m Cu, 25 μ m Ti, 305 μ m Al) was used to reduce the background and increase the precision for the K-alpha peaks for elements in the Mn to Nb range, with detection limits for the trace elements in single-digit parts per million (ppm). With the exception of the obsidian artifact from Kallamas (a very small, thin chip), thick, flat clean faces that covered the detector completely were analyzed.

The raw data produced were calibrated using Bruker software which incorporates many obsidian standards developed at MURR (Missouri University Research Reactor). Carpathian, Mediterranean, and Anatolian obsidian sources have been analyzed extensively with several analytical techniques including pXRF, thereby allowing direct comparison with the archaeological sample data and providing a fairly straightforward assignment to specific sources (Milić, 2014; Tykot, 2017b). For small samples, the use of element ratios resolves any issues arising due to low values in the raw data.

5. Results

Ten elements were measured by pXRF: Mn, Fe, Zn, Ga, Th, Rb, Sr, Y, Zr, and Nb (Table 1). Of these, Fe and the trace elements Rb, Sr, Y, and Zr were most useful in determining the origins of the Albanian obsidian artifacts, while all were used to confirm matches with specific obsidian sources. This is quite normal given that most obsidian provenance studies regardless of geographic location rely on six elements or less, including Fe, Rb, Sr, Y, Zr, and Nb (Ferguson, 2012: 408). The unique combination and proportion of these elements enables researchers to accurately identify the geological source for any given archaeological artifact. For the use of pXRF in the particular region of our study, Milić (2014: fig. 3) has shown that the elements Zr, Rb, and Sr are sufficient to distinguish each of the Aegean sources from Carpathian and Anatolian sources, while for more than a decade Tykot (2017b: figs. 3, 5, 6) has used Rb, Sr, and Nb to distinguish not only between each of the four

Italian island, Carpathian, and Aegean island sources, but also to distinguish four sub-sources on Sardinia, three on Lipari, and both Deme-negaki and Sta Nychia on Melos. In this study, when Carpathian, Melian, and Lipari geological samples are plotted with the other eight Albanian artifacts, the Putanja fragment is clearly not from Melos (Fig. 4a, b, c). It is much too high in Fe, Rb, and Zr to be from either of the Melian sources and is, in fact, from Lipari, which has low Sr. The other seven Albanian artifacts are all from Melos.

6. Discussion

The obsidian artifact compositionally identified as Lipari may have arrived in Albania at the Putanja site as early as the Early Neolithic. The form of the blade and the lack of associated pottery at the open air site suggested a pre-Neolithic date, but the Lipari sources were not exploited until the end of the 7th or the beginning of the 6th millennium BC, that is prior during the Neolithic (Freund, 2017; Tykot, 1996, 2004, 2017a). A similar case can be made for another piece of obsidian, identified from the site of Tsarlambas along the Epirote coast in the area of Preveza. The authors of the publication suggest based on macroscopic observations that it might originate from Lipari and could perhaps date to the Mesolithic (Runnels and van Andel, 2003: 118, 121, 131, 134). The uncertainty regarding the origin and the age of this piece, however, makes the Putanja obsidian artifact the southernmost, securely-identified piece of Lipari obsidian along the eastern Adriatic-Ionian coast. The other group of Lipari finds from the eastern Adriatic is concentrated on the route connecting the islands of Palagruza, Sušac, and Korcula to various points along the middle Dalmatian coast (Tykot, 2004: 32, 2011, 2017a). Given the distances between this area of the Dalmatian coast and the area of Vlora, and the proximity of the latter to southern Italy, we can suggest direct contact between Vlora and Apulia. In which case, a number of candidate sites from the eastern coastal areas of Apulia could have served as intermediaries linking Putanja to the opposite coast and Lipari during the 6th–4th millennium BC (Freund, 2017: Supplemental Table B).

By contrast, the obsidian artifacts compositionally identified as Melian appear to have arrived in Albania beginning in the Middle/Late Neolithic and, perhaps, in the Bronze Age. It is interesting that during the Late Neolithic, when Lipari's obsidian trade network was at its height (referred to by Freund, 2017 as Lipari's "Golden Age"), reaching both interior and coastal sites in Croatia and Bosnia, Albanian sites acquired small amounts of Melian obsidian instead. The inland Albanian sites of Maliq, Kamnik, and Kallamas, located in Korça in southeast Albania, probably interacted with large Neolithic settlements in Macedonia, such as Dispilio, that procured relatively large amounts of Melian obsidian (Milić, 2014: 288). Obsidian may have arrived in the Korça basin from Macedonia via down-the-line trade up the Haliakmon River from the Thermaic Gulf. The Macedonian settlements also received small amounts of Carpathian obsidian (Milić, 2014: 288–289), but it appears to have arrived via routes that accessed Kosovo and bypassed Albania, probably down the Danube and Vardar rivers from the very important tell settlement of Vinča, located in Serbia near Belgrade (Kilikoglou et al., 1996; Tripković and Milić, 2008). By comparison, coastal Albanian sites, such as Dalani i Vogël, Bishti i Pallës, and, perhaps, Konispoli, Dhiapori, Butrinti, Phoinike, and Apollonia would have acquired obsidian through coastal trade routes that ran up the eastern Adriatic shore from southwestern Greece and the Ionian Islands, largely bypassing northwest Greece and Corfu. This trade may have been facilitated by secondary distribution nodes situated at the far northern edge of the Melian distribution sphere, such as Late-Final Neolithic Pangali near Patras, from which 276 pieces of obsidian were

excavated (Sørensen, 2010). Traders operating out of depots, like Pangali and others in the Ionian Islands, may have sought partners at lithic-dense Albanian sites like Dalani i Vogël and Bishti i Pallës, but were rebuffed. The nearest, concentrated assemblages of artifacts of purported Melian origin are from the Ionian islands of Lefkada, Kefalonia, Ithaka, and Zakynthos, are dated to the Late Neolithic and the various different chronological sub-periods of the Bronze Age, and are thought to have been transported via sea routes (Souyouzoglou-Haywood, 1999: 7, 17, 25, 30, 34, 39, 45, 47, 96–97, 100, 121–122). The question, then, is why, at the end of the Neolithic and during the Bronze Age, when Melian obsidian was becoming available in large quantities throughout Greece and adjacent areas, was Albania not pulled into the Melian obsidian exchange interaction sphere?

One explanation we can discount is sampling bias. Since 1991, when Albania's period of isolation ended, modern recovery methods have been introduced, including fine screening and intensive surface survey, producing 1000s of lithic artifacts without a net increase in the number of obsidian artifacts recovered. For example, the Mallakstra Regional Archaeological Project (MRAP) conducted six seasons of intensive surface survey in the vicinity of Apollonia, in central Albania, and excavations at the nearby site of Kryegjata B, recovering 1593 and 1190 lithics respectively (Runnels et al., 2004, 2009). Of these, only one was perhaps obsidian, now disproved by pXRF analysis (see above). Likewise, the Projekti Arkeologjik i Shkodrës (PASH) conducted five seasons of intensive survey in north Albania, recovering more than 1533 lithics; none were obsidian (Ruka, in preparation-a).

What is now abundantly clear is that in all periods of prehistory, the occupants of Albania had access to excellent flint in large amounts, so much so that much later one of the world's primary producers of gun flints was located near Vlora in south Albania (Evans, 1887; Ruka, in preparation-b). Beginning as early as the early 20th century, several authors pointed to Albania as a possible source of flint raw materials, which might have been imported to Greece during late prehistory (Periès 2004: 158, 2012: 542; Parkinson and Cherry, 2010: 4–5; Ruka et al., 2014: 102; Tsundas, 1908: 328; Wace and Thompson, 1912: 71). More recently, work focused in northern Albania indicates that honey-brown flint, which may originate from the Vjosa River valley in the southwest of the country, was exported to the site of Blazi Cave starting at least as early as the Late Upper Paleolithic period or 18,000 cal. BP (Hauck et al., 2017c: 155–156). Similar trends have also been observed for the Mesolithic period at the nearby Neziri Cave (Hauck et al., 2016: 156; Hauck et al., 2017a: 19–20; Hauck et al., 2017b: 164, 166). The practice of collecting and transporting large amounts of honey-brown flint reached its zenith at the site of Bishti i Pallës during the Late Neolithic and Early Bronze Age, where many thousands of honey-brown flint artifacts have been recovered (Požani et al., 2013: 133–134). In short, it may be that obsidian was not imported to Albania in significant amounts simply because it was not needed. Lithic specialists there, operating out of workshops along the coast, may have embargoed obsidian because its importation was not an economic necessity and did not positively impact their livelihood.

We would, however, like to suggest an additional possible explanation: that prehistoric inhabitants of Albania fell into gaps between obsidian distribution spheres not for purely geographic or utilitarian economic reasons, but because the social practices that underpinned the Mediterranean obsidian trade did not appeal to some Balkan peoples, those in the west-central Balkans in particular. The obsidian “embargo” appears to have applied to both coastal and interior Albania, including Korça, the length and breadth of the country, despite the fact that other exotic goods reached Albania during the Middle/Late Neolithic, pottery in particular (Korkuti, 2001: 264, Table 3). In fact, the presence of Neolithic pottery imported to Albania from Greece strongly indicates that the volume and weight of particular goods did not dissuade inhabitants from transporting them over long distances. Moreover, the embargo held through the whole of the Bronze Age, when obsidian from Melos was traded most extensively.

Carter (1994, 1996) has argued that obsidian blades were used by Early Bronze Age Aegean individuals for depilation and/or scarification and were commonly deposited in burials (circa 3100–2000 BCE). West Balkan peoples apparently did not practice these forms of body modification and certainly did not include obsidian blades in burials. And yet, they must have been relatively well aware of Aegean Early Bronze Age burial practices, generally speaking, since so-called violin figurines made out of clay in imitation of Aegean violin figurines were often interred in Albanian Early Bronze Age graves (Govedarica, 2016). Interestingly, Melian obsidian artifacts appear to co-occur spatially with forms of burial practiced to the south in mainland Greece and the Aegean islands, including Crete, often associated with large corporate tombs, such as chamber and tholos tombs, that could be reopened and closed as needed, allowing various performative mortuary rituals, such as the cleaning and secondary reburial of corpses. Prehistoric Albanians practiced burial in tumuli (mounds) beginning in the Early Bronze Age and well into the historic period, much longer than in most other parts of Europe. At least 156 tumuli have been excavated to date in Albania (Bejko, 2014), and whereas lithics (and other artifacts, such as pottery sherds and daub) that range in date from the Middle Paleolithic to the Neolithic are commonly discovered in abundance in the mound and grave fill (Aprile, 2014), none of those reported lithic finds have been obsidian. In fact, primary burial in mounds did not encourage the kinds of mortuary rituals practiced to the south, including secondary reburial. The northernmost tholos tomb in western Greece is located just outside of Preveza in Epirus (Tartaron, 2004). It is perhaps no coincidence that beyond Epirus, the numbers of Melian obsidian artifacts drops to almost zero, and none are found in tombs. Rather, large numbers of exotic goods such as pottery, metal objects, including weapons, amber, and carnelian beads were imported to Albania, in particular during the Late Bronze Age, and these have been recovered almost exclusively from mortuary contexts (e.g., Bejko, 1993; Touchais, 2002; Kurti, 2012; Kurti, 2017). Obsidian is completely absent.

7. Conclusion

To close, the analysis by pXRF of Albanian obsidian artifacts points to Melian origins for the majority, both from coastal and inland Albania. Albania's coast presents the easternmost securely identified extent, albeit sporadic, of Lipari obsidian distribution, and the northernmost extent of Melian obsidian distribution, which is marked by distance decay and considerable fall off. We conclude that sampling bias does not explain the general absence of obsidian from Albania; rather, prehistoric Albanians chose not to participate in the various Mediterranean obsidian interaction spheres that surrounded them through the Neolithic and into the Bronze Age. This could be due to the presence of abundant, excellent flint sources in Albania, but there may be a social explanation as well. Bronze Age inhabitants of Albania were culturally distinct from their southern neighbors. They espoused different mortuary beliefs and practices that did not require obsidian, and so it was not imported. It remained an exotic curiosity, nothing more, found occasionally in settlements, never in any quantity. Connections between the prehistoric inhabitants of Albania and adjacent regions were forged in other ways, with other materials, metal in particular.

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References

- Acquafredda, P., Paglionico, A., 2004. SEM-EDS microanalysis of microphenocrysts of Mediterranean obsidians: a preliminary approach to source discrimination. *Eur. J. Mineral.* 16, 419–429.
- Aliu, S., 1969. Zbulime të reja të kulturës Ilire në rrethin e Kolonjës. *Stud. Hist.* 1, 159–163.
- Aliu, S., Jubani, B., 1969. Vendbanimi prehistorik i Kamnikut (Kolonjë). *Buletin Arkeologjik* 1, 1–13.
- Anamali, S., 1956. Të dhëna mbi elementin Ilir në qytetet antike Epidamn dhe Apolloni. *Buletin Për Shkencat Shoqërore* 1, 3–39.
- Andoni, E., Hasa, E., Kujtila, E., 2016. Kërkime Sipërfaqësor Edhe Gërmime Kontrolli Në Vendbanimet Prehistorike Triport (Vlorë) dhe Qukës (Librazhd). *Candavia* 6, 121–129.
- Andrea, Z., 1983–1984. *Archaeology in Albania, 1973–1983*. *Archaeol. Rep.* 30, 102–119.
- Andrea, Z., 1991–1992. *Archaeology in Albania 1984–1990*. *Archaeol. Rep.* 38, 71–88.
- Aprile, J.D., 2014. The lithic artifacts. In: Papadopoulos, J.K., Morris, S.P., Bejko, L., Schepartz, L.A. (Eds.), *The Excavation of the Prehistoric Burial Tumulus at Lofkend, Albania*. Volume 1: Text. *Monumenta Archaeologica*, vol. 34. Cotsen Institute of Archaeology Press, Los Angeles, pp. 425–465.
- Arias, A., Oddone, M., Bigazzi, G., Di Muro, A., Principe, C., Norelli, P., 2006. New data for the characterization of Milos obsidians. *J. Radioanal. Nucl. Chem.* 268, 371–386.
- Aspinall, A., Feather, S.W., 1978. Neutron activation of Aegean obsidians. In: Doumas, C. (Ed.), *Thera and the Aegean World I*. The Thera Foundation, London, pp. 517–522.
- Aspinall, A., Feather, S.W., Renfrew, C., 1972. Neutron activation analysis of Aegean obsidians. *Nature* 237, 333–334.
- Bass, B., 1998. Early Neolithic offshore accounts: remote islands, maritime exploitation, and the trans-Adriatic cultural network. *J. Mediterr. Archaeol.* 11, 165–190.
- Bejko, L., 1993. Mbi praninë e qeramikës mikene në Shqipërinë Jugore dhe probleme lidhur me të. *Iliria* 23 (1–2), 101–122.
- Bejko, L., 2014. Research on tumuli in Albanian archaeology. In: Papadopoulos, J.K., Morris, S.P., Bejko, L., Schepartz, L.A. (Eds.), *The Excavation of the Prehistoric Burial Tumulus at Lofkend, Albania*. Volume 1: Text. *Monumenta Archaeologica*, vol. 34. Cotsen Institute of Archaeology Press, Los Angeles, pp. 517–524.
- Bejko, L., Aliu, S., 2010. Small finds catalogue. In: Amore, M.-G. (Ed.), *The Complex of Tumuli 9, 10 and 11 in the Necropolis of Apollonia (Albania)*. *British Archaeological Reports, International Series* 2059, vol. 1. Archaeopress, Oxford, pp. 616–692.
- Biagi, P., Starnini, E., 2013. Pre-Balkan platform flint in the Early Neolithic sites of the Carpathian Basin: its occurrence and significance. In: Anders, A., Kulcsár, G. (Eds.), *Moments in Time: Papers Presented to Pál Raczky on His 60th Birthday*. L'Harmattan Kiadó, Budapest, pp. 47–60.
- Biagi, P., de Francesco, A.M., Bocci, M., 2007. New data on the archaeological obsidian from the Middle-Late Neolithic and Chalcolithic sites of the Banat and Transylvania (Romania). In: Kozłowski, J., Raczky, P. (Eds.), *The Lengyel, Polgár and Related Cultures in the Middle/Late Neolithic in Central Europe*. *Polska Akademia Umiejętności*, Krakow, pp. 309–326.
- Bigazzi, G., Meloni, S., Odone, M., Radi, G., 1986. Provenance studies of obsidian artifacts: trace elements analysis and data reduction. *J. Radioanal. Nucl. Chem.* 98, 353–363.
- Biro, K.T., 1984. Distribution of obsidian from the Carpathian sources on central European Palaeolithic and Mesolithic sites. *Acta Archaeol. Carpath.* 23, 5–42.
- Biro, K.T., 1998a. Stones, numbers - history? The utilization of lithic raw materials in the Middle and Late Neolithic of Hungary. *J. Anthropol. Archaeol.* 17, 1–18.
- Biro, K., 1998b. Lithic Implements and the Circulation of Raw Materials in the Great Hungarian Plain During the Late Neolithic Period. *Hungarian National Museum, Budapest*.
- Broodbank, C., 2013. *The Making of the Middle Sea: A History of the Mediterranean From the Beginning to the Emergence of the Classical World*. Thames and Hudson, London.
- Budina, D., 1971a. Harta arkeologjike e bregdetit jon dhe e pellgut të Delvinës. *Iliria* 1, 275–342.
- Budina, D., 1971b. Kalaja e Ripësit (gërmime të vitit 1962). *Iliria* I, 69–82.
- Budina, D., 1974. Gjetje Rasti, rrethi i Sarandës. *Buletin Arkeologjik* 4, 235–244.
- Budina, D., 1986. Foinike në kërkimet e reja arkeologjike. *Iliria* XVI (1), 113–120.
- Budina, D., 1988. Butrinti Pararomak. In: Ceka, N. (Ed.), *Butroti: (Permbledhje Studimesh)*. Akademia e Shkencave e RPSSH; Qendra e Kerkimeve Arkeologjike; Sektori i Antikitetit Ilir, Tiranë, pp. 6–114.
- Cann, J.R., Renfrew, C., 1964. The characterization of obsidian and its application to the Mediterranean region. *Prehist. Soc.* 30, 111–133.
- Carter, T., 1994. Southern Aegean fashion victims: an overlooked aspect of Early Bronze Age burial practices. In: Ashton, N., David, A. (Eds.), *Stories in Stone*. Lithic Studies Society Occasional Paper 4. The Lithic Studies Society, London, pp. 127–144.
- Carter, T., 1997. Blood and tears: a Cycladic case study in microwear analysis. The use of obsidian blades from graves as razors? In: Bustillo, M.A., Ramos-Millan, A. (Eds.), *Siliceous Rocks and Culture*. Consejo Superior de Investigaciones Científicas, Madrid, pp. 256–271.
- Carter, T., 2006. A new programme of obsidian characterization at Catalhöyük, Turkey. *J. Archaeol. Sci.* 33, 893–909.
- Carter, T., Shackley, M.S., 2007. Sourcing obsidian from Neolithic Catalhöyük (Turkey) using energy dispersive x-ray fluorescence. *Archaeometry* 49, 437–454.
- Ceka, H., 1951. Relacion mbi gërmimet e vjetit 1951 n'Apolloni. *Instituti i Arkeologjisë; Qendra e Studimeve Albanologjike*, Tiranë.
- Ceka, H., Adam, J., 1949. Raport mbi zbulimet prehistorike në Maliq. *Buletin i Institutit të Shkencave* (2), 94–105.
- Chapman, J., 1981. The Vinča culture of South East Europe. In: *BAR International Series*. vol. 117 *British Archaeological Reports*, Oxford.
- Chataigner, C., Poidevin, J.L., Arnaud, N., 1998. Turkish occurrences of obsidian and use by prehistoric peoples in Near East from 14,000 to 6,000 BP. *J. Volcanol. Geotherm. Res.* 85, 517–537.
- Çondi, D., 1977. Gjetje arkeologjike nga rrethi i Sarandës. *Iliria* VII–VIII, 339–346.
- Çondi, D., 2004. Urbanistika dhe banesat me peristil në Finiq. *Monumentar* 36–48.
- Constantinescu, B., Bugoi, R., Sziki, G., 2002. Obsidian provenance studies of Transylvania's Neolithic tools using PIXE, micro-PIXE, and XRF. *Nucl. Inst. Methods Phys. Res. B* 189, 373–377.
- De Francesco, A., Bocci, M., Crisci, G.M., 2011. Non-destructive applications of wave-length XRF in obsidian studies. In: Shackley, M.S. (Ed.), *X-ray Fluorescence Spectrometry (XRF) in Geoarchaeology*. Springer, New York, pp. 81–107.
- De Maria, S., 2002. Il sito, la città, la storia. In: De Maria, S., Gjonecay, S. (Eds.), *Phoinike I: Rapporto Preliminare sulla Campagna di Scavi e Ricerche 2000*. All'Insegna del Giglio, Firenze, pp. 13–18.
- De Maria, S., Gjonecay, S. (Eds.), 2002. *Phoinike I: rapporto preliminare sulla campagna di scavi e ricerche 2000*. All'Insegna del Giglio, Firenze.
- De Maria, S., Gjonecay, S. (Eds.), 2003. *Phoinike II: rapporto preliminare sulla campagna di scavi e ricerche 2001*. Ante Quem, Bologna.
- De Maria, S., Gjonecay, S. (Eds.), 2005. *Phoinike III: rapporto preliminare sulle campagne di scavi e ricerche 2002-2003*. Ante Quem, Bologna.
- Evans, A.J., 1887. On the flintknappers art in Albania. *J. Anthropol. Inst. G. B. Irel.* 16, 65–68.
- Ferguson, J.R., 2012. X-ray fluorescence of obsidian: approaches to calibration and the analysis of small samples. In: Shugar, A.N., Mass, J.L. (Eds.), *Handheld XRF for Art and Archaeology*. Leuven University Press, Leuven, pp. 401–422.
- Forenbaher, S., 2013. Small but special: the island of Palagruža in the 3rd millennium BC Adriatic. In: Starnini, E. (Ed.), *Unconformist Archaeology: Papers in Honour of Paolo Biagi*. *BAR International Series*, vol. 2528. Archaeopress, Oxford, pp. 89–99.
- Frahm, E., Doonan, O., Kilikoglou, V., 2014. Handheld portable x-ray fluorescence of Aegean obsidians. *J. Archaeol. Sci.* 56, 228–260.
- Francaviglia, V., 1984. Characterization of Mediterranean obsidian sources by classical petrochemical methods. *Preistoria Alpina* 20, 311–332.
- Freund, K., 2017. A long-term perspective on the exploitation of Lipari obsidian in central Mediterranean prehistory. *Quat. Int.* 468 (Part A), 109–120.
- Fytikas, M., Giuliani, O., Innocenti, F., Marinelli, G., Mazzuoli, R., 1976. Geochronological data on recent magmatism of Aegean Sea. *Tectonophysics* 31, 29–34.
- Fytikas, M., Innocenti, F., Kolios, N., Manetti, P., Mazzuoli, R., Poli, G., Rita, F., Villari, L., 1986. Volcanology and petrology of volcanic products from the island of Milos and neighbouring islets. *J. Volcanol. Geotherm. Res.* 28, 297–317.
- Gjipali, I., 2006. Recent research on the Palaeolithic and Mesolithic archaeology of Albania. In: Bejko, L., Hodges, R. (Eds.), *New Directions in Albanian Archaeology: Studies Presented to Muzafer Korkuti*. *International Centre for Albanian Archaeology Monograph Series*, vol. 1. Oxbow Books, Oxford, pp. 31–42.
- Gjipali, I., 2012. Epoka e Gurit dhe Shqipëria. *Botart*, Tiranë.
- Gjipali, I., 2014. Stone Age investigations in Albania (1998–2013). In: Përzhita, L., Gjipali, I., Hoxha, G., Muka, B. (Eds.), *Proceedings of the International Congress of Albanian Archaeological Studies: 65th Anniversary of Albanian Archaeology (21–22 November, Tirana 2013)*. Centre for Albanian Studies and Institute of Archaeology, Tiranë, pp. 57–64.
- Govedarica, B., 2016. The stratigraphy of Tumulus 6 in Shtoj and the appearance of the violin idols in burial complexes of the south Adriatic region. *Godišnjak* 45, 5–34.
- Hauck, T.C., Ruka, R., Gjipali, I., Richter, J., Vogels, O., 2016. Recent discoveries of Aurignacian and Epigravettian sites in Albania. *J. Field Archaeol.* 42, 148–161.
- Hauck, T.C., Ruka, R., Gjipali, I., Richter, J., Nolde, N., 2017a. Nezir Cave (Mati District, Albania): first results of archaeological research by the 'German Albanian Palaeolithic' programme (GAP). In: *Proceedings of the International Conference: New Archaeological Discoveries in the Albanian Regions; 30–31 January, Tirana 2017*. I. Academy for Albanian Studies; Institute of Archeology, Tiranë, pp. 13–32.
- Hauck, T.C., Ruka, R., Gjipali, I., Richter, J., Nolde, N., 2017b. The 'German Albanian Palaeolithic' programme (GAP): a status report. In: Wojtczak, D., Al Najjar, M., Jagher, R., Elsuède, H., Wegmüller, F., Otte, M. (Eds.), *Vocation Préhistoire: Hommage à Jean-Marie Le Tensorer*. *Etudes et Recherches Archéologiques de l'Université de Liège (ERAUL)*, vol. 148. Université de Liège, Service de Préhistoire, Liège, pp. 159–174.
- Hauck, T.C., Nolde, N., Ruka, R., Gjipali, I., Dreier, J., Mayer, N., 2017c. After the cold: Epigravettian hunter-gatherers in Blazi Cave (Albania). *Quat. Int.* 450, 150–163.
- Haxhis, K., 1998. Preliminary report on the study of pottery on the acropolis of Bouthrotos. *Iliria* XVIII (1–2), 223–230.
- Kaiser, T., Forenbaher, S., 1999. Adriatic sailors and stone knappers: Palagruža in the 3rd millennium B.C. *Antiquity* 73, 313–324.
- Kilikoglou, V., Basiakos, Y., Grimanis, A.P., Souvatzis, K., 1996. Carpathian obsidian in Macedonia, Greece. *J. Archaeol. Sci.* 23, 343–349.
- Korkuti, M., 2001. Ein Überblick über die Wohnsiedlungen des Neolithikums und Chalkolithikums im Korça-Becken. In: Boehmer, Rainer Michael, Maran, Joseph (Eds.), *Lux Orientis: Archäologie Zwischen Asien Und Europa; Festschrift Für Harald Hauptmann Zum 65. Geburtstag*. *Internationale Archäologie. Studia Honoraria*, 1433-4194, vol. 12. M. Leidorf, Rahden/Westfalia, pp. 257–267.
- Korkuti, M., Petruso, K.M., Bejko, L., Ellwood, B.B., Hansen, J.M., Harrold, F.B., Russell, N., Bottema, S., 1996. Shpella e Konispolit (raport paraprak për gërmimet e viteve 1992-1994). *Iliria* XXVI (1–2), 183–224.
- Kourtessi-Philippakis, G., 2009a. Bronze Age lithic production in Northern Greece: the evidence from settlements. In: Eriksen, B. (Ed.), *Lithics in Metal Using Societies*.

- Jutland Archaeological Society, Højbjerg, pp. 143–156.
- Kourtessi-Philippakis, G., 2009b. Lithics in the Neolithic of Northern Greece: territorial perspectives from an off-obsidian area. *Documenta Praehistorica* XXXVI, 305–312.
- Kourtessi-Philippakis, G., 2014. Lithics in the prehistory of Macedonia: historical and methodological approaches. In: Stefani, E., Merousis, N., Dimoula, A. (Eds.), *International Conference Proceedings, 1912–2012, A Century of Research in Prehistoric Macedonia*. Archaeological Museum of Thessaloniki, Thessaloniki, pp. 113–121 (22–24 November 2012).
- Kurti, R., 2012. Qelibari gjatë periudhës së Bronzës të Vonë dhe të Hekurit në Shqipëri/ Amber during Late Bronze Age and Iron Age in Albania. *Iliria* 36 (1), 73–108.
- Kurti, R., 2017. Carnelian and amber beads as evidence of Late Bronze Age contacts between the present territory of Albania and the Aegean. In: Fotiadis, M., Laffineur, R., Lolos, G., Vlachopoulos, A. (Eds.), *ΕΣΠΕΡΟΣ/Hesperos: The Aegean Seen From the West: Proceedings of the 16th International Aegean Conference, University of Ioannina, Department of History and Archaeology, Unit of Archaeology and Art History, 18–21 May 2016, Aegaeum*. Annales Liégeoises et PASPennes d'archéologie Égéeenne, vol. 41. Peeters, Leuven; Liège, pp. 287–298.
- Lera, P., Touchais, G., 2008. Sovjan. Étude et prospection. *Bull. Corresp. Hell.* 132, 875–903.
- Lera, P., Touchais, G., Oberweiler, C., 2009. Sovjan. Bassin de Korçë, Kallamas. *Bull. Corresp. Hell.* 133, 689–724.
- Lera, P., Touchais, G., Oberweiler, C., 2010. Sovjan. Bassin de Korçë, Kallamas. *Bull. Corresp. Hell.* 134, 617–647.
- Lera, P., Touchais, G., Oberweiler, C., 2011. Sovjan. Bassin de Korçë, Kallamas. *Bull. Corresp. Hell.* 135, 661–691.
- Lera, P., Touchais, G., Oberweiler, C., 2012. Kërkimet Shqiptaro-Franceze në projektin e Kallamasit (2011). *Iliria* XXXVI, 371–377.
- Lima, S., 2013. Butrint and the Pavlhas River Valley in the Late Bronze Age and Early Iron Age. In: Hansen, Inge Lyse, Hodges, Richard, Leppard, Sarah (Eds.), *Butrint 4: The Archaeology and Histories of an Ionian Town*. Butrint Archaeological Monographs, vol. 4. Oxbow Books, pp. 31–46.
- Liritizis, I., 2008. Assessment of Aegean obsidian sources by a portable ED-XRF analyser: grouping, provenance and accuracy. In: Facorelli, Y., Zacharias, N., Polikreti, K. (Eds.), *Proceedings of the 4th Symposium of the Hellenic Society for Archaeometry*. BAR International Series, vol. 1746. Archaeopress, Oxford, pp. 399–406.
- Milić, M., 2014. PXRF characterization of obsidian from central Anatolia, the Aegean and central Europe. *J. Archaeol. Sci.* 41, 285–296.
- Molloy, B.P.C., Milić, M., Doonan, R., 2014. Temporal rhythms in Obsidian consumption at prepalatial Priniatikos Pyrgos: a pXRF study. In: Molloy, B.P.C., Duckworth, C.N. (Eds.), *A Cretan Landscape Through Time: Priniatikos Pyrgos and Environs*, BAR International Series, vol. 2634. British Archaeological Reports, Oxford, pp. 118–124.
- Mulliez, D., 2009. Les travaux de l'École Française d'Athènes en 2008. *Comptes rendus des séances de l'Académie des Inscriptions et Belles-Lettres* 153, 947–975.
- Mustilli, D., 1943. Gli Illiri nell'Epiro. *Rivista d'Albania* IV (3), 129–143.
- Nakou, G., 1995. The cutting edge: a new look at early Aegean metallurgy. *J. Mediterr. Archaeol.* 8, 1–32.
- Nanaj, A., 1985. Butroti protourban. *Iliria* XV (2), 303–312.
- Nanaj, A., 1986. Butrint. *Iliria* XVI (2), 255–257.
- Nanaj, A., 1989. Gërmimet arkeologjike të vitit 1989. - Foinike. *Iliria* XIX (2), 272–273.
- Nanaj, A., 1990. Gërmimet arkeologjike të vitit 1990. - Foinike. *Iliria* XX (1), 265–266.
- Oberweiler, C., Touchais, G., Lera, P., 2014. Les Recherches Franco-Albanaises dans La Région de Korçë: Nouvelles Données Sur La Chronologie Absolue de La Préhistoire Albanaise. In: Përzhita, Luan, Gjipali, Ilir, Hoxha, Gëzim, Muka, Belisa (Eds.), *Proceedings of the International Congress of Albanian Archaeological Studies: 65th Anniversary of Albanian Archaeology (21–22 November, Tirana 2013)*. Centre for Albanian Studies and Institute of Archaeology, Tiranë, pp. 83–92.
- Parkinson, W., Cherry, J., 2010. Pylos Regional Archaeological Project, part VIII: lithics and landscapes: a Messenian perspective. *Hesperia* 79 (1), 1–51.
- Perhoč, Z., Ruka, R., 2017. Potential prehistoric sources of chert in the western lowland of Albania. In: *Proceedings of the International Conference: New Archaeological Discoveries in the Albanian Regions; 30–31 January, Tirana 2017*, vol. I. Academy for Albanian Studies; Institute of Archeology, Tiranë, pp. 33–65.
- Perlès, C., 1987. Les industries lithiques taillées de Franchthi (Argolide, Grèce). Tome I: Présentation général et industries paléolithique. In: *Excavations at Franchthi Cave, Fascicle 3*. Indiana University Press, Bloomington and Indianapolis.
- Perlès, C., 1990. Les industries lithiques taillées de Franchthi (Argolide, Grèce). Tome II: Les industries du Mésolithique et du Néolithique initial. In: *Excavations at Franchthi Cave, Fascicle 5*. Indiana University Press, Bloomington and Indianapolis.
- Perlès, C., 2004. Les industries lithiques taillées de Franchthi (Argolide, Grèce): Du Néolithique ancien au Néolithique final. Vol. III. In: *Excavations at Franchthi Cave, Greece, 13*. Indiana University Press, Bloomington.
- Perlès, C., 2012. Le statut des échanges au Néolithique. *Rubricatum: revista del Museu de Gavà* (5), 539–546.
- Perlès, C., Takaoglu, T., Gratuze, B., 2011. Melian obsidian in NW Turkey: evidence for Early Neolithic trade. *J. Field Archaeol.* 36, 42–49.
- Petruso, K., Ellwood, B., Harrold, F.B., 1994. Archaeological investigations in Sarandë district, Albania, 1993. *Am. J. Archaeol.* 98, 286–287.
- Pojani, I., Gjipali, I., Dimo, V., 2013. Epidamne-Dyrrhachion: the chora. In: Gjipali, I., Përzhita, L., Muka, B. (Eds.), *Recent Archaeological Discoveries in Albania*. Botimet Albanologjike, Tirana, pp. 130–135.
- Prendi, F., 1966. La civilisation préhistorique de Maliq. *Studia Albanica* 1, 255–280.
- Prendi, F., 1971. Rezultatet e gërmimeve arkeologjike të vitit 1970 në Kamnik të Kolonjë. *Buletin Arkeologjik* 3, 22–30.
- Prendi, F., 1974. Gërmime të vitit 1973 në Maliq. *Iliria* III, 389–393.
- Prendi, F., 2008. La ceramique 'Impasto' de Butrint. In: *Archaeological Studies*, vol. 2. The Albanological Studying Centre; The Institute of Archaeology, Prishtina, pp. 708–717.
- Prendi, F., Aliu, S., 1971. Vendbanimi Neolitik në fshatin Kamnik të rrethit të Kolonjë (gërmime të vitit 1970). *Iliria* I, 13–30.
- Rapport de Fouille de La Campagne, 2009. Mission archéologique Franco-Albanaise du bassin de Korçë (Albanie). 2009. Université de Paris I – École française d'Athènes – Institut archéologique de Tirana, Paris/Athènes/Tirana. http://www.sovjan-archeologie.net/content/rapports/Sov09_racomplet.pdf.
- Renfrew, C., Cann, J.R., Dixon, J.E., 1965. Obsidian in the Aegean. *Annu. Br. Sch. Archaeol. Athens* 60, 225–247.
- Riebe, D., 2016. Long-distance exchange of obsidian: diachronic changes at the cave site of Alepotrypa, Greece. In: Dietz, S., Mavridis, F., Tankosić, Z., Takaoglu, T. (Eds.), *Communities in Transition: The Circum-Aegean Area During the 5th and 4th Millennium BC*. Oxbow, Oxford, pp. 350–356.
- Riebe, D., 2018. Patterns of exploitation and exchange: preliminary compositional results of the obsidian assemblage from Alepotrypa Cave. In: Papatthanasiou, A., Parkinson, W.A., Pullen, D.J., Galaty, M.L., Karkanas, P. (Eds.), *Neolithic Alepotrypa Cave in the Mani, Greece*. Oxbow, Oxford, pp. 242–252.
- Robb, J.E., Farr, R.H., 2005. Substances in motion: Neolithic Mediterranean "trade". In: Blake, E., Knapp, A.B. (Eds.), *The Archaeology of Mediterranean Prehistory*. Blackwell, Oxford, pp. 24–45.
- Ruka, R., 2019a. Lithic artifacts. In: Galaty, M.L., Bejko, L. (Eds.), *Projekti Arkeologjik i Shkodrës: Final Report*, (in preparation).
- Ruka, R., 2019b. Gun Flints. (in preparation).
- Ruka, R., Galaty, M.L., 2017. The position of Albania in Mediterranean obsidian exchange spheres. In: Fotiadis, M., Laffineur, R., Lolos, Y., Vlachopoulos, A. (Eds.), *Aegaeum 16: Hesperos, The Aegean as Seen from the West*. Proceedings of the 16th International Aegean Conference, University of Ioannina, Department of History and Archaeology, Unit of Archaeology and Art History, 18–21 May 2016. Peeters, Leuven, pp. 299–304.
- Ruka, R., Gjipali, I., Galaty, M.L., Bajramaj, N., 2014. Lithics at one end of circum-Adriatic: case studies from the southernmost Albanian coastal lowland. In: Përzhita, L., Gjipali, I., Hoxha, G., Muka, B. (Eds.), *Proceedings of the International Congress of Albanian Archaeological Studies: 65th Anniversary of Albanian Archaeology (21–22 November, Tirana 2013)*. Centre for Albanian Studies and Institute of Archaeology, Tiranë, pp. 93–106.
- Runnels, C.N., van Andel, T.H., 2003. The Early Stone Age of the Nomos of Preveza: landscape and settlement. *Hesperia Suppl.* 32, 47–134.
- Runnels, C., Korkuti, M., Galaty, M.L., Timpson, M.E., Whittaker, J.C., Stocker, S.R., Davis, J.L., Bejko, L., Mucaj, S., 2004. The Palaeolithic and Mesolithic of Albania: survey and excavation at the site of Kryegjata B (Fier District). *J. Mediterr. Archaeol.* 17, 3–29.
- Runnels, C., Korkuti, M., Galaty, M.L., Timpson, M., Stocker, S., Davis, J., Bejko, L., Mucaj, S., 2009. Early prehistoric landscape and land-use in the Fier region of Albania. *J. Mediterr. Archaeol.* 22, 151–182.
- Sørensen, L., 2010. Obsidian from the Final Neolithic site of Pangali in western Greece: development of exchange patterns in the Aegean. In: Eriksen, B.V. (Ed.), *Lithic Technology in Metal Using Societies*. Jutland Archaeological Society, Højbjerg, pp. 183–202.
- Souyouzoglou-Haywood, C., 1999. *The Ionian Islands in the Bronze Age and Early Iron Age, 3000–800 BC*. Liverpool University Press, Liverpool.
- Tartaron, T.F., 2004. Bronze Age landscape and society in Southern Epirus. In: *BAR S1290*. Archaeopress, Oxford.
- Torrence, R., 1986. *Production and Exchange of Stone Tools: Prehistoric Obsidian in the Aegean*. Cambridge University Press, Cambridge.
- Touchais, G., 2002. Les rapports entre le monde Mycénien et ses marges nord-ouest (Épire, Albanie, Macédoine). In: Touchais, Gilles, Renard, J. (Eds.), *L'Albanie Dans l'Europe Préhistorique: Actes Du Colloque Lorient: Organisé Par l'École Française d'Athènes et l'Université de Bretagne-Sud, Lorient 8–10 Juin 2000*. Bulletin de Correspondance Hellénique/Supplement 42 École française d'Athènes, Athènes, pp. 199–215.
- Tripković, B., Milić, M., 2008. The origin and exchange of obsidian from Vinča-Belo Brdo. *Starinar* 71–86.
- Tsundás, C., 1908. ΑΙ ΠΡΟΪΣΤΟΡΙΚΑΙ ΑΚΡΟΠΟΛΕΙΣ ΔΙΜΥΡΙΟΥ ΚΑΙ ΣΕΣΚΛΟΥ. Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας, Αθήναι.
- Tykot, R.H., 1996. Obsidian procurement and distribution in the central and western Mediterranean. *J. Mediterr. Archaeol.* 9, 39–82.
- Tykot, R.H., 2002. Chemical fingerprinting and source tracing of obsidian: the central Mediterranean trade in black gold. *Acc. Chem. Res.* 35, 618–627.
- Tykot, R.H., 2004. Neolithic exploitation and trade of obsidian in the central Mediterranean: new results and implications for cultural interaction. In: *Acts of the XIVth UISPP Congress, University of Liège, Belgium, 2–8 September 2001*. Section 9: The Neolithic in the Near East and Europe. BAR International Series, vol. 1303. Archaeopress, Oxford, pp. 25–35.
- Tykot, R.H., 2011. Obsidian finds on the fringes of the central Mediterranean: exotic or eccentric exchange? In: Vianello, A. (Ed.), *Exotica in the Prehistoric Mediterranean*. Oxbow Books, Oxford, pp. 33–44.
- Tykot, R.H., 2014. Utilizzo e commercio dell'ossidiana in Adriatico, [Obsidian use and trade in the Adriatic] (The Adriatic, A Sea Without Borders. Communication Routes of Populations in 6000 BC). In: Visentini, P., Podrug, E. (Eds.), *Adriatico senza Confini. Via di comunicazione e crocevia di popoli nel 6000 a.C.* 224–225. Civici Musei di Udine, Museo Friulanodi Storia Naturale, Udine, Italy, pp. 170–181.
- Tykot, R.H., 2017a. Obsidian studies in the prehistoric central Mediterranean: after 50 years, what have we learned and what still needs to be done? *Open Archaeol.* 3, 264–278.
- Tykot, R.H., 2017b. A decade of portable (hand-held) x-ray fluorescence spectrometer analysis of obsidian in the Mediterranean: many advantages and few limitations. *MRS Adv.* 2 (33–34), 1769–1784.

- Tykot, R.H., Freund, K.P., Vianello, A., 2013. Source analysis of prehistoric obsidian artifacts in Sicily (Italy) using pXRF. In: Armitage, R.A., Burton, J.H. (Eds.), *Archaeological Chemistry VIII. ACS Symposium Series*, vol. 1147. pp. 195–210.
- Ugolini, L.M., 1932. *Albania antica: L'Acropoli di Fenice*. vol. II Treves-Treccani-Tumminelli, Milano-Roma.
- Ugolini, L.M., 2000. Butrinti: miti i Eneas, gërmimet. Istituto Italiano di Cultura, Tirana.
- Valmin, N., 1939. Das Adriatische Gebiet in Vor-Und Frühbronzezeit. In: *Lunds Universitets Årsskrift*, n. f., Avd. 1 35(1) C.W.K. Gleerup, Lund.
- Wace, A.J.B., Thompson, M.S., 1912. *Prehistoric Thessaly, Being Some Account of Recent Excavations and Explorations in North-Eastern Greece From Lake Kopais to the Borders of Macedonia*. Cambridge University Press, Cambridge.
- Williams-Thorpe, O., 1978. *A Study of Obsidian in Prehistoric Central and Eastern Europe, and Its Trace Element Characterization*. University of Bradford, Bradford (Ph.D. dissertation).
- Williams-Thorpe, O., 1995. Obsidian in the Mediterranean and the Near East: a provenancing success story. *Archaeometry* 37, 217–248.
- Williams-Thorpe, O., Nandris, J., 1977. The Hungarian and Slovak sources of archaeological obsidian: an interim report on further fieldwork, with a note on tektites. *J. Archaeol. Sci.* 4, 207–219.
- Williams-Thorpe, O., Warren, S.E., Nandris, J., 1984. The distribution and provenance of archaeological obsidian in Central and Eastern Europe. *J. Archaeol. Sci.* 11, 183–212.