Investigating the provenance of obsidian from Neolithic and Chalcolithic sites in Bulgaria

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Introduction

Portable energy-dispersive X-ray fluorescence (pXRF) has become a widely used tool for the chemical characterisation (source identification) of obsidian found in archaeological contexts. While laboratory techniques such as neutron activation analysis (NAA) and inductively coupled plasma mass spectrometry (ICP-MS) can analyse more elements and have lower detection limits, pXRF can provide quantitative data of sufficient resolution to be able to match obsidian artefacts with their volcanic sources. At the same time, pXRF offers several advantages for obsidian research: (i) it can be deployed 'in the field' (i.e. on site or in a museum) without the need to bring samples back to a laboratory for analysis; (ii) information on elemental composition can be obtained relatively quickly; and (iii) measurements require no special preparation of samples and cause no visible damage to materials.

The research outlined here forms part of a wider study of archaeological obsidian in south-eastern Europe involving archaeologists from Bulgaria, Romania and the UK, with the aim of reconstructing changes in patterns of procurement, production and use of obsidian between the Middle Palaeolithic and the Iron Age.

Bulgarian finds

Obsidian is a scarce commodity in archaeological contexts in Bulgaria. It has been reported from just a few sites, and the number of obsidian pieces from any individual site is very small.

We identified and analysed artefacts from four sites: Ohoden, Dzhuljunica and Varna in northern Bulgaria, and Dzherman at the foot of the Rila Mountains in the south-west of

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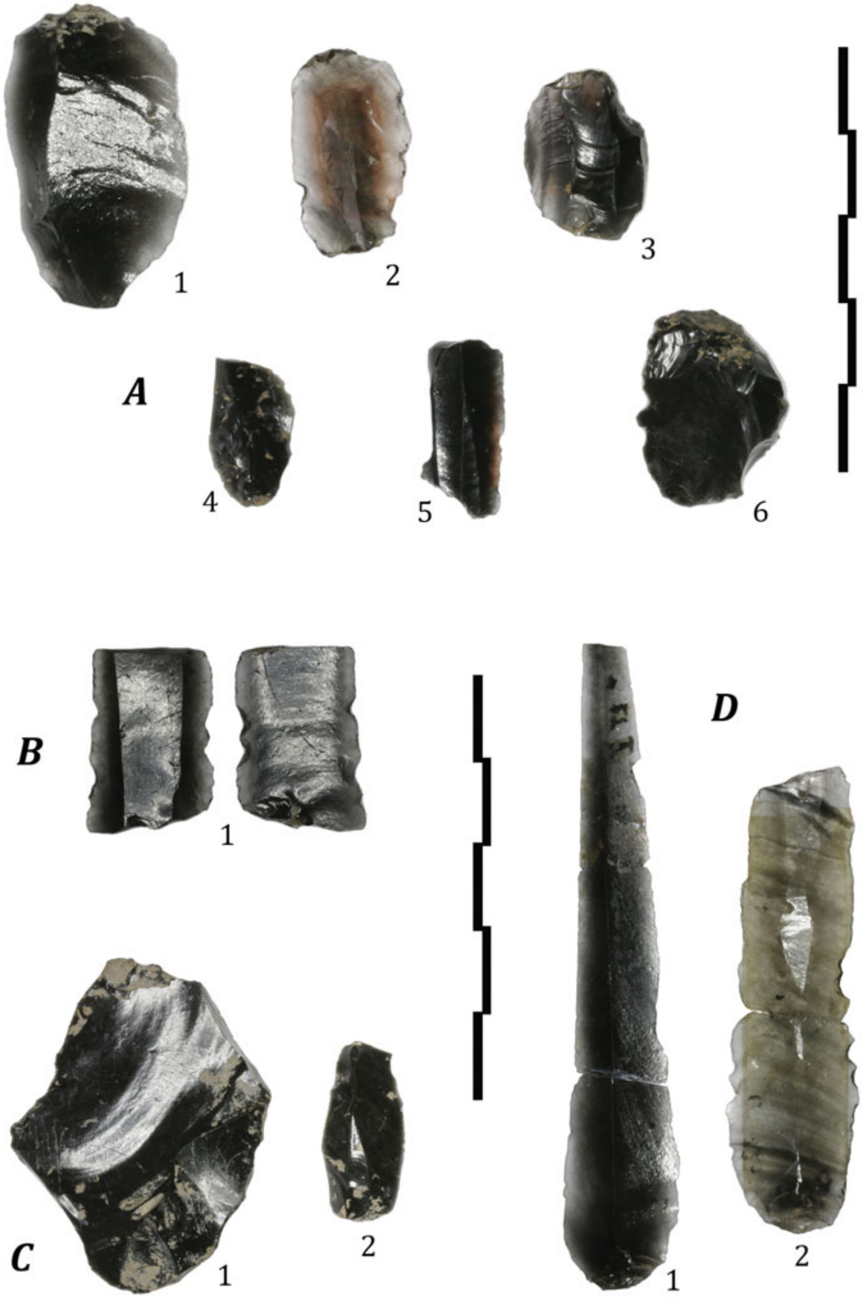

Figure 1. Obsidian artefacts from Ohoden (A), Dzherman (B), Dzhuljunica (C) and Varna (D) in Bulgaria.

the country (Figure 1). The sites range in date from the Early Neolithic to Chalcolithic (*c.* 6050–4200 cal BC), and are located some 600–800km from the nearest geological sources of obsidian in the Aegean, Carpathians and central Anatolia (Figure 2).

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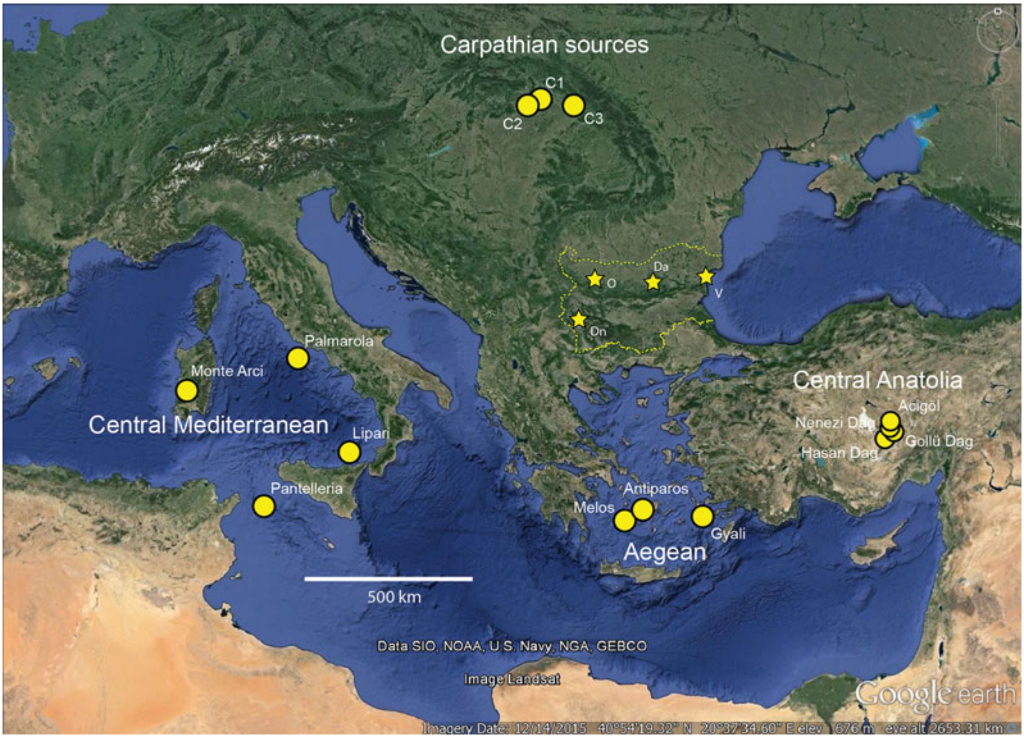

Figure 2. Site locations in relation to major obsidian source areas (base map: Google Earth 7.0, viewed 8 June 2016): Da—Dzhuljunica; Dn—Dzherman; O—Ohoden; V—Varna.

pXRF analyses of 32 minor and trace elements were performed with a 'Niton XL3t ultra' analyser, operated in the fundamental parameters 'mining mode'. Results were compared with measurements taken on geological samples from various sources, and both sets of data were calibrated against 23 geological reference standards (CRMs) (Figure 3).

Results

Two varieties of obsidian were identified among the artefacts analysed. Comparison with measurements made on geological source samples from the Carpathians, the Aegean, the central Mediterranean and central Anatolia shows the chemical profiles of the Bulgarian finds to be most similar to sources in the Carpathian Mountains (cf. Rosania *et al.* 2008). Group 1 matches closely with the Carpathian 1 (C1) source area in Slovakia, while Group 2 most probably comes from the Carpathian 2 (C2) source area in Hungary (Figure 4).

Within this very small sample of artefacts there are several regular blades or blade segments, all made from C1 obsidian—which generally is considered to have better knapping qualities than C2 obsidian (Tripković 2004; Dobosi 2011; Milić 2016).

The work here represents the first systematic chemical characterisation study of archaeological obsidian from Bulgaria. It expands the number of recorded findspots of Carpathian obsidian south of the River Danube, and helps to fill a major gap in the spatial

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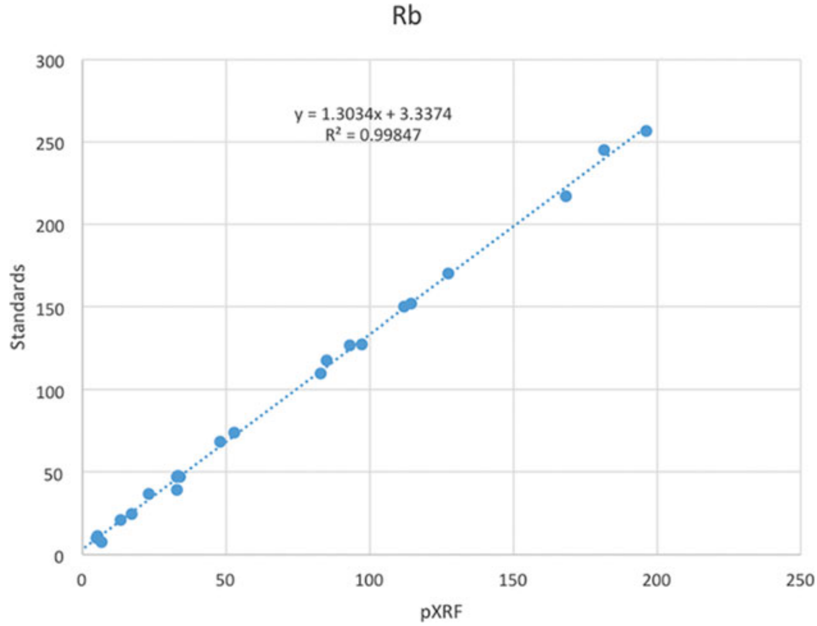

Figure 3. Comparison of pXRF and recommended values for rubidium (Rb) in 23 pressed powder geochemical reference standards. Values for goodness of fit (r^2), slope and intercept are a measure of the performance of the Niton XL3t Ultra analyser and are used to derive calibration factors. Performance was good (r^2 > 0.9) for all elements of interest.

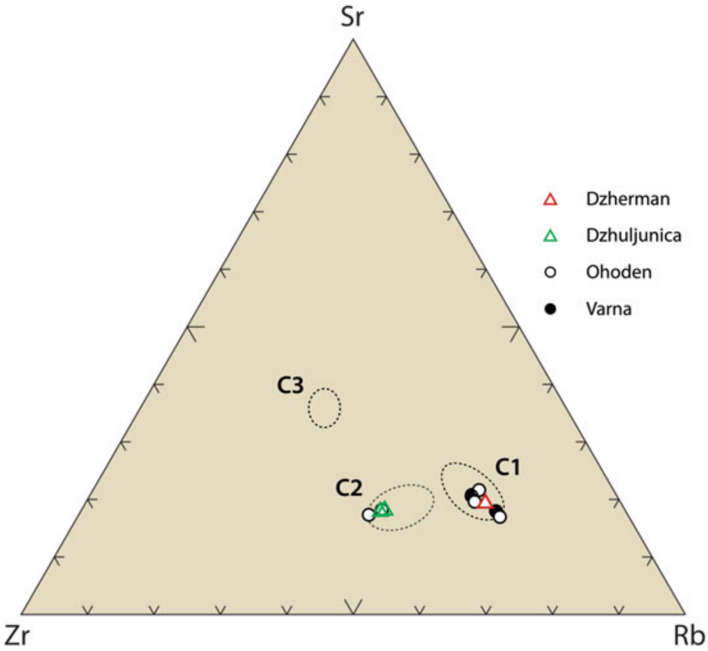

Figure 4. Zr-Sr-Rb compositions of obsidian artefacts from Dzherman, Dzhuljunica, Ohoden and Varna, plotted against the compositional ranges of (calibrated) pXRF data for infinitely thick samples from geological sources in the Carpathians: C1—Slovakia; C2—Hungary; C3—Ukraine (cf. Rosania et al. *2008).*

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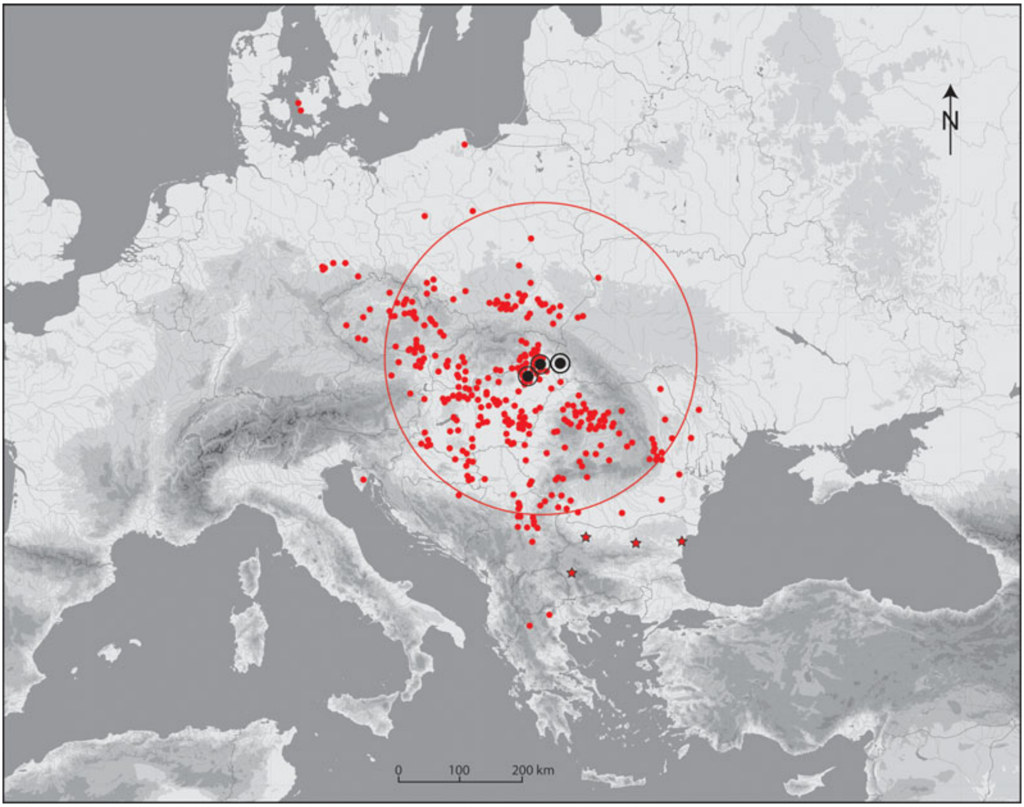

Figure 5. Bulgarian sites (⋆) in relation to previously reported finds of artefacts made from Carpathian obsidian (●)—the circle has a radius of 500km (adapted from Burgert 2015).

distribution of Carpathian obsidian between the finds in northern Serbia and southern Romania, and what previously were seen as remote outliers, at Mandalo (Kilikoglou *et al.* 1996) and Dispilio (Milić 2014) in northern Greece (Figure 5).

Our work also raises questions about the consumption of Carpathian obsidian in Bulgarian prehistory. How was the material moved over distances of more than 600km—what were the social mechanisms involved and how did they develop through time? Were the C1 and C2 sources used simultaneously or at different periods? Was C1 obsidian favoured over C2 for the production of regular blades? Was obsidian acquired mainly in the form of raw material or as pre-prepared blanks? And was it only from Carpathian sources that obsidian reached prehistoric settlements in Bulgaria?

To address these questions, it will be necessary to increase our sample of obsidian from Bulgarian archaeological sites and to date much more precisely the contexts in which obsidian occurs. These will be among the priorities for the next phase of our research.

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