DOLNÍ VĚSTONICE II

Chronostratigraphy, Paleoethnology, Paleoanthropology

Academy of Sciences of the Czech Republic, Institute of Archeology, Brno 2016

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CHRONOSTRATIGRAPHY, PALEOETHNOLOGY, PALEOANTHROPOLOGY

Edited by Jiří Svoboda

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XXI. DENTAL CALCULUS EVIDENCE OF GRAVETTIAN DIET AND BEHAVIOUR AT DOLNÍ VĚSTONICE AND PAVLOV

Robert C. Power, Domingo C. Salazar-García and Amanda G. Henry

An Introduction to Gravettian Subsistence

How modern humans colonised the frigid Late Pleistocene North European Plain is a major theme in the study of human origins. Research has made strides in revealing the technology, art, settlement and subsistence of groups in these northern environments. Although the refuse of ancient meals are frequently found in Gravettian occupational layers in the form of the skeletal remains of fauna, much of what we know about Gravettian and indeed Upper Paleolithic subsistence is incomplete and biased towards certain food types, particularly animal foods (Svoboda et al. 2005; Tagliacozzo et al. 2012). Understanding vegetal diet in order to explain the subsistence strategies of Upper Palaeolithic Eurasians is increasingly gaining importance despite the problem that they leave only ephemeral remains. (Jones 2009). Plant remains are rare or absent on virtually all Gravettian sites in northern and central Europe (Jones 2009). This lack of information biases our reconstructions of Paleolithic diets, limiting our ability to explore the variation and complexity of diet across time and space. Recent advances using plant micro-remains trapped in dental calculus from Palaeolithic chronologies have provided a new window into ancient diets (Salazar-García et al. 2013; Henry et al. 2014; Power et al. 2015a).

The Gravettian era complexes at Dolní Věstonice and Pavlov in Moravia (present day Czech Republic) are the ideal setting to explore human diet in the mid-Upper Paleolithic. These complexes have proven crucial to understanding the human settlement in Central Europe and its relationship to that of the North European Plain during the cold glacial phase of Marine Isotope Stage 3. Like many Upper Paleolithic sites, there is rich evidence for the human-animal interaction. Dense accumulations of bones of mammoth, reindeer, fowl and other fauna occurred widely at the sites (Bocheński et al. 2009; Wojtal et al. 2012). Archaeologists also recovered dense collections of carved bone and modelled clay figurines, nearly all of which are zoomorphic (Svoboda 2010). More recent research using isotopic analysis on human and animal bone collagen (Richards et al. 2001; Richards 2009), as well as zooarchaeological studies of fauna skeletal assemblages at these sites (Svoboda et al. 2005; Bocheński et al. 2009; Wojtal et al. 2012), have revealed widespread hunting and terrestrial meat rich diets. As a result, most reconstructions of models of Gravettian life in the Moravian Region envisaged exclusive reliance on the large and medium game that roamed the surrounding steppe and forest. By providing basic materials for consumption, shelter, art and at times fuel, animals seemed to dominate every facet of life (Beresford-Jones et al. 2010). The ethnographic record supports this view, showing that societies that occupy northern cold ecosystems tend to be predominantly reliant on animal foods which compromising up to 95 % of total energy intake (Kelly 1995). However, even in the most hunting-orientated societies plants are exploited and sometimes are even seasonally important (Kelly 1995).

Thanks to the rich concentration of large human occupations, well-preserved architecture and symbolic artefacts, researchers have conducted multi- disciplinary research at Dolní Věstonice and Pavlov that is usually not possible on other Gravettian sites. Several studies provided tantalizing indications of the importance of vegetal material in diet and technology at these sites. The exceptional preservation of negative impressions on surfaces of fired clay objects at the sites have demonstrated that Gravettian people made plant-fibre basketry, cordage and textiles (Soffer et al. 2001). Also, a number of sandstone grinding tools that were found at Dolní Věstonice and the contemporary site of Pavlov hint that these groups ground their food or other materials. Revedin et al. (2010; 2015) conducted microremain residue analysis on these artefects revealing some surviving starch deposits, ancient traces of plants that were ground potentially for consumption. Other evidence of plant use is found among charred hearth deposits at Dolní Věstonice (Mason et al. 1994; Pryor et al. 2013). Archaeologists also found dense accumulations of charred plant remains in these deposits, unexpected for northern Upper Palaeolithic sites since the volume and breadth of the charred plant remains are entirely unparalleled in the region. The deposits revealed rich use of conifers for fuelling fires with rare fragments of deciduous wood too. Parenchyma tissue indicative of underground storage organs was also present in this deposit. Although, much of the plant remains consist of unidentifiable parenchyma, the diversity indicates these charred tissues are not accidental inclusions and reflect fragments of tubers used for food or other uses (Mason et al. 1994; Pryor et al. 2013).

For all of the above, Dolní Věstonice and Pavlov present the strongest evidence of plant use in any northern European Upper Paleolithic site, yet the actual consumption of plants has not been confirmed. Nor is the diversity of plants that may have been included in the diet fully explored. To address this issue we performed dental calculus analysis, which allowed us to detect underrepresented foods (Henry and Piperno 2008; Power et al. 2015b). The project targeted food debris, especially starch grains and phytoliths, from plant foods that have become trapped in dental calculus in order to trace diet and plant use. We used this method to explore if plant consumption could be confirmed at Dolní Věstonice and Pavlov and to assess what taxa were consumed, something that cannot be done using macrobotanical, isotopic and dental wear-based techniques. Preliminary results of this study are presented in this chapter.

Dental Calculus and Control Sampling

Teeth from Dolní Věstonice and Pavlov were examined for deposits of dental calculus. This initial examination and sampling was performed by R.P. at the Dolní Věstonice Archaeological Laboratory, where the specimens are curated. Deposits of dental calculus were not common on the teeth examined. When present, the sampling surface was gently dry-brushed with a disposable toothbrush to dislodge contaminants at the sampling locations (Tab. 1). R.P. then used a dental scalar to remove small areas of dental calculus onto creased weighing paper underlain by aluminium foil. Some deposits of dental calculus were left on the teeth for future studies. The detached materials collected in the paper were then transferred to labelled microcentrifuge tubes and carefully documented. After sampling, R.P. photographed the teeth and the remaining unsampled dental calculus. The samples were then transported to the Plant Foods lab at the Max Planck Institute for Evolutionary Anthropology (MPI-EVA) in Leipzig (Germany).

Using standard procedures (Power et al. 2014b; Leonard et al. 2015) each sample was weighed and transferred to microcentrifuge tubes while in a clean laminar flow hood set on positive pressure. We then ground the samples in a 1.5 ml Eppendorf microcentrifuge tube containing ~30 µl of a 25 % glycerine solution with a micro pestle to reduce sample loss due to static electricity. The samples were then centrifuged at 1691 x g (Heraeus MEGAFUGE 16 with TX-400 Swinging Bucket Rotors) for 10 minutes. These samples were mounted on glass slides and examined under brightfield and cross-polarized light on a Zeiss Axioscope microscope at 400 × magnification.

To remove risk of contamination from airborne modern plant material and lab supplies (Crowther et al. 2014; Henry 2014), we conducted a regime of weekly laboratory cleaning to remove contamination from our lab facilities. To remove contamination, all lab work surfaces were cleaned with hot water, washed with starch-free soap and with 5 % sodium hydroxide (NaOH). To assess contamination types we additionally performed wipe tests before and after weekly cleaning to quantify starch and other contaminants, as well as to assess contaminating types. Wipe tests retrieved settled particles of the surface area (74 x 43 cm^2) of the laboratory positive-pressure laminar flow hood used for mounting. In addition to our in-house contamination controls, we collected a control calculus sample from associated fauna to explore movement of non-endogenous microremains on to skeletal remains that could have occurred after death. Our final anti-contamination measure involved assessing a blank slide with ~30 µl of a 25 % glycerine solution immediately after mounting a calculus sample.

Identification and classification

We photographed and described recovered microremains using the international nomenclature codes (Madella et al. 2005; ICSN 2011). Phytoliths were classified into conventional morphotypes, while we developed types to classify other microremains based on shared morphology. Starches were classified according to shape, the presence and prominence of lamellae, hilum morphology, formation type (simple or compound), cross features, cracks and other surface features. Some types are unique to a single plant taxon, but in other cases, several types may all have originated from a single taxon, or one type may be common to several taxa. For example, several phytolith types (short-cell, bulliform and psilate) may all represent a single species of grass. Phytoliths in an Eurasia context cannot usually be identified to species or genus but can often be identified to taxonomic levels (family or subtribe) of interest (Madella et al. 2002; Rosen 2010; Power et al. 2014a). Some starches could not be identified to taxon and we developed types to classify them. Images of all microremains are deposited on the Archaeological Microremain Database of the Plant Foods and Hominin Dietary Ecology Research Group in Leipzig (Germany).

Table 1. Samples analysed for plant microremains (taken from mandibular teeth, except Pavlov 11).

Specimen	Specimen	Tooth	Sample type	Sample Wt (mg)
PV 1	Pavlov 1	R PM2	Human calculus	0.478
PV 2	Pavlov 11	R d PM1	Human calculus	0.241
DV 13	Dolní Věstonice 13	L PM1	Human calculus	0.083
DV 15	Dolní Věstonice 15	L C	Human calculus	0.58
DV 31	Dolní Věstonice 31	M3	Human calculus	0.851
DVF II	Dolní Věstonice II	L M	Fox calculus	0.497

Results

Controls

Our control sample consisted of a sample of fox calculus and blanks taken during analysis.

In the fox sample a total of 17 microremains were found (Fig. 1; Tab. 2). 11 starch grains are types 1, 2 or 22 probably produced by Triticeae, and two were starch grains showing possible signs of gelatinization . Concerning non-starch microremains, we found that only two phytoliths deriving from hair cells were found. In blank slides, we found 20 microremains but 14 were fibres and only four were starch grains. No phytoliths were found.

Human dental calculus

For this study, we sampled dental calculus from three Dolní Věstonice and two Pavlov teeth. We examined the calculus from a right second premolar, a first lower premolar from Pavlov, left first premolar, left canine and a lower third molar from Dolní Věstonice (Tab. 1). Calculus samples presented moderate numbers of microremains, with a total of 170 microremains recovered.

Starch grains were found on all of the five teeth and totalled to 75 grains (Tab. 2). None clearly displayed morphology present in Triticeae. We classified these starches into various types depending on size and the presence of other traits. Further studies are needed to identify most of these starch grain types. Phytoliths were found on all of the five teeth and added up to 51 phytoliths (Fig. 2 and 3). The most common forms were long cell psilate phytoliths and parallelepipedal phytoliths. Some probable styloid calcium oxalates were found, particularly in DV 13. Other microremains (pollen, spores, diatoms and microalgae) occurred but were not numerous in any of the samples, with the exception of tentatively identified microalgae that were very common in sample DV 13.

Table 2. Microremains recovered from control and dental calculus samples.

Lab no.	Starches	Gelatinized starches	Poss. /Dmg	SC phytoliths	MC phytoliths	Indet. phytoliths	Diatom	Calcium oxalate	Spores	Pollens	Fibres	Other or unknown unsilicified
PV 1 blank											7	
PV 2 blank												
DV 13 blank												1
DV 15 blank	4										2	
DV 31 blank											4	
DVF 23 blank											2	
PV 1		1		6		2		1	2	2	3	4
PV 2	19		1	11	1	3	1	1	5	1	1	20
DV 13	8		1	11	1	1		6			7	15
DV 15	3		1	5					10		4	5
DV 31	3		1	4		1			1		5	5
DVF II	2	2		2					1		7	5

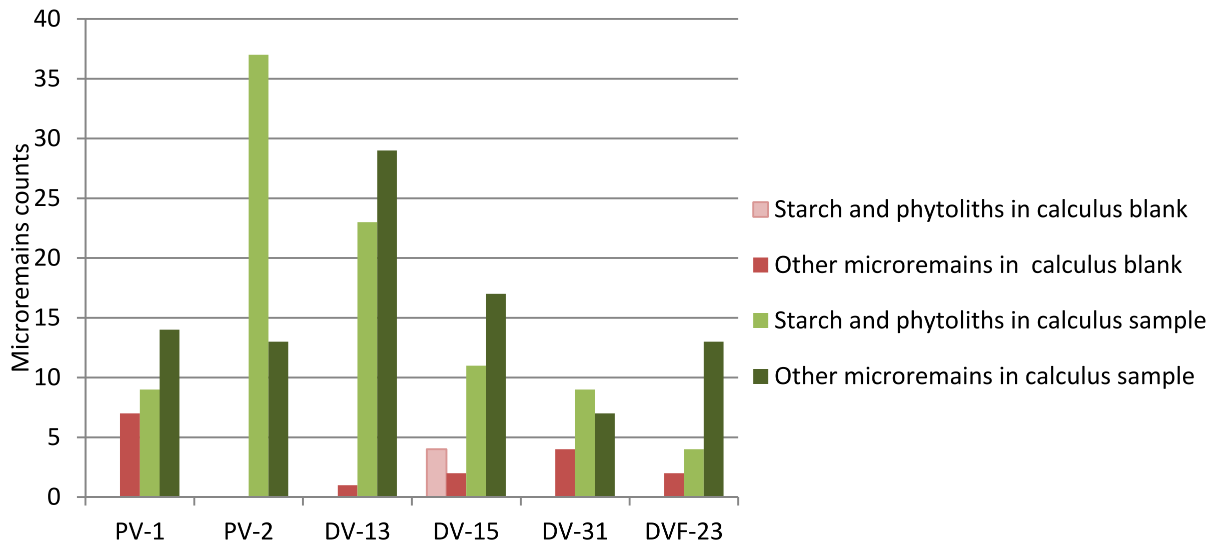

Figure 1. Starch, phytolith and other microremains in control blanks and human dental calculus. Comparison of blanks with dental calculus shows a substantial difference indicating that contamination, especially from starch and phytoliths, is rare.

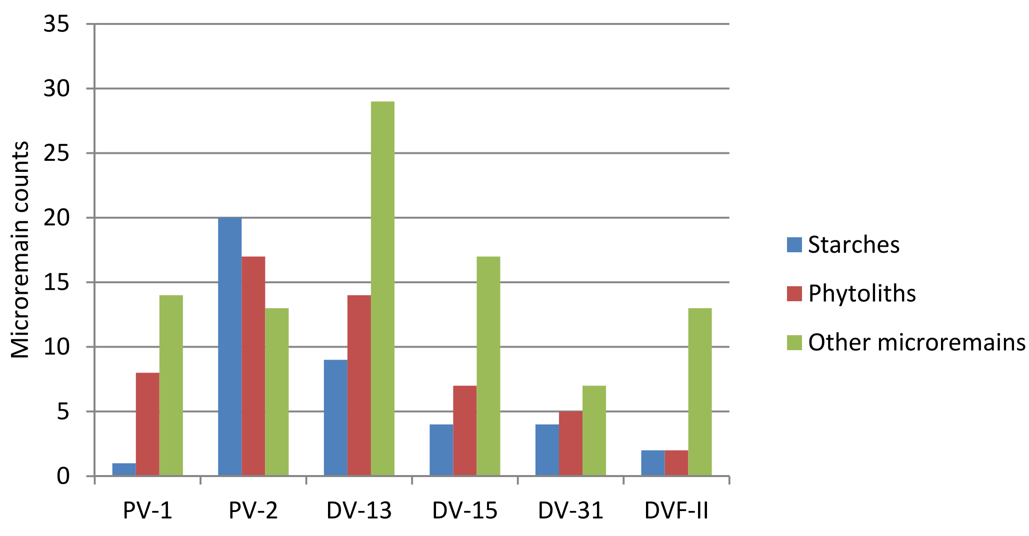

Figure 2. Total number of starch, phytolith and other microremains in dental calculus.

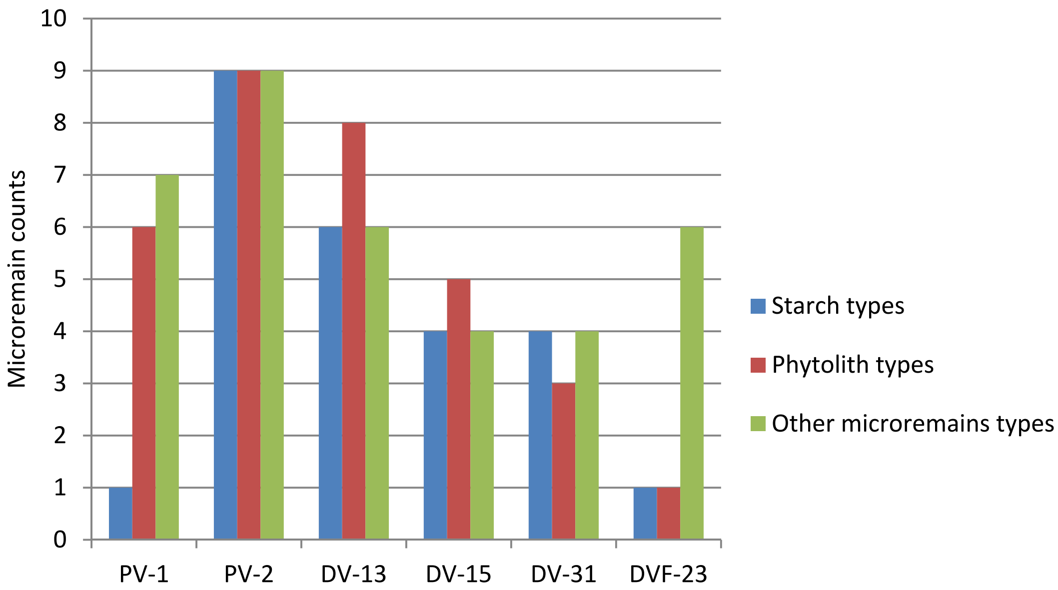

Figure 3. Total number of types of starch, phytolith and other microremains in dental calculus.

Discussion

As research is still ongoing it is not yet possible to make firm conclusions about the plant taxa that produced the micro-remains we recovered. The comparison to the controls clearly indicates that the microremains recovered from the human calculus are endemic and represent dietary input. Interestingly, several starch types have some morphological overlap with those reported in grinding stone analysis, but this has not been conclusively confirmed with morphometrics (Revedin et al. 2010). As the recovered starch, phytolith and other remains reflect plants that entered the mouth during life, they provide direct evidence of plant use and consumption, which complements that previously, found in grindstone residues or charred hearth debris. These various lines of evidence all indicate the use of plants containing starch and oxalate, and give the strongest evidence yet of the consumption of plant foods for this period in this region.

Only nine dental calculus samples from Gravettian contexts elsewhere in Europe have been published, including five from Abri Pataud in France, four from Předmostí in the Czech Republic, and one from the potentially Gravettian assemblage at Cro Magnon (Henry et al. 2014; Power et al. 2015a). Only six microremains comprising of three types were reported from these nine samples suggesting these dental calculus samples are less well preserved than those of Dolní Věstonice and Pavlov. Interestingly, none of the other Gravettian assemblages contain phytoliths, in stark contrast with the Dolní Věstonice and Pavlov assemblages. As phytoliths are especially abundant in monocot plants this may indicate a heightened use of monocots such as grasses and sedges in Gravettian Moravia for food or fibre industries.

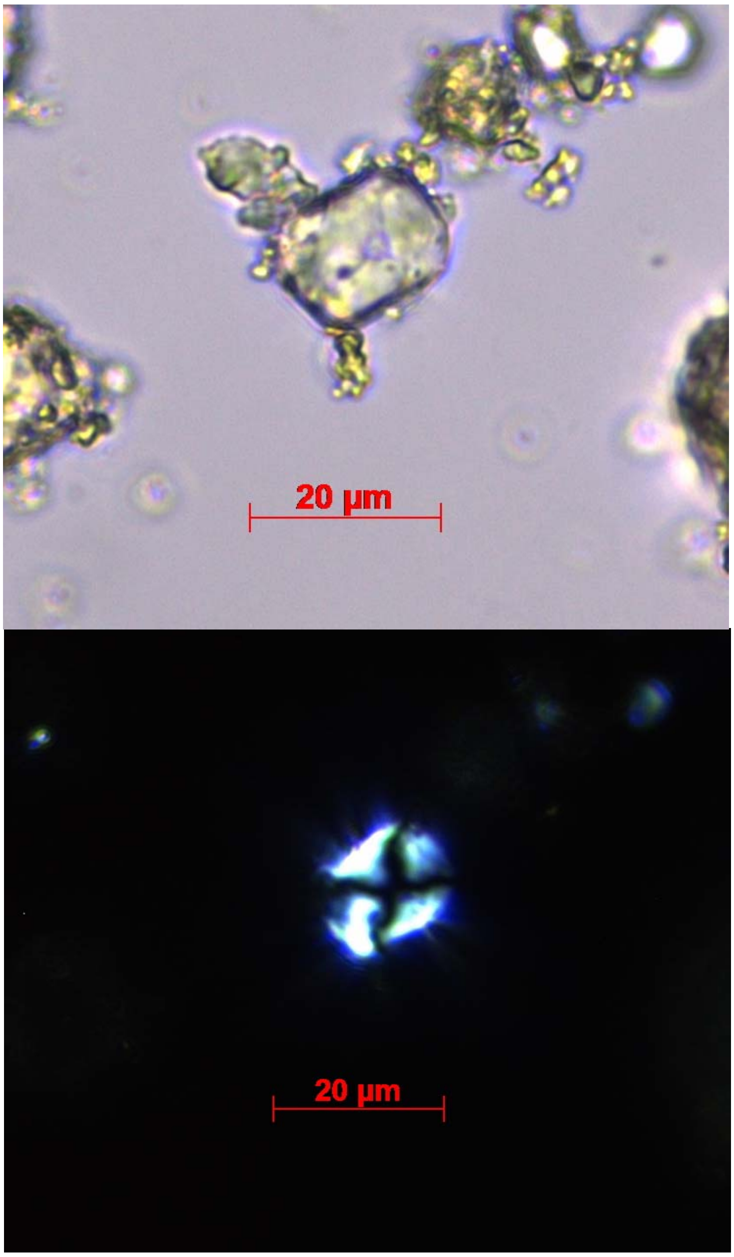

Figure 4. Starch grain from an unidentified starch-rich plant identified in dental calculus from PV 1.

Besides overall suggesting plant consumption, little else can be said at this point about Dolní Věstonice and Pavlov assemblages. Some microremains are not diagnostic to any particular taxon, such as calculus oxalates, but others like starch grains may be diagnostic. Further research is needed to identify potentially diagnostic plant remains because replicable identification protocols are still in development. They may derive from a variety of edible starchy underground storage organs, seeds, nuts and piths that occurred in Central Europe in the era (Hardy 2010). Many categories of plant foods that could have been important have few or no microremains. These include lipid-, sugar-, and inulin-rich plants, like burdock, and other Asteraceae taproots.

Our data contribute to the body of information on Gravettian Moravia plant use. These societies were clearly heavily invested in exploiting animals; hunting provided the bulk of nutrition and zoomorphic motifs dominated their artistic lives. However, these societies also incorporated plants into their diet, and fashioned them into baskets and textiles.

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