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## ONE CENTURY OF STUDIES ON CHOCOLATE FLINT. AND WHAT DO WE REALLY KNOW ABOUT IT?...

### ABSTRACT

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The so-called “chocolate flint” is one of the most popular and the highest quality flint raw material used in prehistoric times in Central Europe. It was known and utilised since the Middle Palaeolithic until the Iron Age. It has been the focus of research for almost 100 years, but the questions related to extraction, processing and distribution of chocolate flint are still valid and taken up by many scholars. To a large extent, this has been the result of the discovery of chocolate flint deposits and places of its extraction in the area of the Kraków-Częstochowa Upland at some distance from the previously-known outcrops, which has significantly changed the current state of knowledge. This article is an attempt to synthesize the knowledge on this flint as a raw material of exceptional quality, widely used by prehistoric communities.

Keywords: Poland, Holy Cross Mountains, Kraków-Częstochowa Upland, chocolate flint, distribution, prehistoric communities

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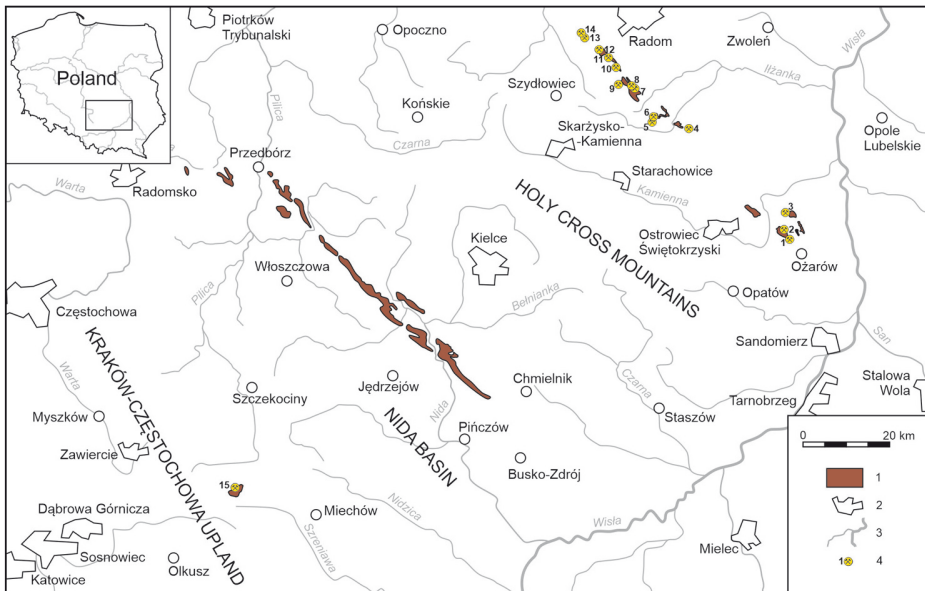
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## 1. INTRODUCTION

The Vistula basin is rich in deposits of several kinds of flint that were widely used in prehistoric times. The varieties of these lithic materials include “chocolate”, grey white-spotted, striped (also called banded), Jurassic-Cracow flints, as well as “cretaceous” raw materials. Amongst them, the so-called “chocolate flint” is one of the most popular, distinctive in terms of both, technical and aesthetic values (Domański and Webb 2000).

The history of research on this flint is at present almost one hundred years old, but in spite of this, there are still many issues related to extraction and processing of chocolate flint in Poland that remain unresolved and are being taken up by many scholars. Moreover, new discoveries are being made, changing the current state of knowledge, and stimulating formulation of new research questions. Therefore, in order to sort out the knowledge on the so-called “chocolate flint” (in Polish: krzemień czekoladowy), the author proposes in the title for this text, addressing “what do we really know about” this raw material and will try to list the further research perspectives.

Archaeological sources prove that chocolate flint was known and utilised since the Middle Palaeolithic until the Early Iron Age in almost all of the regions of Poland as well



**Fig. 1.** Localization of known outcrops of rock bearing chocolate flint (after Krajcarz *et al.* 2012 with author's changes) and prehistoric most important points of exploitation of chocolate flint.

1 – Kimmeridgian rocks with chocolate silicite, 2 – the biggest towns and cities, 3 – the biggest rivers, 4 – location of sites (1 – Śródbrze, 2 – Gliniany, 3 – Duranów, 4 – Prędocin, 5 – Seredzice, 6 – Pakosław, 7 – Polany, 8 – Polany Kolonia, 9 – Wierzbica, 10 – Iłża, 11 – Tomaszów, 12 – Orońsko, 13 – Guzów, 14 – Chronów Kolonia, 15 – Poręba Dzierżna)

as in neighbouring countries, mostly in Central Europe (Sudoł-Procyk *et al.* 2021a). The most recognised and investigated zone of its occurrence is the north-eastern margin of the Holy Cross Mountains (Fig. 1), which for many years was believed to be the only region where this raw material could be found. This is the reason why all of the studies conducted until present adopted one model assuming that chocolate flint was extracted exclusively from the outcrops situated in the NE region of the Holy Cross Mountains (Fig. 1; Krajcarz *et al.* 2012). This viewpoint has been changed by a discovery of outcrops of this raw material almost 200 km westward, in the Kraków-Częstochowa Upland. This finding affected significantly all of the previous interpretations of its utilisation and distribution on a Polish, as well as European scale (Sudoł-Procyk 2021a).

## 2. CURRENT STATE OF KNOWLEDGE

The first macroscopic description of chocolate flints was created by S. Krukowski, who characterised their variability and initial localisation of their outcrops based on material obtained from archaeological sites (Krukowski 1920). He induced an interest in the issue of this flint occurrence in a geologist named Jan Samsonowicz, who joined him in a field survey of this raw material. As early as in 1922, the above-mentioned scholars discovered numerous deposits of chocolate flint within both, secondary and primary (*in situ*) sediments; the latter in a form of exposures in the walls of quarries and surface weathered limestones with chunks of flint (Budziszewski 2008) and a great number of artefacts, being the relics of prehistoric flint workshops (Krukowski 1922, Samsonowicz 1923). The successive years delivered many more discoveries of chocolate flint outcrops accompanied by flint workshops in the region of the north-eastern margins of the Holy Cross Mountains (Samsonowicz 1934).

The 1930s were a period of intense investigations of flint chocolate outcrops carried out by S. Z. Różycki (1939), W. Pożarski (1948), but above all by S. Krukowski, who at that time localised large extraction sites near Wierzbiца, Orońsko and Tomaszów (Krukowski 1939-1948).

Another revival of interest in the issues of identification, location and exploitation of chocolate flint falls at the 1960s and 1970s, mostly thanks to investigations carried out by the research team headed by R. Schild (1971; 1976; 1987; 1995a; 1995b; 1997; Schild *et al.* 1977). These ventures resulted in the creation of a detailed classification of chocolate flint and documentation of a reference collection of particular types of this raw material from the north-eastern margins of the Holy Cross Mountains (Schild 1971).

Until the end of the 20<sup>th</sup> century, studies on chocolate flint had been undertaken repeatedly by many scholars, such as M. Chmielewska (1973; 1980; 1988), W. Chmielewski (1975), M. Kaczanowska and J. Lech (1977), H. Lech and J. Lech (1984; 1995; 1997), J. Lech (1987; 1990; 1997), T. Herbich and J. Lech (1995), J. Budziszewski (1987; 1991b; 2008), M. Bednarz and J. Budziszewski (1997), B. Bargieł, A. Zakościelna, J. Libera (Libera and

Za-kościelna 1990; 2000; 2003), among many others. Regardless of field surveys, these were the times when numerous scientific works were announced, addressing the issues of utilisation and distribution of chocolate flints in particular periods of prehistory, as well as from the perspective of a regional approach (*e.g.*, Cyrek 1981; 1983; 1995; Cyrek and Sudół 2008; Schild 1987; Schild *et al.* 1997; Sulgostowska 1997; 2005; 2008; Balcer 1983; Kaczanowska 1985; Lech 1987; 1990; Domańska 1988; 1995; 1996; Małecka-Kukawka 1992; 1994; 1997; Prinke and Rajchmajda 1988; Zakościelna 1996; Budziszewski 1987; 1990; 1991a; 2008; Domański and Webb 2000).

The beginnings of the 21<sup>st</sup> century have brought a deeper reflection and more thorough exploration of the contemporary knowledge on chocolate flint, based on the data obtained in the previous century (Borkowski *et al.* 2008; Přichystal 2009; 2013; Kerneder-Gubała 2018; Burget 2018). Research on the technical quality of chocolate flints, in particular using mechanical properties, particularly fracture toughness, confirmed the excellent technical qualities of this raw material (Domański and Webb 2000). Now, in the second decade of this century, we are certain that the issues of extraction and processing of chocolate flint in the north-eastern region of the Holy Cross Mountains still raise many questions that need to be answered and are undertaken within various research projects, a great example of which are verification investigations in the chocolate flint mine in Orońsko (since 2016) (Kerneder-Gubała 2018; 2019; Osipowicz *et al.* 2019) and Ilża (Grózdź *et al.* 2021). Moreover, there were made attempts to obtain a diagnostic set of data characteristic for various outcrops of “chocolate” flints from Central Poland, based on geochemical methods of siliceous rocks identification (Grafka *et al.* 2014; Hughes *et al.* 2016; Parish and Werra 2018; Brandl *et al.* 2016; Werra and Siuda 2022).

The first years of the 21<sup>st</sup> century were also the time when M. T. Krajcarz (geologist) and M. Krajcarz (archaeologist) undertook verification investigations (Krajcarz and Krajcarz, 2009) in the scope of occurrence of chocolate flint in the south-western zone of the Holy Cross Mountains (Fig. 1). Until then the so-called chocolate flint in the region in question was reported in the related literature only sporadically (Kutek 1962; Migaszewski and Olszewska 2002; Migaszewski *et al.* 2006).

The theoretical potential of the chocolate flint outcrop on the south-western edge of the Holy Cross Mountains is currently not reflected in the presence of raw material extraction points in this region. One of the reasons may be the poor state of research, using modern methods of analyzing the land surface in terms of documenting anthropogenic transformations. The current state of knowledge, based on surface studies of the outcrop area, has shown only a small number of sites using this raw material. This could be for many reasons, *e.g.* the raw material was unknown or may have been difficult to access in the past, or the prehistoric miners were for some other reason more interested in other regions. Future research should also include comparative analyses between chocolate flint outcrops in terms of technical values and suitability for use, because we cannot exclude that the raw material from some outcrops could also be of lower quality.

The findings made by M. T. and M. Krajcarz, confirming and describing the occurrence of this raw material in the south-western zone of the Holy Cross Mountains, provided the grounds for further studies upon deposits of chocolate flint that can be found within a much larger extent than it had been previously assumed, namely over the entire area of outcrops of rocks of the Upper Oxford and the Lower Kimmeridgian stages (Krajcarz *et al.* 2012).

In this respect the central part of the Kraków-Częstochowa Upland (the Ryczów Upland, in particular) turned out to be exceptionally interesting. This is the region where in the recent decade, the research team headed by the geologist M.T. Krajcarz carried out intense research in order to reveal and document outcrops of siliceous materials. These investigations proved a great variability of flint materials and an existence of new outcrops. Amongst these outcrops there are distinctive deposits of high quality chocolate flint located in the region of the Udorka Valley (Krajcarz *et al.* 2012; Sudoł-Procyk *et al.* 2018; Sudoł-Procyk and Krajcarz 2021; Sudoł-Procyk *et al.* 2021a; 2021b). The studies, aimed at determination of the extent of outcrops of this raw material in the Kraków-Częstochowa Upland and its extraction points outside of the Holy Cross Mountains region, are presently being continued by an interdisciplinary research team headed by the author of this paper within the five-year grant financed by the National Science Centre.

### 3. CHOCOLATE FLINT IN THE KRAKÓW-CZĘSTOCHOWA UPLAND – NEW DATA

The research on the occurrence of flint outcrops in the central part of the Kraków-Częstochowa Upland, as already mentioned above, was started by the research team headed by M. T. Krajcarz in 2007.

During the field surveys carried out in this region, fragments of chocolate flint were found within the currently dry river bed in the Udorka Valley (Fig. 2). Later on, fragments of this raw material were also recognised in other areas in the vicinity of this valley. In the area of outcrops in the Udorka Valley, namely near the site Poręba Dzierżna 24, pits of anthropogenic origins and the remains of mine workshops related to the initial processing of raw materials were an extraordinary discovery (Sudoł-Procyk *et al.* 2018).

Apart from the site Poręba Dzierżna 24, where detailed multi-aspect excavations have been carried out since 2018 (Sudoł-Procyk *et al.* 2021b), field surveys supported by analyses of the digital terrain model revealed similar, though considerably smaller anomalies in other parts of the chocolate flint outcrops in the southern region of the Ryczów Upland (near the villages Poręba Dzierżna, Kąpiele Wielkie and Załęże). They will be the subject of further verification studies focused on the identification of potential new flint mines.

Until present, the best recognised site is the extraction point of chocolate flint in Poręba Dzierżna 24, which was firstly investigated in the scope of its landform, using the LiDAR survey data (Sudoł-Procyk *et al.* 2018). The terrain in question is highly diversified due to



Fig. 2. Chocolate flint nodules in the riverbed of the Udorka stream (photo by M. Sudół-Procyk)

the width and the depth of relics of quarry pits and their location in relation to the slope of the Udorka Valley. The results of excavation, supported by the stratigraphic data and datings, confirmed that there were multiple episodes of prehistoric activity at the site at the end of the Pleistocene and the beginning of the Holocene (Sudół-Procyk *et al.* 2021b).

In the region of the site Poręba Dzierżna 24, there were recorded three levels of chocolate flint occurrence: level “0” – from regolith, and levels “1” and “2” – from weathered rock (Fig. 3). Extraction pits and flint workshops in their closest surroundings proved that the raw material obtained from all of the deposits available in the past was tested on spot. Further studies conducted at the site will focus on more accurate determination of the extent of mining shafts (Fig. 3), their nature and possible diversification in terms of their chronological and cultural affiliation.

## 4. DISCUSSION

All this new information raises one question: what do we really know about chocolate flint?

Without any doubt, this raw material was used in all periods of prehistory, and its finds are known from almost all regions of Poland, as well as neighbouring countries, mainly in Central Europe (Sudół-Procyk *et al.* 2021a).



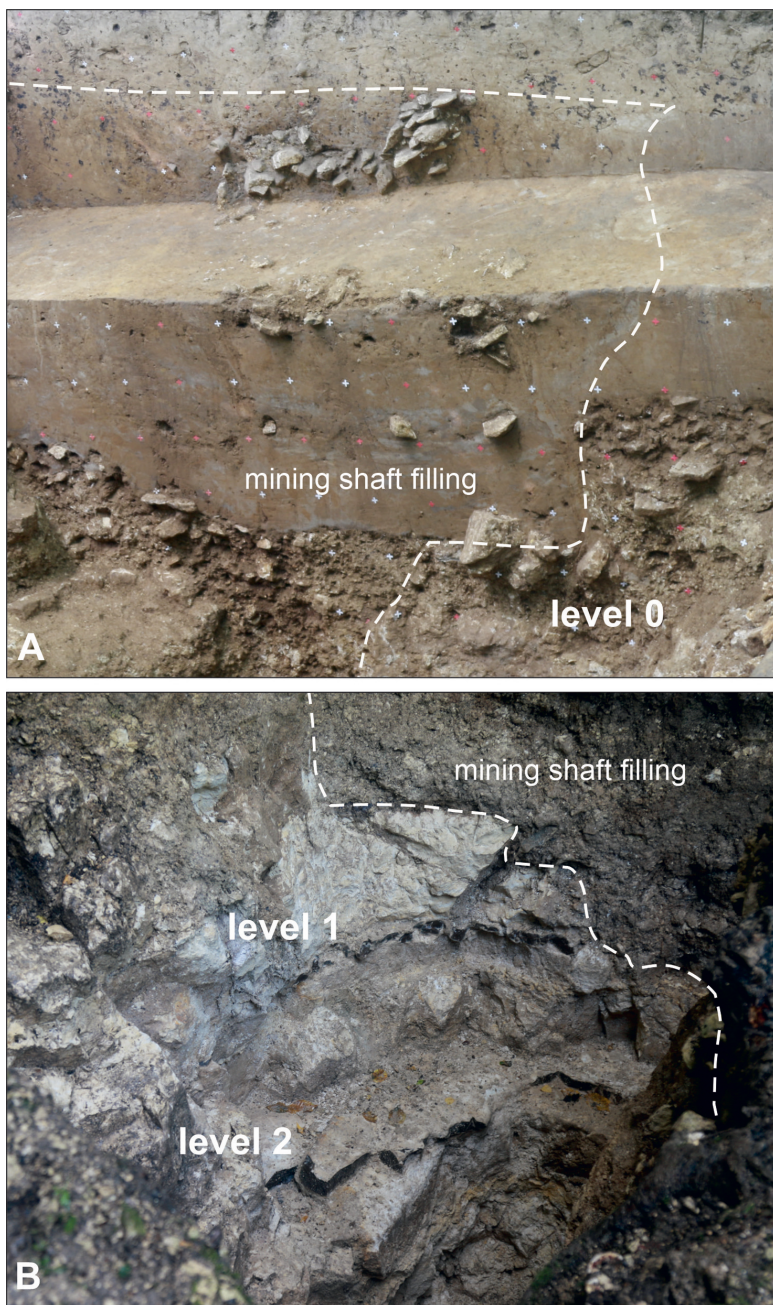


Fig. 3. Levels of chocolate flint and outline of mining shafts in the site Poręba Dzierżna 24, com. Wolbrom, małopolskie voiv. (photo by T. Wiśniewski).

A – level “0” – from regolith in Trench II, B – levels “1” and “2” – from weathered rock in Trench IV

It is also a fact that deposits of chocolate flint in the north-eastern edge of the Holy Cross Mountains (Fig. 1) have been very well recognised, mapped and described in the course of a century of research that has continued until the present day.

We know that the deposits of chocolate flint, outside of the Holy Cross Mountains zone are also located in the central part of the eastern margin of the Kraków-Częstochowa Upland (Fig. 1; Krajcarz *et al.* 2012) and, importantly, we have got evidence that prehistoric communities exploited deposits of chocolate flint both in the Holy Cross Mountains and in the above-mentioned area of the Kraków-Częstochowa Upland (Fig. 1).

Taking into account all of the facts quoted above, there are many new questions and issues that need to be tackled.

Firstly, knowing that chocolate flint was exploited by prehistoric communities in the region of the Holy Cross Mountains and Polish Jura, it is absolutely necessary to identify the provenance of raw materials found at particular archaeological sites in Poland and Europe (Sudół-Procyk *et al.* 2021a). The answer to the question about the route travelled by a particular flint product (*i.e.* where the raw material was excavated and what happened to it) is crucial for understanding the mechanisms of human activity in the past (Sudół-Procyk 2021).

With confirmed chocolate flint outcrops in the central part of the Kraków-Częstochowa Upland we should also raise the question whether it can also be found in other parts of this region, and if the answer is yes, will it occur in the same geological context? In turn, this leads us to further questions, such as: are there any other zones, apart from the one in question, where chocolate flint was extracted and initially prepared? Was it exploited by the same communities?

And finally, there is one more crucial issue: are there any unique petrological and/or geochemical properties of flints from the Kraków-Częstochowa Upland? Is it possible to distinguish chocolate flints from the outcrops in the Holy Cross Mountains from those coming from the Kraków-Częstochowa Upland?

The issue of identification of siliceous raw materials raises many controversies in the scientific environment nowadays, especially among part of geologists (Kochman *et al.* 2020; Matyczkiewicz and Kochman 2020). Silica rocks used in the production of tools in the past are subject to identification, among others on analyzes based on microscopic observations of thin sections which reveal the primary microfacies of limestones subjected to silicification, and X-ray diffraction analyses, including the determination of the crystallinity index of SiO<sub>2</sub> (Kochman *et al.* 2020). These research methods do not allow for identification of the varieties of flint nodules to an extent that would permit them to be even roughly connected with particular outcrops or, at least, with particular regions of the occurrence of siliceous raw materials on a Pan-European scale (Kochman *et al.* 2020).

The Multi-Layered Chert Sourcing Approach (MLA) by combining macroscopic, microscopic and geochemical analyses using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), seems to offer other possibilities (Högberg and Olausson 2007; Andreeva *et al.* 2014; Brandl 2016; Brandl *et al.* 2018; Bradley *et al.* 2020). Recently,



the analysis of samples of chocolate flint from Holy Cross Mountains region revealed clear possibilities to differentiate chocolate flint from Jurassic-Kraków flint based on characteristic microfossil inclusions and trace element contents (Brandl *et al.* 2016). On the other hand, separation of the Holy Cross Mountains chocolate flint is possible to a certain extent only, due to certain limitations resulting from their geographic proximity and consequently, similar geologic environments of their origins.

Searching for answers to the above questions and doubts is crucial from the viewpoint of acquiring new knowledge on raw material distribution. Tracing the routes of its spreading reflects past economic process and behaviours of human groups, which in turn allows us to reconstruct the inter-group contacts, being the channels for exchange of various information, and most likely, genetic material between remote societies.

## 5. RESEARCH PERSPECTIVES

The identification of new outcrops of chocolate flint have supplemented and verified the current knowledge of its occurrence and use in particular periods of the prehistory, mainly in the immediate vicinity of the outcrop, and influenced the reinterpretation of opinions on long-range imports of this type of lithic material from the Holy Cross Mountains to the Upland and the possibility of exporting it to other regions (Krajcarz *et al.* 2012; Sudół-Procyk *et al.* 2021a). We know that also in the southern part of the Cracow-Częstochowa Upland assemblages with chocolate flint products have been documented. These are sites from the Middle Palaeolithic period to the Mesolithic, and Neolithic sites are also known near the highlands (Sudół-Procyk 2021). The discovery of chocolate flint outcrops in the central part of the Upland and – in the context thereof – the Late Paleolithic and Mesolithic open-air and cave sites and workshops, constitutes an important criterion for considering the exploitation of local deposits and their use in particular periods in prehistory (Sudół-Procyk and Krajcarz 2021).

The awareness of the importance of discovering new chocolate flint outcrops and exploitation sites in the Ryczów Upland (middle part Kraków-Częstochowa Upland), resulted in the decision to expand the research area to the entire Kraków-Częstochowa Upland. As a part of the project financed by the National Science Centre, there are designed interdisciplinary studies aimed at the identification of chocolate flint outcrops in the Kraków-Częstochowa Upland, and the spots of this raw material exploitation and utilisation. Moreover, it is planned to conduct a research on the importance and the role played by this flint in particular periods of prehistory (Sudół-Procyk 2021).

In the first phase of the work, a detailed geological map of chocolate flint occurrence will be prepared. The Kraków-Częstochowa Upland has a monoclonal geological structure. Therefore, it is expected that other chocolate flint-bearing outcrops are to be found in the eastern edge of the Upland.

The second step of the research will be to conduct detailed archaeological surveys in the outcrop area, in order to detect prehistoric sites, potentially related to the exploitation and processing of chocolate flint. In the central part of the Kraków-Częstochowa Upland, several such sites are already known, including a flint mine and workshops. As for today, we know that there is a prehistoric chocolate flint mine with, at least, three deposits of this raw material. At the site there were identified mining features, including shafts. Preliminary proxies based on stratigraphic premises, as well as first OSL and  $^{14}\text{C}$  dating, confirm that chocolate flint from this region was known and obtained by hunter-gatherer communities at least since the final Pleistocene and the Early Holocene (Sudoł-Procyk *et al.* 2021b).

The last stage of research is to search for chocolate flint artefacts at archaeological sites situated in both the Kraków-Częstochowa Upland and beyond this region, in Poland and neighbouring countries. The exact number of sites, quantities of chocolate flint artefacts at these sites, and the nature of these artefacts (knapped locally or imported as finished products) have never been fully evaluated. One of the goals of this ongoing project is to create a database that will gather information on all of the chocolate flint artefacts from archaeological sites in Central Europe. This will allow the reconstruction of the prehistoric networks of chocolate flint distribution. However, this requires a tool for identification of chocolate flints and distinguishing them from other flints, and then, for classification of chocolate flint artefacts into those that had come from the outcrops localised in the area of the Holy Cross Mountains, and those from the outcrop (or outcrops) in the Kraków-Częstochowa Upland.

For this purpose, the Multi-Layered Chert Sourcing Approach (MLA), method is planned, combining macroscopic, microscopic and geochemical analyses using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). First, three deposits of chocolate flint obtained *in situ* from the rock and rock weathering, located at the mining site in the Udorka Valley will be analysed. The results will be compared with the samples already tested, coming from the deposits at the north-eastern foot slopes of the Holy Cross Mountains and other Jurassic flints from Polish Jura.

Considering that MLA has been successfully employed to sourcing lithic material in previous studies upon flint materials from other parts of Poland, for example chocolate flint from Holy Cross Mountains and Jurassic flint from Kraków (Brandl *et al.* 2016) and Europe (*e.g.*, Scandinavian flint, Brandl 2016; Brandl *et al.* 2018), it is planned to apply this method in this studies as well. Perhaps it will be possible to answer the question whether it is possible to distinguish between chocolate raw materials from the Holy Cross Mountains and the Kraków-Częstochowa Upland.

## 6. CONCLUSIONS

The current state of knowledge indicates very clearly that the outcrops of chocolate flint from the NE edge of the Holy Cross Mountains played the most important role in prehistory, especially when it comes to the Early Stone Age. Although we have identified

the sites where this raw material was mined and processed we know that the chocolate flint from the Udorka Valley was mainly of local importance. Further research will allow to verify the issue of what role, if at all, it played on a supra-regional scale.

The study on the geological and geomorphological context of the discovered outcrops, aimed at determination of their availability in the past, will allow us to evaluate the economic importance of these deposits for prehistoric societies.

An accurate identification of chocolate flint from the Kraków-Częstochowa Upland, which is macroscopically similar to that known from the Holy Cross Mountains, will allow us to verify the current state of knowledge on the issue of distribution of this raw material. The results will be important for future research, not only in the Upland itself, but also in other regions located both, in Poland as well as in neighbouring countries.

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