Characterising lithic sources

In order to trace the provenance of an artefact, it is necessary to distinguish between different potential sources. There are many methods of doing this ranging from visual to microscopic to chemical analyses. This session will focus on methods that may be used to distinguish between materials as well as characterisation studies of specific raw material sources.

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- KARAGEORGIOU, Stamatia; KOSTAKI, Akaterini; VAVELIDIS, Michail; ANDREOU, Stelios
  Raw material sources of knapped stone tools from the excavation of the prehistoric site at Toumba Thessaloniki, Greece

- BARON, Anne; BURKE, Adrian L.; GRATUZE, Bernard; CHAPDELAINE, Claude
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S6- Characterising lithic sources

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Info

In order to trace the provenance of an artefact, it is necessary to distinguish between different potential sources. There are many methods of doing this ranging from visual to microscopic to chemical analyses. This session will focus on methods that may be used to distinguish between materials as well as characterisation studies of specific raw material sources.
S6- Characterising lithic sources

Abstract

CHERT CHARACTERIZATION USING REFLECTANCE SPECTROSCOPY

Two complimentary reflectance spectroscopy techniques, Visible and Near-Infrared (VNIR) and Fourier Transform Infrared (FTIR), are proving to be non-destructive, fast, cost effective, versatile and accurate methods to differentiate chert sources. The study presents research demonstrating the potential application of reflectance spectroscopy data in chert provenance research. Reflectance spectral data gathered in the visible, near- and middle-infrared regions records the interactions of both the atomic and molecular configuration of chert with portions of electromagnetic radiation. A large chert sample database consisting of over 3,000 samples from 100 plus deposits in the Midwestern and Southeastern United States highlights the application of reflectance spectroscopy to differentiate chert by formation, by outcrop or deposit and by intra-deposit. The non-destructive application of outer surface analysis is tested using controlled experiments. Other potential variables affecting accurate provenance information including, thermal alteration, sample size and thickness, intra-sample or intra-artifact variation, instrument noise, sample geometry and multivariate statistical analysis are considered.

Analysis of approximately 400 Late Paleoindian-Early Archaic diagnostic projectile points from 12 sites along the Lower Tennessee River illustrates the potential chert source applications of reflectance spectroscopy. Also, provenance data for this material refines our understanding of hunter-gatherer group mobility and resource acquisition during the Early Holocene.
S6- Characterising lithic sources

Abstract

HETEROGENEITY OF KNAPPABLE RAW MATERIAL USED FOR CHIPPED STONE ARTEFACT PRODUCTION AT THE MESOLITHIC SITE OF LEPENSKI VIR (SERBIA)

Lepenski Vir is a Mesolithic-Neolithic archaeological site situated in Eastern Serbia, on the right bank of the Danube River. Although it is most famous for its unique sculptures made of sandstone, it is also significant in terms of stone tools. Mineralogical-petrographical analyses of the investigated collection of chipped stone artefacts, represented by 910 samples, were done in order to characterize the raw material and its provenance. The results of research confirm the heterogeneity of the stone material used for making tools. The majority of the knapped stone tools were made of cherts and radiolarite (around 70%), quartzite (around 20%), acid volcanic rocks and their volcaniclastics (around 6%), whereas silicified limestones, basalts, diorite and gabbro represent the rest of the material.

Cherts and radiolarites are heterogeneous in colour – from pale ochre and red to green and dark grey and have amorphous to cryptocrystalline or organic texture. Within this group, 102 items were made of so-called “Balkan Flint”. Quartzite raw material is milky white or dark grey, with typical granoblastic texture and massive fabric. The samples of acid volcanic rocks are dacite-rhyodacite to rhyolite lava and accompanied devitrified welded tuffs, fallout and phreatomagmatic pyroclastic rocks. They are usually purple to gray and show porphyritic to volcaniclastic texture.

Despite the fact that it is not possible to determine the origin of all raw materials on this level of research, some conclusions can be stated on the basis of the existing geological data. A certain number of artefacts were made from cherts and radiolarites, which are known to occur interstratified with Jurassic and Cretaceous limestones situated just above the site. On the other hand, the previously mentioned acid volcanic and volcaniclastic rocks are not found in Serbia. However, just across the Danube, in Romania, such rocks are widespread. This provides evidence to conclude that the raw material originates from the other side of the Danube. Such conclusions confirm already postulated statements that the communities from both sides of the Danube communicated and most likely were able to cross the river. Further multidisciplinary research would help in providing more evidence in order to specify the true localities of origin of the raw material used for making knapped stone artefacts.

Acknowledgements

The study was funded by the Serbian Ministry of Education, Science and Technical Development (projects no. 176016 and 177020).
**S6- Characterising lithic sources**

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**Abstract**

THE IRISH LITHIC LANDSCAPE PROJECT: CHERT PROVENANCING RESEARCH IN PREHISTORIC IRELAND

While Ireland has a very rich archaeological heritage, there is a significant gap in the island’s raw material sourcing research. This project will begin to fill this gap, and therefore deepen our understanding of the prehistoric communities there. The 2014 geoarchaeological prospection for the project centred on the northwest of Ireland, which includes case study assemblages from domestic sites and ritual sites such as megalithic tomb complexes. During 2014 we collected 350 geological samples from over 400 survey points, which included examining c. 250 outcrop groups.

The present analysis is using non-destructive energy dispersive X-ray fluorescence (ED-XRF) as a first-order technique to determine chert whole-rock geochemistry, which will be followed by petrographic analysis on a sub-sample of the collection. A significant part of this project is the creation of a lithoteque reference collection of Irish cherts; this will be physically housed at the UCD School of Archaeology, Ireland and accompanied by a web-based, spatial database, open for use by other researchers.
S6- Characterising lithic sources

Abstract

RAW MATERIAL SOURCES OF KNAPPED STONE TOOLS FROM THE EXCAVATION OF THE PREHISTORIC SITE AT TOUMBA THESSALONIKI, GREECE

The settlement of Toumba in Thessaloniki is an archaeological site of the Bronze Age. This site has the form of an artificial hill due to the accumulated remains of human activity. The period of these activities lasted for almost 2000 years. The excavations showed that there was continuous habitation since the late third or early second millennium B.C.E. until the late 4th or early 3rd century B.C.E.

The lithic tools from the excavation of Toumba were studied in order to compare the raw materials that had been used with respect to the geological occurrences of the corresponding materials in the region. After the macroscopic identification and color categorization of different types of chert products found during the excavation, the site of Vasilika was chosen for sampling respective varieties of chert. Vasilika is a village of Thessaloniki and is located at a distance of about 28 km southeast of Toumba. This area is known for mining activity and extracting raw materials used for knapped tools. The classification of stone tool raw materials in a certain geological context from where these come, suggests their generating mechanism and geochemistry. With such evidence, it is suggested that it is possible to make a connection between this geological occurrence and the human choice of such materials in stone tool manufacturing.

The petrographic examination of 940 lithic products shows whether there are integrated operational sequences at the site. Samples of both tools and raw materials were studied under a polarizing microscope. The determination of the chemical composition of the samples was done with ICP-MS analyses and XRF analyses. After this further geochemical determination, some of the preliminary groups were connected. Apart from silicate rocks, the geochemical study revealed the existence of other kinds of raw materials amongst the findings of knapped stone products, which cannot be connected to the regional area of Vasilika.
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<th>KARAGEORGIOU, Stamatia; KOSTAKI, Aikaterini; VAVELIDIS, Michail; ANDREOU, Stelios</th>
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<td>Raw material sources of knapped stone tools from the excavation of the prehistoric site at Toumba Thessaloniki, Greece</td>
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Abstract

FROM THE SOURCE TO THE OBJECT: AN INTERDISCIPLINARY APPROACH TO TRACING THE ORIGIN OF STEATITE ORNAMENTS MADE BY THE IROQUOIANS OF THE SAINT LAWRENCE VALLEY (QUEBEC, CANADA)

Since precontact times, First Nations groups from northeastern America used steatite, or soapstone, to make many artifacts, such as ornaments, vessels, and ceremonial and decorative objects. Only a few studies have been dedicated to this topic, more particularly on steatite vessels from Northern Dorset sites and from Eastern America. In these regions, steatite vessels are common. In Southern Ontario, Quebec and New York – regions occupied by Iroquoian groups during the Late Woodland period – many beads and pipes have been discovered but steatite vessels are very rare or even nonexistent. Steatite quarries are known for steatite vessels and the manufacture during the Late Archaic and Early Woodland is well documented. But for the Iroquoian region during late prehistory, it is more difficult because the identification of geological sources are unknown. Consequently, tracing the origin of the materials and the diffusion of the steatite artifacts in this area represents an important scientific challenge. A research program based on an interdisciplinary approach is in process in order to understand raw material acquisition and to reconstruct ancient exchange networks for the territories occupied by Iroquoian populations, more particularly in the St. Lawrence Valley. This interdisciplinary research involves i) an archaeological approach to the artifacts to restitute the chaine operatoire, ii) a geological approach to identify and sample the exploited resources and iii) the characterization of the materials to define their origin. Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) was chosen for its micro-destructive aspect, which provides a precise and detailed first estimation of the chemical composition of the materials. The important work of sampling both archaeological objects from Iroquoian sites and geological sources have been realized in different archaeological institutions and also in the field in southern Ontario, Quebec and New York to create a reference collection of the materials. The results obtained from these different approaches will be presented.

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Abstract

The geology of Serbia is dominated by the Dinaride-Hellenide orogen that consists of lithological units with heterogeneous cherty material. This material occurs mainly within the Triassic porphyry-chert formation and the Jurassic diabase-chert formation. The latter is associated with a complex ophiolitic melange. These units contain blocks and olistoliths of layered and massive cherts and radiolarites, sometimes up to 15 m thick. In addition, post-ophiolitic Cretaceous limestones of western and eastern Serbia contain cherts and radiolarites as nodules and lenses, and they usually show gradual transitions to limestones or silicified limestones. This widespread cherty material, which could be used to knap the stone artefacts found at prehistoric sites in Serbia, is very poorly characterized in terms of petrological and geochemical features.

In this ongoing study we present the basic geochemical characterization (obtained by LA-ICP-MS) of the material known as chert in the Serbian geological literature. The analyses include 11 samples of cherts from different localities and with variable ages and lithologies. Moreover, attention was given to collecting material that is petrographically similar to those found in the known archaeological collections. Two samples were taken from the Jurassic diabase-chert formation in southwestern Serbia, five samples originate from Upper Jurassic-Cretaceous limestones of eastern Serbia, two samples are from Cretaceous limestones of western Serbia, one sample was found as a cherty block within the Jurassic ophiolitic melange in central Serbia and one sample originates from the Miocene.

Macroscopic investigations show that all samples have microcrystalline texture and high relative hardness. Their positions within specific geological formations were also indicative for determining this rock type as chert. However, chemical analyses, particularly in regards to the SiO2 and CaO content, indicate that the studied samples display a chemical heterogeneity. Five of them display silica contents in the range of 83.22-98.13 wt %. Other samples are characterized by lower SiO2 and respectively higher CaO contents. As already proposed by some geologists, this could be explained by incomplete processes of silicification of limestones. Hence, these samples cannot be defined as pure cherts.

Through this pilot-study we provide new data, which may be of use to further research on chert as a crucial raw material for producing knapped stone artefacts. We suggest that each rock determination should be done on the basis of both petrographic and geochemical analyses because distinguishing geological sites that provided raw material for the prehistoric knapped stone industry might only be possible with the assistance of detailed petrochemical characterisation.
S6- Characterising lithic sources

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Abstract

COMPOSITIONAL ANALYSIS OF THE CHERT INDUSTRY AT THE PALAEOLITHIC SITE OF GIURGIU-MALU ROŞU (ROMANIA) BY VIBRATIONAL SPECTROSCOPY

New mineralogical analysis of raw materials and tools used at the Giurgiu-Malu Roşu prehistoric settlement and observations on its chert industry are reported. In past research, it was established that at Giurgiu a large number of lithic raw material and a very small number of tools were found [Alexandrescu et al. 2004; Alexandrescu 2012]. Despite this, the tools were obtained by blade Upper Palaeolithic technique and the large quantity of debitage is related to the quality of the raw material which was used. The compositional analysis of cherts of different provenance taking into account the type of raw material and artefact categories allowed for the description of the Upper Paleolithic population of the Romanian Plain concerning its extent, raw material exploitation techniques and predominant varieties.

Infrared (IR) and Raman complementary vibrational spectroscopy methods were used for the compositional analysis of the archaeological materials. Several nondestructive vibrational spectroscopic techniques were used: micro Diffuse Reflectance Fourier Transform Infrared (micro DRIFT), Attenuated Total Reflectance (ATR), micro ATR, NIR FT-Raman, micro Raman and Raman mapping.

The raw material consists almost entirely of a bluish chert (A), a reddish chert (M) (only 4.8 %) and an insignificant number of other rocks (black schist, sandstone, and quartzite). For example, the identification of minerals was made using the position of the NIR FT Raman bands of alpha-quartz (465, 206 and 128 cm-1), moganite (502 cm-1), calcite (713, 1086 and 281 cm-1), anatase (397 and 515 cm-1) and aragonite (1086, 706 and 155 cm-1). The small shifts in the alpha-quartz vibration band positions and the alpha-quartz:moganite bands intensity ratio as well as other spectral parameters were used for provenance studies. Possible sources of raw material, previously established, are the Frăteşti Formation and Danube terrace deposits. In the Raman spectra of the M type chert, the presence of the 396 cm-1 peak of anatase titanium dioxide, a heavy earth mineral may indicate a raw material of higher quality. From the micro DRIFT spectra, it was determined that the M type chert has a more homogeneous composition and a lower content of organic remains than the A type chert.

The heterogeneous composition of the Giurgiu-Malu Roşu chert industry and emphasis was placed on the different mineralogical constituents of the major types of cherts - A and M. The physicochemical properties of the raw material can be correlated with the characteristics of the chert industry. The wide heterogeneity of raw material and high percentage of “lower quality” chert could explain the vast quantity of debitage. The chert industry of Giurgiu-Malu Roşu belongs to an Upper Palaeolithic facies characteristic of the Romanian Plain.

References

S6- Characterising lithic sources

Abstract

Our study area, the Chasicó River Basin (Buenos Aires province), is located in the eastern portion of east-central Argentina (35.5°-41.5° S; 56.5°-67.5° W) (Figure 1). This ample region includes a significant section of the Pampas and the northeast of Patagonia. The former is a flat to slightly undulating surface landscape interrupted by two major orographic systems, Tandilia and Ventania, smaller hilly ranges, and a number of isolated hills and scattered rocky outcrops. The latter is a semi-arid region located south of the Colorado River, in which rocky outcrops are scarce and isolated, being the most relevant geologic feature the Patagonian Shingle Formation, composed of gravel deposits of extraregional (i.e. Andean) provenance. In east-central Argentina, there were two main kinds of raw materials used by prehistoric hunter-gatherers for tool-making: quartzites (orthoquartzites and methaquartzites) and cryptocrystalline quartz (e.g., chalcedonies, jaspers, cherts, silicified dolomite). Other rocks such as basalts, rhyolites, limestones, silicified tuffs, granites, and sandstones were also available, but they seem to have been of second order importance for subsistence activities.

Among the siliceous rocks, one widely used was a silicified limestone informally called “siliceous chert”. The main sources of this rock are located at Meseta del Fresco, a plateau placed in the southwestern extreme of La Pampa province, about 400 km northwest from our study area. A number of some minor outcrops (e.g. El Carancho) have also been described in the literature, which are located about 200 km northwest from our study area. This toolstone is represented in the artifact assemblages of the lower Chasicó basin with frequencies between 10% and 20%, higher than expected considering the distance from the main sources, as well as the relative frequency values in the surrounding areas.

With the aim of evaluating the presence of closer, alternative sources of siliceous chert which could explain the high observed frequency values of this rock in the artifact assemblages from our study area, we are currently performing a set of studies based on a combination of spatial modeling and of petrographic analyses of geological and archaeological samples. Geostatistical models of relative frequency data (i.e. percentage representation of toolstone classes in georeferenced artifact assemblages) constructed using kriging methods can provide a detailed understanding of the spatial distribution of these sources, helping to narrow down the possible alternative locations.

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interpolation, provide relevant clues about source location, to the extent that significant peaks of frequency in continuous surfaces are expected to occur at or near the sources. Peaks of frequency that do not coincide with the location of some previously described source draw attention to the presence of an undetected supply area. This helps to plan problem-oriented surveys and to implement more analytical sourcing activities, such as those based on petrographic analysis. It is expected that the data and analyses presented in this exploratory study will illustrate well both the strengths and limitations of the advocated approach, thus encouraging future theoretical, methodological, and empirical research on the subject.

Acknowledgements

This research was supported by grants from CONICET (PIP-11220120100622CO); Universidad Nacional de La Plata (N740) and Universidad Nacional de Rosario (Hum 363).
S6- Characterising lithic sources

Abstract

In recent decades, archaeometric research about obsidian sources and circulation in Central Mediterranean area has achieved good results, despite what has happened with other knappable materials. Detailed archaeometric literature on cherty materials is poor and discontinuous in time and space. Difficulties in unambiguous characterisation to identify distinguishing features of chert for sourcing, makes it relatively hard to compare materials from different regions and retrace ancient trade routes. Current archaeological knowledge about the circulation of chert in the central Mediterranean Sea identifies Gargano Promontory as one of the main sources. In addition, the Gargano Promontory is located along one of the supposed routes of the spread of the Neolithic in southern Italy, which is the “bridge” of Adriatic islands connecting southern Croatia to the north of Apulia.

In the current state of research, the geography of the Early Neolithic landscape of the promontory shows that only the area exploited for chert sources was inhabited. Early Neolithic sites and mines lie along the coast in a well-defined area, and no other site is present within a radius of about 25 km. This fact suggests an interpretation of the Neolithic mining area as an “island” area and thus the establishment of maritime expedition for the supply of Gargano chert, just as the Mediterranean islands were rich in obsidian. This suggests the possibility of a special status in the Neolithic of these territories rich in lithic raw material.

In general terms, our analytical approach focuses on the correlation among quantitative data of texture or structure, colorimetry, reflectance or gloss and chemistry (through LA-ICP-MS) obtained from geological chert samples and mine debris from Gargano Promontory. Three out of the four geological formations investigated (i.e. Calcare di Peschici Formation, Maiolica Formation, and Scaglia Formation) were mined in the past, whereas traces of mining in the Marne a Fucoidi Formation are unknown to-date.

In this work we present our results based on macroscopic and chemical analysis of a selection of 151 samples of chert to understand the variability of the intrinsic features and use them as potential discriminant factors for provenance. In each formation, cherts with different features and quality coexist. Among multiple sampling in outcrops with several chert layers, macroscopic and chemical results show lateral homogeneity and vertical heterogeneity. The chemical variability of chert samples is influenced by the distance from the cortex, when present. Geochemistry and colorimetry are not able to distinguish cherts of the four formations investigated. However, we observed some chromatic and chemical homogeneity on the level of sites (e.g., Defensola, Arciprete, Tagliacantoni for Peschici Formation, and Martinetti, Guariglia or Valle Sbernia, Bosco della Risega for Maiolica Formation).
Abstract

The Mitra II Dolmen and Zambujeiro Dolmen are two closely related megalithic structures, dated to the Neolithic period, located in the Alentejo region, Portugal. The Mitra II Dolmen was built in the Middle Final Neolithic (approximately 2,600-2,700 B.C.E.) and is one of several dolmens identified by the Leisners (two German archaeologists who studied the Megalithism of the Iberian Peninsula in the first half of the 20th century) in the Alentejo region. This dolmen was first excavated in the 1960’s by a group of amateur archaeologists from Évora, and has since then undergone five different interventions, starting from 2000 until 2011. The Zambujeiro Dolmen (built between the beginning of the 4th millennia B.C.E. and the middle of the 3rd millennia B.C.E.) was found and excavated by Henrique Leonor Pina between 1964 and 1968 (Soares & Silva, 2010), and has since undergone a second phase of interventions between 1985 and 1987, and a final phase of interventions in the early 1990’s (Odriozola et al., 2012).

This study focuses on the chemical and mineralogical analysis of the numerous siliceous lithic arrowheads recovered during the excavations of both prehistoric sites. A geochemical and mineralogical approach is essential to establish the sources of chert raw materials and to compare or to cluster the different artefacts. Due to the high variability of macroscopic characteristics that can be found in a single chert outcrop and the complexity of the material, a multi-analytical approach is required. Thus, in this study, the chemical and mineralogical composition of siliceous lithic arrowheads recovered from the two megalithic sites was determined by noninvasive and minimally invasive analytical techniques, such as in-situ XRF, XRD, LA-ICP-MS, and SEM-EDS.

The results allowed the authors to suggest possible raw material sources, to propose probable trade routes during the Neolithic period, and to establish links between different materials and different sites, as well as different manufacture technologies.

Keywords: Chert; flint; arrowheads; Neolithic; LA-ICP-MS

References


Abstract

FIRST ARCHAEOPETROLOGICAL APPROXIMATION OF THE PROVENANCE OF THE NEOLITHIC AXES AND OTHER ARTIFACTS FROM THE CAN SADURNÍ CAVE (BEGUES, BAIX LLOBREGAT)

Can Sadurní cave, located in Begues (Baix Llobregat, Spain), is an archaeological site that features a wide stratigraphic sequence ranging from the last hunter-gatherer societies at the beginning of the Holocene to the Bronze Age, a fact that has led to the recovery of a large number of different raw materials of different natures. The stratigraphy of the site covers approximately 11,000 years but in this study we will focus on the Early and Middle Neolithic. In this presentation, we present the initial archaeopetrological characterization study and initial hypotheses about the origin of raw materials used for the manufacture of axes, which are the second type of macrolithic tool abundantly recovered at the site. We will also discuss a set of “lighters”. The different steps of the mineralogical analysis, macroscopic and microscopic, will provide a range of complementary data to perform a detailed characterization of the analyzed raw material and their potential catchment areas.
S6- Characterising lithic sources

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Abstract

CHARACTERIZING JURASSIC CHERTS AS A LITHIC RAW MATERIAL IN THE MIDDLE TO UPPER PALAEOLITHIC OF SOUTHERN BURGUNDY

The chert varieties of the Jurassic time period are a well-known and often described lithic raw material in prehistoric research. For many years, in many European study areas the material has been the focus of either archaeological based analysis of procurement patterns or archaeometric analysis of qualities, e.g., the Swabian Jura (nodular Jurassic cherts varieties), Bavaria (tabular Jurassic chert varieties) or Poland (Krzemionki chert). In the area of Southern Burgundy, another lithic raw material had been the focus of research in recent decades, the secondary deposited Cretaceous and Tertiary flints of the so-called “l’argiles à silex” (“flint in clay”). Articles and publications, such as Ruè (2000) for example, have given a good overview of the varieties and the outcrops in Southern Burgundy along the west-side of the Bresse-Saône-Rhône Valley. Still, the lithic raw materials of the Jurassic time period have only played a minor role in the research context. Many prehistoric sites are known in this area, such as the cave sites of Grottes de la Verpillière I & II, the Middle and Upper Palaeolithic open air sites of Saint-Martin-sous-Montaigu or the famous open air site of Solutré, for example. Although the raw material of the so-called l’argiles à silex seems to have been preferred by prehistoric hunter-gatherers, especially the non-local or less used materials can help to understand specific lithic raw material procurement or migration patterns.

The aim of this presentation is to give an overview of the varieties and outcrops of this raw material and try to characterise the macroscopic and microscopic features of the chert, in order to distinguish between the different varieties, particularly in an archaeological context.

Acknowledgements

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Abstract

One of the more important problems related to studies of the Stone Age is determining the mechanisms of long-distance distribution of siliceous rocks. Therefore, it is necessary to develop methods which will allow the different rocks to be distinguished very precisely. Owing to its rich resources, the area of the Vistula Basin is an excellent place for implementing such investigations. It boasts deposits of several kinds of chert which were widely used in the prehistoric times: “Chocolate”, Gray White-Spotted, Striped (banded) and, on its eastern borders, Volhynian. Unfortunately, mistakes are sometimes made when distinguishing the various cherts, especially in the case of “Chocolate Flint”.

The differentiation of the color of “Chocolate Flint” and determination of its characteristic features in relation to other siliceous rocks can be solved by using mineralogical studies. Therefore several samples of “Chocolate Flint” were analyzed, together with comparative samples of other siliceous rock, (from Saspow, Olszanica, Krakow District, Cisowe Wyciąg, Olkusz District, Udórz, Zawiercie District, Janikowa, Ożarowa, Śródborze, Wojciechówki, Opatów District, Borownia and Kremionki, Ostrowiec Świętokrzyski District and Bodaki, Ukraine).

During the research we focused on the study of accessory minerals present in “Chocolate Flint”. On the basis of determining the chemical composition in the microscope within them were identified inclusions of: hematite, pyrite, gypsum, barite, calcite, rutile, ilmenite, zircon, monazite, rare earth elements (REE), phosphates, chuytite group minerals, and apatite. Most of the aforementioned minerals occur sporadically. Only inclusions of pyrite, hematite and barite occur in all types of chert.

Mineral that may be helpful to distinguish “Chocolate Flint” from other varieties of siliceous rocks is apatite. The occurrence of this mineral was found in samples from Wierzbica “Zele”, Polan II, Seredzice, Radom District, Orosisko, Chronów-Kolonia, Tomaszowa, Szydłowiec District, and chert from Bodaki and Janików. There is no apatite in Jurassic-Cracow chert, and the apatite present in Cisowa Wyciąg chert is characterized by an increased content of ytrrium. Most frequently the apatite present in “Chocolate Flint” creates an irregular aggregation of elements that are remnants of skeletal fish. Another variation of this mineral is present in the form of oval apatite, with a drawn grain size of up to 20 μm. The last variety is apatite with irregular inclusions which is always associated with pyrite and barite aggregates. For chert from Ożarów, the characteristic feature is the presence of rare earth elements (REE). The analyses of the chemical compositions of these phases indicate that, depending on the dominant cation, we are dealing with chuyt-Y or chuyt-Nd. These minerals are present in the form of fine inclusions or globular aggregates composed of thin acicular crystals.

Acknowledgements

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Abstract

Chert in its diverse natural occurrences: Geo-tools for a better definition of the sourcing of secondary outcrops

Precise identification of siliceous geo-resources used during prehistory still raises many problems, and archaeologists have an ever-increasing need for this data. The purpose of this study is to provide a database containing an exact and descriptive identity for each different geological type of chert found within a region. The database in this study is being developed for the administrative regions of Rhône-Alpes, Auvergne, Aquitaine and Provence-Alpes-Côte d’Azur. It will contribute to an accurate understanding of precise movements and exchange of raw materials and therefore also to the behaviour of prehistoric groups.

Until now, the problem has been viewed in reverse; by trying to revert to the identity of the original material through study of found objects. Such a procedure follows an illogical route because it is first necessary to characterize raw materials in their primary position and secondly to make an appraisal of the epigenesis of the chert recovered from secondary sources. Our characterization approach is based on mineralogical composition (determined by optical microscopy, SEM, microprobe, and cathodo-luminescence), micro-facies characteristics (identified during microscopy and SEM image analysis), porosity measurements (by image analysis and porosimeter), and the presence and distribution of major and trace elements (using ICP, LA-ICP-MS, XRF, PIXE, Raman and SEM-EDS) on the surface or in cracks in the matrix. Following the collection of information, a statistical evaluation is necessary to produce a reliable identification of the chert. Consideration of all varieties of the same material in its different states, coming from all known primary and secondary sources sets the study of archaeological samples on a solid foundation.
Abstract

SOURCING OF NORTH AMERICAN HURON GREAT LAKES BASIN EARLY HOLOCENE CHERT ARTIFACTS BY LA-ICP-MS

Chert artifacts are often identified with geological sources by visual macroscopic or microscopic analysis in comparisons to reference samples from known geological locations and by geochemical methods. The sources of cherts can reveal travel routes and social interaction and exchange patterns through time. In this study brown and tan chert artifacts of unknown geological provenance, excavated from Early Holocene (Late Paleo-Indian - Early Archaic) archaeological sites are compared with visually similar materials from known geological formations, using semi-destructive laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). In this region of the North American Great Lakes, the early Paleo-Indians, ca. 10,500-12,500 BP, preferred to use a visually distinctive grey Fossil Hill Formation chert, of Silurian age, often transported some distance. The late Paleo-Indian - Early Archaic cultures ca. 9,500-8,000 commonly utilized quartzites and a variety of local cherts but their use of Fossil Hill Formation cherts is poorly known. Tan and brown chert artifacts from the west end of the Alpena-Amberly Ridge (exposed by very low water levels ca. 9,500-7,500 years BP) are found by heavy REE and other minor and trace elements to compare most closely to Fossil Hill Formation cherts. This may indicate a continuity of human preference of this Fossil Hill Formation silica material from the Late Pleistocene into the early Holocene era. Also these brown facies of the Fossil Hill chert may have been available when Great Lakes water levels were very low exposing the brown beds around the western end of Manitoulin Island, Canada.
S6- Characterising lithic sources

Abstract

IN SEARCH OF A NON-DESTRUCTIVE WAY OF IDENTIFYING LIDITE IN ARCHAEOLOGICAL LITHIC ASSEMBLAGES

Lidite is a low grade metamorphosed siliceous sedimentary rock consisting of quartz and approximately 5% non-crystalline shungite carbon. The rock has a conchoidal fracture but often contains internal flaws while the non-crystalline carbon gives it a pitch black colour. In north-eastern Europe, deposits of this rare rock type can be found only on the north-western shores of Lake Onega in Russia among other shungite-bearing rocks.

The Onega lidites from bedrock and glacial-drift-derived pebbles were used for stone tool raw material since the initial postglacial inhabitation of southern Karelia during the Mesolithic. Outside of present-day Russian Karelia, artefacts made of lidite are rare but no systematic study of their distribution outside of the core area has been conducted so far. However, several artefacts made of a raw material closely resembling lidite were recently detected among the finds at Jokivarsi 1, the earliest Mesolithic site in Finland and some 250 kilometres from the western shore of Onega Lake.
S6 - Characterising lithic sources

Abstract

The Canary Islands were populated around the end of the 1st millennium BCE by people of the palaeo-Berber group from North Africa. They underwent a ‘prehistoric’ period, without apparent communication between islands until the arrival and conquest by Europeans during the 14-15th century. During this period, every island developed a particular culture that, in Gran Canaria, led to a hierarchical complex structure in which obsidian played an important role.

Obsidian was exploited by the original populations on Tenerife, Gran Canaria and La Palma Islands, but no exchange of obsidians has been reported so far. At Gran Canaria, obsidian is found in ignimbritic deposits of small size and the only important sources have been found on Hogarzales and El Cedro Mountains, where numerous mining galleries and mining instruments are known. Besides these, Las Vacas Mountain is also known for the existence of ignimbritic obsidians which were exploited from open air deposits.

From 2002 to 2010, 64 individual artefacts have been characterized by means of ICP-OES and ICP-MS in three different analytical series. Thirty six correspond to geological samples: 24 from Hogarzales, Las Vacas and El Cedro, that exhibited the same chemical composition, but also 12 from Tenerife Island. Moreover, 28 archaeological obsidian samples from 7 different archaeological sites around Gran Canaria were also characterized. All of these samples, with 3 exceptions, were found to be compatible with the Hogarzales-Vacas-Cedro source.

Very recently, a large sampling has been conducted on several archaeological obsidians from all over the Gran Canaria Island, and also from a site on Tenerife. In this sampling, several geological samples from Tenerife (La Tabona), Hogarzales, Las Vacas and El Cedro were also considered, including 9 samples analysed previously by ICP-OES and ICP-MS. In this way, a sample of more than 220 artefacts has been characterized by portable-XRF and the results have revealed the possible existence of at least 3 new groups whose relation to new as yet unknown sources on Gran Canaria need to be further explored. The existence of unknown sources would imply a significant change in the understanding of exploitation strategies of obsidians on the island. Thus, a subsample of the previous sample set is being analysed by means of ICP-OES and ICP-MS in order to assess the consistency of the new results.

THE ARCHAEOOMETRIC STUDY OF OBSIDIAN FROM GRAN CANARIA (CANARY ISLANDS, SPAIN): NEW RESULTS, NEW DIRECTIONS

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Abstract

PROVENANCE AND MACROSCOPIC ANALYSIS OF THE CHERT ASSEMBLAGE FROM LAYER D OF LAPA DO PICAREIRO (PORTUGAL)

Human economic and behavioral patterns are partly influenced by environmental factors such as local and regional settings, climate, biotic and abiotic raw materials resources. The study of lithic raw material procurement, consumption and stone-tool production is key to understand complex settlement systems and land use patterns. Here, we focus on raw material procurement and movement during the Early Holocene in Central Portugal. For this investigation we studied raw materials from the cave site of Lapa do Picareiro. The site is located in Serra d’Aire (Central Portugal), at an altitude of 570 meters above sea level, facing west. During the last 20 years, the archaeological excavations have exposed a stratigraphic sequence with more than 8 meters, revealing multiple layers rich in fauna, lithics, charcoal and combustion features that clearly show human use of the cave from the Middle Paleolithic to the Bronze Age.

In this presentation we focus on the acquisition of Layer D of Lapa do Picareiro, dated from 8310+130 BP (9012 – 9528 cal BP), corresponding to the Portuguese Epipaleolithic, in order to better understand behavioral and economical patterns of this period in the Portuguese Estremadura. We surveyed a ~20 km radius area in order to gather geological samples from primary and secondary chert sources that are always relatively well bounded in the landscape, as opposed to the ubiquitous distribution of quartz and quartzite. Geological samples were macroscopically analyzed and compared against the stone tool assemblage, considering a series of traditional visible characteristics. Because some of these features can be subjective, we structured our database in order to make them quantifiable.

Our preliminary results showed that the archaeological assemblage is more related with the sources located towards west than those from east of Serra d’Aire. This research project will ultimately focus on other occupational layers of Lapa do Picareiro and other sites of this region in order to shed light on the subsistence, mobility and economic patterns during the Late Pleistocene.
**Abstract**

**MINERALOGY AND CHEMICAL COMPOSITION OF LITHIC ARTIFACTS FOR IDENTIFICATION OF PROVENANCE IN SALOBO ARCHAEOLOGICAL SITES, CARAJÁS MINERAL PROVINCE, PARÁ, BRAZIL**

The region of the Carajás Mineral Province is home to several archaeological sites with numerous lithic artifacts in various stages of operational chain. Are artifacts that still require mineralogical and chemical studies whose results may help in the identification of raw materials and their provenance, and therefore contribute to the characterization studies of cultural traits. From this perspective lithic artifact recovered in the impact area of the Salobo copper mine (and gold with by-product) were investigated. They are beads and pendants used as loud of a complete operational chain. The results obtained by XRD, XRF and SEM / EDS show that the raw material used is a semi-hard kaolin (semi-flint) consisting mainly of kaolinite, and cryptocrystalline quartz, crandallite group phosphates (florenceite), sericite and hematite. Equivalent material was found in Alto Bonito amethyst mines, 20 km of sites, and then considered as the source area of the raw material used for the manufacture of these devices, which is enhanced by association with amethyst and hyaline quartz chips also associated the semi-hard kaolin. So the people of this region knew how to exploit its mineral wealth in loud production and technological artifacts to the operational chain.
S6- Characterising lithic sources

Abstract

THE VEGAMIAN FORMATION: CHARACTERIZATION OF A SOURCE OF SUPPLY OF POTENTIAL LITHIC RAW MATERIAL DURING PREHISTORY IN THE CANTABRIAN MOUNTAINS

Studies developed to characterize lithic raw materials at the prehistoric sites of the central-western area of the Cantabrian Mountains (near Picos de Europa) highlight the importance of the Vegamian Formation as a potential source of supply of lydites. The macroscopic features of these lydites, presenting a black colour and laminations, are consistent with the so-called 'black chert' found at Mesolithic sites of the region, such as those found in the El Espertín and La Uña Caves (León, Spain). Therefore, an accurate characterization of this formation is essential for research on the exploitation of siliceous resources during prehistory in the Cantabrian Mountains.

The Vegamian Formation is formed of slates and shales of Tournaisian age (Lower Carboniferous) with strata of limestone and black lydites. These rocks are high in silica, normally associated with radiolarians, and the formation is present both north and south of the Cordillera. It was characterized by Comte (1959) at Vegamián (in the south ridge, north of the province of León) a village which, since 1968, has been submerged by the Porma reservoir. On geological maps, the cartographic representation of this formation is imprecise. Given its thinness, sometimes it is not even reproduced. In other cases, it has been included in the overlying formation (the Alba Formation), which is a bedrock of radiolarites. This siliceous raw material has been used in archaeological contexts. Hence, it is necessary to clearly outline the features of both lithologies.

The aim of this work is to define this type of raw material. For this purpose, we will provide a characterization from various points of view, such as textural, with petrographic analysis of thin sections, and mineralogical, through X-Ray Diffraction (XRD). Thermogravimetric and high resolution geochemistry analyses, such as Inductively Coupled Plasma for Optical Emission Spectrometry (ICP-OES), will be carried out. They will be applied to samples from geologic outcrops and, subsequently, contrasted with similar analyses of archaeological samples from the La Uña and El Espertín sites. This will allow us to investigate the exploitation of this type of raw material during prehistory in the southern Cantabrian Mountains. The results can also be extrapolated to the northern area.
S6- Characterising lithic sources

Abstract

The aim of this presentation is to introduce and discuss an approach to sourcing a variety of knappable materials based on the use of geostatistical models of relative frequency data (i.e. percentage representation of toolstone classes in georeferenced artefact assemblages). This is particularly useful in areas where there is scarce information about both the variability of one or many toolstone classes represented in lithic assemblages across the regional space and the localization of their likely or actual sources. Such models are constructed using kriging interpolation under the assumption that continuous surfaces make the spatial information recovered from relatively few, scattered, and unevenly distributed sampling locations more intelligible. As long as it is expected that, in most situations, the relative frequency of a toolstone will decrease as a function of the distance from the source, then the presence of significant peaks of frequency in areas that do not coincide with the location of some previously described source may alert us to the presence of an undetected supply area (Barrientos et al. 2014). This helps to plan problem-oriented surveys and to implement more analytical sourcing activities. We will exemplify the approach with two case studies from regions previously inhabited by hunter-gatherers: southern Patagonia and the eastern Pampas of Argentina (Figure 1).

The Pampas are characterized by an uneven distribution of lithic resources, which are available in rather restricted areas of the landscape, both in the form of primary outcrops and of secondary deposits. In southern Patagonia, the lithic resource base is broader than in the Pampas, with a more ubiquitous localization of primary and secondary sources. Besides differences in raw material distribution, there are remarkable differences in archaeological visibility (higher in Patagonia than in the Pampas), which influence sampling choices.

During the presentation we will discuss the pros and cons of the advocated approach, particularly focusing on some critical issues like theoretical premises, data requirements, spatial modelling, and results interpretation.
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Geostatistical models of artifact relative frequency data and the sourcing of knappable materials: Two case studies from Patagonia and the Pampas of Argentina

References


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**Abstract**

**MONEGROS-TYPE CHERT: PETROGRAPHIC CHARACTERIZATION AND PREHISTORIC USAGE**

In recent years, allusions to the exploitation of a so-called “Monegros-type” chert have been commonplace in archaeologic literature, mostly in Iberia but also in southern France. Most of the time, these references have not offered a true petrographic characterization, being merely de visu descriptions of those products. This work presents macroscopic and microscopic descriptions of around twenty outcrops located in the Monegros territory, in the Middle Ebro Basin, where this chert variety has been found, all of them of primary or sub-primary order. These descriptions allow us to define two different origins: continental lacustrine and evaporitic. This chert appears as kidney-shaped nodules (occasionally very thin, like tablets) that can be found either isolated or stratified. Following the petrologic study, we review materials found at several archaeological sites in the Ebro Basin where this chert type has been described, usually due to the presence of Liesegang rings, easily recognisable by archaeologists.
Abstract

THE ESCALADA FORMATION: CHARACTERIZATION OF A POTENTIAL SUPPLY SOURCE OF CHERT DURING PREHISTORY IN CANTABRIAN MOUNTAINS (NW SPAIN)

Studies developed in order to characterize lithic raw materials in prehistoric sites in the Cantabrian Mountains (NW Spain) highlight the importance of chert nodules found in the Sierra de Gobezanes (Concejo de Caso, Asturias) as a potential source of supply. Although it is the northern Cantabrian Mountains, the macroscopic features of this lithology, presenting a black brilliant colour, are consistent with certain samples of the so-called 'black chert' found at Mesolithic sites of the region on the southern slope, such as those found in the El Espertín and La Uña Caves (León, Spain). Therefore, an accurate characterization of the Gobezanes nodule chert is essential for research on the prehistoric exploitation of siliceous resources in Cantabrian Mountains.

The cherts of Gobezanes probably come from the Escalada Formation, which is formed by massive limestone of Lower to Upper Moscovian age (Carboniferous) and appears only in the Ponga Region. The geographic distribution of this geologic region is restricted to the eastern province of Asturias and northeast of Leon. This includes the headwaters of some of the main rivers both in the northern (Nalón, Sella) and the southern (Esla and Porma) Cantabrian Mountains. Although the occurrence of chert nodules in the geological studies of this formation has not been commonly quoted, this presence has been confirmed by the survey carried out in the Sierra de Gobezanes, around the headwaters of the Nalón River. We have also located another outcrop of the Escalada Formation bearing chert nodules just in the watershed, at the mountain pass of San Isidro, where the source of the Aller (northern slope) and the Porma (southern slope) Rivers is located.

The aim of this work is to define those cherts coming from the Escalada Formation and check whether both outcrops, the Sierra de Gobezanes and the Puerto de San Isidro, are equivalent. For this purpose, we will provide a characterization from various points of view, such as macroscopic and textural, with petrographic analysis of thin sections. The geological and geographic distribution of this lithology will allow us to check the exploitation area of the cited raw material during prehistory.
S6- Characterizing lithic sources

Abstract

The eastern margin of the Ebro Basin (NE Iberian Peninsula) is a territory with abundant chert sources. Prospecting campaigns along the Catalan Coast Ranges and the Central Depression have revealed the existence of numerous silicifications related to similar lithofacies, which make the determination of lithic provenance areas difficult. The applications of GIS methods and Gravity Models allow for the development of new approaches to raw material analysis through the characterization of quantitative features of the chert sources (Wilson, 2007; Soto et al., 2013).

The study that we present is an example of the utility of classifying chert areas for establishing models of lithic catchment models in territories with a high predictability of resources. The digitalization of geological formations with silicifications in a hydrological basins map, using these geological formations with silicifications as units with territorial meaning for mobility, allow us to obtain data related to the extent of the area and to create stratigraphic sections with the main lithologies of the source areas that were located.

The use of GIS software also facilitates the analysis of some factors affecting procurement processes:

- Geological Formation Area (FA). Maximum domain of the geological formation with silicifications.
- Formation Thickness (FCT). Calculated thickness of the geological layer with silicifications in the outcrop area.
- Outcrop Apparent Thickness (OAT). Distance between the base and the top of the chert source.
- Chert Index. Chert (cm²)/enclosing rock (m²).
- Size(S). Averaged maximum size of the nodules.
- Abundance (Ab). Chert theoretical input to the territory based on the previous values.

These factors determine the contribution of the siliceous materials to the basins, thus establishing a Territorial Abundance Index for the different raw materials. This index could be used, combined with the distance between outcrop and site, to determine statistically the catchment areas. The statistical discrimination, based on the raw material distribution of the archaeological assemblages, will contribute to the definition of the catchment strategies, mobility routes and territories frequented by the hunter-gatherer groups.

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TERRITORIAL CHERT ABUNDANCE: A STATISTICAL APPROACH TO DETERMINE PROVISIONING AREAS


S6- Characterising lithic sources

Abstract

CHALCEDONY FROM THE TOLFA VOLCANIC DISTRICT (LATIUM, ITALY): PETROGENESIS AND ARCHAEOLOGICAL POTENTIAL

The area of Monti della Tolfa, located on the coast of Northern Latium (Italy), has been little investigated in terms of prehistoric settlement dynamics. Recent research (I Monti della Tolfa Prima di Homo Sapiens Project) has, however, revealed human occupations starting from the Lower Palaeolithic; among these, Ficoncella site records human presence at 500,000 kyr. Middle and Upper Palaeolithic occupations are also known but only from surface findings of lithic assemblages.

The geology of the Tolfa complex is characterized by a thick volcanic cover and only limited extents of the original substratum do emerge. The latter, mostly made up of marls and shales, shows a scarce occurrence of lithic raw materials suitable for knapping. Siliceous rocks, such as flint and radiolarite, can be found as pebbles (probably reworked from distant geological formations) in Plio-Pleistocene marine and fluvial terraces.

Chalcedony is a peculiar type of silicification which largely contributes to form the lithic raw material potential of the area. Inside the 2 million years old volcanic rocks, chalcedony was deposited in nodules and concretions as a consequence of the hydrothermal circulation of silica-rich hot fluids.

Chalcedony is found today in the area considered for this study both in its primary position and as pebbles in the Pleistocene marine and fluvial terraces. This kind of rock is, however, virtually unknown both in the geological and archaeological literature for the area. In the past, field survey across the Tolfa district led to the recovery of thousands of knapped stone artefacts among which a Mousterian component made on chalcedony can be recognized. At Ficoncella, on the other hand, chalcedony appears to be the least exploited material. A later interest, extending to protohistory, on this lithic raw material is suggested by some findings and could be confirmed by future research.

Here we present petrographic information on the Tolfa Chalcedony together with the results of the first surveys investigating both its geological and geographical distribution and the preliminary archaeological data on its exploitation during prehistory. This with the aim of evaluating the potential of this particular rock to investigate the ancient peopling of the Monti della Tolfa area and to evaluate the extent to which this very localized raw material can serve as a territorial marker for prehistory.
Abstract

THE MARINE CHERT FROM LAS LEZAS (BIEL, ZARAGOZA) AND ITS PREHISTORIC EXPLOITATION

The fm. Uncastillo, in the western piedmont of the Pyrenean External Ranges, is characterized by series of massive conglomerates.

Occasionally, this formation reaches a notable development, like at the relief known as Las Lezas, next to the village of Biel (Zaragoza). The main parts of the boulders embedded in the conglomerate are limestones and sandstones, with a lesser proportion of silicifications of marine origin whose employment by prehistoric people is well documented in this area. The Las Lezas conglomerates are deeply eroded by the Arba de Biel River, which distributes the boulders along its riverbed.

The upper Arba de Biel Basin hosts an interesting archaeological ensemble composed by five sites that were occupied by human groups from the Upper Magdalenian until the Chalcolithic (between ca. 14700 and 4400 years cal. BP).

This work present the results of the petrographic study of the local chert (Las Lezas), as well as the different strategies concerning its gathering, transport and exploitation in every prehistoric cultural phase, in connection to other exogenous cherts: the sites register a recurrent use of the described local flint, accompanied by other varieties (i. e. Monegros-type) whose presence increases over time.