

UISPP Commission

on Flint Mining in Pre- and Protohistoric Times

3rd International Conference in Vienna

"Archaeological Structures from the Flint Mining Site - Differentiation and Studies"

21-25th of September 2010



*Patronised by the Faculty of Historical and Cultural
Studies of the University Vienna – Gefördert durch die Historisch-
Kulturwissenschaftliche Fakultät der Universität Wien.*
&
*Institut für Ur- und Frühgeschichte der Universität Wien
Franz Klein-Gasse 1
A-1190 Wien.*

Programme

Tuesday 21.9.2010	Presentations (Hörsaal 5/lecture hall 5)
10h00 - 10h30	Opening of the session <i>In memoriam Gerd Weisgerber (1938-2010)</i> by J. Lech <i>In memoriam Yves Lanchon (1951-2010)</i> by F. Bostyn
10h30 - 11h00	<i>Archaeological features and structures at flint mining sites: differentiation and significance. An outline</i> (Jacek Lech)
11h00 - 11h30	<i>Technical pragmatism and spiritual aspect of prehistoric underground activities</i> (Andrzej Boguszewski)
11h30 - 12h00	<i>Final Palaeolithic flint mining and basic structures of chipped materials in the Vistula and Oder river basins</i> (Jolanta Małecka-Kukawka)
12h00 - 12h30	<i>Discovery of new flint mining sites in Lower Sindh (Pakistan)</i> (Paolo Biagi & Elisabetta Starnini)
12h30 - 14h00	Midday pause in the yard of the Institute
14h00 – 14h30	<i>The Nagytevel flint mine (W Hungary)</i> (Katalin T. Biró & Judit Regenye)
14h30 - 15h00	<i>Chert mining in Krumlov Forest, South Moravia: From Mesolithic till the Hallstatt Age</i>

	(Martin Oliva)
15h00 - 15h30	<i>Traces of rock-crystal-mining in the Austrian Alps</i> (Walter Leitner, Thomas Bachnetzer & Beatrix Nutz)
15h30 – 16h00	<i>New Research Results concerning the Chert Quarry site in the Rein Basin north of Graz (Styria, Austria)</i> (Michael Brandl)
	Break in between
16h00 – 16h30	<i>New excavations in the flint mine of Abensberg-Arnhofen, Lower Bavaria</i> (Michael M. Rind)
16h30 – 17h00	<i>Analysing the mining organisation of the Neolithic chert mine at Abensberg-Arnhofen by stochastic geometry and geostatistics</i> (Georg Roth)
17h00 – 17h30	<i>Neolithic Chert Quarrying and Settlement on the Southeastern Swabian Alb</i> (Lynn E. Fisher, Corina Knipper, S. K. Harris & R. Schreg)
17h30	Discussion and meeting of the Praesidium
	Drink of fresh wine “Sturm”
Free	During the open end Matthias Mehofer (VIAS) will demonstrate some REM-analysis for interested participants in the lab. Access to posters with discussions of the authors and access to the Lithotheka (VLI)

Wednesday 22. 9.2010	Presentation (Hörsaal 5/lecture hall 5)
09h30 - 10h00	<i>Continuing Research on the Geological Controls of Prehistoric Quarries: Impacts on Quarry Architecture, Implement Types and the Chain of Operation</i> (Margaret C. Brewer-LaPorta & Philip C. LaPorta)
10h00 - 10h30	<i>Three flint knapping areas in the Gargano mining context: differentiation and similarities</i> (Massimo Tarantini)
10h30 - 11h00	<i>Raw materials from the Trento area, and their technical properties</i> (Max Zurbuchen & Jehanne Affolter)
11h00 - 11h30	Pause
11h30 - 12h00	<i>Recent excavations in the chert quarry of Otelfingen-Lägern (Zurich, Switzerland) – A preliminary report</i> (Kurt Altorfer)
12h00 - 12h30	<i>Pits, shafts, and quarries at Mesnil-Saint-Loup (Aube, France)</i> (Anne Hauzeur, S. Bernard-Guelle & H.-G. Naton)
12h30 - 13h00	<i>Contemporary and chronologically differentiated structures at flint mine sites in Britain</i> (David Field)
13h00 - 14h30	Discussion and Midday pause in the yard of the Institute
14h30 - 15h00	<i>New results on the radiolarite mine at Vršatské Podhradie - „Horná Lysá-baná“ (distr. Ilava, Slovakia)</i> (Ivan Cheben & Michal Cheben)
15h00 – 15h30	Introduction to the visit of Mauer - Antonshöhe (Gerhard Trnka)

16h00	Departure to the radiolarite mining site and outcrops of Mauer-Antonshöhe (guided by Gerhard Trnka)
Thursday 23. 9.2010	Excursion
08h00	Departure for Moravia
11h00 - 17h00 20h00 Wien	Krumlovský les mining field, Museum Vedrovice (guided by Martin Oliva)
Friday 24.9.2010	Excursion
08h00	Departure for Upper Austria
13h00 - 18h30/19h00 24h00 Wien	Cable train, Salt mines of Hallstatt (guided by Anton Kern and Team – PA-NHM-Wien), Visiting the Museum and Hallstatt
Saturday 25.9.2010	Hörsaal 7/lecture room 7 at the institute
10h00 - 12h00	Final remarks and further planings

PAPERS – ABSTRACTS:

Affolter & Zurbuchen: "Rohstoffe und ihre technische Eigenschaften im Raum Trentino" // Raw materials from the Trento area, and their technical properties

Die Geologie der Gegend Trentino erlaubt eine Erklärung der Auswahl von bestimmten Silex-Rohstoffen durch die prähistorischen Menschen . Nach einer kurzer Einführung in der regionalen Geologie wurden die technische Eigenschaften aller vorhandenen Rohstoffen experimentell systematisch geprüft und dokumentiert. Somit bekommt die spezifische

Verbreitung der verschiedenen während der Prähistorie verwendeten Rohstoffen nach Nord-Westen eine einleuchtende logische Erklärung.

Altorfer: Recent excavations in the chert quarry of Otelfingen-Lägern (Zurich, Switzerland) – A preliminary report

The Zurich region is widely known for its well preserved neolithic and bronze age lakeside dwellings. Due to a series of rescue excavations in the past decades, we were able to reveal a rich inventory of chert implements. By now, more than 15'000 chert tools are available for economic studies, all closely dated by dendrochronology. Covering a time range between 4300 and 1000 BC, they document different long distance relations, for example to the Paris Basin, to north and middle Italy or to north Germany. These over long distances traded tools are key finds for the age determination of chert mining activities in neighbouring regions and our knowledge about the character of these traded products through time and space.

From an economic point of view, the local chert sources were of great significance for the lakeside dwellings, but until lately, there was merely little information available on chert quarries in Switzerland. The majority of the artefacts from the Zurich lakeside dwellings can be related to the neighbouring chert mining area of the Lägern mountain, known before through several surveys carried out by Max Zurbuchen. Thanks to the financial support of the Swiss National Foundation for scientific research, new studies could be executed to increase our knowledge about this large quarry area. Applying a broad margin of geological, geophysical, micromorphological and archaeological methods, combined with high resolution surface scans (LIDAR), it was possible to collect a lot of important data for a better understanding of the geological situation. They served as a fundament for several archaeological investigations, especially surveys and sondages. In one of the selected areas, we were able to document a neolithic outcrop. Here it was possible to get detailed insight in the extraction methods applied as well as in the neolithic mining activity in this area.

Biagi & Starnini: Discovery of new flint mining sites in Lower Sindh (Pakistan)

Surveys and excavations carried out during the last fifteen years by the Italian Archaeological Expedition in the Rohri Hills (Upper Sindh) led to the discovery of an impressive evidence of flint mining areas and blade workshops, mainly attributable to the Bronze Age Indus Civilisation. Until recently these sources have been generally considered to represent the main, or the almost exclusive, lithic procurement zone of the entire Indus Valley.

The archaeological surveys carried out in Lower Sindh during the last two years have revealed the existence of previously unknown important flint resources in the territory, embedded within limestone deposits, which belong to the Ranikot formation. Although one of these sites is known since the 1960s, and often incorrectly reported in the literature as the Palaeolithic workshop site "Milestone 101", it is only in 2008 that Indus Civilisation mining trenches and workshops were discovered on the top of the terraces of Ongar, Daphro and Bekhain, south of Kotri. Further discoveries, made in 2010 south-west of Jhimpir, have shown that good quality flint sources were available also in this area, which had been first exploited by Final Palaeolithic hunter-gatherers, and later mined, most probably by Chalcolithic, Amri culture, peoples. The discovery of mining trenches and adjacent flint workshops at site Jhimpir 21 (JMP-21), are most probably to be attributed to this period, as the typology of the blade cores recorded from the surface should indicate. These discoveries contribute to the knowledge of both the existing knappable raw material sources exploited, and the mining technology adopted by the populations that inhabited the region in the Chalcolithic (Amri) and Bronze Age (Indus) Civilisation periods. These problems, often oversimplified by most authors, are of fundamental importance for the understanding of the economy and trade

network systems in the territory that surrounds the western region of the Indus delta, during the IV and the III millennia Cal BC.

Biró & Regenye: The Nagytevel flint mine (W Hungary)

Nagytevel is a small village in West-Central Transdanubia close to the city of Pápa. It is situated along the North-Western fringes of the Bakony Mountains facing the Kisalföld (Little Hungarian Plain). To the south of the village centre we find the Tevel-hill, a calcareous block mountain within the Northern Bakony. It is built up of Upper Senonian limestone with large siliceous nodules. This locality is the only source of flint in the strict sense within Hungary and probably also within the Carpathian Basin. The flint became known during the geological mapping of the area. In course of the systematic field survey of prehistoric lithic raw materials in the early 1980-ies by the Hungarian Geological Institute we made several surveys in the area, though at that time it was difficult to access because Tevel-hill was a military ground for Russian troops. After 1989, the environs of Tevel hill became accessible. During the research of the exploitation areas in the Bakony Mountains we paid regular visits to the site. From 2000 onwards, the investigation of the Tevel quarry became more topical as we were excavating the Neolithic settlement at Kup, some 10 kms to the south of the flint outcrop where about half of the chipped stone artifacts were made of Tevel flint. The next step in the analysis of the quarry was a geodetic survey. The intensive study of the area was started with a geophysical survey. Excavations were performed here between 2005 and 2008 by the Hungarian National Museum conjointly with the Veszprém Museum Directorate. In the first year, a large surface was cleaned, divided into 5 x 5 m squares and features appearing were excavated till the level of the mining debris. The bottom of the extraction pits was reached only in two squares. In the next 3 seasons, long trenches were planted over positive magnetic anomalies and excavated till the bottom. Altogether 22 mining features were identified, mainly shallow pits. The finds comprised large amount of flaked flint, some of them very large and flint nodules/precores rejected. There were occasional hammerstones and a few antler fragments in very bad state of preservation. A few prehistoric shards (probably from Lengyel culture) were observed. Dating of the mining features was done directly by pottery finds and OSL dating and indirectly by distribution data.

Boguszewski: Technical pragmatism and spiritual aspect of prehistoric underground activities

What were the role of mining in life and evolution of the Neolithic societies in Europe? Only economic or maybe also social, political and even symbolic or religious? To discuss about these questions is not easy because archaeology hasn't disposed the enough developed methodology to study these problems. Why the prehistoric miners reached the flint underground and produced the axes? How can we explain a role of these axes for men and for his community? We can observe that we find only a small part of produced axes on the archaeological sites however a many hundred of thousands of them were fashioned and exported from the mines during all this time. Why the men have organized the long-distance distribution of some number axes? And what they do with the rest? The underground activity, digging the shafts and galleries and extract tones of raw flint from the earth was a pure economic accomplishment? Rather not. Almost all action in the life of traditional societies is full of the superstitions, the beliefs, and the magic signs. Underground environment was impressive. To mining the flint at this time was harder and more dangerous work than any other occupation. A miner using the force was taken away a flint from the earth and he should be protected against the dangers provoked by his intrusion and "robbery". A human burials and isolated human bones, like as animals skeletons or bones were deposited in the galleries and the shafts of some mines. The deposits of the vessels and shards of pottery but also the

polished flint axes and antler tools were well known. These actions were accompanied by the symbolic drawings and engravings made on the walls of underground galleries of mines. In this text we discuss some questions as:

Was the flint extracted in mines had a special value and why? What were reasons of the long-distance distribution of axes? What can be the meaning of the deposits in the mines? And, finally, the mining activity had only economics reason or rather social and ritual?

Brandl: New research results concerning the chert quarry site in the Rein basin north of Graz, Styria (Austria)

The Neogene fresh water chert source in the Rein basin, north of Graz, was of high interest since its importance for southern Austrian raw material procurement was recognised. Surrounded by low hills, the Rein basin represents an ideal settlement area. On one of the hills, on top of the Ulrichsberg, a late Neolithic settlement was found during forestry operations. This settlement was proved to be the most important Neolithic chert processing site in the catchment area. Due to high similarities of the Rein chert and the Baiersdorf tabular chert, geochemical investigations were conducted to differentiate the two occurrences. Trace elements were determined by LA-ICP-MS (destruction free Laser Ablation Inductive Coupled Plasma Mass Spectrometry) method, which allows analysing samples with a detection limit of approximately 0.1 ppm. Using this method, several lithic assemblages were investigated and proved to originate from the Rein source, inter alia the one from the famous Repolust cave. Finally, the missing link between the archaeological evidence in the Palaeolithic and Neolithic assemblages and the estimated chert source was discovered in 2010, when first quarrying pits were excavated.

Brewer-LaPorta & LaPorta: Continuing Research on the Geological Controls of Prehistoric Quarries: Impacts on Quarry Architecture, Implement Types and the Chain of Operation

Prehistoric-quarry models developed for eastern North America have long postulated that chert occurs in three distinct tectonic cycles. Each cycle records the lithostratigraphic and structural response to regional tectonic events. From east to west (tectonic cycle one to tectonic cycle three, respectively), the chert-bearing stratigraphy is younger and less deformed. Petrofabric constraints decrease considerably westward, while the macro- and microfossil communities become younger. Following the same trend, quarries also become larger, are less complicated in architectural design, contain a simpler mining-tool kit, and preserve a shorter chain of operation. Continued research of prehistoric quarries outside of the Wallkill Valley type section has increased our understanding of quarry architecture, quarry-implement organization and the complexity of the chain of operation. Quarry model modifications are critical to understanding the interrelationship between geologic framework, resulting quarry architecture and associated structures, quarry-extraction implement design, and the length of the chain of operation. This allows for researchers to model extraction and processing technologies, as well as subsistence and subsistence-related behaviors in and around quarries.

Tectonic-cycle-one quarries are smaller, more numerous, and exhibit very complex structural style and architectural elements, as they are located in the core of orogenic belts that experienced intense tectonic deformation. Task subdivision in such quarries is characterized by five zones of activity; namely zones of extraction (I), milling (II), processing (III), beneficiation (IV) and refinement (V). First-tectonic-cycle quarries preserve a complex instrument kit (30 mining tool types) and a long chain of operation (20 to 40 steps) towards the production of finished stone tools.

Quarry layout, productivity and task subdivision at second-tectonic-cycle quarries is characterized by four zones of activity; extraction, milling, processing and refinement. The chain of operation contains 16 to 24 steps, in which the production of stone tools is associated with 11 to 15 quarry tool types. Quarries in the second cycle are fewer in number but generally larger and are structurally and architecturally simpler than first-cycle quarries. Third-tectonic-cycle quarries are the largest in size and the simplest in design due to less intense strain from the waning effects of tectonic deformation. Quarry layout is divided into three zones. Extraction and milling remain as unique loci on the quarry landscape; however processing and refinement may be linked as one. The third-tectonic-cycle chain of operation is approximately 12 to 16 steps and extraction technology includes a very limited number of quarry tool types.

Cheben & Cheben : New results on the radiolarite mine at Vršatské Podhradie - „Horná Lysá-baná“ (distr. Ilava, Slovakia)

Brand-newest results - the excavation is still in progress!

Field: Contemporary and chronologically differentiated structures at flint mine sites in Britain

Excavations at flint mine sites in Britain have largely concentrated on shafts and underground working at the expense of activities on the surface, while those targeting the surface areas have focussed almost exclusively on knapping floors. However, survey of the earthworks has isolated a number of features that are interpreted as structures that appear to be associated with the extraction process. These lie at the heart of the mine complexes and are a rare survival as by their very nature they are likely to have been covered by later mining activities. Stake built structures and other features often interpreted as houses and associated with Beaker pottery are present at Easton Down, but it is unclear whether these are contemporary with the extraction or whether they were attracted to the site because of the availability of discarded flint on the surface or even because of the symbolic nature of the site. Round barrows are features of almost all the extant mine sites and more certainly located because of symbolic reasons but the extent to which flint was extracted purely to provide cairn material is similarly unclear and remains to be investigated. Bronze Age enclosures are integrally linked at Blackpatch and Harrow Hill but are seen to be chronologically later than at least some of the flint mine shafts, nevertheless, the example at Blackpatch used a large amount of flint in its construction. So far dating of the UK mines is based on the excavation of a few excavated shafts and the full chronological extent of the extraction process is not fully understood.

Hauzeur, Bernard-Guelle & Naton: Pits, shafts, and quarries at Mesnil-Saint-Loup (Aube, France)

Recent rescue excavations planned on 9000 m² in the South-East part of Champagne provided more than 600 features related to flint extraction. The site is located in the "Pays d'Othe" where other mining sites are well known since their excavations before the building of the motorway A5.

The exploitation site is located on a slope of a dry thalweg, orientated towards the South in a hilly landscape. All the features are regularly distributed on the excavated area with a very high density.

Despite the erosion, all kind of features have been discovered: shallow pits, shallow shafts, and shafts till 2.8 m. Many groups of shallow shafts are interconnected by means of their chambers, forming polylobed structures on surface. Some large cross sections throughout several shafts revealed an underground network that gives the impression of a quarrying system of exploitation before the last processes of filling.

All the features whatever they are show the same sequence of fulfilling: pure fragments of chalk at the bottom, and in the rooms, chalk fragments mixed with a grey-brown sediment, then the final filling. This one is always bowl-shaped, recognized by dark brown sediment mixed with some small fragments of chalk, and often containing the most part of the archaeological material. All these features didn't contain any kind of significant cultural material, but they provided axe rough-outs. Relative dating seems to be the end of Middle Neolithic / Recent Neolithic.

[Anne Hauzeur, Sébastien Bernard-Guelle, Paléotime sarl, 272 rue du Lycée Polonais, F-38250 Villard-de-Lans.

Henri-Georges Naton, GéoArchÉon sarl, 30 rue de la Victoire, F-55210 Viéville-sous-les-Côtes.]

Fisher & Knipper: Neolithic Chert Quarrying and Settlement on the Southeastern Swabian Alb

Lynn E. Fisher (Springfield, IL), Corina Knipper (Mainz), Susan K. Harris (Tübingen), and Rainer Schreg (Mainz)

This contribution presents results of collaborative research on chert extraction and Neolithic settlement on the Swabian Alb plateau. Though Swabian Jurassic cherts have long been recognized as a regionally important material, this is the first investigation of chert exploitation on the plateau. Also, it was long assumed that Neolithic settlement did not extend onto the karst plateau until the later Neolithic. Five years of fieldwork on the southeastern Swabian Alb have documented a rich archaeological landscape dating from LBK to later Neolithic times. We combine analysis of private collections, archaeological and geomagnetic survey, soil coring, and small, targeted test excavations to locate settlement and chert extraction features and retrieve datable materials and artifact samples for inter-site comparison.

At the center of the study area lies the quarry site of Asch-Borgerhau, where over 220 surface pits and depressions were documented extending over more than 5 hectares. Surface features vary from isolated depressions up to 5 meters in diameter to larger, irregular depressions and debris heaps, associated with widespread lithic scatters. Test trenches excavated at the margins of three large depressions showed that pits in some cases over 2 meters deep were dug into chert-bearing residual clays to extract chert. The depressions visible on the surface today do not reflect individual prehistoric pits or shafts, but are the product of a complex, multiphase sequence of intersecting pit excavations and fill. The varied fill sediments include redeposited clays and dark mottled sediments, in some cases with abundant charcoal. Though some features contained few artifacts, dense concentrations were common just beneath the modern surface. One shallow depression was entirely filled with a dense deposit of flaking debris. The large lithic assemblage is dominated by unmodified flakes, blades, cores, and angular debris. Radiocarbon dates indicate exploitation of the quarry from ca. 5000 – 2500 B.C. Smaller surface features have not yet been investigated, and may reflect different patterns or time periods of chert extraction.

We present an initial discussion of the Asch-Borgerhau quarry features in context of the surrounding settlement landscape, where we have excavated LBK and Middle Neolithic settlements. The near absence of ceramics and formal tools at Borgerhau, compared with their abundance at the nearby Middle Neolithic settlement of Sonderbuch-Grund, suggests spatial separation of chert acquisition and tool production. On-going work focuses on analysis of lithic assemblages, trace element characterization of Borgerhau chert, and soil coring to investigate additional geomagnetic anomalies.

Malecka-Kukawka: Final Palaeolithic flint mining and basic structures of chipped materials in the Vistula and Oder river basins

In the Younger Dryas age in the Vistula and Oder river basins (Poland) were inhabited by communities of reindeer hunters represented in archaeology by the Late Tanged Point technocomplex (earlier known as the Masovian cycle or the Swiderian culture). The Masovian reindeer hunters were mining chocolate flints and hematite (red ocher) on the north-eastern fringe of the Holy Cross Mountains (Góry Świętokrzyskie) and mining of the Jurassic flint in the middle part of the Polish Jura. A long term research into the Masovian flint assemblages lead by S. Krukowski, R. Schild, B. Ginter, Z. Sulgostowska, J. Fiedorczuk and others, enabled to distinguish between various different basic structures of chipped materials related to extraction and processing of flint that reflect the ways in which the works relating to obtaining flint materials and other activities were organized. This paper aims to present the results of studies into these structures and methods employed in the research.

Lech: Archaeological features and structures at flint mining sites: differentiation and significance. An outline

Pre- and protohistoric flint mine sites have been an object of research since the second half of the 19th century. Over the many years, the characteristic types of archaeological features have been well distinguished and a standard questionnaire developed for studies of such sites. The paper will briefly present features typical for flint mine sites and their cognitive significance. The features include extraction pits and ditches, various types of shafts with underground exploitation and without, underground galleries and chambers, and also quarries. Excavations of shaft fills are becoming increasingly important. A separate group of mining features are heaps (dumps) of waste material left by the shafts and below ground. A third group of features and structures are chipping floors (workshops) and their fragments preserved on the surface, under waste dumps or in shafts. The paper will stress the role of comparative studies of flint material from mining fields and their surroundings. Finally, the remains of camps and settlements located within the mining field and in their nearest vicinity will be discussed.

Leitner, Bachnetzer & Nutz : Traces of rock-crystal-mining in the Austrian Alps

Archaeological surveys carried out by the Institute of Archaeologies of the University of Innsbruck in the year 2008 and 2009 at a large quartz fissure on the Riepenkar (Municipality Finkenberg, Tyrol) south of the Olperer provided interesting finds. The find spot is located at an altitude of about 2.800 m above sea level.

According to rock hounds the fissure with a length of about 10 to 15 meters is one of the largest known quartz veins of the Hohe Tauern window and has apparently already been visited about 9.000 years ago by humans quarrying for rock crystal. Massive disturbances due to modern extraction of the treasured rock make the search for traces of prehistoric mining very difficult. Pieces of non-local rock account for it since they must have been brought there deliberately. These pieces might be fragments of hammer-stones used to quarry the rock crystal. Most of the crystals were probably carried to nearby camps for further usage. But in some cases the material was worked into tools on the spot. This is indicated by a number of flakes and tools with retouched surfaces and edges that can be dated to the Stone Age.

The methodical aim is to separate the modern crystal wastage from the one dating to the Stone Age. Therefore the material is first dry-sieved with clearly identifiable find pieces being extracted. The rest of the quartz debris is bagged and carried down into the valley by the hundredweight. In the workshop the material is washed and then examined to detect traces of processing. As a first overview shows narrow blades were produced as well as wide flakes with cutting edges that are perfect to cut up the hunted game.

It is to be assumed that this site probably played a significant role in the early countertrade in the sense of a possible prehistoric transalpine rock-crystal-route.

Oliva: Chert mining in Krumlov Forest, South Moravia. From Mesolithic till the Hallstatt Age

The Krumlovský les (Krumlov Forest) Upland is formed by precambrian eruptive rocks, onto which link up Miocene Eggenburg-Ottang sandy sediments with numerous redeposited Jurassic cherts. The transport in marine sediments and quaternary cryoclastic processes produced numerous fissures in the interior of the chert cobbles. In spite of this on the southeastern slopes of the Krumlovský les lies one of the largest mining areas of European prehistory.

Judging from the significantly varying distribution and use of Krumlov Forest chert in the Holocene, its mining climax can be anticipated in the Mesolithic and Neolithic. The oldest documented mining falls indeed into the Mesolithic. The date of 9410 ± 50 comes from small fireplace with red colored burnt sand situated in the mouth of the shaft I-12. Regarding the mining without doubt represent terminus cum quem or ante quem. Radiometric dates from the complicated system of shafts I-13 proved continuity of mining on the location from Late Mesolithic till Early Neolithic (LBK). The deep extraction, continues in the Late Legyel and can be characterized by mining from rather narrow and very deep pits (up to 8 meters) sunk vertically into the slope. Skeletal remains of two women and 1 new-born were found at a depth of 6 and 7 m. To the final Eneolithic (Bell beakers) is dated the extraction from parallel horizontal terraces on the slope about 150 m westwards from the previous site.

The mining culminates in the Early Bronze Age. Shafts from the Únětice and Věteřov culture predominate in all areas except area VI at least 50 hectares in area. They are up to 8 meters deep and 2 to 4 m across. The fill of each of the shafts amounts to several tons of lithic industry, mostly flakes and discoidal cores at various stages of reduction. Test trenches and surface sampling suggest the southern mining fields contain several tens of such mining pits with analogous quantities of flaked industry. The products were transported to the only Únětice culture settlement near Kubšice (at a distance of some 6 kilometers), which can be considered to have been the gathering place of chert knappers during or after the quarrying season. Greater distances were only reached by some of the sickle blades which then were used in a clearly ritual context.

In the Late Bronze Age (the Urnfield cultures), fragments of vessels, ash and burnt bones were sunk in the Early Bronze Age shaft II-9 together with numerous large stones. This probably constitutes a secondary translation of cremated burials. Lithic industry of that time, of very poor quality, is mainly found in the vicinity of seat-like boulders among older pits yet never directly in the shafts.

The mining activity was renewed in the Hallstatt Age. In the eastern part of mining field VI (9-1) and underneath a large boulder a network of shafts of varying depths was discovered. In contrast to the older shafts, they are considerably narrower and some of them do not even reach the chert seams. However, even they do contain accumulations of chipped industry on their bottoms. However, the amount of this industry drops abruptly and there is no evidence of its distribution in both practical and ritual context.

Even though the extraction of local chert served for no practical use (in the technological sense) in any of the periods mentioned, its reasons varied beyond any doubt. In the Old Bronze Age it was obviously connected with the cult of the ancestral underground world, chert being perhaps considered to be the "gift of the ancestors". In the Hallstatt Age, the local inhabitants would take refuge in the forest from invading Scythians and the contacts with the underground world was merely a rudimentary phenomenon, being probably connected with seeking supernatural protection in that traditionally sacred landscape. At any time, however,

these repeated cooperative acts involved expenditure of human energy and, beyond doubt, they contributed to maintaining traditional values and political stability in those prehistoric societies.

Rind: New excavations in the flint mine of Abensberg-Arnhofen, Lower Bavaria

The area around Abensberg-Arnhofen comprises one of the largest neolithic flint mines in Europe. This flint mine is a monument with international significance. After first excavations between 1984 and 1986 new mining of gravel and sand since 1998 necessitated new excavations until 2009 by the Kreisarchäologie Kelheim under the leadership of M.M. Rind in cooperation with the Bavarian State Conservation Office. During the last 12 years nearly 650 pits have been documented.

The typical raw material from Arnhofen is a fine-grained, banded grey tabular flint, which has been traded over more than 500 kilometers in western, northern and eastern regions. Flint mining in Arnhofen seems to begin in the upper neolithic (Linearbandkeramik) and ends in the younger neolithic period (Münchshöfener Culture). Since two years a lot of antler tools have been found; these are the first tools from this mining area.

The lecture will show the results of the researches and gives a general view of this project, which is sponsored by the Deutsche Forschungsgemeinschaft.

Roth: Analysing the mining organisation of the Neolithic chert mine at Abensberg-Arnhofen by stochastic geometry and geostatistics

Key words: Neolithic, Mining, spatial analysis, point patterns, spatial autocorrelation

The prehistoric chert mine at Abensberg-Arnhofen in Lower Bavaria is the most important German Neolithic mine. The data base for a study, aimed to uncover the mining organisation (ROTH 2008), were excavations near the southern border of the mine between 1998 and 2001 (RIND/ROTH 2007). In a twofold strategy the feature distribution and the connection between the artefact scatters on the surface and the pits below were investigated. The pit pattern was documented with large scale trenches revealing several hundred pits. The density of knapping debris within the mining heap covering the pit mouths was counted in square units of $\frac{1}{4} \text{ m}^2$ for a 96 m^2 trench. C14 dates from the pits in combination with the spatial analysis suggest the excavated area to date ca. 4200 BC.

Since triangulation and tessellation (BOOTS et al. 1992) of the pit distribution were not totally satisfying, the pit pattern was submitted to an approach known as ‘point pattern analysis’ (abbreviated as PPA; ILLIAN et al. 2008). By comparing a given point distribution with simulations of spatial randomness, PPA reveals the presence as well as the distance(-s) of clustering or regularity within the investigated pattern. The results proved the at first sight interconnected pattern of pits to be composed of small regular “elements”. The PPA computations were done in **R** with the package ‘*spatstat*’ (BADDELEY/TURNER 2008). The artefact counts for the $\frac{1}{4} \text{ m}^2$ square units were analyzed with different geostatistical methods (cf. ROTH 2008). The computation of global spatial autocorrelation (SAC) proved the data to meet the preconditions for interpolation (FORTIN/DALE 2005). The following local SAC statistics already identified significant concentrations. A subsequent interpolation (with universal kriging) of artefact counts and mean weights together with the morphological investigation of the computed density surface lead to a taphonomic model for the connection between the debris and the mining activities. ‘*PASSaGE II*’ (ROSENBERG 2009) was used for SAC and ‘*Surfer 8.0*’ (Golden Software) for interpolation and surface analysis.

The combination of the results from different methods applied to the distributions of features and artefacts produced a consistent picture of small scale mining activities encompassing, on average, only three pits at one time. Chert extraction at Arnhofen was therefore neither

conducted on an “industrial” level, but was integrated in the annual farming cycle of small working groups of Neolithic villagers.

Tarantini: Three flint knapping areas in the Gargano mining context: differentiation and similarities

The paper deals with the preliminary results of investigations carried out in three flint knapping areas located in as many mining contexts of the Gargano promontory, in south-eastern Italy. An aim is to point out differentiation and similarities among these workshop areas.

The first difference is the location of the three flint knapping areas analysed: in two cases (Defensola A and Defensola B) they are physically linked to a mining structure (an inside area, though close to an entrance, in the case of Defensola A mine; an entrance area in the case of Defensola B mine), whereas at Cruci mining site the flint workshop area have been discovered on an external large conoidal spoil heaps. To this different location seems to correspond also functional differences. In the case of Defensola B, lithic industries, in general terms, shows a reduction sequence finalized to the first reduction of the flint nodule extracted from the mine. The presence of big cortical flakes documents the first stage of the reduction sequence, whereas the almost complete absence of cores suggest a segmentation of the operational sequence with a distinction between the place of extraction and first reduction and the place where the supports were produced and transformed. The workshop area of Cruci presents only partially similar characters. In this case, as a matter of fact, is well-documented both the first reduction of the flint nodules (that are much smaller than those of the Defensola B mine), and the whole chaîne opératoire of a single category of tools, the bifacial tranchets. Completely different, at last, appears the case of the workshop area of the Defensola A mine. Here it seems to deal with a lithic assemblage roughly built and used for an extemporaneous activity. Use-wear analysis confirm this impression, showing the use in loco of some of this flint tools, apparently for the working of wood. The more probable hypothesis is therefore that this area was devoted to flint knapping and the manufacture of tools used for activities secondary to mining proper, such as the construction or repair of pick handles, or wood containers to transport debris and flint, etc.

=> Massimo Tarantini, Attilio Galiberti, Leonardo Carmignani, Cristina Lemorini

Trnka: The neolithic radiolarite mining site of Wien-Mauer – Antonshöhe (Austria)

In the southwest of Vienna occur one of the easternmost parts of the upper jurrasic Klippenbelt zone at the Antonshöhe (356 m above sea level). Since the 19th century limestone was quarried there. As in 1924 human bones were discovered, archaeologists became interest in and Josef Bayer (Prehistoric Department of the NHM-Wien) controlled 1929-1930 the site, collected finds and registered four shafts of a complex mining system with human burials. In 1949 further investigations had been done and the position of the shafts and archaeological objects were reconstructed in the enlarging quarry. In total six graves with seven individuals (2 adult males, 3 adult females, one child and one infant) had been found. The shafts were refilled after their abandonment with debris of the mining activities and till nowadays it's easy to collect raw material and artifacts there.

Three radiocarbon dates of human bones date the recorded mines in the 2nd half of the 5th millennium BC, but radiolarite type Mauer had been in use since upper palaeolithic times. His main demand was for shure in the neolithic.



POSTERS:

Biagi & Starnini: The discovery of Balkan flint outcrops in the lower Danube Valley: evidence of mining activity?

Surveys in the lower Danube Valley carried out last year led to the discovery of large Balkan flint outcrops along the slopes of Ali Kach Baba Hill, at the outskirts of the present-day town of Nikopol (Bulgaria).

The occurrence, on the surface, of a small spot of laminar debitage wastes, consisting of blade blanks, crested blades and subconical blade cores, proves the exploitation on the spot of the above-mentioned outcrops.

Furthermore, along the profile exposed by the pathway that leads to the shrine on the hilltop, the typical feature of a pit was observed, which might result from mining activity for the extraction of flint nodules.

Waiting for more detailed investigations and research, a preliminary attribution to the Early Neolithic can be proposed on the basis of the characteristics of the laminar products and the presence, on the surface, of one coarse ware potsherd with rough surfaces and a "sandwich" like fabric, which is a feature common to the early Neolithic pottery production of the Balkans.

This discovery is of basic importance for the knowledge of the precise location of the Balkan flint sources, which can be considered one of the markers of the Neolithisation of the central and northern Balkan Peninsula that is one of the many open questions still waiting for an answer.

Finally, this site can contribute to the understanding of the exploitation and procurement strategies of this raw material by the first farmers that inhabited the region during the First Temperate Neolithic.

Brandl et al: Radiolarite Investigations

Poster 1: Microscopical Properties

Poster 2: Microscopical Analysis

Poster 3: Geochemical Analysis

Brandl et al: Approach to Geochemical Finger Prints of Chert Sources – the case of the Repolust Cave (Styria, Austria)

Collet: Spiennes - three shafts (11, 20 and 79.1) excavated last years in Petit-Spiennes

Dominguez-Bella: Siliceous Raw materials exploitation in the Strait of Gibraltar area in the prehistory.

Šošić Klindžić: Radiolarites and silicified limestones sources used by Neolithic and Copper age societies in the Sava river basin (Croatia)

Leitner, Nutz & Bachnetzer: Silex Resources and Exploitation in the Alps of Western Austria

In the course of research of the SFB HiMAT (History of Mining Activities in the Tyrol and adjacent areas) numerous surveys on prehistoric flint mining were carried out by the project part 05 (Silex and Rock-Crystal Mining in Alpine Prehistory) from 2007 to 2010 in western Austria (North Tyrol and Vorarlberg) and South Tyrol (Italy). The intent was to find resources of high quality chert and radiolarian rock for further investigation on mining traces.

The chert containing Ruhpolding formation stretches from Vienna across the entire northern limestone Alps and surfaces in irregular intervals. With the help of geological maps many

radiolarian rock and chert resources could be systematically detected. In North Tyrol in the Rofan Mountains at the Grubalacke and the Grubersee, in the eastern Karwendel near the Pasillalm and in the Allgäuer Alps at the Rothornjoch resources were found providing a lot of varieties with surprisingly good impact property.

Based on the reference collection (lithotheca) and the associated database that has been established in cooperation with Mag. Michael Brandl (Austrian Academy of Sciences - Prehistoric Commission) many finds from excavations could be assigned to these varieties. Primarily during the Mesolithic many stone tools found in the northern limestone Alps were produced from local raw material.

In 2009 the research activity was extended to the southern limestone Alps (Dolomite Alps, South Tyrol) by Mag. Michael Brandl. Thereby two main geological formations emerged as possible raw material resources – the Buchenstein Formation and the Puez Formation. Both provide material of good quality. Considering the minor occurrence of stone tools made from local silex varieties in collections of museums and private collectors regular exploitation on a larger scale seems unlikely. A core area for Mesolithic raw material supply for South Tyrol can be found in the province of Trento and Verona (Italy). Here the deposits of the Val di Non and the Lessini Mountains (Scaglia Rossa, Scaglia Variegata Alpina and Biancone Formation) play an important role.

Leitner, Nutz & Bachnetzer: An open air mining site on Radiolarian Rock in the Kleinwalsertal (Vorarlberg, Austria)

The archaeological excavation at the Feuerstein (1600 m above sea level) in the Gemstetal/Kleinwalsertal (municipality Mittelberg, Vorarlberg) clearly confirmed Stone Age open air mining activities of radiolarian rock (Special research program HIMAT, History of Mining Activities in the Tyrol and Adjacent Areas).

Trenches from former excavations were extended and brought important new results concerning finds and mining period.

One of the highlights were two oval shaped stone hammers to be attributed to the category of mining-tools. Together with two fist sized whetstones this makes a tool set that can be defined as mining equipment. The find spot of these tools is of special interest since Stone Age miners deposited them in an artificially knocked out pit in the bedrock. This was the only way the tools could be prevented from inevitably rolling down the exceedingly steep slope.

A few stone tools but many thousands of flakes found in the entire excavation area reveal that people came here solely to mine chert raw material. They knocked the radiolarian rock out of the primary deposit and subsequently reduced it to expose the valued core, this being finally worked into stone tools at their camp. Quality and quantity of the raw material suggest extraction and distribution on a supra-regional scale.

Radiocarbon-dates from a charcoal layer in the profile give evidence to mining activities during the 2nd half of the 3rd millennium BC. Stone tools from hunter gatherer camps in the vicinity suggest that mining activities at the Feuerstein might date back to Mesolithic times.

Oliva: Chert mining in Krumlov Forest, South Moravia: From Mesolithic till the Hallstatt Age

Poster: 1. The oldest mining in the Krumlov Forest

Poster 2. The latest mining in the Krumlov Forest

Trnka: The Radiolarite Mining Site of Wien-Mauer (Vienna)