SCHOOL OF GEOGRAPHY, ARCHAEOLOGY & PALAEOECOLOGY

MODULE GUIDE

2016/2017

Module No. GAP3061

Metals, Miners and Merchants
From Stone to Steel

Module Co-ordinator: Dr Dirk Brandherm
Welcome to Students

Welcome to the School of Archaeology and Palaeoecology and to this module. We hope that you will enjoy it.

Module Content

This module is intended to provide a general introduction to mining archaeology and archaeometallurgy. The focus is not only on the technological aspects of these two fields, but the module also covers the social and environmental implications of prehistoric mining and metallurgy. Consequently, subjects from a wide chronological range are involved, from the earliest known mining activities aimed at the procurement of lithic resources by hunter-gatherer societies right down to the large-scale, quasi-industrial mining operations of the Bronze and Iron Ages. Regarding its geographical focus, case studies discussed in the course of this module are drawn from Ireland, Britain and continental Europe alike, although where appropriate, attention is also given to evidence from the Near East.

Within these chronological and geographical limits, three broad thematic areas are covered, the first of which is the development of prehistoric mining and quarrying from a technological point of view. Here, in particular the differences between the procurement of lithic and other non-metal resources on the one hand, and metal ores on the other hand are discussed. A second thematic focus is on the operationnal chain of metal-artefact production beyond the actual mining process. Finally the environmental and social implications of mining and metal production are examined.

An introduction to the most important topics relating to these thematic areas is provided by a series of lectures. In a corresponding series of seminars the imparted knowledge is consolidated by student presentations on special aspects or important sites. Every student is required to prepare a 20-minute classroom presentation on a specific topic which will be further developed in a semester paper of 3000–4000 words. Students are also required to prepare a project proposal in relation to one of the sites visited as part of the day field trip which is part of the module.

The lectures are divided into six blocks, each dealing with a distinct set of topics.

- **Block 1: Introduction to mining archaeology and archaeometallurgy**
- **Block 2: The exploitation of lithic resources**
- **Block 3: Early copper metallurgy and the importance of tin**
- **Block 4: Other non-ferrous metals, salt, pigments and rare minerals**
- **Block 5: Iron metallurgy**
- **Block 6: Economic, social and environmental implications of metallurgy**
Module objectives

- To provide a comprehensive survey of different types of prehistoric mines and surface remains relating to ancient mining activities.
- To provide an understanding of the different stages in the chain of production of metal artefacts.
- To give an overview of scientific techniques employed in archaeometallurgical analysis.
- To explore the socio-cultural context of mining and metal production in prehistoric societies.
- To provide an insight into the environmental impact of prehistoric mining activities and metal production.

Generic learning outcomes

- Self-organised learning.
- Critical analysis of information.
- Verbal and written self-expression.
- Ability to identify relevant reading using a variety of bibliographic aids.

Specific archaeological skills taught

- Identifying and interpreting prehistoric mining sites.
- Identifying early mining and metalworking tools, and identifying the respective stages in the operating chain of production to which a given piece of evidence relates.
- Understanding what archaeometallurgical methods are most adequate to address which archaeological questions.
- Understanding the role early mining and metallurgy have played in the archaeological discourse on the rise of complex societies during later prehistory.

Teaching methods

The course is taught through a combination of lectures and student paper presentations in seminars. A full timetable is appended at the back of this module guide.
Lectures will be held on Tuesdays at in Room OG/043 in the Fitzwilliam Building and during the first part of the term also on Thursdays at 2 pm in the same room. It is in your own best interest to attend all of the lectures! Archaeology is a fast-evolving field and much of the older literature you may come across will be outdated or incomplete. The lectures will guide you through current debates and will enable you to conduct your reading in an organised and critical fashion, and since they are illustrated lectures, no amount of copying notes from others can replace the experience of attending lectures yourself!

Seminars will take place during the second half of the term, also in room OG/043, on Thursdays from 2–5 p.m. The seminars consist mainly of oral presentations of student papers and discussions of the topics raised in them.

** Note that seminar participation is assessed (see below) and a register will be taken at all sessions.

As well as attending formal classes you will be expected to work on your own. On average, you will find that at least twelve hours a week of private reading for lectures and seminars, library research and preparing Semester Papers is needed. Two to four hours will be time-tabled classes; the remainder is for you to organise.

If you require specific guidance or advice you may contact me at lectures, via the School Office, or by e-mail:

Dr. Dirk Brandherm: Room 01046, ArcPal building, e-mail: d.brandherm@qub.ac.uk

Queen’s Online resources

Students will be expected to make full use of the teaching facilities made available through Queen’s Online. Online resources for this module include the following:

- Copy of this Module Guide
- Lecture handouts (will be placed on Queen’s Online as the course progresses)
- Seminar presentation handouts (will also be placed on Queen’s Online as the course progresses)

Assessment scheme

Three marks are combined to produce the final mark for the module, in the following proportions:

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The Semester Paper Draft and Semester Paper are designed to develop and assess your ability to research, construct, and present a piece of written work. The oral presentation is intended for you to
practice your skills in presenting a topic to the public. In preparing the Semester Paper you will be expected to evaluate information and hypotheses concerning a specified topic and write an essay on this topic in your own words. The initial Semester Paper Draft should be about 1000 words long, the full written Semester Paper should have between 3000–4000 words.

Submission of the Semester Paper Draft, full Semester Paper and Project Proposal for this module is electronically via Turnitin, and all submissions will be subject to an electronic originality check. The Semester Paper Draft must be submitted no later than 11.59 pm on Monday, 27th February (Week 5). The full Semester Paper must be submitted no later than 11.59 pm on Monday, 15th May (Week 13).

Your seminar contribution consists of three different elements: an oral classroom presentation, a written outline handout to go with your presentation, and your active participation in classroom discussions. Each of these elements contributes one third to your total seminar mark. The oral presentation is to be illustrated by drawings and/or photographs using PowerPoint (for preparing your presentation, you may use any other presentation software of your choice, e.g. LibreOffice Impress, but as PowerPoint is used on the School’s computers, you will have to save it in PowerPoint format; it is your responsibility to avoid data format compatibility problems). The oral presentation must be accompanied by a two-page handout that includes an outline of the presentation, an abstract of the most important points made and a list of relevant references. This handout must NOT be simply a “Handouts” view of your PowerPoint slides, but a two-page text document (preferably in Rich Text Format [.rtf]) which must be submitted electronically via QOL, uploading it to the relevant assignment folder together with your presentation slides (either in Open Document Presentation [*odp] or MS Office PowerPoint [*ppt/*.pptx] format) no later than 3.30 pm on the last Monday preceding the date of your scheduled classroom presentation (Turnitin does not handle the submission of slides very well, which is why submission of this assignment is via QOL).

The handouts and slides will then be put up on Queen’s Online, so all participants in the module can access them well in advance of the respective presentation, to provide the basis for a fruitful discussion in the seminar. As contributions to the seminar discussion are also an element to be assessed, it is instrumental that everybody comes to the seminars well prepared for discussing the respective subjects. The handouts and the general reading list are both available on Queen’s Online in advance of the seminars, so there is no excuse for coming unprepared to any of the sessions.

The field trip for this module which is organised towards the end of term is intended to provide first-hand experience on a selected exemplary case or cases from the broad field of early mining and metals. Following the field trip, you will be required to write a project proposal of 1000–1500 words either for future research at one of the visited sites, or for research exploring the further use of raw material from one of the sites in question (a proposal template is provided on QOL). The project proposals are to be submitted to the School Office by the same date as the Semester Paper, i.e. no later than 11.59 pm on Monday 15th May (Week 13).

All submitted work must be typed. It should be stapled or contained within a folder and clearly marked with your student number, the module name and number, the lecturer’s name, and the title of the paper. You are advised to submit well ahead of the deadline and use Turnitin’s originality
report to avoid any potential problems with unattributed material. Failing to submit any of the written work on time will inevitably lead to loss of marks.

Guidelines for writing Semester Papers are given in your Student Handbook. You should read this carefully. Semester papers will be marked on their content but failure to comply with these guidelines will be penalised. Marking criteria used by staff to assess Level 2/3 essays are also outlined in the ArcPal Undergraduate Handbook.

You must reference within the text of your Semester Paper any source (book, article or web-site) from which you derive information. Although you will of course be expected to quote material, for example to show a person’s view concisely and accurately by giving their actual words, you must always put the quote between quotation marks and give a reference to where it comes from (including the page reference). If you do not do this, it looks as though you are trying to pass of their work as yours: this is plagiarism, which is a form of cheating and viewed seriously in a University. The lecturing staff are very familiar with the texts relevant to the module and you must realise that plagiarised material is very obvious in terms of its style and context – it will always be detected. Note that penalties for plagiarism can be severe depending on the seriousness of the individual case. In one recent academic year several students were caught using plagiarised material in this module. Variable penalties were employed, but in the most serious case a student was expelled from the module for copying material from the internet and submitting it as their own work. If you are in any doubt as to what constitutes plagiarism, consult one of the lecturing staff.

Guidance on correct referencing and on how to avoid plagiarism can be found in the ArcPal Undergraduate Handbook and in additional guidance documents available from the QOL web site for this module at:

https://learning.qol.qub.ac.uk/2161/GAP/3061-SPR-QUB/Resources/Forms/AllItems.aspx

Information on student key and study skills, including essay writing, is also available from the University’s Learning Development Service:

http://www.qub.ac.uk/directorates/sgc/learning/

Students are strongly advised to avoid leaving the printing of their work until the last day before submission. The university computing and printing resources are in heavy use during these periods, and students commonly experience problems in printing. Failure of the printers at that period is not a valid excuse for late submission, neither is loss of data due to not producing safety copies.

See the ArcPal Undergraduate Handbook and the appendix to this Module Guide for details regarding late submissions, absence and illness.

Course reading

Essential course books:


Students will be expected to read the course books in depth, as this provides essential supplementary information to the lectures.

The following books are also very useful:

Other reading associated with the lectures is given with each lecture outline. In addition, useful journal articles may be found in *Archaeometry, Journal of Archaeological Science, Historical Metallurgy, Der Anschnitt, World Archaeology, Antiquity, Proceedings of the Prehistoric Society,* and *Oxford Journal of Archaeology,* some of which can now be down-loaded from the web via the University library site.

**The Semester Paper**

The Semester Paper will be submitted in three stages: first as a structured essay draft, secondly as an oral presentation and thirdly as a full written Semester Paper. Advice on preparing a Semester Paper can be found in the ArcPal Undergraduate Handbook. Please also make sure you read the notes provided above concerning assessment. All Semester Papers should be 3000–4000 words long. Some topics very much lend themselves to including images (figures from the internet, diagrams, maps or written sources), but be sure to reference these as you would a quote, otherwise it is tantamount to plagiarism. Wikipedia as a source of information is NOT permitted, since it is not guaranteed reliable.

**The Semester Paper Draft**

The purpose of the Semester Paper Draft is to enable you to establish the correct format and prepare the argument for your semester paper. The Semester Paper Draft should be about 1000 words long, double-spaced or space-and-a-half. Do not use single spacing. It is paramount that you discuss the Semester Paper Draft after it has been assessed with the lecturer before you embark on penning the full Semester Paper.

Although the Semester Paper Draft is not the same as the full Semester Paper, it will require students to do a great deal of the work needed for the final version. In particular you will have to do all the basic reading required (although you may add further texts subsequently, or perhaps further ideas deriving from subsequent lectures and tutorials). You will also need to prepare notes on your reading, summarising key issues. You must think through your arguments and how you are going to present them. You will need to establish the main issues, how you are going to order them, and what line of argument you will follow. You will need to have identified the examples or other evidence which you will use to support your argument, and you will need to have decided on your conclusions. In short, the Semester Paper Draft involves the great majority of the work required for the full Semester Paper, except for the detailed writing of text and any corrections or refinements you may wish to include. You should view it as a first draft of your Semester Paper. It is not intended to be merely a declaration of goodwill or intent. You should avoid phrases like “in my semester paper I will”.

If you can get the Semester Paper Draft right, you will have done the bulk of the work for the full Semester Paper, so it is worth the investment of time.

**What must you hand in?**

The Semester Paper Draft will comprise the following components:
**Introductory section:** this should define the key issues and clarify any difficult or ambiguous terms. It should lay out the general structure of the paper indicating the key points you intend to cover. You may also want, where appropriate, to set the question in context in time and space.

**Structural summary:** this may be laid out in tabular or bullet point form, and should set out the main points you will cover, and the main examples you will use. It need not be written in continuous prose, but it should enable the lecturer to judge whether you know what you are going to write.

**Concluding section:** this should outline your main conclusions and summarise the main issues. If there are matters for which the evidence is insufficient, you should draw attention to them. It should clearly relate to the introduction and structural summary.

**Bibliography:** if at all possible, you should include a full list of references you are going to use in your Semester Paper. The lecturer will check that you have listed sources in the correct format (see notes earlier in this guide and on the School web page relating to referencing style). The lecturer will also check that you have referenced your sources correctly in the text of your introduction and/or conclusion.

**General:** take scrupulous care over grammar, especially the use of commas, capital letters, inverted commas etc. These things will be checked and they will affect your mark.

**Assessment – what are we looking for in the Semester Paper Draft and Semester Paper?**

At a basic level we want to see that you have done the reading and thought clearly about the question (40%).

We need to know that you have a clear idea of how the work will be structured (20%).

We want to see clear, grammatical, well-argued prose in the introduction and conclusions. It must be properly punctuated and spelled (20%).

We need to see that you can cite your sources correctly in the bibliography (10%)

We need to see that you have mastered the system of referencing and can cite your sources in the text itself. You need not put a reference in the text after every sentence, but each major piece of information derived from your reading should have a citation. The introduction and conclusion will probably have fewer references than the main body of text which you will write later – there should be no references in the structural summary (10%).

Make sure that you incorporate all comments made by markers on your Semester Paper Draft into your oral presentation and your written full Semester Paper. Where feedback has been ignored, e.g. where references are still incorrect in the final version despite comments on the earlier draft, you will be penalised.
Oral presentations

With the oral presentation you inform the audience about the key points of your Semester Paper. **The presentation should be timed to last about 20 minutes** and will be followed by up to 10 minutes discussion. If in any way possible, you should give the paper in free speech.

You should illustrate your talk with PowerPoint slides. For a talk of 20 minutes 15–20 slides are sufficient.

Base your statements on the material basis which is presented in the literature. Make sure that you keep close to the problem and limit yourself to the essentials.

It might help you, if you gave your presentation beforehand to some friends, relatives, family etc. Then you can find out whether the length is ok and the audience understands what you want to tell. Experience shows that this helps you also to be more relaxed while giving your paper in the seminar.

Semester Paper topics

Below are the Semester Paper titles from which you should make your selection. Associated with each paper is a list of suggested initial references, from which you should start your reading. The reading is intended to provide you with starting points, but you will have to seek further information through a range of sources and books (including many of those listed in the bibliography at the end of this Module Guide). A good way to source literature is by following references cited at the end of articles. Try also looking along the shelves of the library as books on a given subject often have similar shelf marks, and also search through the library catalogue system using appropriate keywords.

The Semester Papers take up several key topics covered in the lectures and should lead to their in-depth treatment. Each topic can be treated by one student only. They will be assigned after the introductory lecture in Week 1.

*Topics in order of their presentation:*

1) Grimes Graves: How was the mine operated? What was its role in the regional economy? What importance does it have within the context of Neolithic flint mining in Britain in general?


2) Flint axe production in southern Britain: What is the importance of deep flint mining vs. the exploitation of surface deposits for flint axe production? Did this change between the Earlier and the Later Neolithic?

   (Craddock et al, 1983; Hansen & Madsen 1983; Gardiner 1990; Madsen 1984)

3) Obsidian in the Mediterranean: How was obsidian procured and distributed? What impact did the obsidian trade have on Neolithic economy and society?

   (Georgiadi 2008; Luglie et al. 2007; Sørensen 2010; Tykot 1996; 2004; Tykot et al. 2005; Williams-Thorpe 1995)
4) Stone axe factories in Cumbria: How were the quarries operated? What was the role of the Cumbrian production sites in the Neolithic ‘axe trade’? Did this role change between the Earlier and the Later Neolithic?
   (Bradley & Edmonds 2005; Bradley & Ford 1986; Bradley et al. 1992; Briggs 1989; Chappell 1987; Clough & Cummins 1979; 1988)

5) Rudna Glava: The oldest copper mine in Europe? Did it provide the raw material for the rich Chalcolithic metal province in southeastern Europe?
   (Chernych 1978; Jovanović 1980; Pernicka et al. 1993; 1998; Borić 2009)

6) Earliest metal in central Europe: How was metal introduced into central Europe and where does it appear first? Was metallurgy locally invented or was it an innovation brought from the Balkans? What evidence do we have for local production?
   (Ottaway 1982; Bartelheim et al. 2003; Höppner et al. 2005)

7) Early metallurgy and mode of production in south-eastern Europe: Which impact – if any – did the inception of copper metallurgy have on chalcolithic societies in south-eastern Europe? How was metal production organized in these societies?
   (Kienlin 2008; 2011; Borić 2009)

8) Early copper production in northern Italy: How and where was copper mined? How was copper distributed and used?
   (Barfield 1971; Maggi & Pearce 2005; Pearce 2007; 2009; Dolfini 2013)

9) The copper mining district of Cabrières (Provence, France): What evidence for Chalcolithic metal production do we have in Cabrières? Which significance does it have for research into the early metallurgy in the Western Mediterranean?

10) Early metallurgy in the Iberian Peninsula: Was metallurgy there invented independently? What are the particularities of Chalcolithic metal production on the Iberian Peninsula?
    (Montero 1993; Müller et al. 2005; Nocete et al. 2008; Rovira 2002; Ruiz Taboada & Montero 1999)

11) Prehistoric copper production in south-west Spain: Is there evidence for Chalcolithic mining in the rich copper ore zones of the Huelva area? Was copper produced locally or was it imported? What is the date of the Chinflón mine?

12) Chalcolithic and Bronze Age copper mining in Ireland: How did it develop? What was its economic importance? Was metallurgy invented independently in Ireland or where did influences come from?

13) The mining district of Timna (Israel) – Reconstruction of copper smelting site 30: How was copper produced and how much copper was produced during the Egyptian New Kingdom? How were the natural conditions?
14) Faynan (Jordan): How was copper production organized and which impact did the industry have on the development of local communities?
(Barker et al. 2007; Hauptmann 2003; 2007)

15) Bronze Age copper production on Cyprus: How was it organised? What was its economic and social significance?

16) Ox-hide ingots and their role in Mediterranean Bronze Age metal production: Where and for what purpose were they made? What economic importance did they have?

17) The Ulu Burun shipwreck: What contribution does it make to our knowledge about Bronze Age metal trade and about trade at that time in the Eastern Mediterranean in general?
(Bachhuber 2006; Fawcett & Zietsman 2001; Pulak 1998; 2000a; 2000b; Sherratt 1998; 1999)

18) Bronze Age copper metallurgy on Sardinia: Was copper produced in Sardinia or was it imported as ox-hide ingots from the Eastern Mediterranean? What archaeological evidence for mining and metalworking do we have?
(Gale 1999; Lo Schiavo 1998; 2009; Lo Schiavo et al. 2005; Webster 1996)

19) Bronze Age copper production in the Alps – its socio-economic importance: To what degree were economy and society based on metal production and distribution?

20) Prehistoric copper production in Britain: What evidence do we have? How long and to what extent was Britain supplied by its own resources?
(Barber 2003; Northover 1982; Rohl & Needham 2002; Timberlake 2002; 2003a; 2003b)

21) Tin in the Eastern Mediterranean: How was the region supplied? Was the Kestel mine in southeastern Turkey the origin?
(Charles 1975; Muhly 1973; 1993; Yener & Vandiver 1993; Yener et al. 2003)

22) Tin in Central Asia: Where and when was it produced? Did it play a role in the supply of the Near East and the eastern Mediterranean?
(Charles 1975; Boroffka et al. 2002; Weisgerber & Cierny 2002; Pigott 2011)

23) Tin in continental Europe: Was central Europe during the Bronze Age supplied with tin from the ore deposits in the Saxon/Bohemian Erzgebirge or from Cornwall?
(Bartelheim et al. 1998; Muhly 1973; Niederschlag et al. 2003)
24) Tin mining in Cornwall: How and for how long was tin produced? Did Cornish tin gain economic importance at a supra-regional level?
   (Gerloff 1975; Penhallurick 1986; Renfrew 1968)

25) Introduction of iron: Did the Hittites invent iron metallurgy? How was iron introduced into prehistoric Europe? Did the advent of the iron produce a radical change in the use of metals and in the general economy?
   (Maxwell-Hyslop 1972; Muhly et al. 1985; Pleiner 2000; Waldbaum 1980)

26) Bronze Age salt production in Central Europe: What was the technology? How was it organized? What effect did it have on the producing communities?
   (Harding & Kavruk 2010; Harding 2011; Nikolov & Bacvarov 2012; Weller 2002)

27) Lead and silver production in the Bronze Age Aegean: From which sources was the Aegean supplied with lead and silver during the Bronze Age? Which technologies were involved in the mining and production of these metals? How were lead and silver traded in the Bronze Age Aegean? Which impact did the trade in these metals have on Aegean Bronze Age economy at large?
   (Wagner et al. 1980; Wagner & Weisgerber 1985)

28) How did silver during the early first millennium BC become the first widely accepted currency in the Old World, particularly in the eastern Mediterranean? How was it produced and distributed?
   (Balmuth 2001; Thompson 2003; 2011)

There are lots of other sources for each of these topics, but you will need to search them out for yourself.

Project Proposal

You are required to write a project proposal of 1000–1500 words for a research programme that further explores some aspect related to any site visited during the field trip (please use the proposal template provided on QOL). This may involve further fieldwork, experimental studies, analytical work on raw material from the respective site, or a study involving finished objects produced from that raw material.

You will need to argue the significance of the work you are proposing, and explain how it complements previous research on the subject (include references). Clearly define the expected research output, include a plan of action for your proposed programme and state how you expect to publish and disseminate its results. You will also have to include a breakdown of the expected costs, and a brief justification of how these expenses are necessary for the successful completion of the programme.

For the purpose of this exercise please assume that the maximum duration of the research programme you put in for is 2 years, and that the maximum funding you can apply for is £ 10,000.
Salaries cannot come out of this budget, but specialist consultants’ fees can. These parameters are based on the current British Academy/Leverhulme Small Research Grants scheme, and among other considerations this exercise is designed to give you a taste of and at least some dry-run experience in applying for research funding in the world out there. Assume that in a real-life situation you would need to obtain a mark of at least 70% to stand any chance of receiving funding for your proposal.
Lecture outlines and associated reading

The following outlines give guidance on the general content of each lecture, along with relevant reading. The more you read up as you go along, the more you will take from the lectures.

Block 1: Introduction to mining archaeology and archaeometallurgy

1 Metals and other mineral resources
This introductory lecture gives an overview of the lithic resources and metal types used in Old World prehistory whose exploitation will be covered in later lectures. It thus provides the physical background to the archaeological study of prehistoric mining and metallurgy.

Reading
Craig et al. 2001; Rapp 2009.

2 Mining, metalworking and metal analysis
A general overview of early mining technology and of the most common production techniques of metals is given in this lecture. This covers the mining and processing of ores as well as the working of finished metals. Finally, techniques of metal analysis are presented and discussed as well.

Reading

Block 2: The exploitation of lithic resources

3 Neolithic flint mines
Before prehistoric man started mining for metal ores, in many parts of the Old World mining operations were aimed at the procurement of lithic resources, flint perhaps being the most important of these. This lecture provides a broad overview of Neolithic flint mines in different parts of Europe. The importance of flint mining for Neolithic economies is also discussed.

Reading

4 Neolithic quarries and axe factories
Apart from flint, in the Neolithic jadeite, eclogite and some other rocks were highly sought-after raw materials for the production of axes. This lecture looks at the exploitation of these resources and at the exchange networks through which the axes were distributed from a few production centres over considerable distances throughout large parts of Europe.

Reading

Block 3: Early copper metallurgy and the importance of tin
5 The origins of metallurgy in the Near East
The earliest traces of the use of copper and other metals were found in the Near East, especially in the area of the Fertile Crescent, where metallurgy developed in a drawn-out process from a long-standing tradition of experimenting with pyrotechnology and using coloured stones. This lecture looks at the archaeological evidence for early metallurgy in the Near East (from the 9th millennium onwards) and discusses the production techniques used at that stage.

Reading

6 Early copper metallurgy on the Balkans and in central Europe
In south-east Europe the earliest copper metallurgy dates back to the mid-5th millennium BC, soon spawning a quite substantial industry. From the end of the 5th millennium onwards the first metal objects appeared in central Europe, where they have always been considered to be imports from the south-east. Only a few years ago evidence was unearthed that metal might have been produced in the Alps almost as early as in the Balkans, while in southern and western Europe metal production only starts in the mid-4th millennium. In this lecture the material evidence for the beginnings of metallurgy in different parts of central and south-eastern Europe is presented and discussed as well as the question of how and how fast technological innovations can spread.

Reading

7 Early copper metallurgy in southern and western Europe
Early metallurgy south of the Alps and west of the river Rhine shares a number of characteristics with the remainder of continental Europe, but there are also a number of differences. Particularly with regard to Iberia, this has led some scholars to postulate an independent invention of copper metallurgy in the later 5th millennium. The evidence for this, however, is highly contested. This lecture will provide an overview of early metallurgy in Italy, France and Iberia, and to current scholarly debate concerning this subject.

Reading
Maggi & Pearce 2005; Dolfini 2010; Mille & Carozza 2009; Roberts 2009a; Ruiz Taboada & Montero 1999.

8 Copper and tin in Bronze Age Europe
Intensive research in mining archaeology during the last decades has revealed a large number of prehistoric mining and metal production sites in the Eastern Alps and its surroundings. This provided new insights not only into the applied technology, but also into the organisational structure of this important part of the region’s economy during the Bronze Age. In combination with a significant increase of knowledge in the field of settlement archaeology it is now possible to reconstruct almost the entire production and distribution chain. Its ups and downs can also be correlated quite well with general features of the development of prehistoric settlement.

Reading
O’Brien 2015; Pare 2000; Roberts 2009b; Shennan 1995; Winghart 2000.
9 Tin sources in the Old World

Tin is the raw material for the most important copper alloy in Old World prehistory: bronze. Apart from producing better material properties it gives finished objects a golden look. Both properties from the 3rd millennium onwards made bronze an increasingly sought-after commodity. However, tin is a relatively scarce raw material that is hardly found in the vicinity of the large bronze production and consumption centres of the Near East and the eastern Mediterranean. In contrast, some parts of Europe have large resources of tin ore. Among those the main areas are: Cornwall, Brittany, the western and southern parts of the Iberian Peninsula and the Saxon-Bohemian ore mountains. In this lecture the evidence for prehistoric tin mining and trade in different parts of the Old World is discussed.

Reading

10 Prehistoric copper production in Britain

While until recently the evidence for prehistoric copper mining in the British Isles has generally been rather scant, as a result of intensive research over recent years a relatively large number of prehistoric copper mining sites are now known, especially in northern Wales and southern Ireland. The earliest of this evidence dates to the second half of the 3rd millennium BC, but most of the mining activity in Britain and Ireland took place during the Early Bronze Age in the first half of the 2nd millennium, the mines seemingly being abandoned afterwards. This lecture is intended to provide a general overview of the mining sites in question and of other contemporary evidence for copper production in the British Isles.

Reading

11 Bronze Age metallurgy in Britain and Ireland

While there now is plenty of evidence for Early Bronze Age copper mining in the British Isles, so far no source of copper is known to have been exploited in either Britain or Ireland during the Middle or the Late Bronze Age despite the considerable quantity of metalwork known from these periods. Although large-scale imports from the continent have been often postulated, no conclusive evidence for this hypothesis has yet been found. Equally mysterious is the almost total lack of smelting sites. This lecture discusses the development of Bronze Age metallurgy in Britain and Ireland throughout the Bronze Age and the different types of evidence at our disposal.

Reading

Block 4: Other non-ferrous metals, salt, pigments and rare minerals

12 Gold, silver and lead
The precious metals gold and silver were appreciated since very early in the history of metallurgy. Also for lead, whose metallurgy is intimately linked to that of silver, a very early occurrence is attested. In this lecture evidence for prehistoric gold, silver and lead mining is presented as well as the development of their use and processing.

Reading

13 Salt, pigments and rare minerals
Mining in prehistory was not only done for the purpose of procuring lithic resources and metal ores, but from very early on also for that of pigments and rare minerals. Particularly from the Bronze Age onwards, rock salt became another important non-lithic, non-metal resource exploited in large-scale mining operations. This lecture examines the archaeological evidence for mining activities related to these specific commodities which tend to be relegated to a secondary role within mining archaeology, but whose importance for prehistoric economies, specifically in the case of salt, can hardly be overestimated.

Reading

Block 5: Iron metallurgy

14 Early iron metallurgy
The introduction of iron metallurgy occurred only after a long process of technological innovations necessary to master problems with the peculiar properties of the new material. Unfortunately our knowledge about the early stages of its working and use is quite limited, and the importance of its introduction is often overestimated. So, although iron ore occurs much more widely than copper or tin ores, there is no evidence that the increasing use of iron at the Late Bronze Age/Early Iron Age transition overthrew existing economic systems. In this lecture evidence for early iron metallurgy in Europe is presented and its implications are discussed.

Reading

Block 6: Economic, social and environmental implications of metallurgy

15 Metal production and trade in Bronze Age economies
The production of metals is a very complex activity which depends on a number of external factors. First of all it has to be supported by many other sectors of the economy: directly by the supply of raw materials which are necessary for mining and smelting and by manpower, and indirectly by the supply of food and shelter for the metallurgists. Subsequently the finished products have to be traded and transported to the consumer, which requires a complex economic system and transportation infrastructure that have to be established and maintained. This lecture uses a number
of examples to demonstrate the economic implications of metallurgy that can be inferred from the archaeological record.

Reading

16 & 17 Mining, production processes and society I & II
Already the procurement of lithic resources and stone tool production functioned within the complex parameters of Neolithic societies. The socioeconomic role of metals later seems to have played a considerable part in the transformation of these societies. In this lecture the respective developments are treated by comparing evidence from three different areas: Andalusia, Cyprus and Europe north of the Alps.

Reading

18 Mining, metal production and the environment
While the environmental impact of modern industrial mining operations has been the object of extensive research, much less is known about the effects prehistoric mining might have had on the environment. By looking at archaeological, palaeoecological as well as documentary evidence, this lecture tries to explore the potential for gaining insights into the effects mining may have had on prehistoric landscapes and environments.

Reading
GAP3061

Miners, Metals and Merchants

Bibliography

Please inform relevant staff of any inaccuracies in this list.


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Timberlake, S. 2006. Excavation of Early Mineworkings at Twyll y Mywn (Cwm Darren) and Erglod, Ceredigion. Archaeology in Wales 46, 79–86.


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## Module Timetable

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture/Event</th>
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<tbody>
<tr>
<td>1</td>
<td>31 Jan</td>
<td>Lecture 1: Metals and other mineral resources</td>
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<td>2 Feb</td>
<td>Lecture 2: Mining, metalworking and metal analysis</td>
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<td>2</td>
<td>7 Feb</td>
<td>Lecture 3: Neolithic flint mines</td>
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<td>9 Feb</td>
<td>Lecture 4: Neolithic quarries and axe factories</td>
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<td>3</td>
<td>14 Feb</td>
<td>Lecture 5: The origins of metallurgy in the Near East</td>
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<td>16 Feb</td>
<td>Lecture 6: Early copper metallurgy on the Balkans and in Central Europe</td>
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<td>4</td>
<td>21 Feb</td>
<td>Lecture 7: Early copper metallurgy in southern and western Europe</td>
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<td>23 Feb</td>
<td>Jack Kerr Memorial Conference – NO TEACHING</td>
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<td>5</td>
<td>27 Feb</td>
<td>Submission of Semester Paper Draft</td>
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<tr>
<td></td>
<td>28 Feb</td>
<td>Lecture 8: Copper and tin in Bronze Age Europe</td>
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<td>2 Mar</td>
<td>Lecture 9: Tin sources in the Old World</td>
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<td>6</td>
<td>7 Mar</td>
<td>Lecture 10: Prehistoric copper production in Britain</td>
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<td>9 Mar</td>
<td>Lecture 11: Bronze Age metallurgy in Britain and Ireland</td>
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<td>7</td>
<td>14 Mar</td>
<td>Lecture 12: Gold, silver and lead</td>
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<td>16 Mar</td>
<td>Reading Day – NO TEACHING</td>
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<tr>
<td>8</td>
<td>21 Mar</td>
<td>Lecture 13: Salt, pigments and rare minerals</td>
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<td>23 Mar</td>
<td>Seminar 1: Student Papers</td>
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<td>9</td>
<td>28 Mar</td>
<td>Lecture 14: Early iron metallurgy</td>
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<td>30 Mar</td>
<td>Seminar 2: Student Papers</td>
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<td>10</td>
<td>4 Apr</td>
<td>Lecture 15: Metal production and trade in Bronze Age economies</td>
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<td>6 Apr</td>
<td>Lecture 16: Mining, production processes and society I</td>
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<td>7 Apr</td>
<td>Field Trip</td>
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<td>11</td>
<td>2 May</td>
<td>Lecture 17: Mining, production processes and society II</td>
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<td>4 May</td>
<td>Lecture 18: Mining, metal production and the environment</td>
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<td>9 May</td>
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<td>11 May</td>
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<td>13</td>
<td>15 May</td>
<td>Submission of Semester Paper and Project Proposal</td>
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→ Submission of slides for classroom presentations and accompanying handouts no later than 3.30 pm on the Monday preceding your presentation.