ARCHAEOLOGICAL CERAMIC ANALYSIS (ARCL0102)

2023-24, Term 2 Lectures Mondays 4:00:6:00pm, IoA Room B13 Practicals Wednesdays 2:00-4:00pm, IoA Room 410 (Except Weeks 10 & 11) MSc/MA module 15 credits

DR PATRICK QUINN patrick.quinn@ucl.ac.uk



Please refer to https://www.ucl.ac.uk/archaeology/current-students/ioa-study-skills-guide/referencingeffectively-and-ioa-guidelines https://www.ucl.ac.uk/archaeology/current-students/ioa-study-skills-guide/referencingeffectively-and-ioa-guidelines https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-Al for instructions on coursework submission, IoA referencing guidelines and marking criteria, as well as UCL policies on penalties for late submission, over-length work, the use of text generation software (AI) and academic misconduct

1. MODULE OVERVIEW

Module description

This module provides a practical and theoretical introduction to the scientific analysis of archaeological ceramics. It delivers in-depth training in the principles of thin section ceramic petrography and its role alongside instrumental geochemistry, X-ray diffraction and scanning electron microanalysis in the interpretation of pottery provenance and manufacturing technology. The module will demonstrate how data on provenance and technology can be used to tackle archaeological questions such as trade and exchange, craft technology, tradition, social identity and the organisation of production.

Module Aims

This module aims to introduce participants to the scientific analysis of archaeological pottery and other ceramic materials. It will demonstrate the types of microscopic, mineralogical and chemical signals discernible in archaeological ceramics and review how these contribute to broader issues in ancient material culture. It aims to provide practical training in the principles of thin section ceramic petrography and its application to the determination of provenance and reconstruction of manufacturing technology.

Learning Outcomes

On successful completion of this module participants should:

- Be able to evaluate the relevance and applicability of scientific methods of ceramic analysis.
- Be able to evaluate critically published work relating to archaeological ceramic analysis.
- Gain an appreciation of the role of ceramic analysis within the wider study of pottery and the application of scientific approaches alongside other archaeological data.
- Have gained a basic practical understanding of how to undertake thin section petrographic analysis on archaeological ceramics that can be further developed by independent research within an MSc/MA dissertation or PhD thesis.

Methods of Assessment

The module will be assessed on the basis of two items of coursework. Assessment 1 will be a practical microscope test on the identification and classification of minerals and rocks in lithic and ceramic thin sections. Assessment 2 will be a short critique evaluating specific aspects of archaeological ceramic analysis. The topic of this critique will be announced at the lecture in Week 2. The two assessments carry a weighting of 30% and 70% of the total module mark respectively.

Communications

- MS Teams is the main hub for this course.
- Important information will be posted on the ARCL0102 2023/24 MS Team and you will automatically receive email notifications
- Please post any general queries relating to module content, assessments and administration on the ARCL0102 2023/24 MS Team
- For personal queries, please contact the co-ordinator by email
- Coursework is to be submitted via Moodle

Week-by-week summary

Week	Date	Торіс	Lecturers
1		Archaeological Ceramics and their Analysis. Introduction to Optical Mineralogy	PQ
2		Igneous Rocks: Their Classification and Identification in Thin Section	PQ
3		Sedimentary Rocks: Their Classification and Identification in Thin Section	PQ
4		Metamorphic Rocks: Their Classification and Identification in Thin Section	PQ
5		Clay, Soil and Weathering. Introduction to Thin Section Ceramic Petrography	PQ
6		READING WEEK	
7		Classification and Characterisation of Ceramics in Thin Section	PQ
8		Interpreting Ceramic Provenance in Thin Section	PQ
9		Reconstructing Ceramic Technology in Thin Section	PQ
10		Instrumental Geochemical Analysis of Archaeological Ceramics	PQ
11		Scanning Electron Microscopy and X-Ray Diffraction Analysis of Archaeological Ceramics	PQ

Lecturers and other contributors: Patrick Quinn (PQ) Module Coordinator. Archontoula Barouda (AB) and Sara Carrion Anaya (SC) PhD Assistants.

Weekly Module Plan

The module will be taught via lectures, laboratory practicals and demonstrations. Participants will be required to undertake weekly set readings and complete practical tasks at home. Lectures will be delivered face to face in Room B13 of the IoA on Monday afternoons between 4–6pm. Laboratory practicals will take place on Tuesday afternoons in Room 410 of the IoA between 2–4pm. These will build upon the topic of the current week's lecture. The first eight practicals will consist of microscope-based exercises in which each participant works on their own microscope with a set of slides. The module will also include one computer-based practical and a demonstration on scanning electron microscopy, both of which will take place in the IoA. Weekly readings that supplement the lectures and other activities will be available on the on-line reading list and/or supplied as pdfs on the ARCL0102 2022/23 MS Team.

Workload

The module is composed of 10 two-hour lectures, nine two-hour practical sessions and one twohour demonstration (total 40 contact hours). Participants will be expected to undertake 70 hours of private study for the module, reading the recommended texts and working on the critique. They should also spend up to 40 hours undertaking the practical assignments. The total workload for the module is 150 hours.

2. ASSESSMENT

Each assessment and possible approaches to it will be discussed in class, in advance of the submission deadline. If participants are unclear about the nature of an assignment, they should discuss this with the module coordinator in advance. Feedback on written coursework will be provided via email, and participants will be given the opportunity to discuss their marks and feedback with the module co-ordinator.

Assessment 1 - On-line Practical Test

Participants will be expected to identify and classify several mineral and rock specimens in thin section using photomicrographs as well as identify mineral and rock inclusions within archaeological ceramic thin sections. This will draw upon the content of the first five weeks of the module. In order to prepare for this assessment, participants should complete all weekly practical exercises. The on-line practical test will be completed in Moodle during Reading Week (Week 6) and will account for 30% of the final module grade

Assessment 2 - Critique

Participants will be expected to write a short critique evaluating specific aspects of archaeological ceramic analysis. The topic of this critique will be announced at the lecture in Week 2. In order to tackle the assignment, participants will need to have read the recommended reading, as well as undertaken additional reading on the specific topic. The assignment will assess understanding of the concepts introduced on the course and participants ability to assess and synthesise published works on archaeological ceramic analysis. It will account for 70% of the final module grade. The paper must be between 1900-2100 words in length excluding title page, contents pages, lists of figure and tables, abstract, preface, acknowledgements, bibliography, lists of references, captions

and contents of tables and figures, appendices, and wording of citations in the text. Assessment 2 should be submitted on or before Thursday 11 April 2024.

3. INSTRUCTIONS FOR ATTENDING CLASSES

You are expected to attend the face-to-face lectures on Monday afternoons and the practical sessions on Tuesday afternoons, except Reading Week (Week 6). Microsoft Teams will be used as a means of sharing information, lecture notes and reading, however, on-line lectures will NOT be broadcast using the ARCL0102 2022/23 MS Team. An exception might be the scanning electron microscopy demonstration in Week 11, due to space in the SEM lab.

Weekly Reading

Participants will be expected to read selected papers and chapters on archaeological ceramic analysis and geology. These will supplement the material provided in the lectures. Some of the readings are available on-line at the link below. The week's reading will also appear at the end of each lecture. Participants will be expected to complete the reading in time for the next week's lecture, but not before.

https://rl.talis.com/3/ucl/lists/551355AE-B02C-DAAC-D191-10F421CE529D.html?lang=en&login=1

4. RECOMMENDED COURSE TEXTS (*Most used)

Chernicoff, S. and Venkatakrishnan, R. 1995. *Geology: An Introduction to Physical Geology*. Worth Publishers.

Hunt, A. (Ed.) 2016. Oxford Handbook of Archaeological Ceramic Analysis. Oxford University Press.

*MacKenzie, W. S. and Adams, A. E. 1994. *A Colour Atlas of Rocks and Minerals in Thin Section*. Manson Publishing, London.

Pollard, M., Batt, C. Stern, B and Young, M. M. 2007. *Analytical Chemistry in Archaeology.* Cambridge Manuals in Archaeology. Cambridge University Press.

*Quinn, P. S. 2022. Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics. Archaeopress, Oxford.

Quinn, P. S. (Ed.) 2009. Interpreting Silent Artefacts: Petrographic Analysis of Archaeological Ceramics. Archaeopress, Oxford.

Reedy, C. L. 2008. Thin-Section Petrography of Stone & Ceramic Materials. Archetype, London.

Rice, P. M. 2015. Pottery Analysis: A sourcebook. Second Edition. University of Chicago Press.

5. SYLLABUS

Week 1

Lecture - Archaeological Ceramics and their Analysis. Introduction to Optical Mineralogy - 8 Jan

Following an introduction to the module, we will discuss the different types of ceramics and related artefact types that occur in archaeological contexts. We will then consider the ways in which archaeological ceramics can be studied and the types of information that we can gain from them. The various techniques of ceramic compositional analysis, including thin section petrography, instrumental geochemistry, scanning electron microscopy and X-ray diffraction analysis, will be briefly outlined and contrasted with other methods of studying ancient pottery.

In order to prepare you for the study of archaeological ceramics in thin section, an introduction to the basics of optical mineralogy and mineral identification with the polarising light microscope will be provided. The key features used to identify the most common rock forming minerals will be discussed.

Practical - Identification of Minerals in Thin Section - 9 Jan

In the practical session, we will familiarise ourselves with the polarising light microscope and get a brief first opportunity to see archaeological ceramics in thin section. We will then observe the main rock forming minerals in thin geological specimens and learn to recognise them down the microscope.

Recommended Reading:

MacKenzie, W. S. and Adams, A. E. 1994. *A Colour Atlas of Rocks and Minerals in Thin Section*. Manson Publishing, London (Pages 1-64).

Maritan, L. 2023. Ceramics: Chemical and Petrographic Analysis. In: *Reference Module in Social Sciences*. Elsevier. https://doi.org/10.1016/B978-0-323-90799-6.00020-3

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 1. Introduction to Ceramics and Compositional Analysis)

Week 2

Lecture - Igneous Rocks: Their Identification and Classification in Thin Section - 15 Jan

We will first go over the optical properties of the the main rock forming minerals encountered last week. The rock cycle and tripartite classification of rocks will then be introduced. The formation, classification and petrographic study of the main acidic, intermediate, basic and volcaniclastic igneous rocks will be explained in detail, including the mineralogical and textural features that are used to identify them in thin section.

The essay topic for Assessment 2 will be handed out and discussed in Week 2.

Practical - Classifying Igneous Rocks in Thin Section - 16 Jan

In the practical session we will observe thin sections of the main igneous rocks and familiarise ourselves with their composition and classification under the polarising light microscope. This will also provide another opportunity to observe many of the main rock forming minerals in thin section.

Recommended Reading:

Chernicoff, S. and Venkatakrishnan, R. 1995. *Geology: An Introduction to Physical Geology*. Worth Publishers. (Chapter 3 - Igneous Processes and Igneous Rocks)

MacKenzie, W. S. and Adams, A. E. 1994. *A Colour Atlas of Rocks and Minerals in Thin Section*. Manson Publishing, London. (Pages 67-105)

Cootes, K. V. E. and Quinn, P. S. 2017. Prehistoric Settlement, Mobility and Societal Structure in the Peak District National Park: New Evidence from Ceramic Compositional Analysis. *Archaeometry*, 60: 678-694.

Week 3

Lecture - Sedimentary Rocks: Their Identification and Classification in Thin Section - 22 Jan

We will firstly go over the mineralogical and textural features of the main igneous rocks encountered last week. The formation, classification and petrographic study of the main clastic and carbonate sedimentary rocks will then be explained in detail, including the mineralogical and textural features that are used to identify them in thin section.

Practical - Classifying Sedimentary Rocks in Thin Section - 23 Jan

In the practical session we will observe thin sections of the main sedimentary rocks and familiarise ourselves with their composition and classification under the polarising light microscope. This will also provide another opportunity to observe many of the main rock forming minerals in thin section.

Recommended Reading:

Chernicoff, S. and Venkatakrishnan, R. 1995. *Geology: An Introduction to Physical Geology*. Worth Publishers. (Chapter 6 - Sedimentation and Sedimentary Rocks)

MacKenzie, W. S. and Adams, A. E. 1994. *A Colour Atlas of Rocks and Minerals in Thin Section*. Manson Publishing, London. (Pages 107-151)

Quinn, P. S., Zhang, S., Xia, Y., Li, X. 2017. Building the Terracotta Army: Ceramic Craft Technology and Organisation of Production at Qin Shihuang's Mausoleum Complex, China. *Antiquity*, 91: 966-979.

Week 4

Lecture - Metamorphic Rocks: Their Identification and Classification in Thin Section - 29 Jan

We will firstly go over the mineralogical and textural features of the main sedimentary rocks encountered last week. The formation, classification and petrographic study of the main metamorphic rocks will then be explained in detail. The mineralogical and textural features of the main clastic and carbonate sedimentary rocks will be discussed, including the mineralogical and textural features that are used to identify them in thin section.

Practical - Classifying Metamorphic Rocks in Thin Section - 30 Jan

In the practical session we will observe thin sections of the main metamorphic rocks and familiarise ourselves with their composition and classification under the polarising light microscope. This will also provide another opportunity to observe many of the main rock forming minerals in thin section.

Recommended Reading:

Chernicoff, S. and Venkatakrishnan, R. 1995. *Geology: An Introduction to Physical Geology*. Worth Publishers. (Chapter 7 - Metamorphism and Metamorphic Rocks)

MacKenzie, W. S. and Adams, A. E. 1994. *A Colour Atlas of Rocks and Minerals in Thin Section*. Manson Publishing, London. (Pages 153–187)

Sorresso, D. C. and Quinn, P. S. 2020. Re-examining Shell-Tempered Chickasaw Pottery in Postcontact Mississippi, USA. *Journal of Archaeological Science Reports*, 32: 102415.

Week 5

Lecture - Clay, Soil and Weathering. Introduction to Thin Section Ceramic Petrography - 5 Feb

We will firstly go over the mineralogical and textural features of the main metamorphic rocks encountered last week. The mineralogy, formation and classification of clay and soil will then be introduced. The subject of ceramic petrography will be introduced in detail. We will consider the composition of archaeological ceramics in thin section, focussing on the their three main components.

Practical - Composition of Ceramics in Thin Section - 6 Feb

In the practical, we will familiarise ourselves with the three main components of archaeological ceramics in thin section under the polarising light microscope. We will also observe examples of archaeological ceramics with igneous, sedimentary and metamorphic rock inclusions.

Recommended Reading:

Chernicoff, S. and Venkatakrishnan, R. 1995. *Geology: An Introduction to Physical Geology*. Worth Publishers. (Chapter 5 - Weathering: The Breakdown of Rocks)

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 3. Composition of Archaeological Ceramics in Thin Section)

Rice, P. M. 2015. *Pottery Analysis: A sourcebook*. University of Chicago Press. (Section 2.2: Definition of Clays).

Week 6 - Reading Week

No lecture or practical. Participants should complete Assessment 1 in Week 6. Detailed instructions will be provided.

Week 7

Lecture - Classification and Characterisation of Ceramics in Thin Section - 19 Feb

We will consider how archaeological ceramics can be classified and characterised in thin section in order to identify meaning compositional patterns within artefact assemblages. Visual and quantitative approaches to classification and grouping will be contrasted with one another in terms of their strengths and weaknesses and their application to particular types of ceramic assemblages.

Practical - Classification and Characterisation of Ceramics in Thin Section - 20 Feb

In the practical we will group real assemblages of archaeological ceramics thin sections and characterise them using recommended descriptive procedures. A demonstration of quantitative petrographic data collection will be given.

Recommended Reading:

Amicone, S. and Quinn, P. S. 2015. Verulamium Region White Ware Production at the Roman kiln site of Brockley Hill, Middlesex: A Compositional and Technological Reassessment. Journal of Roman Pottery Studies, 16: 1–22.

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 4. Classification and Characterisation of Archaeological Ceramics in Thin Section)

Whitbread, I. K. 1986. The Characterization of Argillaceous Inclusions in Ceramic Thin Sections. *Archaeometry*, 28: 79–88.

Week 8

Lecture - Interpreting Ceramic Provenance in Thin Section - 26 Feb

The application of petrographic data to the interpretation of ceramic provenance will be introduced, focussing on the methodology of provenance determination, the scale and the types of archaeological questions that it can be used to tackle, including trade and exchange, interaction and migration. Thin section petrography will be contrasted with geochemical approaches to ceramic provenance and a case will be argued for a combined approach. We will discuss several published case studies in which petrography has been used for provenance determination.

Practical - Interpreting Ceramic Provenance in Thin Section - 27 Feb

In the practical, we will work in groups and attempt to determine the provenance of several real assemblages of archaeological ceramic thin sections using geological maps and associated archaeological information. The outcome of this exercise will be discussed at the end of the practical class.

Recommended Reading:

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 5. Petrographic Provenance Determination)

Quinn, P. S., Day, P. M. and Kilikoglou, V. 2010. Keeping An Eye on Your Pots: The Provenance of Neolithic Ceramics from Cyclops Cave on the Island of Youra, Greece. *Journal of Archaeological Science*, 37: 1042-1052.

Travé Allepuz, E. T., Quinn, P. S. and López Pérez, M. D. 2015. To the Vicinity and Beyond! Production, Distribution and Trade of Cooking Greywares in Medieval Catalonia, Spain. *Archaeological and Anthropological Sciences*, 6: 397-410.

Week 9

Lecture - Reconstructing Ceramic Technology in Thin Section - 4 March

The role of ceramic petrography in the reconstruction of ceramic technology will be outlined with reference to the *chaîne opératoire* of pottery production by examining the petrographic evidence for each step in the typical production process. The reasoning behind potters actions will then be considered with reference to ethnography of traditional pottery production. Finally, the value of technological data will be discussed in terms of wider archaeological themes such as beliefs, tradition, style and expression.

Practical - Reconstructing Ceramic Technology in Thin Section - 5 March

In the practical, participants will observe and familiarise themselves with the evidence for ancient ceramic technology in thin section using archaeological material from different periods and geographical regions worldwide.

Recommended Reading:

Ho, J. W. I. and Quinn, P. S. 2021. Intentional Clay-mixing in the Production of Traditional and Ancient Ceramics and its Identification in Thin Section. *Journal of Archaeological Science Reports*, 37: 102945.

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 6. Reconstructing Ancient Ceramic Technology in Thin Section)

Sillar B, and Tite, M. S. 2000. The Challenge of 'Technological Choices' for Materials Science Approaches in Archaeology. *Archaeometry*, 42: 2–20.

Week 10

Lecture - Instrumental Geochemical Analysis of Archaeological Ceramics - 11 March

Bulk geochemical compositional characterisation of archaeological ceramics will be introduced. This will start with a consideration of the typical elemental signature of ceramics and sources of alteration and contamination. We will go through the main instrumental techniques used to analyse the chemical composition of ceramics, highlighting their relative strengths and weaknesses. The topics of standards, calibration and accuracy will be discussed. Statistical methods of dealing with the multivariate compositional data that is generated by these approaches and identifying meaningful patterns within them will be outlined. We will then look at the role of geochemistry in the determination of ceramic provenance, using case studies.

Practical - Multivariate Statistical Classification of Ceramic Geochemical Data - 12 March

In the practical session, which will take place in a cluster room of the IoA (room number to be confirmed later in the term), we will analyse statistically a real multivariate dataset from the geochemical analysis of archaeological ceramics in order to identify the existence of compositional groups and the likely provenance of the material.

Recommended Reading:

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 8. Instrumental Geochemistry of Ancient Ceramics)

Quinn, P. S., Ying, Y., Xia, Y., Li, X., Ma, S., Zhang, S. and Wilke, D. 2020. Geochemical Evidence for the Manufacture, Logistics and Supply-Chain Management of Emperor Qin Shihuang's Terracotta Army, China. *Archaeometry*, 63: 40–52.

Miše, M., Quinn, P. S. and Glascock, M. D. 2021. Lost at Sea: Identifying the Post-Depositional Alteration of Amphorae in Ancient Shipwrecks. Journal of Archaeological Science, 134: 105463.

Week 11

Lecture - Scanning Electron Microscopy and X-Ray Diffraction Analysis of Archaeological Ceramics - <u>18 March</u>

The application of scanning electron microscopy to the analysis of archaeological ceramics will be summarised, focussing on the determination of firing temperatures, the chemical characterisation of the clay matrix and the technological investigation of decorative treatments. We will also discuss X-ray diffraction and its roles in the investigation of clay mineralogy and the determination of ancient firing conditions.

Demonstration - Scanning Electron Microscopy of Archaeological Ceramics - 19 March

In the demonstration session, we will see how the SEM can be used to analyse the microstructure and chemical composition of ceramics. This will take place in the SEM Lab (Room B4) in two groups and will take one hour.

Recommended Reading:

Amicone, S. R., Radivojević, M., Quinn, P. S., Berthold, C. and Rehren, T. 2020. Pyrotechnological Connections: Pottery firing technology and the origins of metallurgy in the Vinča Culture, Serbia. *Journal of Archaeological Science*, 118: 105123.

Quinn, P. S. 2022. *Thin Section Petrography, Geochemistry and Scanning Electron Microscopy of Archaeological Ceramics*. Archaeopress, Oxford. (Chapter 9. Scanning Electron Microscopy and X-ray diffraction of Ancient Ceramics)

Trave, E., Quinn P. S. and Alvaro Rueda, K. 2019. Another One Bites The Dust: Quality Control And Firing Technology In The Production Of Medieval Greyware Ceramics In Catalonia, Spain. *Archaeometry*, 61: 1280–1295.