

Archaeology Research Excavation Grant 2021

Brendan O'Neill

1. Title:	Dr
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2. Email:	
3. Grant programme	Archaeology Research Excavation Grant
4. Year awarded	2021
5. Title of project	Moynagh Lough Metalworking: A detailed scientific examination of early medieval non-ferrous crafts
6. Summary of report (Min. allowed 100 words)	<p>This funded project sought to identify the nature of non-ferrous metalworking on the early medieval crannog site of Moynagh Lough, Co Meath. To do this, metal artefacts and technical ceramics (moulds, crucibles, tuyères) were catalogued and characterised based on their morphologies and use-wear indicators. A selection of these artefacts were also analysed using spectroscopy to determine bulk chemistries and identify inorganic residues relating to their use. The results of this research are the discovery of a range of different metalworking technologies, the identification of key metalworking contexts, and a reclassification of or early medieval Irish crucible typologies.</p> <p>The datasets generated during this research include –</p> <ul style="list-style-type: none">o A completed catalogue of all artefacts relating to non-ferrous metalworking from the Moynagh Lough excavations.o Raw analytical data relating to non-ferrous metal object bulk chemistry analysis.o Raw analytical data relating to inorganic residue analysis of technical ceramics (moulds and crucibles in separate datasets).o Photographic images of all diagnostic technical ceramics.o Photographic images of all non-ferrous metal artefacts. <p>With these datasets, a combined catalogue of all artefacts (grouped by type and sub-type) is now being compiled (completed at the end of December 2021) from which subsequent publications will be written. This will include, but not be limited to, a chapter on the non-ferrous metalworking from this site in the Moynagh Lough Crannog Monograph (project principal investigator – Dr Michael Potterton).</p>
7. Date the report was submitted	Oct 29, 2021

8. Please provide two appropriate images



9. Please outline the objectives of the project

The objectives of this project were guided by its primary research question - What is the nature of non-ferrous metalworking at the early medieval settlement of Moynagh Lough? To answer this, the project used a staggered methodology with key modules of work and millstones established in advance. These were -

1. Catalogue all non-ferrous metalworking artefacts from Moynagh Lough excavation.
2. Inorganic residue analysis of a selection of diagnostic moulds (clay and stone) using pXRF.
3. Bulk chemistry analysis of all non-ferrous metal artefacts using pXRF.
4. Inorganic residue analysis of a selection of diagnostic crucible types using SEM-EDS.
5. Compile a catalogue of all artefacts, contextual information, comparanda and analytical result for publication(s).

10. Please describe the methodology used in conducting the research

This project used a staggered methodology (cataloguing of artefacts, bulk chemistry analysis metals, and inorganic residue analysis of technical ceramics) to determine the range of technologies present on the early medieval settlement of Moynagh Lough Crannog and develop a chrono-typology for these activities.

1. Cataloguing materials

Although initially delayed (hiring restriction on research staff due to covid19), the cataloguing of all available artefacts is now completed. The cataloguing system was adapted from the National Museum of Ireland's (NMI) artefact register spreadsheet. This allowed relevant information required by NMI to be gathered as well as additional information relevant to the projects aims. All initial catalogue entries were macroscopic based on type, morphology, use indicators, and fabrics. This was used to identify specimens that were suitable for further analysis (i.e., those that retained use information, residues, and were broken – allowing them to be analysed under SEM-EDS).

This catalogue, together with selected images of diagnostic forms and bulk chemistry analysis results, is now being compiled into its final format. This

document will be compiled and submitted to the Principal Investigator of the Moynagh Lough Publication Project, Dr Michael Potterton, Maynooth University.

2. Analysis of metal artefacts

Bulk chemistries of metal artefacts have been obtained using portable X-ray Fluorescence (pXRF analysis). The elemental results of this aspect of the project have been processed and are being used to identify metals being used, variations in composition between object types and key metalworking contexts on the early medieval settlement of Moynagh Lough Crannog. This information has also been cross referenced with the bulk chemistry results of the inorganic residue analysis of moulds and crucibles from this site. This has allowed technological trends to be identified, such as the consistent pattern of using leaded bronze in the casting of objects.

3. Inorganic residue analysis of technical ceramics

A selection of diagnostic moulds from the site have been analysed for the presence of inorganic residues (metals) on their interior surfaces using pXRF. These were selected based on their condition and the presence of an identifiable matrix (the object cast). In all cases, the results show the consistent use of the ternary alloy, leaded bronze. Elevated or trace zinc was detected in some samples, which is being interpreted as aqueous enrichment from the surrounding soils. To determine the source, a small number of pottery sherds from the site will also be analysed to assess base line levels of zinc in other ceramic artefacts.

A cross-section of crucibles is also being analysed using scanning electron microscopy and energy dispersive x-ray spectroscopy (SEM-EDS). All specimens have been identified and analysis is ongoing, having been slightly delayed due to covid19 restrictions. This analysis will be completed at the end of Nov 2021 and integrated into the project output catalogue before the end of the calendar year.

4. Synthesis

Pending the completion of crucible analysis at the end of November 2021, an output catalogue document will be completed and submitted to Dr Michael Potterton and other stakeholders.

11. Please outline the findings of your research and/or milestones achieved

The millstones within the project were based on the completion of established modules of work and are listed below. The findings that resulted from this research are still emerging (pending the completion of inorganic residue analysis of crucibles) but a summary of the key findings to date are also listed below.

Milestones

- Cataloguing of all artefacts completed despite initial issues hiring research staff (covid19).
- Key metalworking contexts and phases identified.
- Bulk chemistry analysis of all metal artefacts completed.
- Inorganic residue analysis of moulds completed.
- Inorganic residue analysis of selected crucibles delayed due to covid19 but started. Current completion date of end of November 2021.
- Final catalogue is drafted and awaiting SEM-EDX result and images. Current completion date of end of December 2021.

Findings

- This project has identified over 1134 artefacts relating to non-ferrous metalworking from Moynagh Lough Crannog excavation.
 - o 508 crucibles.
 - o 497 moulds.
 - o 96 non-ferrous metal artefacts.
 - o 33 'other' (including tuyère, burnt clays, etc.).
- Objects being cast on this site include penannular brooches (120 mould frags), pins (34 mould frags), mounts (anthropomorphic heads – 4 mould frags, triquetra mount – 60 mould frags), decorative panels (4 mould frags), ingots (1 stone ingot mould and 5 fragments of clay versions).
- Almost all metals analysed from this assemblage were ternary, leaded copper alloys. The use of this metal in the casting operations from this site is confirmed by XRF analysis of moulds where the same signals were identified. While most of the identified and analysed melting crucibles (those with specific forms, use indicators, and inorganic residues) additionally confirm this, a large number of flat-bottomed and related assaying crucibles (identified through SEM-EDX analysis) show that silver was also being processed on the site. Interestingly, although this detection does confirm metalworking technologies specifically relating to silver, other indicators for how this metal was being used are so far absent.
- A fragment of a 'gold' filigree panel was XRF analysed and found to be a silver/gold alloy (electrum). No other evidence for the making or working of this metal has so far been identified from the assemblage.
- One of the key findings of this research is the sheer number of different technologies represented in the range of different crucibles. Three aspects were used to determine 'function'; morphology, use indicators, residue analysis. So far (some analysis still outstanding), 9 different functions have been identified, including melting/casting, reduced reaction melting/casting (lidded variant crucibles), reduction reactions, oxidising reactions (including assaying and cupellation), and alloying. Comparanda for these crucible types are being identified from sites in early medieval Ireland and Europe to establish a picture of technological availability and movement over time.
- Fragments of brazing shroud material were also identified implying the coating of iron bells in thin layers of copper alloy at Moynagh Lough during the early medieval period. This can be added to a growing list of evidence for Christianising influence on the site.

12. a) Please provide details of the dissemination of the outcomes from this project (inc. publications, presentations, outreach, media etc.) including details of any social media/web platforms used to publicise this project

The primary output of this phase of the project will be a full catalogue of artefacts relating to the nature of non-ferrous metalworking on the early medieval settlement of Moynagh Lough Crannog. This will be structured into individual object types, including metal objects, moulds, crucibles, tuyère, other. These will be further subdivided into sub-types; for example brooch, pin, rings, bracelets, tweezers, hair loops, etc. Each catalogue entry will include their recorded details (dimensions, weight, description, condition, morphology, use indicators, etc.), contextual information, national and international comparanda, bulk chemistry results (if applicable), and any relevant images. This document will form the primary dataset from which the non-ferrous metalworking chapter of the Moynagh Lough monograph will be written. Similarly, it will be the key resource for other publications examining a functional typology for early medieval Irish crucibles and early medieval Irish non-ferrous metalworking in a broader European context.

On October 4th 2021 I was invited to speak to RSAI members in a virtual

presentation on the topic of early medieval non-ferrous metalworking. The title of this presentation was 'Functioning in Early Medieval Ireland: Understanding metalworking, craft and making through a detailed investigation of technical ceramics'. For this, I focused on the implications of research into early medieval non-ferrous metalworking, particularly technical ceramics. This set the scene for the Moynagh Lough publication and used information gathered as part of this current project.

From January – April 2021 I was the module coordinator for a UCD School of Archaeology master's level module called 'Practical experimental Archaeology'. During this, students (19 last year) must investigate how early medieval non-ferrous objects were made and what this can tell us about the society that produced and used them. Key to this module is the student's ability to draw in a wide range of sources, including historical, secondary literature, analytical results, contextual analysis, artefact analysis, and experimental archaeology. This current project was used as a case-study in lectures for this module and a selection of artefacts were used in controlled handling sessions. This allowed students to see first-hand how technical ceramics can be used to better understand ancient process and to consider the opportunities and challenges presented by their complex use biographies. This direct 'research to teaching' approach immerses students in real world archaeology, familiarises them with artefacts away from the field under specialist supervision, and provides them with a clear understanding of the implications of researching these kinds of artefacts.

b) No. of Academic Papers/articles published:

0

c) No. of Lectures given/outreach events involved in:

2

e) How will you continue to communicate the results of your project and what are your publication plans?

By the end of December 2021 a full draft catalogue will be completed and ready for use in synthesising additional published material. The most important of these will be a chapter in the Moynagh Lough monograph (PI – Dr Michael Potterton), which will outline in detail the findings from this research, provide dating evidence for activities/technologies identified from this site, and place the non-ferrous metalworking at the early medieval settlement of Moynagh Lough into its national and international context. It is also intended to make this catalogue an open-source document through UCD's Research Repository (pending final agreement from all stakeholders).

Other publications will include a journal article aimed at the Irish archaeology sector outlining a comprehensive chrono-typology for early medieval crucibles in Ireland (published in JIA). This will use Moynagh Lough as the key case-study providing field excavators and researchers a tool to more easily identify and contextualise finds of this material. It will include detailed descriptions of form (including high quality imagery), key use indicators, functions, use chronologies in Ireland, and international comparanda.

A second journal article is also planned for publication in the Journal of Medieval Archaeology in 2022. This will outline the evidence for non-ferrous metalworking during the early medieval period on the island of Ireland and compare it to wider trends in western and northwestern Europe. Importantly, this research on the Moynagh Lough non-ferrous metalworking evidence will provide crucial information to date different technologies (through use indicators on crucibles), allowing Ireland's place in early medieval Europe to be critically assessed.

A key strand of dissemination will be through 'Research to Teaching'. This will

be delivered primarily through a master's level module at UCD called 'Practical Experimental Archaeology' (Module Coordinator – Dr Brendan O'Neill), where the class must use a range of different sources to identify how early medieval non-ferrous objects were made and what this can tell us about the society that made and used them. The catalogue and publications from this project will be a primary dataset for this module and the images, analytical datasets, and written descriptions will all be made available for additional research (including postgraduate theses). Aspects of this new dataset will also be used in other modules delivered for the School of Archaeology, School of Mechanical and Materials Engineering, and the School of Sociology.

As a lecturer at UCD I am also heavily involved in public outreach and education, providing several public demonstrations of ancient technologies each year. In line with this, I am designing an outreach event to show audiences how early medieval people made and used objects in bronze, brass, silver, and gold. This will involve remaking crucibles, furnaces, moulds, tuyères, bellows, etc. and demonstrating how they were used in live casting events. Although final stage planning and preparatory work has yet to commence, this research project and analytical work are vital dataset in designing and delivering this ambitious programme.

16. How did the grant enhance your professional development (e.g. in terms of specific opportunities, opportunities for enhancing skills, collaborations with others etc.)?

This project has enhanced my research in the area of early medieval non-ferrous metalworking by providing access to and funding to examine this unique archaeological assemblage. Most legacy excavations of this kind do not provide the opportunity to examine such a comprehensive dataset, nor do they allow for detailed contextual or chronological information to be considered together with artefacts. This project has established the baseline data to identify key trends on this site, developments over time as well as comparisons to other sites in Ireland and internationally (northwest Europe).

It has also provided me with the opportunity to develop and grow my research networks nationally. These include forging new relationships with Maynooth University and the RIA, while further growing my established relationship with the National Museum of Ireland.

17. What plans (if any) do you have to further your proposal/project?

It is my intention to use the first six months of 2022 to develop detailed strategies for the dissemination of this material based on this project's catalogue of materials. This will include writing up drafting manuscripts for publications mentioned earlier. To add to this unique dataset, additional 14C dating will likely be required, for which I will seek funding in the future. Additionally, a comprehensive review of similar material already excavated from Irish, Scottish, Welsh, English, Scandinavian, French, and eastern European sites will be undertaken in the future, allowing the Moynagh Lough assemblage to be placed into its wider national and international context.

