

## The Beginnings .....

The Science@Silchester project began with limited analysis of soil material in 1998 from one hearth associated with House 1 and of probable second century date which yielded evidence of a high calcium content, consistent with the use of bone in a cupellation furnace, as well as high levels of lead.

The opportunity for undertaking more extensive survey of soil-material analysis of successive phases of House 1 presented itself in 2002-3 (published as Cook et al., 2005 in the *Journal of Archaeological Science*). The purpose of the work was to use soil geochemical analyses to interrogate the archaeological evidence particularly with reference to potential metal-working at the site. Notable absences in the area of House 1 were finds of the commoner detritus of Romano-British precious metal and copper alloy working such as droplets, off-cuts, slags, crucible or mould fragments, as have been found previously at Silchester. Analysis of soil samples using a bulk analytical technique (x-ray fluorescence) has shown the existence of several metal "hotspots" which in some cases coincide with the location of hearths leading us to infer the working of metals in these areas. Other "hotspots" do not coincide with evidence for hearths or heating and may provide evidence of metals worked in the absence of heat or of sweepings.

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## Science@Silchester

Following on from the preliminary work the focus of this first year of the formal Science@Silchester project has been the collation of existing data; we now have five seasons worth of soil analysis data. This has enabled a more directed approach to sampling in 2007.

The targeted approach, based on results from previous seasons, has allowed us to select specific archaeological questions to answer. This season we have focused on the sampling of occupation deposits which proved to contain high levels of copper and zinc as well as sampling a late 1st/early 2nd Century circular structure, possibly a shrine [ERTB 3; Period 2 c. AD80 - 125/50]. Samples have also been taken from contexts between buildings to investigate the use of external space and from occupation deposits which comprise the floors of newly revealed buildings. This work is complemented by ongoing PhD research (Rowena Banerjea) investigating the changing use of space at Insula IX. Rowena's work uses micromorphology and an investigation of phytoliths as well as soil chemistry to study how the use of space within a Roman Insula changes with time.

Samples collected in previous seasons from in situ hearths have also now been analysed and the results will be submitted to the *Journal of Archaeological Science* (Marshall et al., *The geochemistry of Roman Hearths at Silchester, Hants - evidence for non-ferrous metal-working*).

Other projects which have previously been carried out in an ad hoc manner have been formalised with the acquisition of funding for an Undergraduate Research Opportunity Programme (URO) through the University's Centre for Excellence in Teaching & Learning in Applied Undergraduate Research Skills (CETL-AURS). This allowed the analysis of soil samples and the training of an undergraduate student (Kirsty Bax) during the summer vacation.

An important aspect of Science@Silchester is our commitment to undergraduate and master's level teaching, each year we provide a selection of suitable dissertation projects and assist with planning and sample collection. This year we also organised a series of talks for the students at the excavation to showcase the various science based projects. Early next year we will also be running a one-day Science@Silchester meeting for members of the University and invited guests. The meeting which follows on from previous one day meetings held at the University is an opportunity for all of the researchers involved in to catch up

on progress not only in the various science areas but also with the archaeology to enable us to define a targeted and appropriate direction for future projects.

The ultimate aim of this research is to characterise the evolving use of space through time at Insula IX.

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## Multidisciplinary investigations

**An important part of the Science@Silchester work is the initiation of multidiscipline research projects. As well as the vital links between Earth Sciences and Archaeology which have been strengthened through work with micropalaeontologists (see below) we are also involved in projects with the departments of chemistry, food science and physics.**

**This year the collaborative projects have progressed with the completion of three work packages:**

### **1) Roman diet and trade: evidence from organic residues on pottery sherds recovered at the Roman town of Calleva Atrebatum (Silchester, Hants).**

*Marshall L.J., Cook S. R., Almond M. J. & Fulford M. G.*

This work which was submitted as a short paper to Britannia looked at the organic residues which were deposited on sherds of pottery with the aim of determining what the pots were used for. One sherd from a Gauloise amphora (imported from the south of France) proved to contain pine resin, possibly applied as waterproofing, whilst a BB1 cooking pot made in Poole Harbour on the south coast of England was used in the preparation of both leafy vegetables and ruminant meat (cow or sheep).

The work was carried out as part of a PhD (Lisa Marshall) in collaboration with the Science@Silchester team.



**Rim sherd of a BB1 Cooking pot used for residue analysis**



**Mineralised cereal grains x10 magnification**

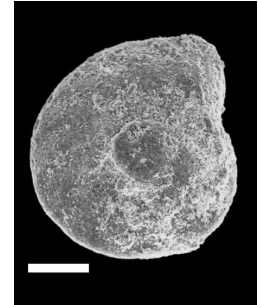
### **2) Understanding the Roman mosaic artisan using microfossils.**

*Wilkinson I.P., William M, Young J, Lott G, Cook S.R & Fulford M.G.*

In collaboration with the University of Leicester, the British Geological Survey and the Natural History Museum we are involved using microfossils for the provenancing of chalk tesserae from Silchester and other locations (Corfe and London). The microfossils present in the chalk are time-zone specific and can therefore be used to identify the age of the chalk in use, this can then be correlated to outcrop locations to help us understand the sources used by the Roman artisans.

Preliminary results show that indurated chalk or calcrete [hard chalk] was being used. This is a very specific type of chalk which is not found locally and was chosen by the artisans as it is dense and hard-wearing.

In conjunction with Leicester University and the British Geological Survey we hope to secure funding for a PhD which will increase the area of study to include tesserae found at locations outside of areas of chalk geology (NE and midlands).



**Foraminifera extracted from the Silchester tesserae**

### **3) Mineralised organic remains from cesspits at the Roman town of Silchester: Processes and preservation**

*Lisa-Jane R. Marshall, Matthew J. Almond, Samantha R. Cook, Wendy Matthews, Manolis Pantos, Mark J. Tobin, Luanne A. Thomas*

A third project is looking at the processes of mineralization for the exceptionally preserved mineralised remains (seeds, fruit skins and insect larvae) found in one of the cess pits at Insulae IX. To date we have looked at the identification of the mineral using infra-red and x-ray techniques as well as an analysis of homogeneity using elemental mapping. Our investigations identified the mineral as dahlite a carbonate substituted calcium phosphate and revealed the rapid nature of the process as shown by the small crystal size.

The work was also carried out as part of a PhD (Lisa Marshall) in collaboration with the Science@Silchester team.

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## Other projects and collaborations

Professor Averil MacDonald (Physics) has worked with a final year student (Maria Gallagher) on frescos (painted wall plaster) samples using Raman Spectroscopy and EDS (energy dispersive X-ray spectroscopy) combined with electron microscopy, to look at the range of red pigments to ascertain if there were any identifiable techniques in colour combinations.

Briefly she found most of the red comprised red ochre with calcium carbonate detected confirming the colour was applied while the plaster was wet, but may also have been added to the mix to lighten the colour. However there was also evidence of carbon which may have been added to give a deeper tone, or may have been a result of contamination from fires etc. Further work is needed to investigate the relative quantities of the three components to determine whether the amounts detected form any pattern that could lead us to determine whether the white and black colours were added to achieve a particular paint effect.

Maria Gallagher has recently accepted a place to do an MSc (part time) continuing and extending work from her third year projects on wall plasters but going beyond the Raman spectroscopy. She will work developing the synchrotron analysis firstly at Daresbury and then at Diamond. In addition she will use XRF and use the Ultra-fast laser (ULL) while it is here and after it moves.

There are also plans to use these techniques on the glass samples and enamels.

## Dr Paul Hatherly (Physics)

Paul's work looked at the green and blue colours used in painted wall plaster. Paul has also worked with Victoria Taylor (MSc student) using the ultra fast laser to investigate the composition of metallic artefacts.

Silchester Blues and Greens - Expensive Imports or Local Substitutes?

Many fragments of wall plaster recovered from Roman Silchester (Calleva) bear evidence of blue and green paints, colours particularly favoured by the Romans. Evidence from Pompeii and other sites in the Mediterranean region suggests the green volcanic mineral celadonite and the artificial material Egyptian Blue (now known to be a copper silicate) were used. However, what were the circumstances in the outskirts of Empire? Were the citizens of Calleva sufficiently prosperous that they were able to import these rare and expensive materials from the imperial centre, or were they "making do" with locally sourced materials?

To address the above questions, we have carried out a study of blue and green samples from Calleva using x-ray diffraction at one of the UK's synchrotron radiation sources, the SRS at Daresbury. The advantages of synchrotron radiation over other x-ray sources include intensity, small beam size and highly monochromatic beam at the sample, meaning that high quality data can be obtained with very small sample size and in a short time. Hence, many samples can be investigated, and the amount of sample required is minimal - important in minimising damage to archaeological artefacts.

The results were surprising, and may imply either a sophistication of material choice beyond simply "expensive" versus "cheap", or "sharp" practice by the Callevan artisans!

The results from the green paint clearly showed the presence of the mineral glauconite. In terms of composition, it is similar to celadonite, but is of marine origin and is common in the south of England as the familiar greensands. Given this outcome for the green material, one might

expect to find local materials in the blue samples - indeed, Raman studies suggest the presence of indigo. Surprisingly then, the clear signature of Egyptian Blue was also present.

This study combines physical and human science to improve our understanding of the lives, aspirations and status of some of the citizens of Calleva, and reveals the materials used the choices and practices of the artisans.

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## Publications

Marshall L.J., Cook S. R., Almond M. J. & Fulford M. G. (In press) Roman diet and trade: evidence from organic residues on pottery sherds recovered at the Roman town of Calleva Atrebatum (Silchester, Hants). *Britannia*

Cook S.R, Clarke A.S & Fulford M.G (2005) Soil geochemistry and detection of early Roman precious metal and copper alloy working at the Roman town of Calleva Atrebatum (Silchester, Hampshire, UK). *J.Arch.Sci* 32 (5) 805-812

Cook S.R, Fulford M, Clarke A & Pearson C (2003) Soil geochemical analyses as an indication of metal working at the excavation of a house in the Roman city of Silchester (UK). *J.Phys IV France* 107 319-321

Allen, J. R. L., Fulford, M. G. and Todd, J. A. (2007) Burnt Kimmeridgian Shale at Early Roman Silchester, South-East England, and the Roman Poole-Purbeck complex-agglomerated geomaterials industry *Oxford Journal of Archaeology* 26(2), 167-91

Allen, J. R. L. and Fulford, M. G. (2004) Early Roman mosaic materials in southern Britain, with particular reference to Silchester (Calleva Atrebatum): a regional geological perspective *Britannia* 35, 9-38

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## The Team

There are so many people involved in Science@Silchester projects that we are in danger of missing people out with an attempt at a definitive list, however the main points of contact are:

- Dr Samantha Cook (Science@Silchester coordinator)
- Professor Michael Fulford (Director of the Silchester 'Town Life' Project)
- Amanda Clarke (Archaeology and Field School)
- Rowena Banerjee (PhD student and sampling coordinator for the excavation)

For further information please see the excavation website  [www.silchester.rdg.ac.uk](http://www.silchester.rdg.ac.uk) or contact Samantha Cook [s.r.cook@reading.ac.uk](mailto:s.r.cook@reading.ac.uk)