II. TOWNS AND HINTERLAND

ROADS AND LAND TRANSPORT

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1. Introduction

This section of the Tiber Valley Project focuses on the extensive evidence within the Tiber Valley of road building with a view to understanding the maintenance and improvement to the transport infrastructure by the state, communities and private individuals (corresponding to *viae publicae, viae vicinales,* and *viae privatae*). The cost of road building was considerable (20-24 sesterces per Roman foot), as was the maintenance. The project sets out to provide a dynamic understanding of the processes that produced the patterning of roads and paving materials found via field survey and incorporated into the British School at Rome Tiber Valley GIS database by Helga Di Giuseppe and Rob Witcher.

Roads and streets in the Tiber Valley were paved with either basalt blocks (*selce*) or in other less durable materials such as limestone. The use of materials appears at first sight to depend on the local geology. For example, the Via Salaria to Reate was paved in basalt and limestone according to the geology that it overlies or is adjacent to (Quilici 1994: 92). In the past, this common assumption equating the find of a material to the closest known point of quarrying has prevailed, based on a nineteenth century assumption by archaeologists and antiquarians that the quarries currently in use were in similar locations to those of antiquity (e.g. Kahane et al *PBSR* 23: 118, 158, assumed the Monte Maggiore quarry was the source for much paving on the Via Flaminia). At the heart of the project to date, has been a desire to test these assumptions of the archaeological literature: did the builders of roads depend on local materials? What distance were paving materials transported prior to use? What was the cost to communities/towns of road building? To achieve this objective, Dr Stuart Black and Josie Browning (Postgraduate Research Institute for Sedimentology, University of Reading) were brought into the project to develop a scientific methodology to analyse samples across the Tiber Valley.

2. Field work

In May 2002, samples of paving stones were taken from sites on the Via Amerina and the Via Flaminia and all possible geological sources across the middle Tiber Valley. The purpose of sampling these two roads funded by the Roman state was to examine the variation of sourcing from Malborghetto in the south to Ocriculum in the north on two roads that were viewed as a single entity. All sample points were entered into the Tiber Valley Project GIS.

3. Methodology

All samples were photographed, described and visually analysed on return to the laboratory. This process was vitally important as several visually different basalts were present in the sample collection. Twenty five representative samples from paving and source sites including the Via Flaminia, Via Amerina and Ostia were thin-sectioned to

30 microns, and analysed for distinctive similarities in mineralogy and crystalline structure (Fig. 1). Sixty five samples were analysed by X-ray fluorescence. The samples percentage total for all equated to 100% +/-2% clarifying a) the precision of the technique and b) the unaltered nature of the materials. The resulting data was then plotted on basalt discrimination diagrams. One of the most commonly used, the igneous discrimination diagram (Fig 2), utilises total alkali data ($Na_2O + K_2O$) against total silica (SiO_2; LeBas *et al.,* 1986). This shows that there are major geochemical differences between paving samples collected at different points in the Tiber Valley. The source samples (geological outcrops) were split into groups of similar characteristics (geochemical, mineralogical and visual). Potential sources for each group of paving stones were then identified.

4. Results

It was possible to accurately match the source of several paving stones laid in the Via Amerina and the Via Flaminia. The matches discovered by hand specimen, petrological analysis and confirmed by geochemical analysis are illustrated geographically in figures 3 and 4. Results indicated that the Via Flaminia has the largest diversity with respect to the range of basalts utilised as paving stones, including phonolites, tephrite-phonolites and phonolitic-tephrites. These were likely to have been obtained from different geographical sources. The Via Amerina mainly consisting of tephrite-phonolite basalts and appears to have utilised a smaller range of sources (based solely on the samples collected). This difference in the variety of sources utilised for paving materials may have a reflection on both the preference for materials during construction or simply those available locally. However, both roads, which pass over or near to many basalt sources, run no greater than 15-20 km apart (in the region of study). From the provenance determinations identified in Figures 3 and 4, it is possible to say with some certainty that the choice of Roman contractors for the construction of the Via Amerina and the Via Flaminia was not casual.

Based on previous literature, it has been assumed (commonly in antiquity (Laurence pers. comm.)) that Roman engineers typically utilised the nearest material source (Frederiksen & Ward Perkins 1957). This is clearly not the case within the Tiber Valley. Figures 3 and 4 suggest that a particular basalt 'occhio di pesce' (a porphyritic leucite rich basalt) in the case of samples V01/c, V02/c and their source S02/a were transported up to 40 km as well as being utilised locally. This huge distance certainly suggests that this source was particularly favoured above those available locally. Paving sample V02/c at Malborghetto may be assumed to be special for its crossroad position and 4-way arch, however, the fact remains that sources such as S02/e, S02/d, S02/f and S03/b which were a great deal closer (and already used in the case of S02/f for the Via Amerina) remained un-used. Further evidence that the convenient source was not always utilised comes from the Via Amerina. A source basalt location occurring within 1 km of the road itself was apparently disregarded. Similarly, sample S02/g from just north of Settevene is geochemically different from any of the paving sample taken nearby. This evidence supports that Roman contractors may not of been pre-occupied with utilising the convenient source.

It is not possible to state that any specific basalt groups had better road building properties, or that they were easier to cut or transport. In the case of Malborghetto, certainly at Ocriculum and at the Roman settlement of Falerii Novi, the use of the heavily porphritic leucite basalts was greatly apparent. This may have been due to their aesthetic value as the stones are arguably decorative or to produce a gripping surface

(by the large crystals weathering out). Yet vast stretches of both roads were also paved in fine-grained varieties. In the light of this study, which has been successful not only for determining the provenance of basalt paving stones, it has been possible to establish that their must have been a preferential choice in the diverse assemblage of quarry sources utilised within the Tiber Valley, with respect to road construction.

5. Conclusions

It is possible to accurately identify the provenance of basalt paving stones within the Tiber Valley, with respect to the Via Amerina and the Via Flaminia. This provenance is distinguishable by using a multi–proxy analytical technique, in the case of this study, hand specimen, petrological and geochemical analysis.

The use of thin-section petrology as an individual tool for determining provenance has several flaws and cannot be interpreted with any degree of reliability if applied solely on its own. Rather, petrological techniques need to be supported by geochemical analysis as shown in this report.

The Via Flaminia has shown greater diversity of basalt types utilised for its surfacing stones in comparison to the Via Amerina. The Roman site of Ostia, pending the few samples analysed, has no diversity and all sample appear to originate from the same source (which remains unknown).

Roman contractors were transporting basalt paving materials up to 40 km as identified by basalts present at the southerly sampling site of Malborghetto, originating much further north at site S02/a. Contractors were also utilising the same source to pave adjacent road sections, indicating a preference for and continued use of the source.

During the paving of the Via Amerina the nearest sources were often overlooked for sources at a greater distance. The same statement can be applied to lengths of the Via Flaminia. This indicates that preference of choice overrides convenience at several sites within the Tiber valley.

It is possible to suggest reasons for the choice of hand specified basalt groups, however these remain assumptions and are in need of further investigation.

It has been possible to design hand specimen groups with complimenting petrological and geochemical specifications as a field guide for use in non-scientific studies. This guide will greatly aid field expeditions.

This study has greatly extended the limited information available on the Roman roads of the Tiber Valley, as well as extending previous assumptions as to the utilisation of paving materials, and will go some length to complimenting current research projects underway in the region.

6. Future work

A successful application for an ESRC/NERC PhD studentship was made in 2002 to enable Josie Browning to undertake further work on sites from Ostia to Ocriculum, and to build up a larger database to support the conclusions of the fieldwork undertaken to date. It is anticipated that a more quantitative approach will be applied to the problem in the future.

7. Publications related to this project

Frederiksen, M.W. and Ward Perkins J.B (1957) The Ancient Road Systems of Central and Northern Ager Faliscus. (Notes on Southern Etruria, 2). *Papers of the British School at Rome* 25: 67-205.

Jones, G.D.B. (1963) Capena and the Ager Capenas. Part II. *Papers of The British school at Rome* 31: 100-169.

Laurence, R. (1999) *The Roads of Roman Italy, Mobility and Cultural Change*. London, Routledge. [Chapters 1-5; pp1-77]

Peacock, D.P.S. (1980) The Roman millstone Trade: a petrological sketch. *World Archaeology* 12 (1): 45-53.

Shaw, C.S.J (1996) The petrology and Petrogenesis of Roman Province-Type Lavas and Ultrapotassic Leucitites. In R.H. Mitchell, *Undersaturated Alkaline Rocks: Mineralogy, Petrogenesis, and Economic Potential* 24: 175-192 [chapter 8]. Mineralogical Association of Canada.

Williams-Thorpe, O. (1988) Provernancing and archaeology of roman millstones of the Mediterranean area. *Journal of Archaeological Science* 15: 253-305.

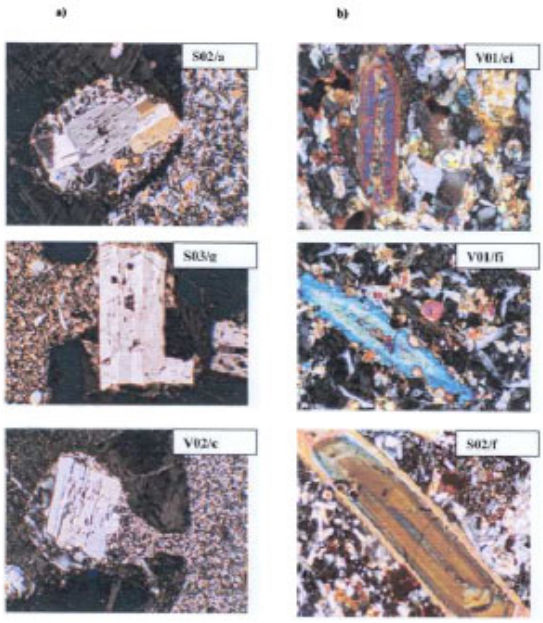

Fig 1 This set of photomicrographs indicates the similarities in mineralogy and crystalline texture between both sets of samples a) and b) which aided the determination of provenance.

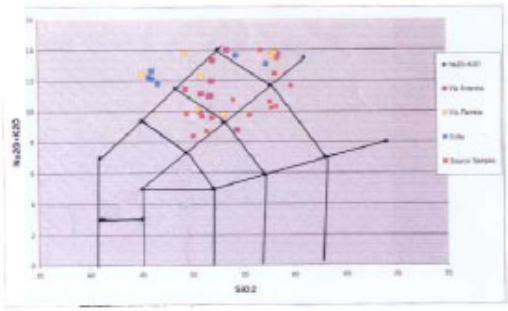

Fig 2) An example of a Total Alkali Vs Silica discrimination diagram including all sample plots grouped according to their origin.

Both arrow sets do not represent transportation paths for paving material, however they do represent provenance matches between sampling sites.

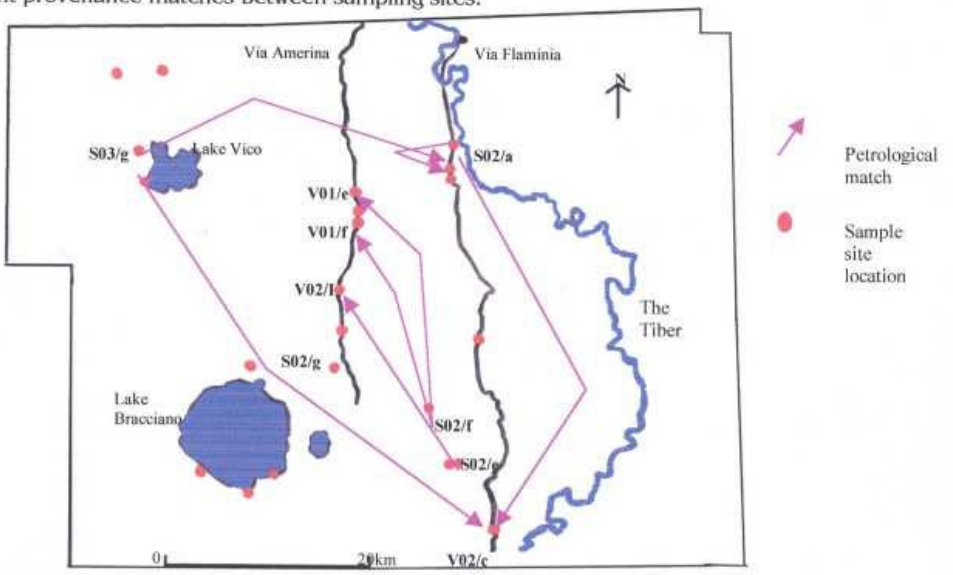

Fig 3 Simplified plan of the Tiber Valley indicating sampling sites (red) with arrows representing the paving and source sample matches determined by petrological thin-section analysis.

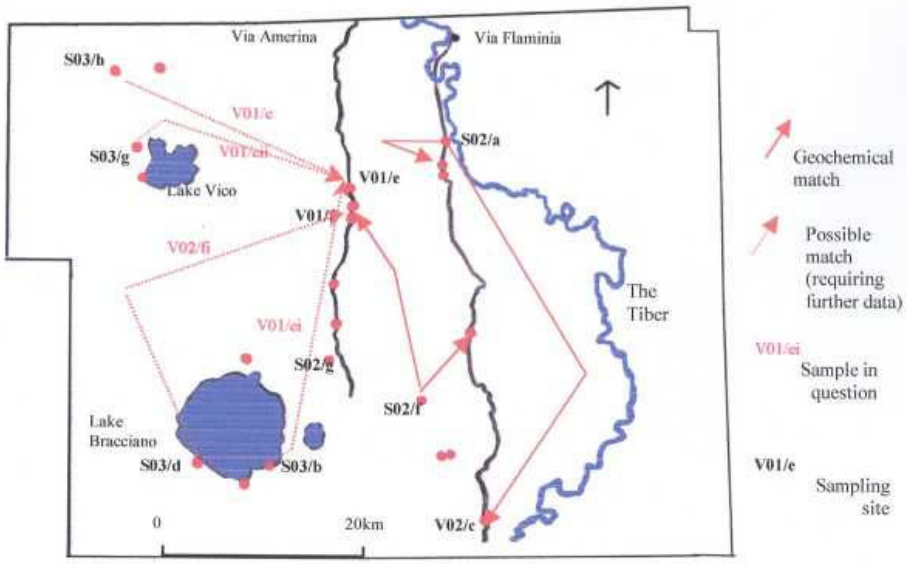

Fig 4 simplified plan of the Tiber Valley indicating the geochemical matches between samples from source areas and paving sites. The solid arrows indicated firm geochemical matches, those with dashed arrows indicated likely matches requiring further data.