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GIS and Artefact Distribution: A Case Study on Regional Cooking Wares in Northern Gaul

Annick Lepot

Introduction

Researchers are now confronted by new technologies like Geographic Information Systems ("GIS"), but the difficulties in using such tools in archaeological interpretation are numerous. GIS offers a way of moving interpretation beyond 'black dots on a map' by placing settlements or artefacts in their geographical, socio-political and cultural contexts.

Artefacts, such as consumption goods, can provide information about socio-cultural contexts, exchange patterns and mechanisms. In artefact studies, GIS can be used as a precise cartography tool which allows the re-interpretation of data collected on consumption sites. However, behind the finished maps lies a great deal of work collecting and reflecting on the data before it is used in the software, in order to avoid producing completely unusable maps. GIS can produce visually spectacular maps, but not always intellectually elaborate analysis. This paper explores the importance of GIS as an analytical tool in the understanding of artefact distribution, through an examination of regional cooking wares in areas of Northern Gaul.

GIS and artefacts

Geographic Information Systems are computer programs which integrate operating procedures to store, manipulate, analyze and visualize spatial information. GIS in archaeology can work at different levels, from a micro level for intra-site studies to the large scale distribution of settlements (for more details of GIS and archaeology see Lock and Stancic 1995; Maschner 1996; Kvamme 1999; Wescott and Brandon 2000; Harris 2002; Wheatley and Gillings 2002; Conolly and Lake 2006).

Intra-site distribution studies are characteristic of current research that combines GIS-use and artefact distribution , focusing on the spatial analysis of objects across a site. The objective is to geo-reference artefacts on archaeological sites in order to determine functional zoning. This is an ideal approach for prehistoric habitat reconstruction (Spikins *et al.* 2002; Williams 2004) or underwater archaeological excavations (Oxley 2001; Mather and Watts 2002). An extension of this application is to create an on-site geo-referenced database for archaeological artefacts (e.g. Zahab and Sawada 2005). GIS also has great potential within rescue archaeology, and in archaeological surveying, to map the distribution of artefacts and define the archaeological potential of an area or site.

However, the main use of GIS-based analysis for artefacts is probably in visualizing their relationships with political boundaries, socio-economic contexts and environmental factors within a large region. More than just indicators of the economy, artefacts can inform us about the cultural preferences of the populations who produced and used them. Using GIS to map artefact distribution has been used effectively by Anglo-Saxon scholars such as Jason Lucas (2001) on the distribution of Roman military sites and stamped brick and tiles, whilst Allison (2006) has examined the distribution of 'gendered' artefacts at Roman military sites.

GIS and artefact distribution in Northern Gaul

The research presented here is a case study of GIS use in artefact distribution research. This paper is related to studies undertaken by the Centre de Recherches d'Archéologie Nationale (CRAN) of the Catholic University of Louvain-la-Neuve (Belgium) on Gallo-Roman civilization in Northern Gaul, principally Gallia Belgica. Whilst this is not the place to discuss the concept of Romanisation (e.g. Woolf 1992; 1997; Hingley 2005), this study forms part of the debate about the diversity within the overall unity of the Empire and further explores the evidence for cultural multiplicity beyond a simple Roman/native dichotomy.

The study focuses on geographic areas of countryside within about thirty kilometres of three cities in Belgium and France: Tongres, Bavay and Tournai (Fig. 1). The borders of the mapped areas were defined on the basis of modern Belgian communes and French Cantons.The zones cover sections of four *civitates* territories; the *civitas Tungrorum*, the *civitas Nerviorum*, the *civitas Menapiorum* and a small part of the *civitas Atrebatum*. This geographic framework and the use of GIS allows for more detailed studies than previously, providing a new interpretation of space.

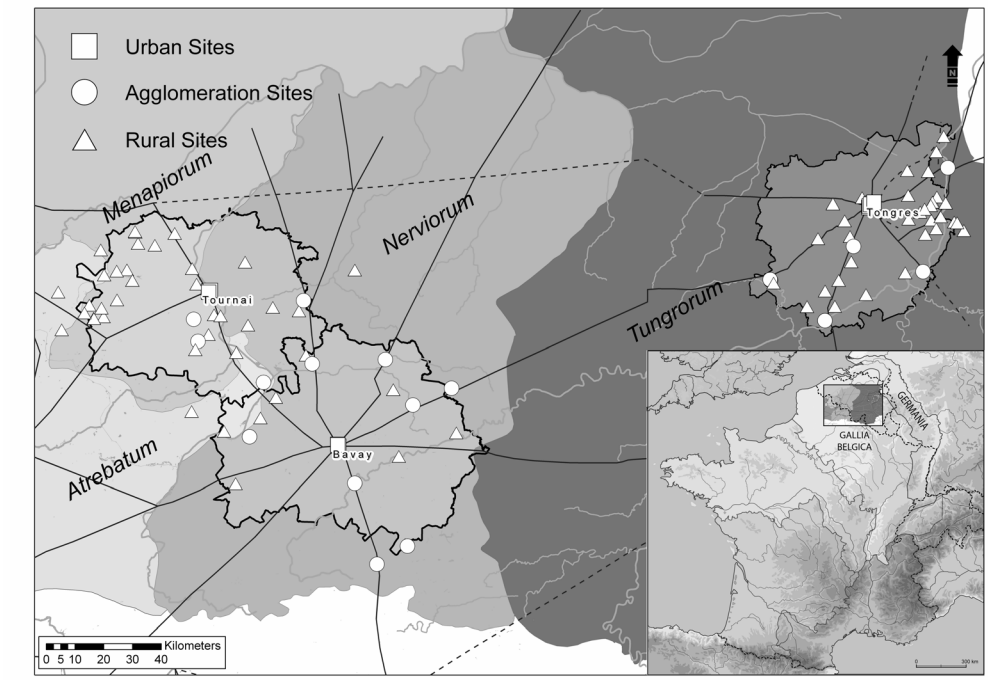

Figure 1: Location of the areas under investigation. The plots represent sites with potential for pottery studies (square: urban sites, circle: agglomeration sites, triangle: rural sites).

The overall collective project explores the process behind, and the impact of, Romanisation in Northern Gaul within both urban and rural contexts. Its objectives are to understand landscapes, land use, and the density, chronology and typology of settlements within the regions. The research project also aims to identify the timing of the infiltration of a variety of

Roman habits into daily life (e.g. architecture and material culture), and to understand the relationships between towns, agglomerations and the countryside, through exchange patterns relating to the production, distribution and consumption of goods such as pottery and food (Lepot 2008). The overall project has an archaeological catalogue as a relational database imported into GIS (for a synthesis of GIS and DBMS software in archaeology see Djindjian 1998), thus creating A.P.I.S., the Archaeological Project of Interconnected Studies for Roman Northern Gaul. A.P.I.S. is kept up-to-date through the use of an electronic user input form, onto which researchers can enter data whilst they work. Through this approach a systematic register of Roman sites in the three regions has been created, integrating many different types of information. These include location coordinates, occupation phase, site type, structure type, description, type of excavation, author of the excavation and bibliography. This archaeological database project connects the varied fields of study on Romanisation in Northern Gaul, linking different databases relating to villa sites, functional zoning within cities and agglomerations, and especially pottery.

Specificity of pottery studies

The artefact study in progress at CRAN focuses principally on pottery, as it is the most abundant archaeological material. The aim of our pottery studies is to move beyond the limited view that pottery is only useful in dating a site or exploring economics (Hawthorne 1997, Hawkes 2000; 2001), to explore other avenues such as the regional economy, socio-cultural contexts, pottery supply and demand or phenomena relating to consumption and food habits. Regional ceramics – particularly cooking wares – are an ideal pottery class through which to examine artefact distribution. Often overlooked in pottery studies, cooking wares are good indicators of the degree of dissemination of Roman material culture, the persistence of indigenous pottery use and the creation of a new repertory. Due to their technical and typological characteristics, and because they are less affected by fashion trends, this category of pottery has many advantages in the study of acculturation.

The method of analysis of sherds from consumption sites is based on the model defined by the CRAN Ceramic Laboratory. On the basis of technological and typological characteristics, the main ceramological categories of Northern Gaulish cooking wares have been defined for the three regions. Briefly, the most important categories are: Modelled Cooking ceramic (MC), Reduced Cooking ceramic (RC), Oxidized Cooking ceramic (OC), Smocked Cooking ceramic (SC) and Colour-Coated Cooking ceramic (CC) (Fig. 2). Modelled cooking wares are traditional pre-Roman cooking ceramics fired at low temperatures and presenting coarse inclusions. Reduced Cooking wares were an evolution of traditional cooking ceramics, integrating Roman technological innovations such as throwing and firing at high temperatures, but in a reducing atmosphere. Oxidized cooking ceramics present the same technological innovations but were fired in an oxidizing atmosphere. Smocked Cooking ceramics are a category within which the wares present a smocked surface and an oxidized matrix, an effect due to a particular post-firing atmosphere (Picon 1973: 67). Finally Colour-Coated wares, which appear to have been a marginal phenomenon, present an argillaceous glaze and an oxidizing firing.

Sherds were examined at macroscopic level and attached to paste groups before undergoing petrological examination, which identifies particular fabrics attributable, in certain cases, to individual workshops. This analysis was followed up with reference to published typologies, where available, and the total number of pots was identified through sherd counts and the

estimation of the Minimal Number of Individuals (MNI), based on counting the number of rims. The study model is based on examination of sufficiently well-dated pottery assemblages. These assemblages were collected from publications, old excavations and current researches, and have been classified by chronological horizons through the analysis of whole ceramics, context, and other supporting data such as coin issues (for chronological horizons valid in Northern Gaul see Brulet 2008: 20–21).

Figure 2: The main ceramological categories represented within the site assemblages:(from left to right) Reduced, Oxidized, Smocked and Modelled cooking ceramics.

In the field of ceramology, GIS offers a significant deviation from the more traditional approaches of find-spot maps, providing a tool to search and map spatial queries based on pottery categories, pottery fabrics or pottery types. Three factors can expand our understanding of the distribution of pottery. The first is the recognition of ceramological categories, where maps can characterize a particular ceramic supply to the different sites. The second factor is the recognition of pottery types, with maps representing the areas where particular types were in use. The final factor is the differentiation of pottery fabrics, and maps based on this factor represent the diffusion of a particular kiln production. If the production centre is not localised, such maps can define an area where a particular fabric is strongly represented and, in certain cases, associations with a geological outcrop.

To link the ceramic form in the A.P.I.S. database with the site data, each assemblage was identified by both site and trench locations. The objective in using GIS technology in Roman pottery studies is to generate a computer-based system that allows researchers to carry out a series of spatial analyses. The system can be used to view ceramic distributions according to culture, group, time period and/or region in relation to historical, political, cultural or topographical contexts, as well as soil types. A map plotting the ceramic types can then chart local, regional and supra-regional movements, or identify homogeneous cultural groups.

Possibilities and limits of GIS-use in pottery artefact distribution

According to Ressler (1989), GIS analysis demands a structure consisting of problem definition, data acquisition, data manipulation and report or map generation. Creating a database is not difficult in itself, but the researcher must be aware of the final objectives of the research in order to create the appropriate fields. What types of requests are needed, and which questions should be answered? Limitations with GIS are also due to the current state of research and the specific characteristics of pottery. The first problem is with data

standardization. The difficulty in compiling fully quantitative distribution maps from published sources is well known (Orton *et al*. 1993). Difficulties also lie in non-standard vocabularies, reports without quantitative analysis or with minimal study of ceramic fabrics. The second problem is time management. Geographic Information Systems cannot manage the fourth dimension, so that the only way to deal with the temporal is at a thematic level, by creating diachronic maps using chronological periodization. Another primary difficulty with the application of GIS to pottery studies is the multiple expressions of pottery. In order to analyze the material successfully, the researcher needs to classify it into ceramological categories, paste groups, fabrics, types or functions. All these aspects are important in analyzing sherds, so must be integrated within the GIS database before creating a map. The final difficulty is linking GIS visualization with quantitative analysis. Quantity of ceramics is an important factor in comparing sites, and the plotting of pottery does not mean that there will be the same percentages at each site.

Mapping cooking wares

In total, data were analyzed in a homogeneous way for twenty percent of the sites. These assemblages enable comparisons both within a site and between sites. The initial results below are based on three simple models of GIS-based requests. The first model illustrates the supply of sites based on the proportion of different ceramological categories. The second model illustrates the regional specificity through the technological aspects of fabrics. The final model illustrates regional characters based on typological patterns.

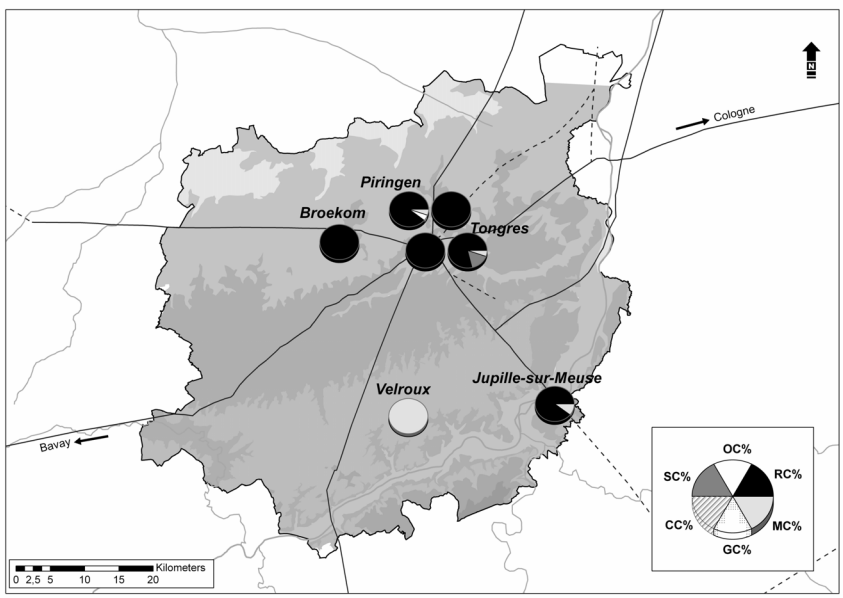

Figure 3: First century A.D. pottery assemblages in the area of Tongres.

The GIS-based maps are the result of information regarding the percentage of MNI of each ceramological categories. In the Tongres areas, both urban and agglomeration sites evolved in the same way, with assemblages from Tongres (Vanderhoeven *et al.* 1992; 2006) and Jupille-sur-Meuse showing Reduced Cooking ceramics predominating over traditional Modelled wares from the pre-Flavian period (Fig. 3). In contrast, Reduced Cooking ceramics appear on rural sites, such as the *villae* at Piringen and Broekom, slightly later during the second half of the first century A.D.

In the areas of Tongres and Bavay-Tournai, the cooking ware supply shows a difference at second century A.D. sites. Within the Tongres area, the pie charts (Fig. 4) show a multiplicity of different cooking ware production techniques, with Smocked ceramic prevailing. Smocked ceramic is characteristic of the *civitas Tungrorum* and appeared during the last decades of the first century A.D. Oxidized Cooking wares also appear on sites at the end of the first century and then increase in number, particularly in the second century A.D. assemblages from the villa at Velroux. Oxidizing firing applied to cooking wares is also attested for production in the second century A.D. at Cologne (Höpken 2006: 115).

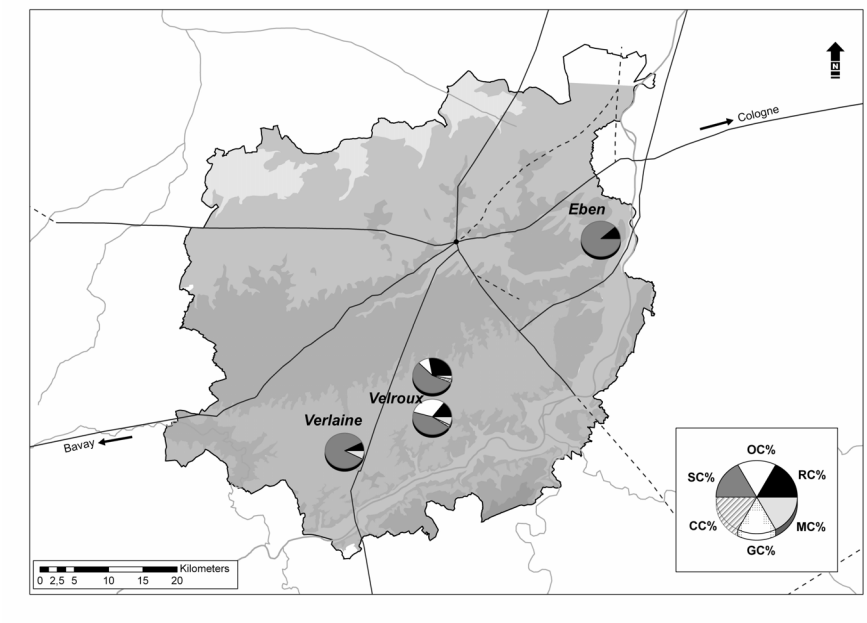

Figure 4: Second century A.D. pottery assemblages in the area of Tongres.

During the third century A.D., the assemblages from sites in the region of Tongres underline the preference for Smocked Cooking ceramics, with assemblages from Tongres and the agglomerations of Braives and Amay, as well as rural sites, being dominated by this category (Fig. 5). The map shows that Oxidized Cooking ceramics are well represented on sites located along the River Meuse, which suggests that the river had an important role in the diffusion of pottery goods.

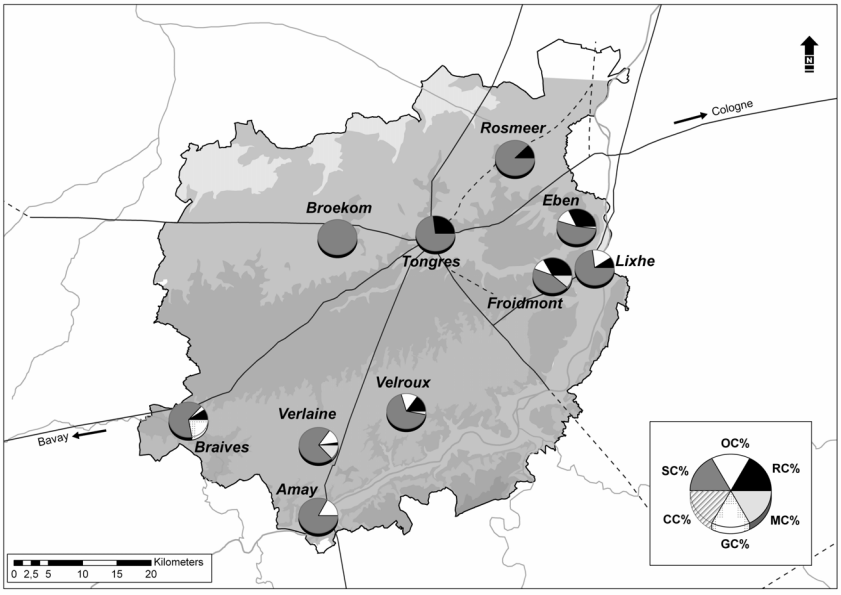

Figure 5: Third century A.D. pottery assemblages in the area of Tongres.

The two remaining study areas of Bavay and Tournai indicate a consistent level of continuity. Both places were supplied with Reduced Cooking ceramics during the second century A.D., which prevailed over Modelled ceramics (Fig. 6). This pattern may suggest that these areas retained a tradition of, or preference for, pre-Roman dark aspect cooking wares.

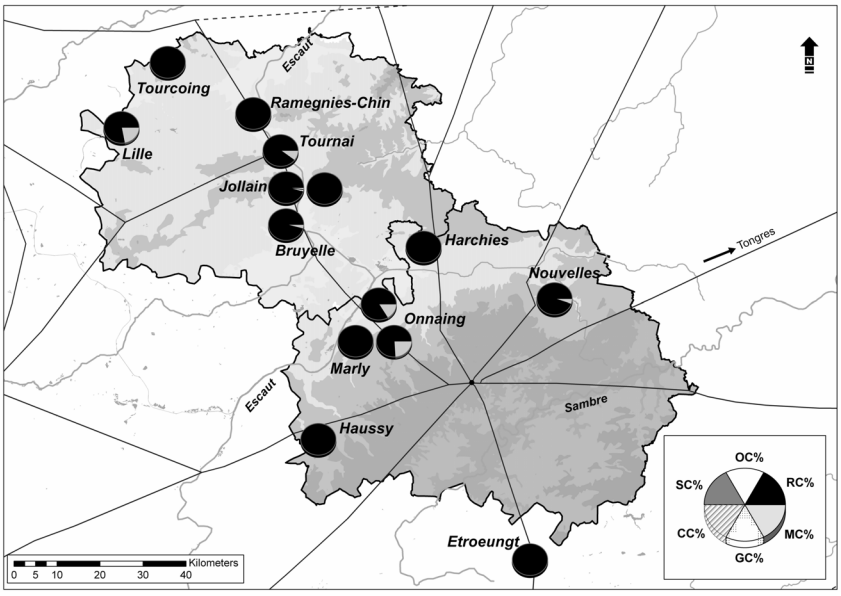

Figure 6: Assemblages of the second century A.D. in the areas of Tournai and Bavay.

The first occurrences of Smocked Ceramic within the Bavay and Tournai regions were during the third century A.D. in the agglomeration site of Waudrez, and in rural contexts such as Merbes (Fig. 7). Examination of the sherds shows that they were importations from *civitas Tungrorum*. Based on a movement from east to west, this dispersion pattern follows the Roman road connecting Bavay to Cologne and the river Sambre, which flows into the Meuse.

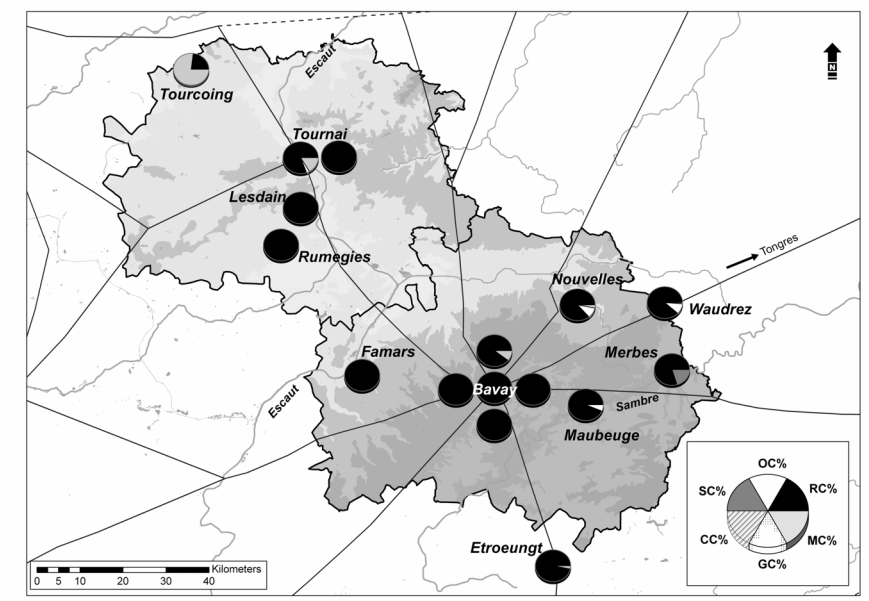

Figure 7: Assemblages of the third century A.D. in the areas of Tournai and Bavay.

Technological characteristics of pottery, especially cooking wares, are significant in understanding production, exchange patterns and exchange mechanisms. It is now well demonstrated that Gallo-Roman potters applied new technologies to produce wares with specific technological characteristics, such as shock resistance or thermic resistance (Picon 1997, Desbat and Batigne 1996). This can be identified in the study of cooking ware, as its use requires resistance to both environmental factors and high temperatures. For example, kaolin-type clays, used in the production of Roman cooking wares, are a shock and heat-resistant raw material (Picon 1992–1993). During the third century A.D., the sites in the Tongres area show that several productions of both Oxidized and Smocked ceramics were made from white pastes, similar to kaolin-type clays, which correspond to the MOSA fabric from the *vicus* of Liberchies (Vilvorder 2001: 121–122). The distribution of this fabric type (Fig. 8) shows a strong representation at rural sites within the Meuse valley and in the agglomeration sites located along the river, suggesting that both production and diffusion were closely related to the river or to the Meuse valley. The only Roman workshop so far attested within this area which produced Oxidized cooking wares using kaolinitical clays was located at Amay, but its diffusion is quite limited (Vilvorder and Rekk in press). The link between this type of clay and the Meuse valley is further supported by the presence of kaolinitical outcrops, more common in this geographical area than in the more sandy northern part of the *civitas Tungrorum* (Calembert 1945).

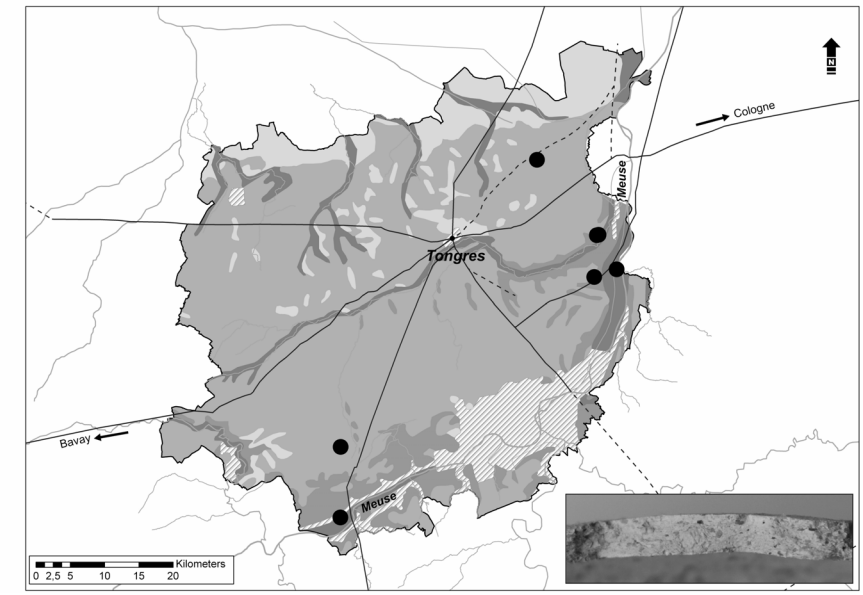

Figure 8: Sites with assemblages having more than 50% MNI of the cooking wares in MOSA fabric.

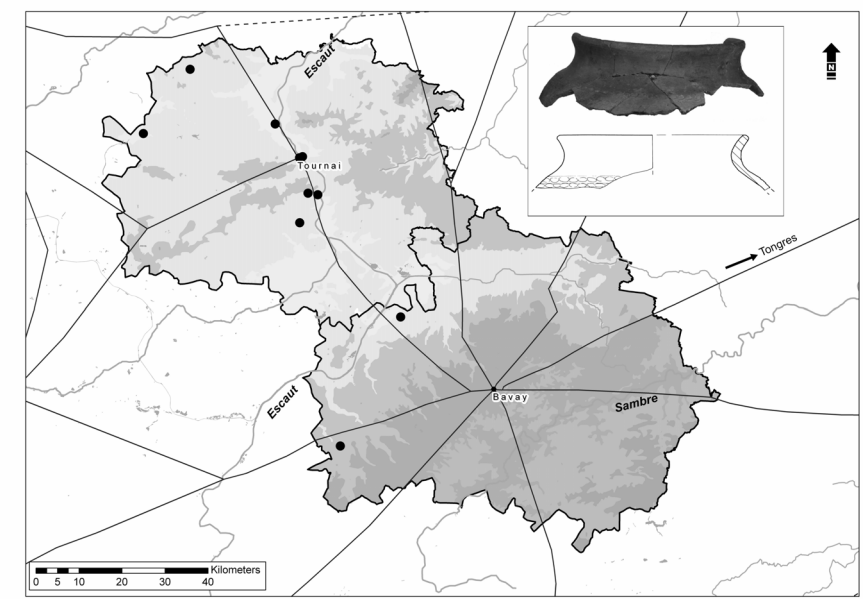

Figure 9: GIS map recording the presence of the Reduced ceramic "Menapian" cooking pot during the second century A.D.

Ceramological studies are increasingly focused on understanding population groups or boundaries through the definition of *facies. Facies* means the appearance of an object group and reflect its morphological, technological, regional and/or chronological coherence (D'Anna

et al. 2003: 277; Lepot and Brulet 2007). The definition of ceramological *facies*, as a homogeneous regional sequence of ceramics, allows areas of expansion or cultural interaction between population groups to be identified. These *facies* can be defined on the bases of typology, with specific types representing a population group. The adoption of Roman forms and the creation of new repertories are indicators of the acculturation or assimilation of Roman habits. This assimilation is perceptible in cooking wares through the use of Roman techniques, such as throwing and improved firing, whilst still preserving indigenous traditional forms. Fig. 9, for example, shows the diffusion of the "Menapian" globular cooking pot, derived directly from an indigenous type (Vermeulen 1992), but produced using the Roman technique of Reduced ceramic. The GIS mapping of this pottery type shows a concentration within the eastern part of the *civitas Menapiorum* territory and at the sites situated along the River Escaut and its tributaries, suggesting that the river created a natural frontier which corresponded to the *civitas* territory limits.

Conclusion

The effect of Romanisation on the northern provinces of the Empire can be seen through different themes, including economic and architectural changes, or through the variation in material culture. The use of GIS in mapping these changes requires confidence in its applicability to the strand of artefact research being undertaken on an inter-site basis. By developing GIS at a regional level, the objective is to create a dynamic reading of regions by combining social, cultural, environmental and material data. Whilst the difficulties of GIS, outlined above, and the problem of time and monetary constraints in training archaeologists to handle the new technologies, are a current limitation, the benefits of GIS are evident. The use of GIS in artefact distribution, particularly pottery studies, provides a tool to test ideas or models, and the acquisition and creation of the data layers allows a more detailed interpretation of spatial, economic and cultural relationships. Archaeologists must first collate the data, frame ideas and then test them to find out if they are correct. The 'reality' of the maps depends on the state of research, number of sites and scales of analysis, as determined by the researcher. If these factors are taken into account, GIS holds exciting possibilities for further understanding cultural variation within the Roman Empire.

GIS can help bring out the regional patterns in pottery consumption. The effects of Romanisation are not uniform within these three regions and the differences in ceramological categories, fabrics and typology, highlighted in this paper, underline the regional variation. The specificity of ceramics in the Tongres region appears to be a consequence of the influence of the Rhenan Limes, which reached this area early and had a large impact on the technological and typological evolution of cooking wares. In contrast, the regions of Bavay and Tournai, geographically closer to one another and with a pre-Roman cultural background deeply rooted in the *civitas Menapiorum*, evolved under more diverse influences. Moreover, these GIS-based samples clearly show the importance of the topography, whether it is rivers or roads, in the production, distribution and consumption of pottery. Further GIS research will be focused towards identifying distinctive local identities through pottery, as well as the exchange patterns and mechanisms, which characterize these regions of Northern Gaul.

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