Medieval burial and the necessity of stratigraphy

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Abstract

In 1994 a plan to redevelop the site of St Mary Spital in London was established and a large-scale excavation programme began in 1998. The main area of the site was approximately 10 acres (4 hectares) in size and the resulting archaeological investigations uncovered over 10.000 medieval burials. The volume of burials required a modification to the usual methods for the capture of spatial data. By combining the osteological and spatial data via GIS it was possible to answer key questions about the site. The GIS-map revealed the position of former building and a network of pathways through the cemetery and it became clear that the mass burial pits which were focused at the southern and eastern boundaries of the cemetery stemmed from a period of famine, the result of crop failures due to short-term climate change triggered by a massive Volcanic eruption in the 13th century. The combined results of the stratigraphic information and the radiocarbon dating enabled the identification of four, well-dated chronological phases. When, in 2007, the large-scale excavation of the medieval St Peter's cemetery in Berlin began, the excavators could build upon the MOLA concept, developed for St Mary's Spital. The remains of 3.717 individuals were recorded, based on the adapted MOLA recording scheme, and lifted from the ground. An international research program has now been set up, to enable the comparison of the structure of the population and the living conditions in medieval London and Berlin.

Zusammenfassung

Ab 1998 wurde der Friedhof des Londoner St. Mary-Hospitals mit mehr als 10.000 mittelalterlichen Bestattungen durch das Museum of London Archaeology (MOLA) ausgegraben. Die zügige Erfassung der Gräber und die Auswertung der umfangreichen Daten erforderte die Entwicklung neuer, innovativer Dokumentationsansätze. Für die Verbindung der Feldmessdaten mit den archäologischen und anthropologischen Sachdaten wurde ein Geografisches Informations-System (GIS) aufgesetzt. Dabei zeigten sich Wege und Standorte von Gebäuden auf dem Friedhof und es wurde deutlich, dass die Massengräber im südlichen Bereich des Friedhofs auf Phasen der Mangelernährung zurückzuführen waren. Die Phaseneinteilung der Gräber wurde mittels Radiokarbondatierungen gestützt, nach einem Entnahmeschema, das seitdem weiter sehr erfolgreich angewendet. Als 2007 die Ausgrabungen auf dem Berliner Petri-Kirchhof begannen, konnte strategisch auf das Londoner Konzept aufgebaut werden. Innerhalb von drei Jahren wurden so die Gebeine von 3.717 mittelalterlichen Menschen umfassend dokumentiert. Im Rahmen eines internationalen Forschungsprojekts sollen die mittelalterlichen Londoner und Berliner nun miteinander verglichen werden.

Introduction

The medieval priory of St Mary Spital lay on the east side of Bishopsgate, immediately north of the medieval city wall. This Augustinian priory was founded in 1197 by a group of merchants. Enlarged in 1235 it became the largest hospital in London, caring for the elderly, sick and infirm, the poor, pilgrims, and women in childbirth until its dissolution on 1st January 1539. The priory complex included a church, charnel house and an open air pulpit – St Paul's Cross. The area was then partially built over for housing for minor members of the aristocracy, whilst the remaining lands became an artillery ground. In the 17th century the area became the site of the Spitalfields market, which by the early 20th century was a thriving fruit, vegetable and flower market housed in a purpose-built development.

This paper outlines the methods which have been used in the context of the St Mary Spital excavation, focussing on a stratigraphic approach which MOLA use for all the urban environments in which we work and on how we can use this stratigraphy to phase the site and to create a meaningful narrative, through the combined use of GIS and absolute (radiocarbon) dating. It outlines examples of how the tight dating of the phases of use on the site then enabled questions to be addressed which would otherwise have been impossible, and how the novel use of GIS has enabled questions to be asked rapidly and interpretative 'dead ends' equally rapidly written off.

In 1994 a plan to redevelop the site of St Mary Spital was established and, in advance of this and following a series of smaller archaeological interventions and desk-based assessments during the 1980s and 1990s, a large-scale excavation programme began in 1998. The main area of the site was approximately 10 acres (4 hectares) in size and the resulting archaeological investigations uncovered Roman and post-medieval remains, the east wall of the medieval priory church, a well-preserved charnel house (which still remains in situ and can be viewed through a glass floor in the modern development) and over 10.000 medieval burials. In addition to those whose burials formed part of a normal attritional cemetery, 143 large burial pits containing multiple interments were revealed. The subsequent programme of developer-funded analysis and publication examined in detail the remains of 5.387 of these burials including 2.300 of those who had been buried in mass graves. As the largest group of medieval burials recorded in Europe, they form an invaluable comparative sample.

Using spatial data and GIS

The volume of burials encountered presented the excavation team with a number of logistical issues and required a modification to the usual methods for the capture of spatial data. The team of archaeologists did not have sole occupation of the site and had to be able to move quickly. Traditionally the excavator would hand-draw plans of each skeleton at a scale of 1:10 and grave cuts at a scale of 1:20. This information would then be sent back to the office and each separate plan would be digitised. The plans would be accompanied by vertical photographs of the grave. Such methods enable detailed recording and reconstruction but are relatively time consuming. Thus, each skeleton was digitally photographed and a total station (electronic theodolite) was used to record three points on the skull, three on the pelvis and the proximal and distal ends of the limb bones, in three dimensions. This work was carried out by a roving team of expert surveyors, who could be called upon by the excavators when each burial was ready for recording.

Once this electronic data is captured, it is then possible to use GIS to derive other products. A box can be taken around the data for each skeleton to produce a point, useful for simplifying the display and enabling the examination of spatial distribution and density. Finding the centre of each bone, it is possible to fit a regression curve through each line, which enables burial orientation to be examined. Idealised grave outlines were also generated, a useful interpretative tool when real grave cuts were not always visible in the intensively used areas of the site.

Dating the cemetery

Excavating complex cemetery sites using the single context recording system provides detailed stratigraphic data which enables the burials to be phased relative to one another. However, with Christian burials of medieval date there are usually few artefacts interred with the individual which would allow date parameters to be accurately established, even more so when many of the individual had been interred rapidly in mass graves. Thus it was clear that, whilst GIS could be used to assist in the creation of separate phases within the cemetery, to capitalise on the potential of this extraordinary dataset, a targeted programme of radiocarbon (^{14}C) dating would be required. A team from English Heritage designed this programme using a Bayesian approach, enabling accurate dating from the minimum number of samples, keeping costs down and avoiding gratuitous destruction of human remains (Sidell e.a. 2007, 594). The combined results of the archaeological (stratigraphic) information and the radiocarbon dating enabled the identification of those individuals who might have been incorrectly phased and placed the burials into four, well-dated chronological phases through destructive sampling of just 61 individuals, and with an overall accuracy of 84% (ibid., 605). The analysed sample of 5.387 burials were therefore subdivided as follows: c. 1120–c. 1200 (512 individuals); c. 1200–1250 (1.390 individuals); c. 1250–c. 1400 (2.835 individuals) and c. 1400–1539 (650 individuals) (Connell e.a. 2012).

To further test the possibility that a dietary offset (the result of the so-called marine reservoir effect) had influenced the dating. Three alternative models were investigated based on: an entirely terrestrial model, an offset of 10 +/-5% marine carbon and an offset of 20 +/-5% marine carbon. The results demonstrated that even with the possible variance introduced by diet, the phasing model was unlikely to be significantly wrong. This was also supported by dietary isotope results which suggested that marine fish did not form a significant component of the foods which the medieval population of London had eaten (Sidell e.a. 2007, 606).

The Bayesian approach to radiocarbon dating, pioneered at St Mary Spital, has since been used to accurately date early Neolithic causewayed enclosures in Britain, establishing a new chronology which is far shorter than previously believed (Whittle e.a. 2011).

London's catastrophic burials in a global perspective

The 143 mass burial pits uncovered during the archaeological excavations at St Mary Spital were focused at the southern and eastern boundaries of the cemetery. Clearly such burial practices are a response to an event or events that resulted in the break-down of the social and funerary norms, with strangers interred together in the most expedient fashion, albeit not without care as indicated by the supine and extended nature of the remains. The immediate assumption was that they were plague pits, associated with the Black Death of 1348/49. However, burial pits were found throughout the period of the cemetery's use, and the targeted programme of radiocarbon dating enabled the two major phases of pits to be dated to 1200–1250 and 1250–1400. The first phase consisted of medium-sized rectangular pits containing between 8–20 people; the second phase consisted of larger square pits containing between 20–40 people. Furthermore, the careful stratigraphic excavation of these pits showed that the second phase of burials occurred sufficiently shortly after the first phase to result in the disturbance of fleshed remains, as where the pits intercut, articulated limbs from the early phase could be found within later pits. Radiocarbon dating focussed specifically on the pit burials suggested that the two phases fell between: 1230–1260 (95% probability) or 1235–1255 (68% probability) (Connell e.a. 2012).

The combination of the stratigraphic approach and the use of Bayesian analysis to refine the radiocarbon work, clearly indicated that the burial pits were not a response to that most infamous of medieval catastrophes, the Black Death and the team at MOLA began to look for another possible cause. In the late 1250s and early 1260s, a series of cold spells, unseasonable rains and unusual astronomical events were noted (Connell e.a. 2012). This short-term climatic change caused poor harvests across Europe. For London, the worst of these events took place in 1258 when *"the north wind prevailed for several months, and when April, May, and great part of June were over, scarcely a small rare flower or shooting germ appeared, whence the hope of harvest was uncertain. […] innumerable multitudes of poor people died, and their bodies were found lying all about swollen from want, and livid, five or six together, […] Nor did those who had homes dare to harbour the sick and dying, for fear of infection, […] the pestilence was immense – insufferable; it attacked the poor particularly. In London alone 15.000 of the poor perished; in England and elsewhere thousands died. The nobility distributed bread on certain days in London […]. The rich only escaped death by purchasing foreign grain [...]"* (Farr 1846, 161).

Clearly, the resulting toll of this period of famine provides the most logical explanation for the mass burial pits at St Mary Spital, but it also provides an unexpected global connection and demonstrates how understanding the stratigraphic, and therefore dating, relationships on an archaeological site can enable local events to be interpreted in a global perspective. Volcanologists have noted that around 1258 the largest eruption of the last millennium occurred somewhere in the tropics (Crowley 2000). The eruption was so large that it resulted in significant climatic variation in Europe, leading to agricultural crises and from that to famine. The mass burial pits at St Mary Spital are therefore a response to a volcanic eruption (Connell e.a. 2012). Without the combination of stratigraphic excavation and radiocarbon dating, the parameters of the cemetery would have simply been that the sample dated from the late 12th to mid 16th centuries and the natural conclusion would have been that the mass burials did result from the Black Death.

The osteological database

The osteological information was recorded into a bespoke database, created to enable the rapid and accurate capture of detailed skeletal information, and designed so as to make the extraction and analysis of that data as simple as possible. In order to ensure the data integrity and speed of input validation rules were enforced wherever they could be applied and traits could only be recorded if they were appropriate to record (e.g. femur length could only be recorded if a femur was present).

The value of the simple data structure was to ensure that the creation of queries on that dataset is straightforward, thereby encouraging exploratory data analysis. The osteology system has three main components. The first (Catalogue) records details about the skeleton as a whole (Fig 3). This includes the context number (the key identifier by which all records are linked), the preservation of the remains, the name of the site from which they originate and its unique, alpha-numeric identifier (site code), and basic phasing and date information. The second (Level 1) contains a record of all the bones and teeth that are present; and the third component (Level 2) records the characteristics and traits exhibited by those bones and teeth. In addition, a pathology table is provided into which all observations of skeletal changes may be recorded using a combination of codes and written descriptions (Connell/Rauxloh 2003). The coded system enables easy search and retrieval of specific disease parameters, whilst the written descriptions provide greater detail.

By combining the osteological and spatial data via GIS it is possible to start to answer key questions about the site. For example, how did burial around the charnel house or the Pulpit Cross differ from elsewhere in terms of age, sex, or evidence of disease and what was the relationship between burial practice and the boundaries of the cemetery? Demographic queries quickly established that the area of the Pulpit Cross had been preferentially used for the burial of young infants. Of course GIS cannot answer why this was the case, but it enables the correct questions to be posed.

Stratigraphy and GIS

In addition to a super-abundance of osteological data, the Spitalfields project had a great deal of stratigraphic data. This is common with most urban excavations, where many, concentrated phases of human activity are super-imposed onto a relatively small area. Indeed the compressed nature of city excavations was well demonstrated at Spitalfields, where there were more than 10.000 burials occuring in no more than 2 m of ground. This meant that the stratigraphic relationships which record the relative order of deposition were invaluable. To omit the recording of these relationships would be to lose the most unequivocal information an archaeological site has to offer.

One way the stratigraphic data was used was to process it into a simple two column table of relationships, i.e. context 23 overlies 24, context 24 overlies context 25 etc. This format allowed the data to be checked for topologically incorrect relationships, but more importantly it allowed the matrix of relationships to be 'squashed'. That is, the matrix contained relationships between skeletons and between skeletons and non-skeletal contexts, e.g. earth layers, grave cuts etc. For this part of our analysis we wished to deal solely with the skeletal data, and so from the full matrix we wished to remove intermediate non-skeletal contexts to generate a burial-on-burial matrix that was stratigraphically accurate. This enabled a clearer picture to emerge when looking for patterns in the traits exhibited by burials.

The quality and abundance of spatial and stratigraphic data provided a new opportunity to view the matrix. One of the major problems when trying to visualise complex groups of stratigraphic relations is that one is trying to depict a three dimensional problem in a two dimensional plan. This data strain is manifest in the way lines of stratigraphic association have to graphically 'jump' over each other when they have to cross but there is no actual stratigraphic relationship.

If one shows stratigraphic relationships in a three dimensional environment, then this problem disappears, since one may view the matrix from different angles one of which will show the unobstructed line of association. For the Spitalfields data this first required the calculation of a centroid for each burial to be calculated in the GIS by processing the spatial data described above. This provided the X and Y values to represent the burial. The third dimension of the burial (Z) was provided not by its physical elevation but by the burial's 'depth' in the burial-on-burial matrix: in other words its stratigraphic depth relative to all other burials. When viewed in a 3D GIS environment the resultant matrix allowed both standard plan-view GIS queries to be run and the result shown in 2D plan view, and in 3D stratigraphic view. For example, it was possible to view all the infant burials, or all female burials with syphilis. This enabled us to search for concentrations of particular diagnostic groups of traits in both the standard 2D and less common 3D plains.

By using this heuristic to examine the relative depths to which each stratigraphic string goes, one can rapidly identify those areas in which activity was intense and those in which it was sparse. Once you have dismissed the fact that such differences are an artefact of differential survival, for example indicating the intrusion of a later building, then you can start to ask why some burials were cut into, whilst others were not and from there examine issues such as monumentation and respect. The 3D matrix can also be used to examine a myriad of osteological traits and how they relate to the stratigraphy of the site.

Conclusions: St Mary Spital and St Petri-Kirche

As the largest medieval cemetery sample yet excavated in Europe, the burials from the cemetery of the priory of St Mary Spital are of international significance. Whilst there is undoubted intrinsic value in a skeletal sample of such magnitude, the real benefit of the St Mary Spital assemblage is that the accurate phasing and dating of the remains has enabled the examination of trends through time and some important discoveries were made that would not have otherwise been possible. This level of phase separation could only be obtained using stratigraphic data combined with radiocarbon dating. The database enables direct links to be made between the burials and all other stratigraphic and artefact data, to allow an holistic examination of the behaviour of those living in medieval London. The relationship between the two phases of mass burial pits, established by careful, stratigraphic excavation, enabled them to be securely interpreted and linked to specific historical events.

Although the data recording protocol was originally designed specifically to record the burials from St Mary Spital, it has become the standard recording tool for all inhumed remains excavated by or analysed at MOLA, with revisions and additional capabilities added as they become required. By standardising the recording methods and categories of data collected, queries can be simply written to enable direct comparison with other sites and examine statistically valid samples, looking at geographic and temporal patterns in health, disease, demography and mortality.

The innovative use of GIS as not just a traditional spatial tool, but a tool to visually display stratigraphic data in three dimensions, opens up enormous possibilities for enabling us to have a detailed understanding of the patterns within cemetery populations. However, it is vital that the use of GIS is question led, it should not be employed 'because we can'. Work is now underway to employ the methods used at St Mary Spital to the 3.126 burials excavated from St Petri-Kirche cemetery, Berlin. The possibility of identifying catastrophic events in tightly dated burial populations from other cities and of the comparison of demographic profiles and disease prevalence is an exciting one. Work is well underway: first the 27.569 data elements recorded on the site were grouped to reduce them to a set of 4.500 elements of (grave) data. In GIS, centres were created for each of those data points, and surfaces laid on top of them to help show specific subsets within the data. Centres created for each bone enabled the generation of an orientation and interesting distribution patterns are appearing. As the information is refined further, with dating evidence from finds integrated into the 3D matrix, tightly dated phase groups can again be created and the possibility for examining spatial patterns by date becomes a very real one.

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