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Urban network evolutions

Towards a high-definition archaeology

Edited by Rubina Raja and Søren M. Sindbæk

Aarhus University Press |

Urban network evolutions
Towards a high-definition archaeology

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We furthermore also thank the Carlsberg Foundation for funding several projects, which have served as springboards for developing the centre idea and which have also allowed us to run large-scale fieldwork projects testing out some of the ideas developed within the framework of the centre. A number of other funders should also be thanked and they have been mentioned in all the relevant contributions.

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Rubina Raja and Søren M. Sindbæk, UrbNet, Aarhus
June 2018

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Defining space in house contexts: Chemical mapping at Unguja Ukuu, Zanzibar

1. Capturing daily life in urban households

Researching past human activities in houses poses several challenges to archaeological investigation. The recovery of artefacts and organic remains from house contexts, pottery and charcoal for example, may be associated with food preparation and/or consumption and the presence of hearths. However, a number of other routine activities – such as sleeping and cleaning – and how different spaces were used within the house may not leave readily visible traces. However, indicators of past activities and spatial organisation may be preserved at microscopic scale within sediments – the 'earth' embedding archaeological deposits. Soils and sediments represent a valuable archive of information about the history of a site, whether this be a house, a town or a landscape used in the past. Yet, the extraction and interpretation of this information remain challenging for archaeology because soils and sediments are composed of heterogeneous materials and are subject to mixing and change over time due to natural and human-induced processes. In addition, soil markers of past activities are often preserved at a scale beyond the reach of standard archaeological sciences (French 2015).

Our current research is developing new high-definition approaches to investigate urban dynamics and transition processes in East Africa. One special focus of research deals with devising methods to detect, extract and interpret indicators of past conditions and activities in urban households. In July 2017, the project excavated a sequence of house deposits at the site of Unguja Ukuu, Zanzibar (Figs. 1 and 2). This essay discusses some of the key results from chemical mapping of past activities within one house. Here it has been possible to identify some elements of past activities – particularly in the enhancement of elements through intensive use of certain spaces – and to distinguish between roofed and unroofed areas. Our results also show that mainstream archaeochemical approaches to domestic space have limited applicability to the investigation of past daily life and domestic activities in urban households. High-definition sampling and analyses of a wider range of elements together with a multi-cluster approach have enabled us to recover the traces of a former mud house and to identify internal spatial organisation and possible daily activities.

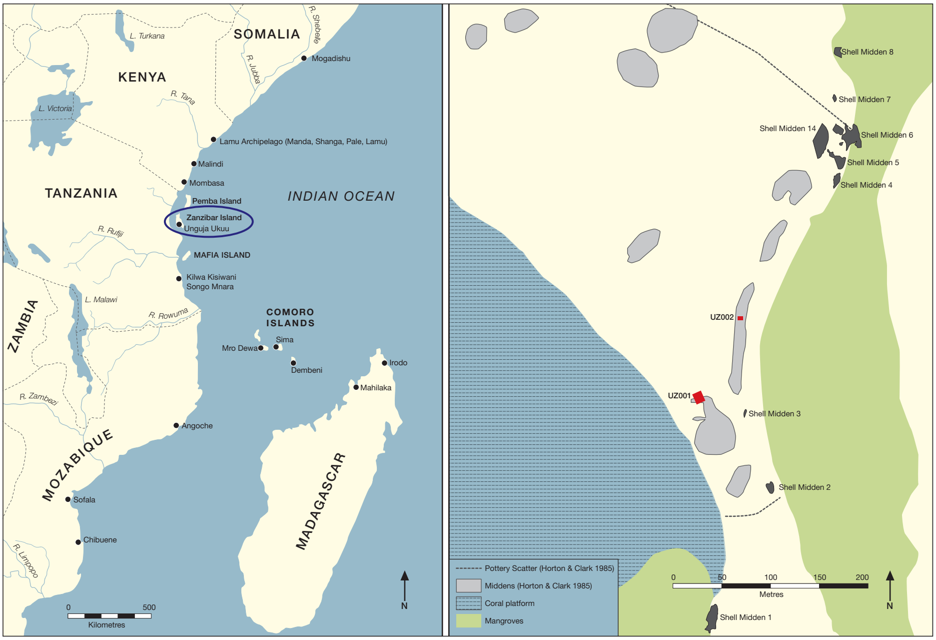

Fig. 1. *Map of East Africa and site map (site map produced by T. Fitton, redrawn by L. Hilmar, Grafisk Tegnestue, Moesgaard Museum).*

1.1 Archaeological context

Previous exploratory excavations at Unguja Ukuu have recorded the presence of settlement deposits dating back to the 7th century CE, making this site the best candidate for the origin of coastal urbanism in East Africa. The findings from test trenches feature both local and imported goods, including materials coming from the western Indian Ocean (Horton & Clark 1985; Juma 2004; Crowther et al. 2016). A recent site survey recovered a probable mosque and began a spatial exploration of the site (Fitton & Wynne-Jones 2017), but until the current research no domestic structures had been excavated in detail. UrbNet's first season of excavation exposed the remains of a house structure with multiple levels of occupation and floors. The house was built of daub, a material used for thousands of years by several ancient cultures and obtained by mixing clay, sand, water, plant stuff and, in some cases, animal dung as a binder. Daub houses are known from archaeological sites along the East African coast spanning the last two thousand years, and daub is still widely used for house building in fishing villages and rural areas in the region.

In archaeological contexts, daub houses are very difficult to excavate. Upon abandonment and/or collapse, daub architecture degrades quickly due to soil fauna and mixing. Such houses may disappear but for a colour staining left on the ground. In our case, the former presence of a daub structure was just traceable following slight changes in the colour, texture and compactness of the archaeological sediments. To complicate things

View of the harbour area of the site, taken during fieldwork in July 2017. The seashore of Menai Bay is visible in the foreground, characteristic mangrove trees to the left and low grassland vegetation cover (photo: Zanzibar Urban Transitions Project). **Fig. 2.**

further, the ancient inhabitants of Unguja Ukuu used the same red, sandy materials to make both the walls and floors of houses. Contextual recording of artefacts and archaeological features during excavation provided a general layout for spaces and levels of occupation associated with the house. The findings were particularly rich in local and imported pottery, metal and glass artefacts and organic materials (shell, animal bone and plant fragments), covering a period from the late 1st millennium until the mid-2nd millennium CE. The range and types of findings recovered suggest that the people living in this house were engaged in different activities. Archaeological excavation records were informative but unable to provide conclusive information on key issues such as the layout of the house, roofed and unroofed spaces and how people lived there. To answer these questions, the project implemented a high-resolution sampling strategy to detect potential chemical traces of past activities within floors and occupation surfaces.

2. Methods and materials

The house deposits were investigated using a contextual approach whereby the characteristics and property of each deposit/context/feature were recorded in detail, all materials (artefacts, plant/bone/shell remains, etc.) were collected, measured and analysed. Samples of sediments were taken from floor and surface deposits at 1 m and 0.5 m intervals (Fig. 3).

Laboratory analyses concentrated on establishing two main types of information:

1. Local environmental characteristics and resources, including soils and sediments, and how these relate to archaeological deposits.
2. Markers of past conditions and human activities preserved in archaeological soils and sediments.

Fig. 3. *House trench and sampling grid at 0.5 m (photo: Zanzibar Urban Transition Project).*

The samples collected were then analysed for physical and chemical properties, such as particle size, organic content and chemical elements. The concentration of 59 chemical elements was measured using ultra-trace Inductively Coupled Plasma Mass Spectrometry (ICP-MS) on 342 samples. The suite of elements chosen for measurement can be divided into three main groups:

1. Background, environmental chemical elements that we may expect to find in tropical, island environments.
2. Elements that can concentrate (or deplete) as a result of human activities (e.g., cooking, waste disposal, etc.) and have been found concentrated in archaeological contexts (Oonk et al. 2009).
3. Elements that are preserved only in trace amounts and have rarely been considered in archaeological research but may be associated with specific human activities.

3. Results

3.1 Regional soils and archaeological sediments

The first, crucial step was to establish local environmental conditions as a prerequisite for isolating properties, features and/or components that may be considered 'intrusive' and resulting from past human activities.

The site is located along a creek in Menai Bay, western Zanzibar. Here, mangrove growth alternates with areas of low grassland that thrive over a (coralline) limestone geology (Fig. 2). The latter is typical of coastal areas and provides materials for the development of red, sandy soils (laterites). In the area, two main soil types were recorded: a bright red (lateritic), sandy loam and a darkish brown, fine, sandy, silty loam. At the site, red soils are found under forest and orchard vegetation and are characterised by relatively high concentrations of organic matter (LOI > 4.5%), and chemical elements such as iron, copper and zinc – to mention but a few. The dark, brown soil type, instead, is widely found in tributary valley bottoms and contains much lower amounts of organic matter (LOI 1.6%) – almost half the amount recorded in the red, sandy soil. In terms of chemical properties, the dark brown soil type had lower chemical concentrations than the red soil type but yielded slightly richer amounts of some metallic elements, such as cobalt, manganese and barium.

Compared with the regional soils, archaeological sediments generally had very low contents of organic matter and most chemical elements but for enrichment in some salts, metals and rare earth elements (Fig. 4). The sediments found in the floors yielded higher contents of organic matter (LOI > 2%) and specific elements including, for example, aluminium, antimony, barium, potassium, nickel, sodium, vanadium and some rare earth elements (e.g., cerium, lanthanum). Sediments from other occupation surfaces, adjoining to the floors and provisionally attributed to external areas, yielded generally depleted or range concentrations of most elements. In apparent contrast to the floors, these spaces were enriched in barium, cobalt, potassium, sodium and lead and contained much depleted concentrations of rare earth elements. Surprisingly, most of the key chemical elements traditionally considered as anthropic markers in archaeology (e.g., calcium, phosphorus, manganese) were virtually absent in our archaeological sediments.

3.2 Indoor spaces

The floors investigated are composed of red sands and contain variable amounts of daub fragments. The main constituent of such building material is a bright red sand, similar to the lateritic red, sandy soils and sediments recorded in the area and analysed for chemical properties. Enhanced levels of elements such as aluminium, caesium and zirconium in the floors may well reflect the background chemistry of red lateritic sandy material used for making the daub. However, enrichment of other elements found in the floors, such as barium, iron, potassium, sodium, strontium, nickel, antimony, vanadium and rare earth elements (cerium, lanthanum, samarium) cannot be explained in the same way. Most of these elements can concentrate where organic matter is deposited and/or used and are relatively stable and resistant once they reach the soil. They have been found concentrated in archaeological sites, but sources of input may be quite different, ranging from wood, bone ash and dung to sea-related resources such as seaweed, fish and shells. Some metallic elements (e.g., antimony), instead, must be related to the presence and/or processing of metal-bearing resources, such as lead, iron or even pigments. Rare earth elements (e.g., cerium, lanthanum, samarium) are quite special in that they can be released in soils/sediments through what is generally called 'human detritus': that is, residues of skin, hair and nails.

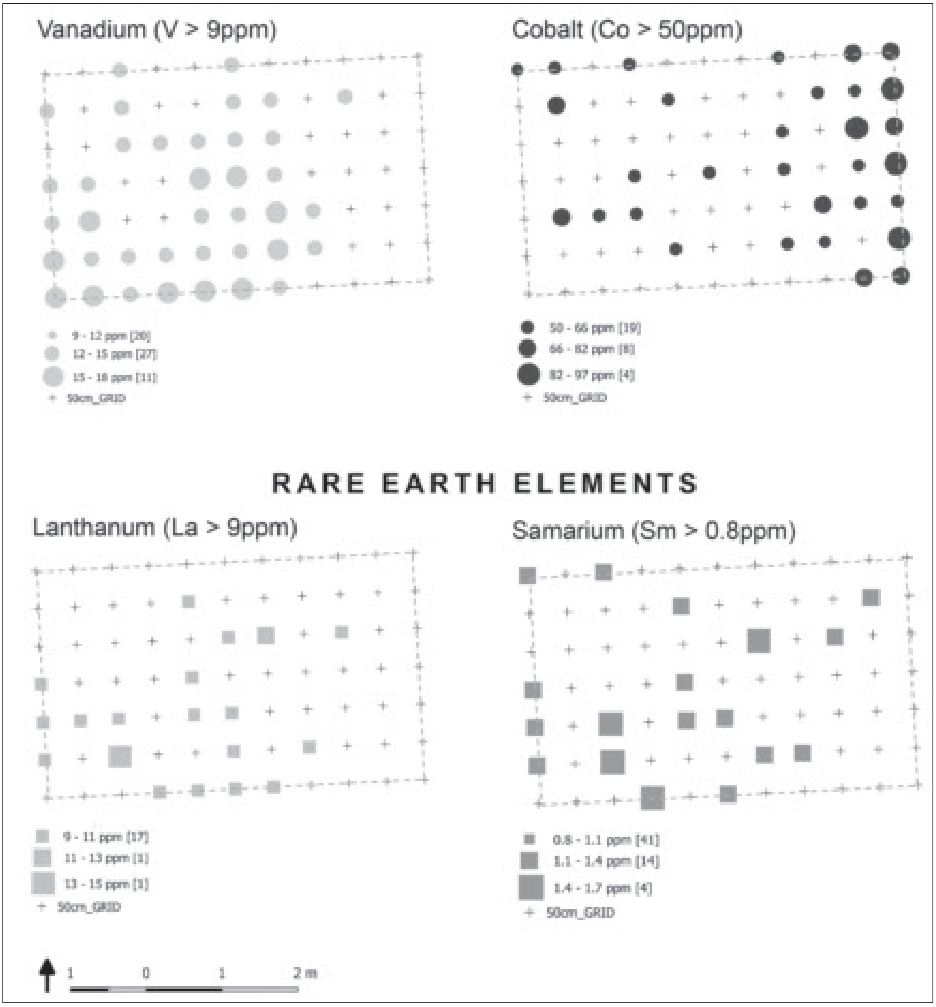

Fig. 4. *Selected chemical element concentrations detected in the house trench (Zanzibar Urban Transitions Project).*

The floor's chemical signature may thus derive from a combination of things. People spending time indoors may explain concentrations of rare earth elements, possibly using (eating?) marine resources, which would release elements such as potassium, sodium and vanadium. Iron and nickel may be associated with the presence or use of animal dung (e.g., as fuel or building material).

3.3 Outdoor areas

In contrast with the floors, sandy occupation surfaces yielded a very different chemical signature: Most elements were found in much depleted contents. Such a pattern suggests that these surfaces were associated with unroofed spaces, kept relatively clean of waste and possibly less intensively used by people. Enrichment of metallic elements in these spaces would point to the presence and use of metal-bearing resources and wood ash (e.g., barium, cobalt, potassium, lead). However, in contexts where metalworking debris and wood charcoal have been recorded, these elements are found in much lower concentrations. Another potentially important source of metallic elements are pigments. It is not unreasonable to consider that inhabitants may have used these spaces for activities involving the use of pigments.

4. Conclusions

The type of chemical enrichment usually linked to anthropogenic impact on archaeological deposits appears hardly visible in the house investigated at Unguja Ukuu. This may be due to local environmental conditions contemporary to the occupation but also to post-abandonment processes. However, when a wider suite of elements is considered, we can detect important chemical patterns of spatial organisation. During the excavation, the division between indoor and outdoor space was sometime impossible to record given the very nature of house deposits, with standing architecture and floors being made of the same red, lateritic sandy materials. The determination of the physical and chemical properties of the sediments spread across the various archaeological contexts enables the detection of differences between spaces. Rare earth element enrichment seems to mark the division between different spaces: enhanced levels in the indoor floors; depleted levels in sandy surfaces outdoors. The floor chemistry appears to reflect the input of lateritic sands used as building material, the presence of people and possibly the use of sea-related resources. Outdoor surfaces, instead, may have functioned as patio-like spaces where specialised activities may have taken place.

In sum, a tight sampling resolution and the analysis of a wide range of elements were key for detecting different sediment types and associated spaces within the house. High-resolution chemical mapping was instrumental in establishing chemical concentrations that may be associated with specific activities. However, elements traditionally used in archaeological research as anthropogenic markers were not particularly informative in our house contexts. Had we not expanded the suite of elements to be measured and developed a cluster-based approach (rather than a single-element one) in the interpretation, we would not have been able to decode the record of uses, conditions and activities taking place in the house. Clusters of elements, including trace and rare earth elements, in fact, proved to be particularly sensitive to picking up differences between roofed/unroofed spaces, intensity of space use and types of activities.

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6. Bibliography

Crowther, A., Faulkner P., Prendergast, M.E., Quintana Morales, E.M., Horton, M., Wilmsen, E., Kotarba-Morley, A.M., Christie, A., Petek, N., Tibesasa, R., Douka, K., Picornell-Gelabert, L., Carah, X. & Boivin, N. (2016). Coastal Subsistence, Maritime Trade, and the Colonization of Small Offshore Islands in Eastern African Prehistory. *The Journal of Island and Coastal Archaeology*, 11 (2), 211-237.

Fitton, F. & Wynne-Jones, S. (2017). Understanding the layout of early coastal settlement at Unguja Ukuu, Zanzibar. *Antiquity*, 91 (359), 1268-1284.

French, C. (2015). *A handbook of geoarchaeological approaches for investigating landscapes and settlement sites*. Oxford: Oxbow.

Horton, M.C. & Clark, C.M. (1985). *The Zanzibar Survey 1984-5.* Zanzibar: Ministry of Information Culture and Sports.

Juma, A. (2004). *Unguja Ukuu on Zanzibar: An archaeological study of early urbanism*. Uppsala: Uppsala University.

Oonk, S., Slomp, C.P. & Huisman D.J. (2009). Geochemistry as an aid in archaeological prospection and site interpretation: Current issues and research directions. *Archaeological Prospection*, 16, 35-51.