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Soil Micromorphology in a New Context – the Science-art Project: "Ground-breaking: Experience Past Landscapes in Grains and Pixels"

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4 Figures

1 Introduction

The premise for the work described in this paper is that the public understanding of the application of soil micromorphology methods is limited; commonly only people working in the subject domains of soil science and, more recently, archaeology, readily appreciate the benefits of developing pedogenetic and archaeological understandings of soils through microscopic evidence. In this paper we discuss the nature of a science-art project that uses soil thin-section images as a basis for building an audio-visual installation called **Ground-breaking: Experience Past Landscapes in Grains and Pixels**. The importance of bringing to wider attention the intrinsic nature and use of soils and their study through micromorphology is developed as a theme. The creation of the installation itself poses questions in relation to the expression and understanding of cultural soils, and their interpretation. Similarly, the audiences experiencing the sounds and images in the installation may seek to develop a new narrative for the underlying scientific rationale presented. For audiences – such as

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those in a museum – seeking a better understanding of such subject areas, a contrast can be made between the more traditional approaches to public outreach based on scientific assertion of fact, and the approach adopted in **Ground-breaking.** Here the audience is asked to explore data presented in a novel manner; in doing so creating their own, and hence new, novel explanatory frameworks. The **Ground-breaking** installation (Fig. 1) was commissioned from the authors by the UK research councils to raise awareness of the scientific aspects of understanding past environments and how people have coped with past environmental changes. The installation comprises a generative audio and visual display, together with supporting literature; to date it has been exhibited in various galleries and museums, including the National Museum of Scotland, Edinburgh; Prague City Gallery, Prague and at Shunt Vaults, London.

2 Materials

Soil thin-sections were produced from samples taken from a settlement site in Nigeria. This site is on the fringe of a modern-day village called Tiwa (11° 59' N, 14° 21' E) located in the Lake Chad basin, in North East Nigeria a region previously been considered in detail from archaeological, pedological and chronological perspectives (CONNAH 1981; AITCHISON et al. 1972; ADDERLEY et al. 2004). With the earliest materials dated c. 10,000 BP, the samples span the onset of human settlement at c. 4.000 BP through to present-day cultural activities. Thin-sections were produced using standard procedures after polyester resin impregnation (MURPHY 1986). The sections were imaged at 80x magnification using different illumination methods: between cross-polarizers, circularly-polarized, plane-transmitted, and oblique incident. A total of thirty-two sample areas (i. e. a total of 128 images) were analysed over eight thin-section slides. Each image was made by capturing a mosaic of smaller images (ADDERLEY et al. 2002). Using image-analysis techniques to segment images using colour and shape criteria, objects considered to represent different cultural events (e. g. rubified clay materials – construction of buildings with fired brick; Fig. 2) were quantified. For each object, its size and shape – including Feret measurements (RUSS 2006) and fractal dimension (MANDELBROT 1983) – were measured (Fig. 3). Together with the spatial location of each object and the 10,000 year temporal data, these data form a major component of the information used in the **Ground-breaking** installation.

3 Implementation of The Ground-breaking Installation

The **Ground-breaking** installation runs constantly with cycles lasting between 20 and 30 minutes each. The installation is generative, in that data are explored, images transformed and animated, and sounds synthesised all in real-time (i. e. live) by computer; it is not playback of an audio-video recording. The detail of the construction of the installation, written in Max/MSP & Jitter is described elsewhere (ADDERLEY & YOUNG 2008). The key features (Fig. 4) are that each cycle of the installation represents 10,000 years at the Tiwa field-site. Each cycle uses reconstructed Lake Chad water-level data as the main source for the generative component of the installation – the so called master clock. The visual component comprises on-site photographs and thin-section images. Visual behaviours such as cross-fades between images and zooming-in within images are deployed stochastically; such behaviours are related to the lake-level data and the interpreted human events pertaining to this. Thus: lake-level high → flooding → human migration → rapid image movement. Sound materials are also influenced at this structural level, in that the most clearly referential sound materials (i. e. recordings of environmental sounds, music and human voices) are more likely to be heard when they are relevant to the historical/temporal scale, all driven be reference to the master clock. Audio material is generated using these soil data as a source of parameters for both the direct synthesis of sounds and the transformation of recorded sound materials. This, therefore, relates the image seen, via object descriptors (size, colour, and shape), to the sound itself. This linkage is perhaps most evident when the installation software selects and displays an individual object in close-up, while simultaneously articulating its structural properties in sound; these sounds transform as the installation progresses from one object to another, according to its underlying generative behaviour. The result is a constantly shifting bricolage of animated slide images and multi-layered textures of sound, both abstract and referential in nature.

4 Discussion and conclusion

In building this installation the aim was not to create a user-interactive sonification (i. e. point at an object to hear a sound), or produce images conveying overt scientific dissemination; instead we have focussed on providing a means for the audience to explore and self-narrate the nature of, and context of, cultural soils and sediments. The sounds and images displayed, therefore, do not act as a proxy for the actual data, or indeed relate mimetically to it: direct deduction of the processes or events is not explicitly sought. Instead, there is a new emergent narrative that references data both directly and obliquely (ADDERLEY & YOUNG 2008). This, furthermore, problematises the understanding of sounds and their abstraction from raw data, a concept that is increasingly addressed in real-time sound-art media (YOUNG 2008). The narrative developed seeks a relationship between data types and the presentation itself that is consistent and, in theory, comprehensible. Within the boundaries of the physical space available for display, the installation fully utilizes the opportunities offered by the different media-projections used for novel expression of scientific data. With these previously acquired data refashioned as part of a new total work, the coherence of the linkage between sounds-heard to images-seen is critical to developing this narrative and is central to explanatory literature at each venue.

The role of narrative in scientific explanation is increasingly discussed as part of wider discourses on public understanding of science (MICHAEL 2002). With such discourse tending towards humanistic explanation, the archaeological component embedded within the **Ground-breaking** installation is important for its success, since it provides a route for the audience to create a suitably scaled narrative of spatial and time-related processes. Such processes in this instance are interpretable in different ways and it could be argued that the audience is self-narrating (NORRIS et al. 2005) since the scientific interpretations of soil micromorphology images and image analysis-data are not directly referenced. Such new conceptions of archaeological micromorphological studies are not only important for reasons of developing public understanding of science, they offer a means of problematizing data analysis more generally (ADDERLEY & YOUNG 2008). The (dis)ambiguation of rates affecting pedogenic processes in archaeological soil micromorphology is one such problem; this problem parallels the issues of scientific approaches to African environmental histories considered by HOLL (1996) where time-lines of historical events mis-match scientific evidence and vice versa. With increasing amounts of data and hence numerically led analysis in the archaeological soil micromorphology subject domain, this installation presents, and in its construction represents, a new mode of understanding for both public and practitioner.

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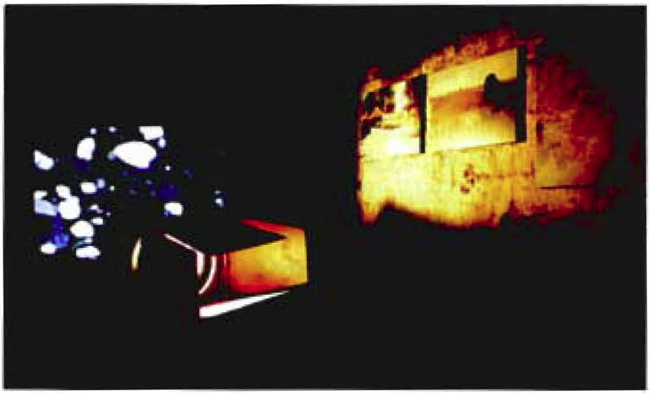

Fig. 1 *Ground-Breaking* installation presented at the Shunt Vaults venue, London Bridge, London, during June 2007

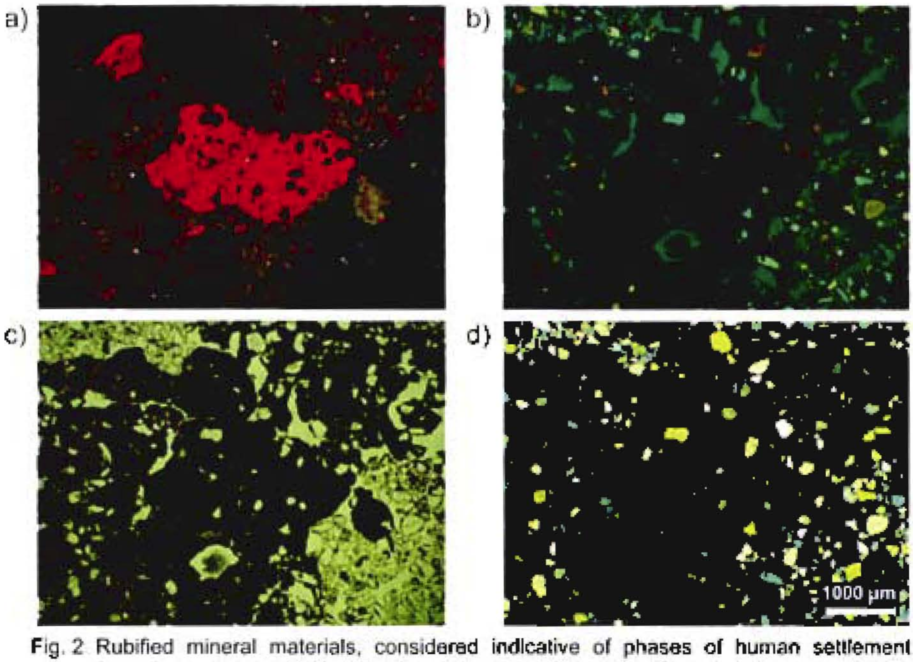

Fig. 2 Rubified mineral materials, considered indicative of phases of human settlement including building with fired bricks at the Tiwa village site. Sample TW2 from 121 cm depth. Calendar age c. 2967 ± 270 years BP (ADDERLEY et al. 2004). a) Oblique incident illumination; b) circularly polarized illumination; c) plane polarized illumination; and d) between crossed polarizers

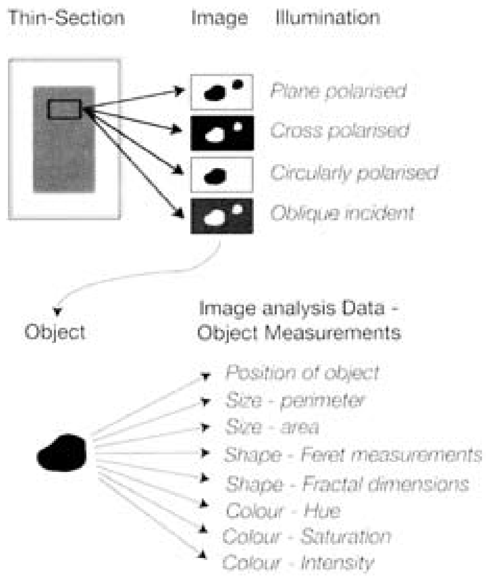

Fig. 3 Schema showing the steps taken from soil thin-section imaging to produce the image-analysis data set

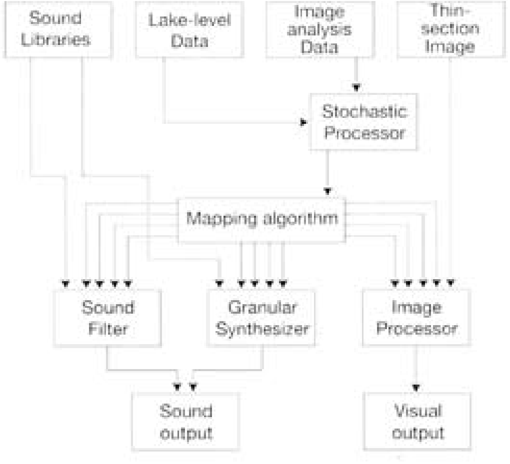

Fig. 4 Schema for the **Ground-breaking** installation, showing the incorporation of soil-based and temporal data, along with archive sound recordings and soil image materials