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Original article

Towards refining the classification of glass trade beads imported into Southern Africa from the 8th to the 16th century AD

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ABSTRACT

Tracing the origin of glass trade beads excavated at archaeological sites can contribute significantly to dating a site and reconstructing prehistoric trade routes. Wood developed a temporally sensitive bead sequence dating from the 8th to the 16th century AD for beads excavated at southern African sites that is commonly used by archaeologists to classify beads according to their morphology. In this study, we develop a multidisciplinary methodology to refine the classification of glass beads based on morphology alone. Glass trade beads excavated at 11 sites along the upper reaches of the Limpopo River in east-central Botswana are used as case study. The beads were visually classified according to their morphological properties (colour, size, etc.) and analysed with Raman spectroscopy and portable X-ray fluorescence (XRF). Energy Dispersive Spectroscopy (EDS) of one bead showed that two types of glass were sintered together to form a recycled product, explaining the divergence of Raman spectra recorded on different zones. The study confirms the value of a morphological classification based on existing data sets as a first approach, but demonstrates that both Raman and XRF measurements can contribute to a more exact classification of glass beads imported into southern Africa from the East before the 17th century AD.

1. Research aims

Glass beads have been part of indigenous southern African culture and tradition since they were first imported into the region during the 7th century AD [1,2]. In order to date sites and accurately reconstruct trade routes or connections, appropriate analytical techniques are essential to correctly classify bead assemblages. Although a substantial amount of scientific research has been conducted on the classification of glass trade beads, the field archaeologist still largely depends on classification by means of morphological parameters, which may lead to wrongful attributions. In this study, we aim to assess the viability of using two unbiased techniques, namely Raman spectroscopy and X-ray fluorescence spectroscopy (XRF), to refine a bead classification system that relies on morphological parameters.

2. Introduction

The most commonly used system to classify beads recovered at archaeological sites dating from the 8th to the 16th century AD in southern Africa is the temporally sensitive bead sequence (Table S1) developed by Wood [1,2]. The sequence was developed by classifying beads from securely dated sites according to morphological parameters, after which the attributions were chemically tested by Robertshaw et al. [3] using Laser ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS).

In most instances, the beads retrieved from southern African archaeological sites are small monochrome drawn beads and, as a result, they are difficult to classify unambiguously in the field. The means to chemically analyse beads using LA-ICP-MS as applied

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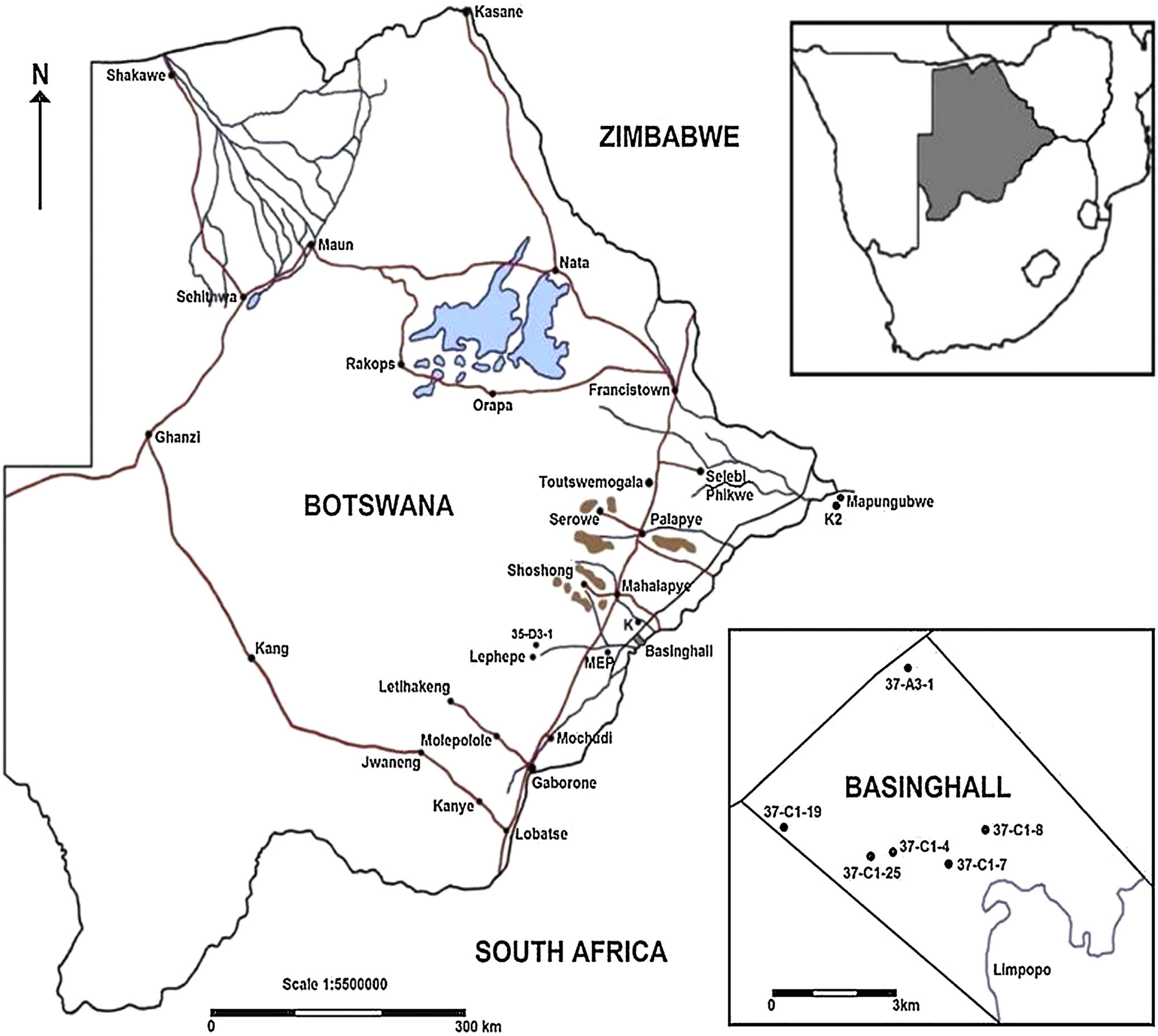

Fig. 1. Map of the region indicating the sites where the beads were excavated (K: Kudumatse Village; MEP: Mmamabula Energy Project) in relation to the important archaeological sites of K2 and Mapungubwe.

by Robertshaw et al. [3] are also not always readily available and, due to very large variations in the chemical composition of each bead series, assignments are not always clear-cut (Table S2). Raman spectroscopy has been successfully used to classify glass trade beads [4–7] and has the advantage that information about the composition of the glass, as well as pigments colouring the glass, can be obtained from the same spectrum or by more than one spectrum, focusing either on the glass or the pigment. However, Raman spectroscopy also has its limitations as the intensity of a Raman signature greatly depends on the number of electrons involved in the bond and some phases are hardly detected. Furthermore, ions that are in many instances the origin of glass colour do not give special Raman signals, and if classifications depend on the presence of trace elements (e.g. uranium), Raman spectroscopy is not useful.

Recently, the progress in developing portable instruments (Raman and XRF) has made these techniques more accessible to archaeologists. In this study, we endeavour to develop a multidisciplinary methodology to classify glass trade beads, using as case study glass trade beads excavated at 11 sites in the Upper Limpopo River region in east-central Botswana (Fig. 1). An experienced field archaeologist classified the beads based on morphological parameters [8], according to the bead sequence developed by Wood [1,2]. Using this classification as a guideline, representative beads were selected for Raman measurements and the spectra compared to the spectral database of the beads excavated at Mapungubwe [4,5]. Based on the classification of bead types according to their Raman spectra, beads were selected for XRF analyses in order to form a link between the chemical composition and Raman spectrum of a bead.

3. Materials and methods

3.1. Archaeological context and samples

A substantial number of glass trade beads (1014) were recovered from Iron Age sites in the Mahalapye area of east-central Botswana (Fig. 1). The sites are in the proximity of the upper reaches of the Limpopo River on Basinghall Farm, at Kudumatse