**Beyond Technology: Pottery Reveals Translocal Social Relations at a Bell Beaker Monumental Site in Central Europe**

**Adam Gašpar, Jan Petřík, Pavel Fojtík, Anna Tsoupra, Basira Mir-Makhamad, Ana Cardoso, Massimo Beltrame, José Mirão, Nick Schiavon, Jan Kolář**

**Supplementary material**

**Detailed Methods**

**Petrography and chemistry of the ceramic**

Using a polarizing microscope, ceramic fabrics and mineral or rock inclusions were identified in seventeen thin-sections. Estimating the abundance of the inclusions followed a semiquantitative scale. The samples were classified into fabric groups that took account of texture, the size of the inclusions, and the combination of identified rock fragments and mineral inclusions. Granulometric measurements were undertaken in ImageJ software on images captured at 1× and 4× magnification, recording at least sixty values. The data were then analysed in R software using the Rysgran library (Camargo, 2006), and sorting and skewness were characterized.

The chemical composition of the ceramic was determined by an Energy Dispersive Fluorescence Spectrometer (ED-XRF), specifically a Rigaku NexCG device with a 50-W Pd tube and silicon drift detector (SSD) with a resolution of up to 145 eV. The measurement time was 120s for every secondary target and the results were quantified according to appropriate reference materials. Samples were measured in the form of a pressed powder (0.5 g). The chemical elements defining the fabrics were identified by a classification tree algorithm, as implemented in R software according to Breiman et al. (1984) in RStudio software (Therneau & Atkinson, 2019; R Core Team, 2021).

**Micro-analysis of white inlay incrustations**

µFTIR analysis was performed using a Bruker Tensor 27 Mid-infrared (MIR) spectrometer. The samples were analysed in transmission mode using a 15× objective lens and an EX’Press 1.6 mm diamond compression microcell, STJ-0169. The infrared (IR) spectra were plotted in the region of 4000–600 cm−1, with 64 scans at 4 cm−1 spectral resolution. Compounds and peaks were identified with the help of a spectral database (IRUG, n.d.). µXRD analysis was undertaken to identify the mineralogical composition of incrustations using a Bruker D8 Discover X-ray Diffractometer of the Da Vinci design and a Cu K-α source at 40 kV and 40 mA. Data were collected within a 2θ angular range of 3°–75°, with a 0.05° step size and 1s measuring time by point. The system was employed with a Goebel mirror and a 300-μm beam collimator. SEM-EDS analysis was performed on a HITACHI S-3700N SEM interfaced with a Bruker Quanta EDS microanalysis system. The system was equipped with a Bruker XFlash 5010 Silicon Drift Detector (SDD) with a resolution of 129 eV at Mn K-α. The analysis was done with an accelerating voltage of 20 kV, 10 mm of working distance, 120 μA of emission and a chamber pressure of 40 Pa.

**Metric and decoration analysis**

In the case of descriptors of decorative motifs A1 to A3 and C1 to C3, the values were graded from 1 to 3 after the variation of the motifs at the same beaker and the number of zig-zag lines (Supplementary Figure S1). For metric analysis,the following were noted: diameter of the rim and base, bottom concavity, overall height, maximum diameter of the body, minimum diameter of the neck, the vertical distances from the base and the top to the maximum of the body diameter and minimum diameter of the neck. The metrics were analysed by using Principal Component Analysis (PCA), and the number of clusters was estimated based on a clustering scree plot (Lê et al., 2008). After PCA, the Coefficient of Variation (CV) was estimated (Eerkens & Bettinger, 2001; Wang & Marwick 2020). The collected data on decorative motifs were evaluated in R software by the FactoMineR package (R Core Team, 2021). The input matrix was first subjected to Correspondence Analysis (CA) with the determined number of dimensions and then to cluster analysis (Supplementary Material: Beakers).

**Data, Code and Supplementary Figures and Tables**

Figures, data, and code are available in two html files exported from RStudio. The html knit file of metric and decoration analysis (SM-Beakers-metric\_decor) presents the whole script with notes, data preparation with metrical and decoration input matrices, statistical analyses, results and synthesis with relevant plots, and sources of used R libraries. The other html knit file (SM-TableS1-S6\_FigS1-S4) contains supplementary tables (Tables S1–S6), literature related to the mapped sites, and figures (Figures S1–S4). All files can be found under doi in a Zenodo repository**:** [https://doi.org/[10.5281/zenodo.7214895](https://doi.org/10.5281/zenodo.7214895)](https://doi.org/10.5281/zenodo.7214896)

**References**

Breiman L., Friedman J.H., Olshen R.A. & Stone, C.J. 1984. *Classification and Regression Trees.* Pacific Grove (CA): Wadsworth.

Camargo, M.G. 2006. SysGran: um sistema de codigo aberto para analises granulometricasdosedimento. *Revista Brasileira de Geociencias*, 36: 345–352.

Eerkens, J.W. & Bettinger, R.L. 2001. Techniques for Assessing Standardization in Artifact Assemblages: Can We Scale Material Variability? *American Antiquity*, 66: 493–504.<https://doi.org/10.2307/2694247>

IRUG. n.d. Infrared & Raman Users Group [online] [accessed 31 May 2020]. Available at: <<http://www.irug.org/search-spectral-database>>

Lê, S., Josse, J. & Husson, F. 2008. FactoMineR: An R Package for Multivariate Analysis. *Journal of Statistical Software*, 25: 1–18.<https://doi.org/10.18637/jss.v025.i01>

Quinn, P.S. 2013. *Ceramic Petrography: The Interpretation of Archaeological Pottery & Related Artefacts in Thin Section*. Oxford: Archaeopress.

R Core Team. 2021. R: A language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria [online] [accessed 1 September 2022]. Available at: <[http://www.R-project.org/](http://www.r-project.org/)>

Therneau, T. & Atkinson, B. 2019. rpart: Recursive Partitioning and Regression Trees 25 [online] [accessed 1 September 2022]. Available at: <[https://cran.r-project.org/package=rpart](https://cran.r-project.org/package%3Drpart)>

Wang, L. & Marwick, B. 2020. Standardization of Ceramic Shape: A Case Study of Iron Age Pottery from Northeastern Taiwan. *Journal of Archaeological Science: Reports*, 33: 102554.<https://doi.org/10.1016/j.jasrep.2020.102554>