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A Multi-Method Analysis of the Engravings in the “Kleines Schulerloch” Cave (Bavaria, Germany)

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Research Interest

The engravings in the Kleines Schulerloch cave were discovered in 1937. The image panel features a runic inscription, an animal figure, several rod lozenges, and a grid of lines in a honeycomb-shape (Fig. 1). Just days after their discovery, plaster casts of the engravings were made, which required previous cleaning of the cave wall. This process irreversibly altered the wall and the morphology of the lines. Additionally, there is reason to believe that some lines, including the animal figure, were retraced with a unknown modern tool by one of the discoverers to enhance their visibility. As a result, the authenticity and dating of these engravings have been the subject of controversial discussions over the past few decades. While the medieval runic inscription is considered authentic[1], the classification of the other motifs as prehistoric remains questioned. For instance, the animal figure has been described in two extremes: as both a modern forgery[2] and the earliest Ice Age art in Germany[3]. The research interest of this master's thesis arises from the opportunity to classify the remaining motifs of the image panel using various methods to address questions of authenticity, interpretation, and dating.

Methods

The engravings were examined using a multi-method approach that combined various methodological and practical strategies to discuss different research questions. The following methods were applied:

- **Morphometric analysis of the engravings**
- **Creation and evaluation of experimentally produced lines for the classification of their morphology**
- **Description of the formation of the motifs and detailed analysis of the image panel**
- **Dating methods: Absolute dating, relative chronology, and image analysis**

The primary focus was on the morphometric analysis of the engravings, aiming to provide insights into relative chronology, classification, tool identification, and the authenticity of the motifs. A systematic data collection process involved the use of 3D models (created with *Agisoft Metashape Professional Software*, Version 2.0.2, 2023) and a microscope (*Dino Lite Edge* Series AM4000 Series) directly inside the cave. Additionally, experimental lines were made on limestone (Fig. 2) using various tools to generate comparative data. Both the experimental and original lines in the cave were analyzed under the same criteria. The data were evaluated using *R Studio*[4] and grouped into clusters (Fig. 3) through Multiple Correspondence Analysis (*MCA*), Principal Component Analysis (*PCA*) and cluster dendrograms, forming the basis for discussions and the systematic description. Furthermore, an image analysis was conducted to identify and contextualize the motifs and their chronological classification.

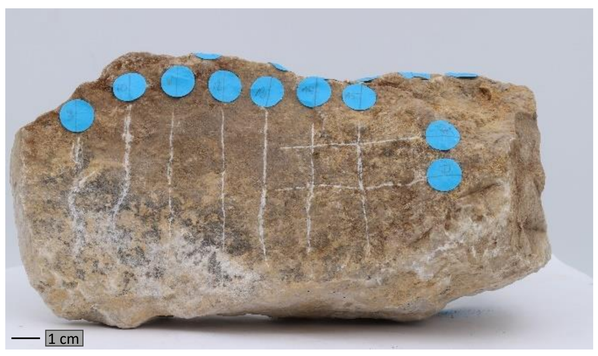

Fig. 2: Experimental lines on limestone were systematically created and analyzed as a comparative basis. These lines were made using different tools to obtain various data, including flint tools, metal knives, iron nails, and limestone fragments. The experiments were thoroughly documented, and while the incised lines do not fully replicate the conditions in the Kleine Schulerloch, the impressions and results can still be transferred for comparative analysis.

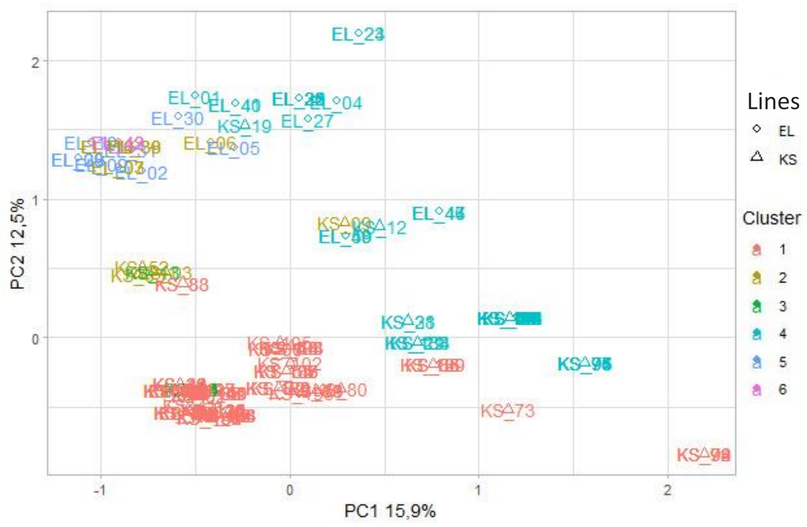

Fig. 3: The graphic shows a *PCA* of two datasets: EL: Experimental Lines, KS: Lines from Kleines Schulerloch. The *PCA* visualizes the distribution of different clusters, revealing a clear separation between them while also enabling a visual differentiation between the experimental lines and the lines from the cave. Each cluster has also an individual combination of attributes that were important for the analysis, such as the profile shape of the lines, the angle of the edges or the possibly used tool.

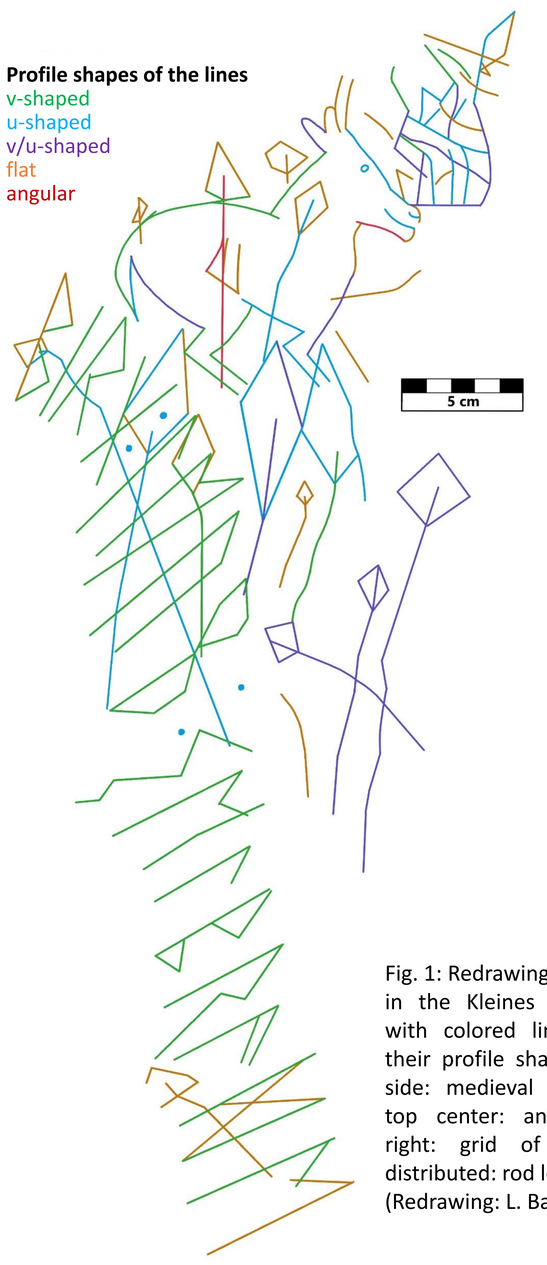

Fig. 1: Redrawing of the engravings in the Kleines Schulerloch cave with colored lines according to their profile shapes. (On the left side: medieval runic inscription; top center: animal figure; top right: grid of lines; centrally distributed: rod lozenges)
(Redrawing: L. Bandasch)

Results and Conclusion

The study focused on questions regarding the **age**, **authenticity**, and **interpretation** of the motifs. By employing a multi-method approach, a solid data foundation was established to compare the individual lines and techniques.

- The question of its **age** cannot be conclusively answered through absolute dating, despite previous attempts. Dating based on stylistic analysis is also only partially feasible. While the runic inscription can be assigned to the Early Middle Ages, the other symbols and the animal figure exhibit stylistic features that could fit into various periods. The relative chronology of the lines suggests that, on one hand, the runes and rod lozenges, and on the other hand, the animal figure, the gridlines, and additional rod lozenges are chronologically linked. This indicates that the runic inscription and the rod lozenges likely originated at the same time and possibly thus also the animal figure.
- Regarding **authenticity**, there is no evidence to suggest that these engravings are modern forgeries. Instead, the similarity in depiction styles and the careful integration of motifs suggest that the engravings may have been created simultaneously as a cohesive composition.
- The precise **interpretation** of the motifs remains uncertain, though some interpretations appear more likely than others. The animal figure could represent a (female) ibex or a goat-like creature, or possibly a deer. Depending on context and temporal classification, the rod lozenges could be understood as weapon symbols or vulva representations.

Overall, the analyses in this study demonstrate that no additional insights into the symbols and the animal figure can be expected beyond the results obtained using the available technical tools. However, the combination of digital technologies and practical methods, such as the creation of experimental lines for comparison, enabled the best possible results for the engravings in the Kleines Schulerloch. Moreover, previously unnoticed lines were made visible through digital methods.

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