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SHAPE VARIATIONS OF GRASS PHYTOLITHS IN EURASIA: TOWARDS IMPROVED INTERPRETATION OF FOSSIL PHYTOLITH RECORD USING NEW METHODS OF GEOMETRIC MORPHOMETRY

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Analysis of microfossil silica phytoliths is becoming an increasingly important research tool in paleoecology. A considerable amount of investigations focused, for instance, on the evolution of grassland ecosystems. Such an advance was achievable mainly by the fact that generally used classification of grass phytolith short cells (*GSSC*) allows determination of grasses to the subfamily level. The standard method used in phytolith analysis is based on qualitative identification of idealized morphotypes (Madella et al. 2005), which relies mostly on visual cues of the shape and requires highly trained experts. An alternative quantitative approach could minimize the observer's bias and ensure the consistency of data between labs. Moreover, quantitative approach provides data on a continuous scale, which reflects better the continuous variation of phytolith shape.

Here, we demonstrate a modern methods of size and shape analysis, called geometric morphometry, which have a considerable potential for classification of phytoliths. This method focuses on analysis of so called *landmarks* - structurally homologous anatomical loci (Zelditch et al., 2004). The *landmarks* contain in their coordinates information about their relative positions, which can provide entire image of shape variations of the investigated object. We present an example of such an analysis performed on phytolith data obtained from reference collection of various grass species of Eurasian flora.

Our findings suggest that application of geometric morphometry for analysis of phytolith *landmark* coordinates has a considerable potential to discriminate between species. Besides, the analysis of *landmarks* allows to explore (and quantify) intra-specific variation in phytolith shapes, which is assumed to be controlled by changing environmental conditions. Understanding of environmentally induced variations in phytolith shape, which was not possible with qualitative methods, is, nevertheless, crucial for correct interpretation of fossil record. Thus, a dataset of *landmarks* acquired from modern reference material can be utilized for objective interpretation of the fossil phytolith record

We conclude that methods based on geometric morphometry represent highly effective tool with a considerable potential not only to enhance objectivity of phytolith research, but also to improve the ability of phytolith analysis to differentiate between grass taxons considering also intra-specific variations in phytolith shape. We suggest that such an approach, which can be readily performed thanks to freely distributed software (Rolf 2006), could be reasonable alternative to standard methods used in phytolith analysis.

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