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A Conceptual Framework for a Computer-Assisted, Morphometric-Based Phytolith Analysis and Classification System

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Abstract

Although automated approaches to shape analysis and object classification have been widely applied in the biological sciences, technical and time considerations have limited their use in phytolith research. As advanced microscopy systems become more affordable and accessible and digital imaging software provides a wider range of sophisticated analytical tools, there is increased potential for effective use of machine-vision and automation in phytolith research. In this paper, we describe technical limitations of phytolith imaging and identify several techniques that might improve results. Drawing on examples of software developed for related disciplines, we then describe a conceptual framework for development and integration of automated phytolith analysis software for: separating phytoliths from non-phytolith material in digital images; segmentation of phytolith boundaries; quantitative phytolith feature extraction, including a discussion of potentially more powerful, non-traditional parameters of phytolith shape and texture; phytolith classification and identification; and phytolith database image retrieval. While recognizing the difficulty of implementing this framework and the need for extensive empirical testing of suggested approaches on phytoliths, we examine the possibility of aggregating quantitative phytolith data collected in studies worldwide to construct a cloud-based database of phytolith images with associated morphotype data.

Keywords