Morphometric analysis of the calcareous nannofossil group *Aspidolithus* in the lower Campanian: Implications for taxonomy

Paula Granero
University of Vienna, Department of Geology, 1090 Vienna, Austria; paula.granero.ordonez@univie.ac.at
Adam Wierzbicki
Jagiellonian University in Krakow, Institute of Geological Sciences, Krakow, Poland; adam.wierzbicki@uj.edu.pl
Michael Wagreich
University of Vienna, Department of Geology, 1090 Vienna, Austria; michael.wagreich@univie.ac.at

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Changes in the coccolith morphometry of the *Aspidolithus parcus* group have been used to distinguish biostratigraphically relevant subspecies for the Late Cretaceous. However, insufficiently detailed morphometric analyses have hindered the establishment of statistical differentiation among the subspecies. Consequently, the taxonomic classification of this group remains ambiguous, which also affects the accuracy of biostratigraphic correlations. In this study, a morphometric analysis of samples from the lower Campanian of the Loibichl section (Rhenodanubian Flysch Zone, Austrian Alps) was performed that focused on the *Aspidolithus* group. Semi-quantitative analyses of the nannofossil assemblages allowed the calculation of paleoenvironmental indices. In addition, 1021 well-preserved specimens of the *Aspidolithus* group were measured for several key parameters: (1) the maximum coccolith length (L), (2) the maximum coccolith width (W), (3) the width of the outer rim versus the small diameter of the central area (b/a), and (4) the number and arrangement of perforations in the central area. The main objective was to identify significant differences between *Aspidolithus* morphotypes and to explore possible factors influencing size variation within this group. In addition, we analyzed $CaCO_3$ content and stable isotope ratios of $\delta^{13}C$ and $\delta^{18}O$ to aid stratigraphic and paleoecological interpretations.

Five distinct morphotypes were identified: *Aspidolithus enormis* subsp. 1, *A. enormis* subsp. 2, *A. parcus expansus*, *A. parcus parcus*, and *A. parcus constrictus*. Morphometric analyses revealed significant taxonomic differentiation between the "small" *A. enormis* (<8–8.5 µm in length) and the "large" *A. parcus* group (≥8–8.5 µm in length). However, the study found no clear patterns that naturally classify the "subspecies" (*A. parcus expansus*, *A. parcus parcus*, and *A. parcus constrictus*) within the *A. parcus* group. These morphotypes appear to be an evolutionary lineage, probably driven by the global cooling that began in the late Santonian. Moreover, it was observed that the dimensions of the central area, represented by the value of the ratio b/a, correlate with surface temperature values. An in-depth examination of global versus regional environmental influences is essential to fully understand these findings. Therefore, calcareous nannofossil samples from the Smoky Hill Member of the Niobrara Formation (Kansas, USA) are being analyzed to confirm this impact on size variation.