



## **Morphometric analysis of Eocene nummulitids in Western and Central Cuba - inferences on taxonomy, biostratigraphy and evolutionary trends**

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None other larger benthic foraminifera (LBF) group in the Caribbean realm has led to such diverse opinions and controversy about their classification than the nummulitids. Unlike the Tethys species, where delimitation and details of evolutionary changes within species are well known, intraspecific evolution in the Caribbean remains understudied and generic nomenclature has not reached consensus yet. Morphometric studies appear to be the most appropriate methods in solving this unsatisfactory taxonomical situation. For every proposed species, morphological variations correlating with paleoecological factors and precise stratigraphic occurrence and range has to be studied in detail. Thus, the morphology in equatorial sections of nummulitids without chamber partitions was quantified at seven localities from Western and Central Cuba and interpreted by eleven growth-independent and/or growth-invariant characters and attributes. 102 isolated megalospheric individuals originating from Cuban localities, spanning the time interval from lower Middle Eocene to lower Oligocene, were classified by nonmetric multidimensional scaling and cluster analysis. Thirteen Caribbean specimens, which are considered as type material, were included. Two clearly differentiated morphogroups could be differentiated according to cluster and ordination analysis into the genera *Nummulites* and *Palaeonnummulites*. Main differences in morphological characters between the morphogroups were confirmed by discriminant analysis. *Nummulites* differs from *Palaeonnummulites* in a weak increase of the marginal radius and weak backbend angles. All specimens of *Nummulites s. stricto* from different localities were regarded as *Nummulites striatoreticulatus*. Based on discriminant analysis, *N. striatoreticulatus* specimens with similar depositional environments, but of different stratigraphic occurrence, are strongly separated. The older forms have a smaller backbend angle, perimeter ratio and proloculus nominal diameter, thus documenting stratigraphic and evolutionary trends. The species *Nummulites striatoreticulatus* in the Cuban sections ranges from lower middle Eocene to lower Priabonian.

Within the *Palaeonnummulites* group, the exceptional range of morphological variation tends to obscure the fact that there are several well-defined morphological species. Based on discriminant analysis the species *P. willcoxi*, *P. trinitatis*, *P. floridensis*, *P. ocalanus* and *P. soldadensis* were classified ranging from tightly coiled individuals that are very similar to *Nummulites* to loosely coiled morphotypes. Major separators between the species are the marginal radius, proloculus nominal diameter, spiral chamber height increase and the length of the first chamber. Stratigraphic trends within species were not clearly detectable, but paleogeographic differences and the morphological overlap between morphogroups in certain species are obvious. *Palaeonnummulites* species have long stratigraphic ranges from late Middle Eocene to probably lower Oligocene.