



Growth-invariant and growth-independent characters in equatorial sections of *Heterostegina* shells

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Morphological characters in equatorial sections of planispirally enrolled larger benthic foraminifera can be quantified using growth-independent and growth-invariant characters. While the embryonal apparatus (nepiont) is growth-independent, the following chambers change size and shape during growth, whereby time is represented by chamber sequence. Using specific growth stages for grouping (classification) of specimens hinders comparison between species with different growth modes. Here, constants of growth functions adapted to the specific character can be used as growth-invariant attributes. The independent growth variable time is replaced in these functions either by chamber number or revolution angle. The complete chamber sequence is not necessary for fitting growth functions: a representative number of chambers enables the establishment of functions. Incompletely preserved tests can thus be used and compared. Additionally to former growth-invariant characters developed for larger benthic foraminifera, we describe chamberlets and their change during growth to enable a complete geometrical reconstruction of tests in equatorial sections in a general way. This relieves the comparison between specimens in classifications based on morphology, which can be interpreted either phylogenetically as species or paleobiogeographically as subspecies.