The investigation of conjoined tests in Larger Benthic Foraminifera: state of the art

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Ever since the beginning of studies on Foraminifera, teratologies and aberrant forms of Larger Benthic Foraminifera (LBF) tests have been observed. Among the broad diversity of morphologic deviations the most frequent are represented by the following four types:

1) pluriembrional apparatii (which may generate one or more growth planes);

2) abnormally shaped chambers or test geometries;

3) recoveries after injuries causing abnormal forms;

4) so-called "conjoined individuals" caused by the fusion of two adult individuals.

"Conjoined" Foraminifera are two (or more) individuals that live the first part of their life separately before, from a certain growth stage onwards, fusing their tests. They then start to form new chambers from a common outer lamella, sharing a part of their marginal chord. They have been reported in both Recent (e.g. *Ammonia*, HAYASAKA, 1935) and fossil (e.g. *Nummulites,* MUKHOPADHYAY, 2007) Foraminifera.

While a precise diagnostic investigation of such peculiar individuals using traditional methods like thin sections has proven difficult, the introduction of new technologies like µ-CT and advanced visualization packages enable the detailed study of these abnormal morphologies. Image processing software like AMIRA allows the production of virtual cross-sections in any possible plane as well as the visualization and dissection of a three dimensional model, showing the arrangement of chambers of both individuals both prior to and after the fusion.

The rendering of a three dimensional models furthermore allows precise volumetric analyses as well as its virtual disassembling for a better visualization of the complex geometric structures in question. µ-CT scans and three dimensional models of conjoined individuals of *Nummulites* spp. (lower Cuisian and middle Lutetian of Biron and Gan, France) show that the morphology of all individuals prior to the fusion does not seem to be linked to the cause of the abnormal test shape.

In this work we present the case study of two fused adult individuals of *Nummulites* spp. based on a virtual, three dimensional model constructed with the use of µ-CT scans. It is possible to observe that the individuals not only keep growing after the fusion but also seem to adapt their growing strategies to better support the new structure of the test.