# MASTERARBEIT

Titel der Masterarbeit

„Growth of *Heterostegina depressa* under natural and laboratory conditions"

verfasst von


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**Zusammenfassung**

Die rasche Entwicklung von computerunterstützten tomographischen Verfahren bietet erstmalig eine einzigartige Möglichkeit in die Gehäuse von Großforaminiferen zu blicken und deren Kammervolumina effektiv zu messen. In Kombination mit mathematischen Methoden zur Berechnung umweltgesteuerter Oszillationen des Gehäusewachstums von Foraminferen, können diese genutzt werden, um eine neue Art von ökologischen Proxys zu berechnen. Diese neue Methodik wurde auf rezente Exemplare von *Heterostegina depressa* von unterschiedlichen Beprobungsorten und aus Laborkulturen angewandt. Anhand der vorab Kenntnis der rezenten ökologischen Bedingungen, konnten Informationen über den Zusammenhang zwischen diesen Oszillationen und ökologischen Schwankungen gewonnen werden. Im Vergleich mit den Exemplaren aus Laborkulturen, welche unter kontrollierten Bedingungen gezüchtet wurden, konnte die Gültigkeit der Methodik überprüft werden. Dies ist äußerst wichtig, um eine bessere Einsicht in die Art und Weise zu gewinnen, wie Gezeitenströmungen und das Mondmonat bzw. saisonale Schwankungen das Foraminiferenwachstum beeinflussen.

**Abstract**

Development of computed tomography gives a unique opportunity to look into larger benthic foraminifera and measure chamber volumes efficiently. Combined with new mathematic methodologies for calculation of environmentally driven oscillation in foraminiferal test growth a, new kind of ecological proxies can be created. This new methodology has been applied on recent specimens of *Heterostegina depressa* from different sampling sites and laboratory cultured ones. With known recent ecological constraints the informative value of these oscillations for environmental relations has been inspected and in comparison with laboratory cultured individuals, grown under controlled conditions, its validity has been tested. This is important to gain insight in which manner tidal currents and lunar months or seasonal fluctuations interfere with foraminiferal growth.

## Preamble

Larger benthic foraminifera (LBF) are large single-celled eukaryotes, mostly restricted to marine oligotrophic shallow water environments. They build large and highly complex structured tests and harbour just beneath their test walls photosymbionts of different algal groups. Such tests are important in carbonate rock-forming processes during the upper Paleozoic, Cretaceous and the Cenozoic. The group, which includes *Heterostegina depressa*, a nummulitid, is considered as an excellent biostratigraphic marker during the Palaeogene and originates from the sub-order of the Rotaliina (Fig.P1).

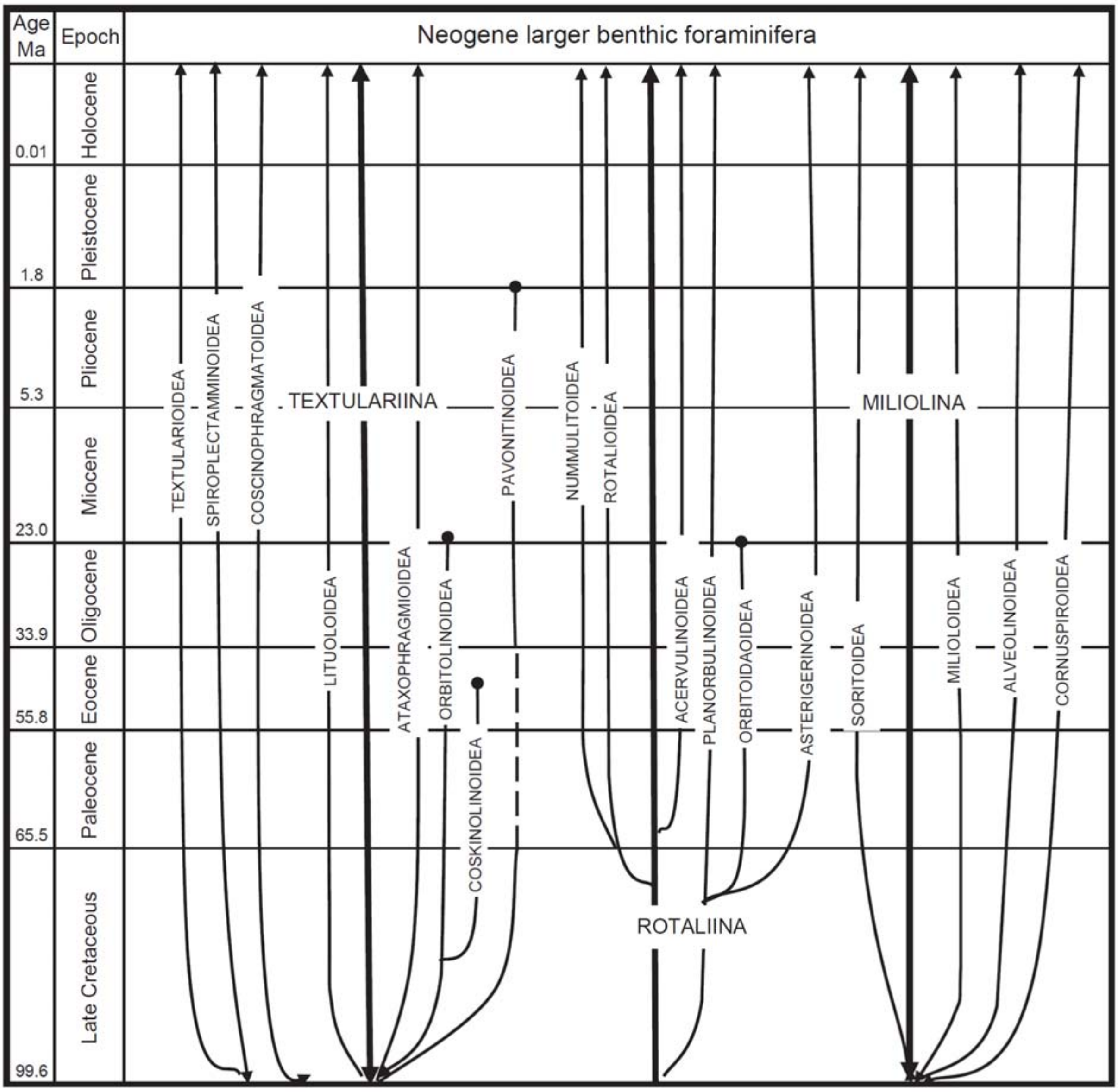



Fig.P1 Evolution of the Neogene suborders (BouDagher-Fadel, 2008).

LBF seem to have kept their way of life since their origin during the carboniferous and still populate analogous habitats. Therefore fossil, as well as recent taxa record unique paleo-environmental information (BouDagher-Fadel, 2008).

A dimorphic lifecycle is well documented on many different foraminiferal taxa and show clear alterations between a diploidic asexually reproductive generation (microspheric agamonts, called B-forms) and a haploidic sexually reproductive generation (megalospheric gamonts, called A-forms). Additionally to this, a third phase has been also found within *Heterostegina depressa,* shown in figure P2. This so-called schizont is a megalospheric generation, which reproduces through multiple cell fission (Röttger & Krüger., 1990).

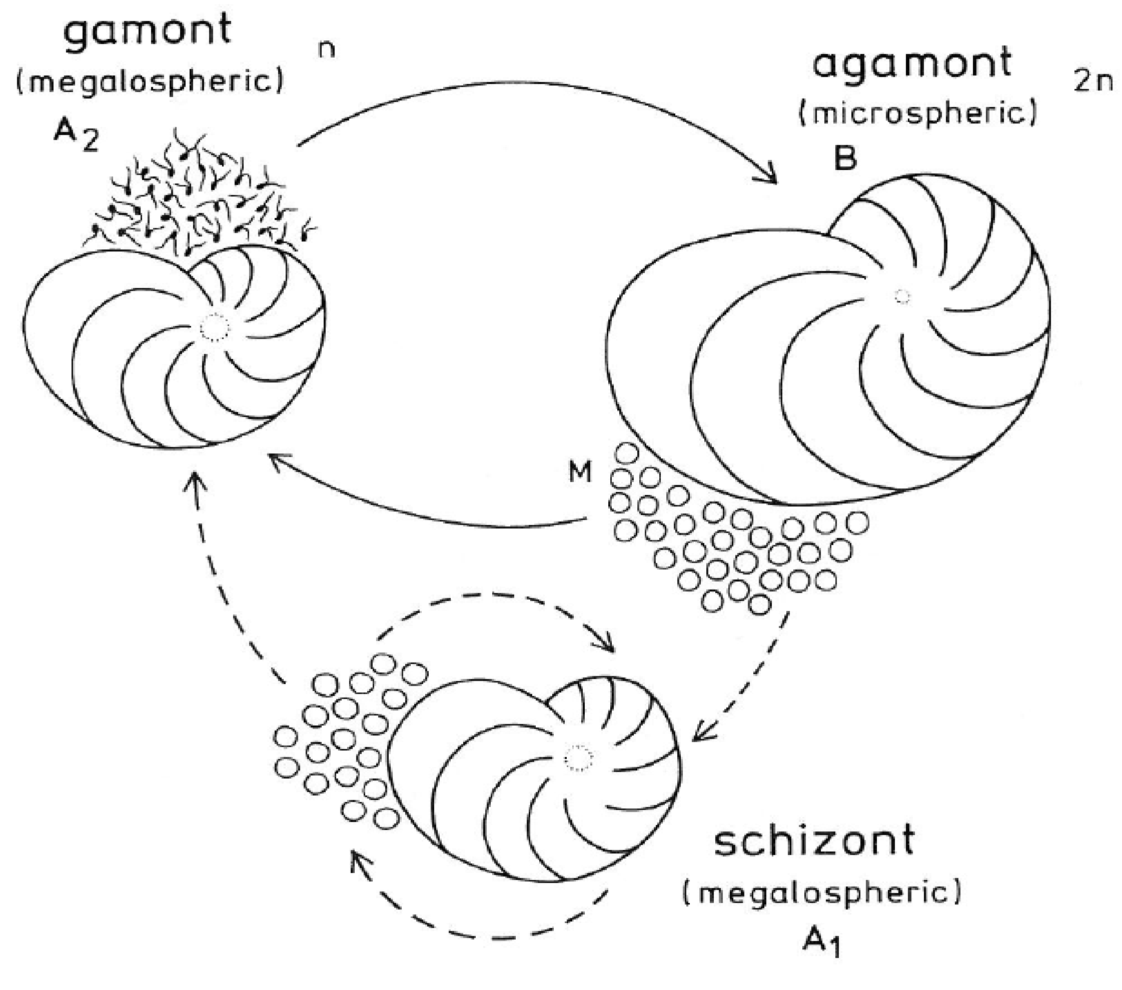



Fig.P2 the "trimorphic" life cycle of *H. depressa.* (Röttger & Krüger, 1990)

The test of *Heterostegina depressa* is divided into radially arranged chambers, which are well defined by the septa and are again subdivided into small chamberlets by septula. Those compartments serve as greenhouses for their endosymbiotic diatoms. Generally there are four different systems of cavities within the test of *H. depressa*. First the major lumina build up by chambers and chamberlets. Secondly, the organism has a system of canals, located within the keel (marginal canal), the septa and the septula (Fig. P3).

When a new chamber is build, parts of the marginal canals connect to the inner part of the test, therefore the marginal chords reaches spirally through the whole shell. The septal canals are originally marginal canals, which get incorporated into the septa during chamber building processes.

Furthermore there are tube like connection between chamber and chamberlets. They are divided into foraminal tubes, interconnecting chambers and apertural tubes, connecting the last chamber to the surrounding medium (Fig. P3). The last kind of connections is between the canal system and the cavities of chambers and chamberlets (Spindler, 1978).

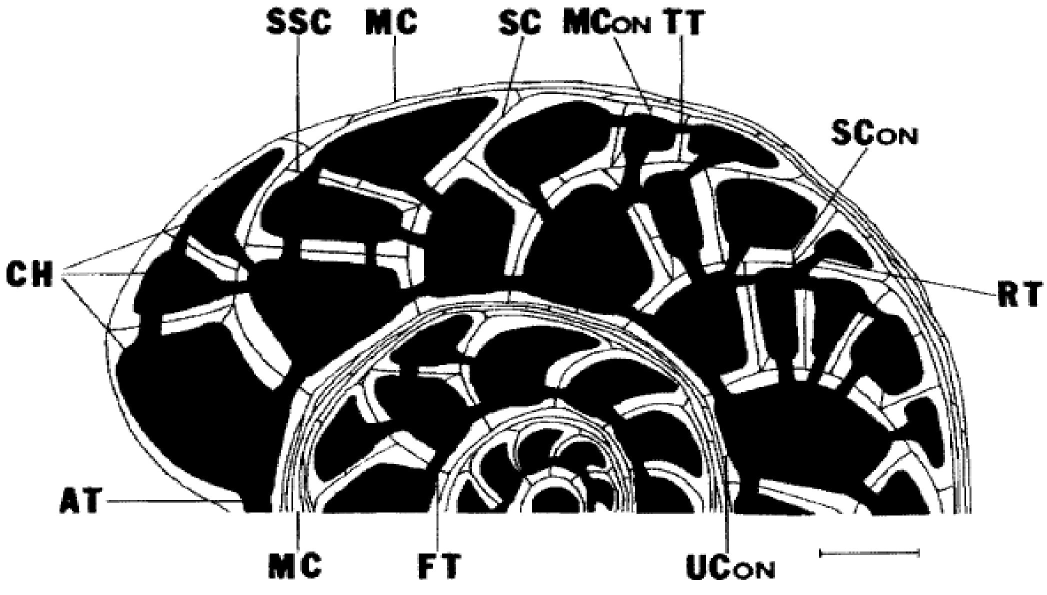



Fig.P3 Scheme of a *H. depressa* test; AT = apertural tube, CH = chamber divided into three chamberlets, FT = foraminal tube, MC = marginal canal, MCon = marginal connection, RT = radial tube, SC = septal canal, SCon = septal connection, SSC = secondary septal canal, TT = tangential tube, UCon = umbilical connection. Scale 100 µm (Spindler, 1978).

The task of this work was to take a more precise look on oscillatory growth in LBF, namely in recent specimens of *Heterostegina depressa*. Therefore, the quality of these oscillations, as well as the presence or absence of cyclicities in laboratory-cultured specimens, have been in focus. To gain the required data set 12 *Heterostegina depressa* d'Orbigny specimens were chosen (Tab.P1).

| Code | Origin | Sample No. | A/B | Depth in *m* | Gompertz prameter | Amplitude | Phase | Period | *p* | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| D1-68 | Maui, Kekaa Point | #68 | A | 40 | $k$ = 723,21 $b$ = 12,016 $c$ = -0,0105 $R^2$ = 0,998 | $\alpha 1$ = 0,289 $\alpha 2$ = 0,243 $\alpha 3$ = 0,213 | $\varphi 1$ = 3,02 $\varphi 2$ = -1,6 $\varphi 3$ = -0,822 | $\tau 1$ = 192,6 $\tau 2$ = 12,20 $\tau 3$ = 28,16 | 0,00000009 | 0,54922000 |
| D2-68 | Maui, Kekaa Point | #68 | A | 40 | $k$ = 70184,09 $b$ = -17,113 $c$ = -0,008 $R^2$ = 0,996 | $\alpha 1$ = 0,252 $\alpha 2$ = 0,188 $\alpha 3$ = 0,156 | $\varphi 1$ = 3,10 $\varphi 2$ = -2,81 $\varphi 3$ = 2,63 | $\tau 1$ = 158,30 $\tau 2$ = 24,38 $\tau 3$ = 13,79 | 0,00000006 | 0,60285000 |
| D3-68 | Maui, Kekaa Point | #69 | A | 40 | $k$ = 2,396 $b$ = -8,946 $c$ = -0,033 $R^2$ = 0,999 | $\alpha 1$ = 0,281 $\alpha 2$ = 0,331 $\alpha 3$ = 0,23 | $\varphi 1$ = 0,269 $\varphi 2$ = 3,03 $\varphi 3$ = 1,13 | $\tau 1$ = 32,33 $\tau 2$ = 14,27 $\tau 3$ = 10,29 | 0,00000887 | 0,57488000 |
| B44 | Maui, Kekaa Point | P.1.10.91 | B | n.n | $k$ = 562,694 $b$ = -16,118 $c$ = -0,011 $R^2$ = 0,988 | $\alpha 1$ = 0,253 $\alpha 2$ = 0,241 $\alpha 3$ = 0,217 $\alpha 4$ = 0,196 | $\varphi 1$ = -2,47 $\varphi 2$ = -3,11 $\varphi 3$ = 1,22 $\varphi 4$ = -2,4 | $\tau 1$ = 36,02 $\tau 2$ = 178,3 $\tau 3$ = 26,19 $\tau 4$ = 13,48 | 0,00000000 | 0,57470000 |
| A1 | Sesoko-Jima | Transect A | A | 20 | $k$ = 164,52 $b$ = -13,271 $c$ = -0,012 $R^2$ = 0,999 | $\alpha 1$ = 0,282 $\alpha 2$ = 0,202 $\alpha 3$ = 0,198 $\alpha 4$ = 0,17 | $\varphi 1$ = 2,74 $\varphi 2$ = 2,71 $\varphi 3$ = 0,402 $\varphi 4$ = 3,13 | $\tau 1$ = 62,24 $\tau 2$ = 34,6 $\tau 3$ = 26,75 $\tau 4$ = 12,20 | 0,00000001 | 0,70263000 |
| A2 | Sesoko-Jima | Transect A | A | 20 | $k$ = 2,192 $b$ = -10,794 $c$ = -0,031 $R^2$ = 0,999 | $\alpha 1$ = 0,318 $\alpha 2$ = 0,115 $\alpha 3$ = 0,145 $\alpha 4$ = 0,0948 | $\varphi 1$ = -1,44 $\varphi 2$ = 0,697 $\varphi 3$ = -1,7 $\varphi 4$ = -1,32 | $\tau 1$ = 84,40 $\tau 2$ = 10,89 $\tau 3$ = 34,24 $\tau 4$ = 25,08 | 0,000000003 | 0,75477000 |
| A3 | Sesoko-Jima | Transect A | A | 20 | $k$ = 0,693 $b$ = -12,602 $c$ = -0,0375 $R^2$ = 0,995 | $\alpha 1$ = 0,27 $\alpha 2$ = 0,23 $\alpha 3$ = 0,161 $\alpha 4$ = 0,137 | $\varphi 1$ = -1,29 $\varphi 2$ = 0,503 $\varphi 3$ = 2,11 $\varphi 4$ = 2,69 | $\tau 1$ = 74,32 $\tau 2$ = 22,69 $\tau 3$ = 10,12 $\tau 4$ = 35,92 | 0,00785910 | 0,50903000 |
| B1 | Sesoko-Jima | Transect A | B | 20 | $k$ = 146482,1 $b$ = -25,3 $c$ = -0,009 | $\alpha 1$ = 0,309 $\alpha 2$ = 0,288 $\alpha 3$ = 0,263 $\alpha 4$ = 0,423 | $\varphi 1$ = -0,948 $\varphi 2$ = -1,08 $\varphi 3$ = -2,43 $\varphi 4$ = 3,01 | $\tau 1$ = 26,96 $\tau 2$ = 17,74 $\tau 3$ = 43,6 $\tau 4$ = 213,63 | 0,00000000 | 0,78054000 |
| R1 | Universität Kiel | F1.27.1.91 | A | n.n. | $k$ = 0,573 b = -8,944 $c$ = -0,05 $R^2$ = 0,987 | $\alpha 1$ = 0,741 $\alpha 2$ = 0,246 $\alpha 3$ = 0,16 | $\varphi 1$ = -2,45 $\varphi 2$ = 0,216 $\varphi 3$ = -2,11 | $\tau 1$ = 290,1 $\tau 2$ = 52 $\tau 3$ = 37 | 0,00000000 | 0,87033000 |
| R2 | Universität Kiel | F1.27.1.92 | A | n.n. | $k$ = 7,269 $b$ = -7,990 $c$ = -0,015 $R^2$ = 0,976 | $\alpha 1$ = 1,13 $\alpha 2$ = 0,3 $\alpha 3$ = 0,115 | $\varphi 1$ = 1,75 $\varphi 2$ = 1,23 $\varphi 3$ = -2,56 | $\tau 1$ = 275,3,1 $\tau 2$ = 55,05 $\tau 3$ = 21,32 | 0,00000000 | 0,98282300 |
| R3 | Universität Kiel | F1.27.1.93 | A | n.n. | $k$ = 0,548 $b$ = -8,642 $c$ = -0,046 $R^2$ = 0,988 | $\alpha 1$ = 1,22 $\alpha 2$ = 0,76 $\alpha 3$ = 0,699 | $\varphi 1$ = -2,13 $\varphi 2$ = -2,55 $\varphi 3$ = 1,22 | $\tau 1$ = 336,5,1 $\tau 2$ = 47,35 $\tau 3$ = 43,79 | 0,00000000 | 0,90321000 |
| R6 | Universität Kiel | F1.27.1.94 | A | n.n. | $k$ = 1119289,97 $b$ = -20,39 $c$ = -0,005 $R^2$ = 0,996 | $\alpha 1$ = 0,674 $\alpha 2$ = 0,335 $\alpha 3$ = 0,36 | $\varphi 1$ = -2,73 $\varphi 2$ = 1,75 $\varphi 3$ = -2,62 | $\tau 1$ = 146,4,1 $\tau 2$ = 30,43 $\tau 3$ = 40,41 | 0,00000000 | 0,83679000 |

Tab.P1 List of the used specimens of *Heterostegina depressa*, showing Gompertz parameter, amplitudes, phases, periods as well as *p* and $R^2$ values.

Four gamonts were cultured by Röttger in 1991 at the University of Kiel (R1, R2, R3, R6), three naturally grown gamonts were sampled by Kürger in Maui at Kekaa Point (D1-68, D2-68, D3-68) and another agamont also sampled at Kekaaa Point (Fig.P4) was used (B44). Additionally three gamonts and one agamont from Sesoko-Jima (Fig.P5) were kindly provided by Hohenegger (A1, A2, A3, B1). Those specimens from Sesoko-Jima and Hawaii, which grew under natural conditions were used as reference group and posed as control fauna for comparison with laboratory-cultured specimens. All samples have been analysed using micro-computed tomography (Micro CT) with the high energy Scanner Skyscan 1173 at the Department of Palaeontology, university of Vienna. CT scanners are quite simple instruments composed mainly of an X-ray source represented by a (micro) focused X-ray tube, a charged-coupled device (CCD) camera such as the X-ray detector, and a sample tray, as seen in figure P6.

During the scanning process, several one- or two-dimensional radiographs are recorded for different positions during a stepwise rotation around a central axis of either the sample or the system source-detector. Commonly, in scanners built for academic purposes, the sample rotates and the system source-detector remains fixed. For LBF, the use of high resolution CTs (micro or nano) is commonly mandatory since the resolution needed to visualize chambers or parts of chambers are always < 0.5 mm.

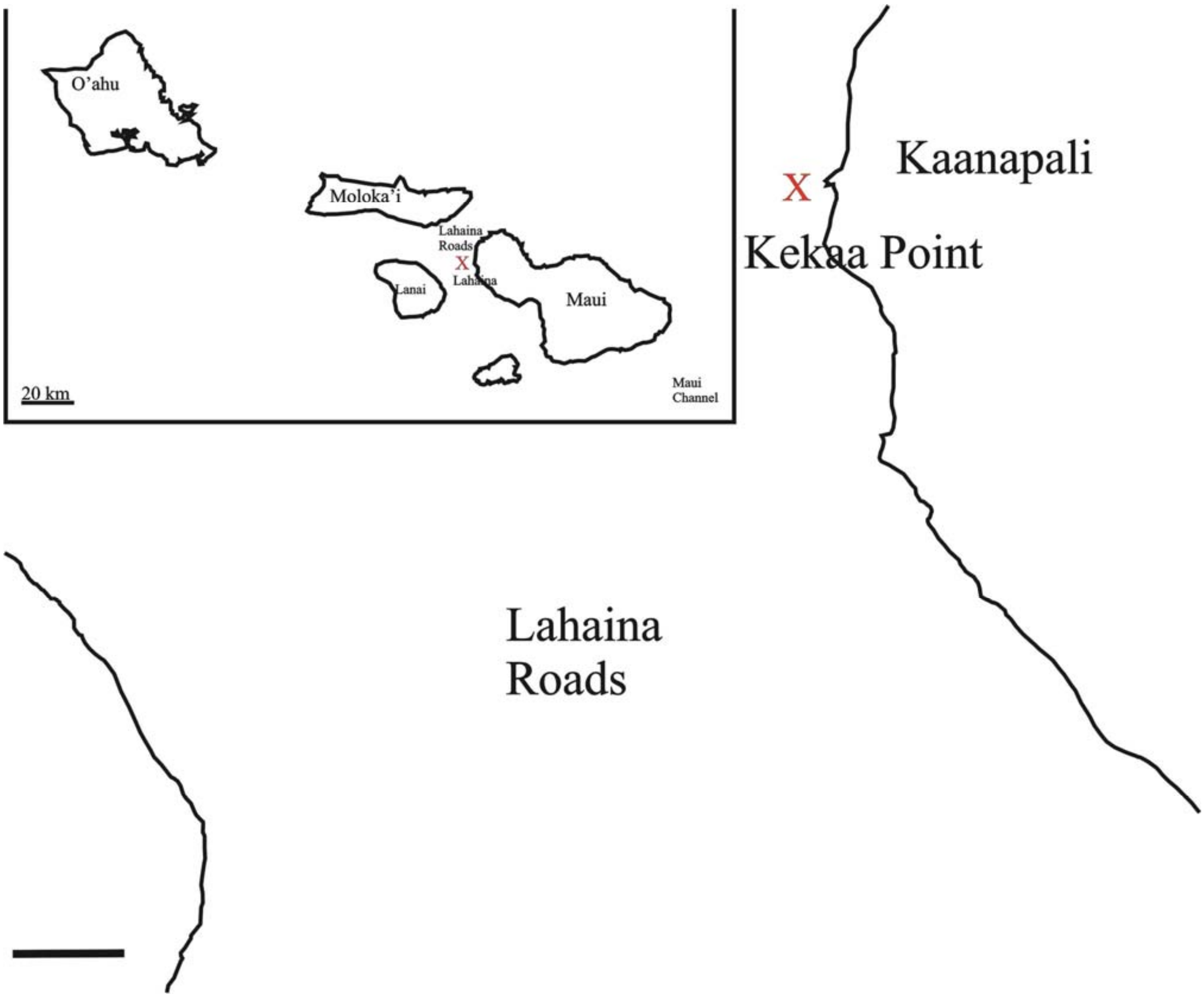



Fig.P4 Sketch of western Maui coastline, the red X marks the sampling point, modified after Krüger, (1994).

The magnification of a scan depends mainly on the CCD camera resolution and on the position of the sample along the line defined by the system "X-ray source-object-detector".

In CT scanners, the resolution is given in pixels depending on the detector type, but on the three-dimensional models obtained, the word “voxel” is used instead of pixel.

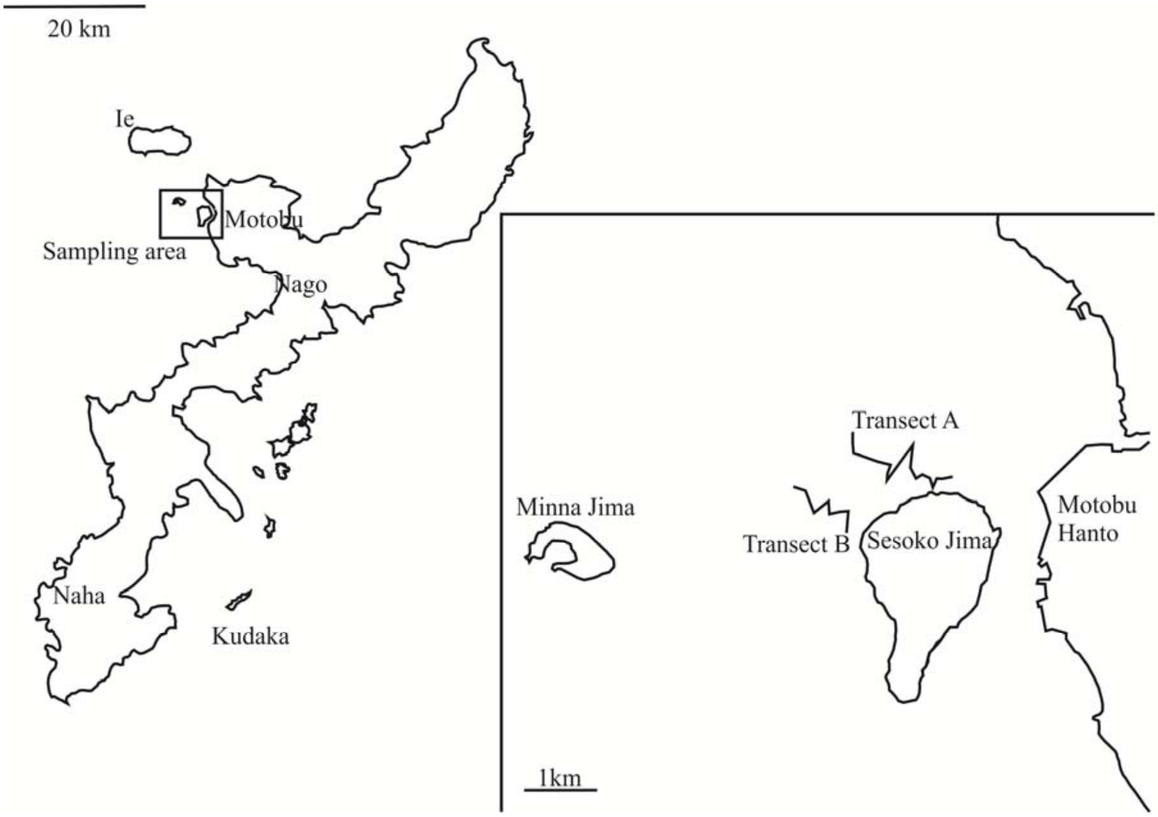



Fig.P5 Sample locality Sesoko-Jima, Okinawa, showing Transect A and B, after Hohenegger et al., (1999).

The voxel is a three-dimensional pixel, it has commonly a cubic shape and, therefore, the pixel size represents the length, the height and the thickness of the voxel.

The slices are put together afterwards by digital geometric processing by an algorithmic-based procedure, which is commonly made by a computer cluster equipped with larger storage and memory systems. Extreme computational power is needed because the reconstruction process must collect information stored by the CCD detector and reveal slices normal to the X-ray imaging plane. The volume is calculated by counting the number of voxels within selected slice areas defined by greyscale thresholds (Briguglio et al., in press).

Initially six specimens of laboratory cultured gamonts of the culture F1 27.10.1991 have been scanned at 100 kV. Two of them were preliminarily discarded because of alignment issues and blurred images. The remaining four specimens are presented in Table 1 and have been used for 3D segmentation, reconstruction and data evaluation, which have been done using the dedicated software Amira 5.4.3 VSG.

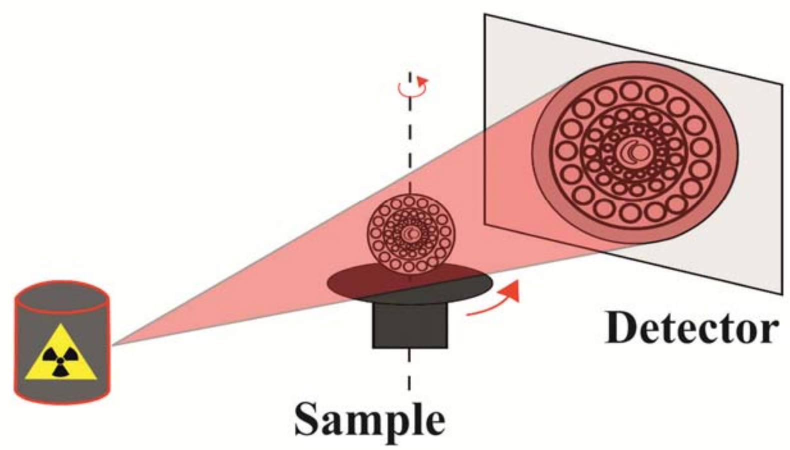


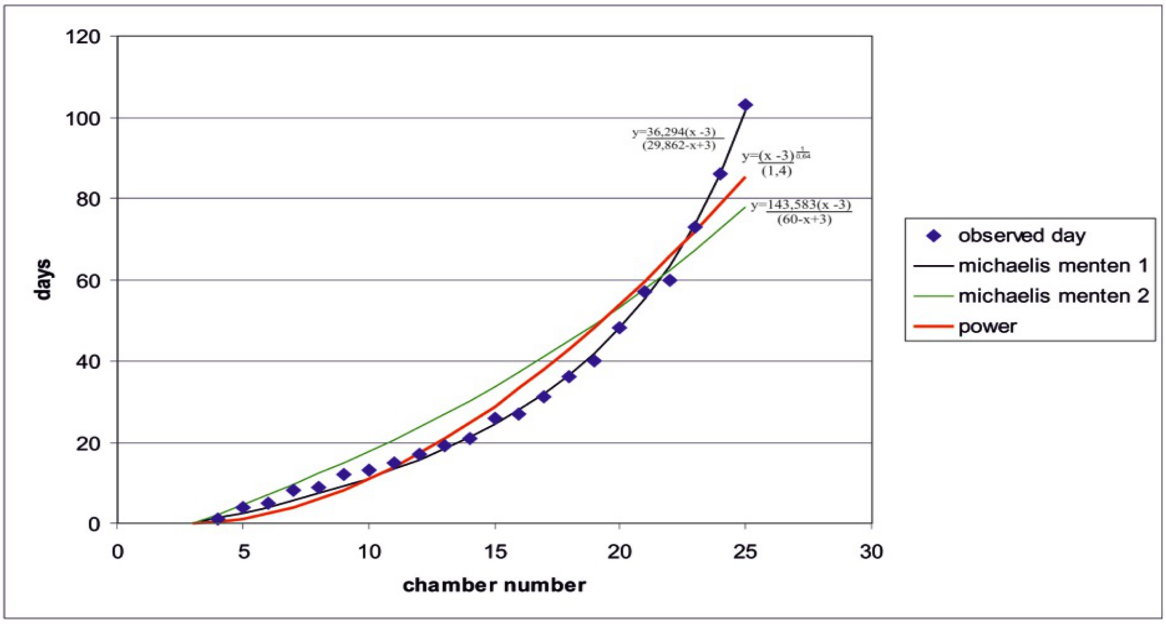

Fig.P6 simplified CT Scanner (Briguglio et al., in press).

One major problem during the segmentation process was the definition of the greyscale threshold. It should be wide enough to contain the complete chamber cavity, but small enough that the selected areas don't include parts of the test or ingress through stolons and foramina into the next chamber. If this happens, a manual barrier has to been drawn, implementing a biased error in the data.

Serendipitous observations led to the discovery that the gamonts cultured by Röttger show great alteration in septal growth (see appendix figures A1 – A12). Septa and septula are strongly underdeveloped or are uncompleted and chambers have large connections. These fused chambers, i.e., cavities, present a relative great problem for 3D segmentation and later on also for estimating oscillation in growth. Hence, to accelerate the segmentation process different greyscale threshold have been used for these gamonts. However, the greyscale threshold had to be adjusted slightly every 10 to 20 chambers or otherwise artificial boundaries had to be drawn to replace underdeveloped septa or septula.

All naturally grown gamonts and agamonts from Kekaa Point and Sesoko-Jima didn't show any strong alteration of internal structures. They have mostly grown according to their bauplan structure and showed only some reparatory chambers as reaction to fractioning.
The aim of this was not only to compare specimens of *H. depressa* grown under natural and laboratory conditions, but also to search for growth oscillation by looking at chamber volumes gained trough MicroCT Analysis and 3D segmentation.
To estimate growth oscillation, the estimation of the growth rate is pivotal as it can alter the length of the measured periods dramatically. Based on observed growth values for *H. depressa* gamonts of Röttger's culturing experiments in 1972, estimation has been made by using the Michaelis-Menten function (for more details see p.12) shown in figure P7.
This growth rate is probably correct for naturally grown gamonts, because the gained growth curve based on laboratory-cultured gamonts has slightly slower growth. Still the same curve has been used for both to keep the procedure relatively simple and the results comparable.
The growth curve for agamonts has not been based on observed values, but was gained by altering the growth rate of the gamonts to fit the assumption, that growth in agamonts is accelerated in early ontogenesis and slows down later on, reflecting their strict K-strategic life.
Finally one major problem concerning the timing of the teratologies should be mentioned.
Since the aforementioned cavities don't grow independently, but consist of many fused chambers, this single value of volume contains different planes of time. Therefore, any chamber influenced by the cavities has not been taken in account and secondly the point in time contained in the cavities have been estimated and then deleted before searching for oscillations. For further information how to calculate these oscillations see p. 23 or Hohenegger et al. (in press).
First results of naturally grown specimens confirmed the *a priori* assumption that these periodicities in growth are related to oscillation of the earth-moon system. The most

significant periods of approximately 14 and 29 days respond to the tidal cycle and the lunar month. Additionally the naturally grown LBF recorded more intermediate to long-term cycles, which probably reflect seasonal fluctuations and therefore differ in each sample locality.



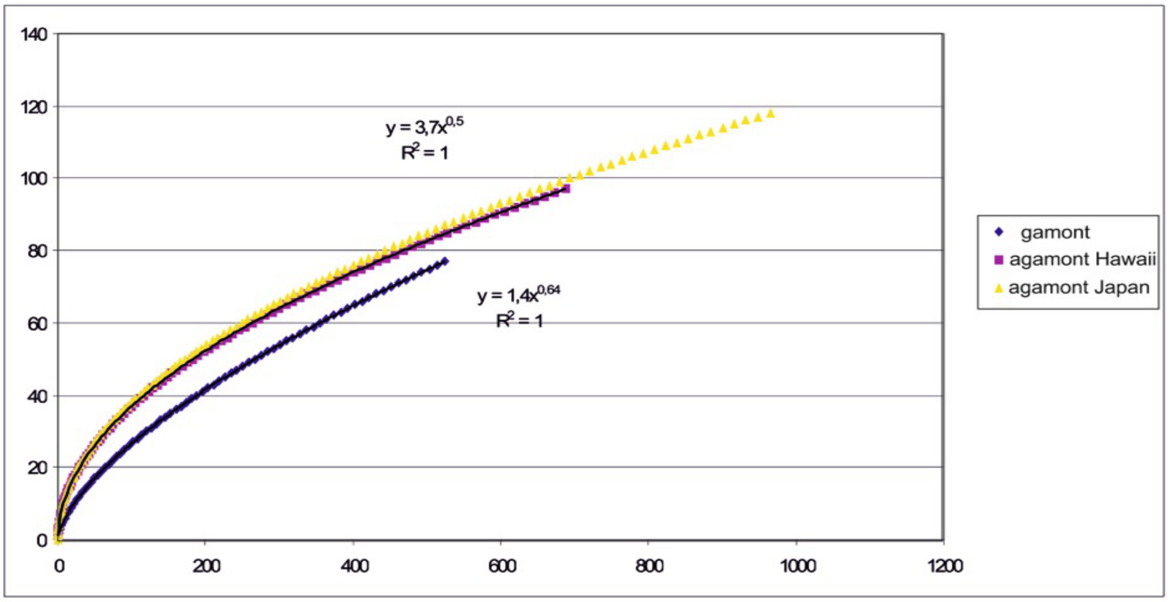




Fig.P7 the upper graph shows the observed values; Michealis Menten; power function for estimating the gamont growth rate and the lower one shows the estimated agamont growth rate in relation to those of the gamonts.

At the end most of these long-term cycles could be explained either by seasonality in local rainfall or wind regime.

The laboratory-cultured specimens recorded also periods of different lengths, but with smaller significance than that of the control fauna. These are very likely artefacts of the used methodology, since no fitting environmental factor controlling these periods could be determined. Due to the large amount of internal morphological abnormalities, which are not visible from the outside, we have discovered within the test of the cultivated specimens of *H. depressa*, it is advisable to be careful in using cultivated foraminifera as proxy for whatever task. Most of times, good cultivation experiment are designated by increase of diameter or by chamber building events. As discovered in this study, neither the formation of new chambers nor the increase in size depicts a well and healthy growth condition for the specimen.

**Systematic Palaeontology**

## Order Foraminiferida Eichwald, 1830

### Family Nummulitidae de Blainville, 1827

#### Genus Heterostegina d'Orbigny, 1826

*Heterostegina depressa* d'Orbigny, 1826.

1826. - *Heterostegina depressa* d'Orbigny, A., p. 305; pl. 17, figs. 5-7.
1839. - *H. antillarum* d'Orbigny, A., p. 122; pl. 7, figs. 24-25.
1862. - *Heterostegina sp.* Carpenter, M., p. 288; texte, figs. 45-47; pl. 19, fig. 1.
1880. - *H. curva* Moebius, K., p. 105; pl. 13.
1884. - *H. depressa* d'Orbigny. Brady, H., p. 746; pl. 112, figs. 14-18.
1884. - *H. cf. curva* Moebiue. Brady, H., p. 746; pl. 112, figs. 19-20.
1896. - *H. niasi* Verbeek, R. et Fennema, R., p. 1155; pl. 9, fig. 126.
1904. - *H. suborbicularis* d'Orbigny in Fornasini, C., p. 396; pl. 14, figs. 5-7.
1907. - *H. depressa* var. *spiroclypeus* Silvestri, A., p. 176.
1909. – *H. depressa* d'Orbigny. Rhumbler; pl. 39, fig. 24.
1914. - *H. depressa* d'Orbigny. Cushman, J. A., p. 38; pl. 19, fig. 5.
1921. - *H. suborbicularis* d'Orbigny. Cushman, J. A., p. 385.
1927. - *H. suborbicularis* d'Orbigny. Hofker, J., p. 70; pl. 35; pl. 36, figs. 6-12.
1930. - *H. antillarum* d'Orbigny. Cushman, J. A., p. 33; pl. 12, figs. 1, 2.
1949. - *H. curva* Moebius. Said, R., p. 24.
1949. - *H. suborbicularis* d'Orbigny. Said, R., p. 24; pl. 2, fig. 40.
1954. - *H. suborbicularis* d'Orbigny. Cole, W. S., p. 576; pl. 205, figs. 5-8.
1954. - *H. suborbicularia* d'Orbigny. Cushman, J. A., Todd, R. et Post, R.;18.2 , figs. 7, 8; pl. 87, fig. 2.
1957. - *H. gatarensis* Küpper, H., p. 103; figs. 28-31.
1968b. - *H. curva* Moebius. Hofker, J., p. 34; pl. 12, figs. 15-20.

1968. - *H. antillarum* d'Orbigny. Moncharmont Zei, M., p. 27; pl. 5, figs. 3-7.
1971. - *H. suborbicularis* d'Orbigny. Hofker, J., p. 76; PI. 107, fig. 6.
1971. - *H. depressa* d'Orbigny. Lutze, G. F., Grabert, B. et Seibold, E., p. 23
1972. - *H. depressa* d'Orbigny, Röttger, R., p. 234; fig. 3.
1973. – *H.depressa* d'Orbigny. Spindler, M., Röttger, R., p. 149; figs.5.
1978. – *H.depressa* d'Orbigny. Spindler, M., p. 329; fig.3.
1990. - *H. depressa* d'Orbigny. Hohenegger, J. et al., p.157; fig. 7.
1994. - *H. depressa* d'Orbigny. Krüger, R., p. 2; fig. 1.
2011. - *H. depressa* d'Orbigny. Hohenegger, J., p. 42, p. 67-68.

*Description*: The test is involute to evolute and centrally thickened. The megalospheric proloculus is followed by up to sixteen operculinoid and unfolded septa. Microspheric tests are larger and relatively rare with about thirty unfolded septa, with chamberlets formed by complete secondary septa, which are produced by folds of the septal flap.

The marginal cord consists of an anastomosing bundle of canals in the peripheral band that connects to those in the spiral septum of earlier whorls. Intraseptal canals are formed from parts of the former marginal canals, as new chambers are added, and connect the marginal canals of successive whorls. Secondary sutural canals within the septula of the chamberlets connect successive sutural canals. The apertures of the proloculus and early undivided chambers form the primary stolons or apertural or foraminal tubes. Later chambers and chamberlets of a single chamber are connected by radial stolons or tubes and may have annular stolons or tangential tubes, so-called because of their position. Y-shaped supplementary stolons occur at the distal tip of the secondary septula in the median plane. Smaller connections occur between the chamber lumen and peripheral canals of the final whorl and spiraling canals of the underlying whorl and may lead to the intraseptal canals. The canal system opens through small branches or trabeculae into the relative large pores or openings of the margin. Septal and secondary septal canals reach to the exterior. The wall is calcareous and finely perforate. U. Eocene to Holocene (Hottinger, 1977).

*Distribution*: cosmopolitan, tropical to temperate Atlantic. Pacific, and Indian Oceans, e.g.: Bazaruto Archipelago, Caroline Islands, European waters, Guam, Maldives, Mediterranean

Sea ,New Caledonia, Rabbit Key Basin, South Florida Keys, Okinawa, Hawaii (W.o.r.m.s., 2013).

**Introduction**

Larger benthic foraminifera (LBF) are a non-taxonomic, informal group of symbiont bearing marine shallow water organisms, which belong to the phylum of foraminifera. Their tests are commonly very large and quite complex, which function as greenhouse structures for their phototrophic algal symbionts (Hohenegger, 2011). They are well adapted and abundant in extreme oligotrophic environments (Hallock, 1985).

In shallow water deposits, LBF are among the most important sediment builders of the late Paleozoic and Cenozoic. The Nummulitid family was extremely diverse, abundant and dominant in all shallow water sediments of Eocene to Oligocene times (BouDagher-Fadel, 2008).

Nummulitids, as well as all other LBF, are considered as non-opportunistic K-strategists organisms, they gain large body size as a product of continuous and constant growth (Hottinger, 1982).

Additionally, it has been recently identified that shell form and size of larger benthic foraminifera reflect environmental changes. Each of their growth steps is represented by the addition of a single chamber, or a set of chamberlets. Volume, size and shapes of these growth steps are influenced by the environmental scenario they are living in (Hohenegger, 2011; Ferrández-Caňadell, 2012; Briguglio et al., in press).

During the last decades, much effort has been spent on cultivation of larger benthic foraminifera, to get some insights on the chamber building process, its timing, its geochemical composition and reproduction cycles of the cell. However, cultivation attempts on larger benthic foraminifera are known since the beginning of last century (Winter, 1907) but successfully cultivation experiments have been obtained only during the last 15 to 20 years,

when laboratory facilities allowed the creation of stabile and complex cultivation settings. LBF demand complex requirements concerning their habitat, e.g. high median temperature and rather high light intensity. These restrictions are due to their photosynthetic endosymbionts, which, in case of *Heterostegina*, are diatoms (Hohenegger, 2011).
While several species have been held in captivity, only few research groups were able to culture gamonts of LBF. Among the first was Winter (1907), who has been able to reproduce gamonts and even a filial generation of agamonts of *Peneroplis pertusus*.
Irwan (1980) achieved a reproduction of *Amphistegina.lessoni*, while Hallock (1981) could calculate growth functions for *A. lessoni* and *lobifera*. The first definite megalospheric filial generation belonged to *Marginopora vertebralis* by Ross (1972). Lutze and Wefer (1980) observed the forming of megalospheric daughter cells of *Cyclorbiculina compressa*. Krüger (1990) managed to observe a complete reproduction cycle of *Calcarina gaudichaudii* and successfully
cultured consecutive generations of *Heterostegina depressa* (Krüger, 1994).
Beside these former developments in cultivation, periodicity in growth of Nummulitids has also been an important topic in research for quite some time. Purton and Brasier (1999) worked on isotopic signals of $\delta^{18}O$ and $\delta^{13}C$ isotopes in extinct taxon of *Nummulites laevigatus.* They conclude that species of *Nummulites* were long-lived protists and could have recorded isotopic signals over a longer time span.
Even though wavelength and amplitude of the isotopic signal aren't constant over time the cyclicity is evident. Both authors interpret this oscillation as seasonal variations and, by using the chamber-building rate estimated for *Heterostegina depressa* by Röttger (1972), estimate ages roughly about 60 years for the very large *Nummulites millecaput* at a diameter of 160 mm.
Contrary to this, Ferrández-Caňadell (2012) assumes a higher growth rate in nummulitids under optimal conditions. The evidence of multispiral growth can play a major role in such

large protists and the same size measured by Purton and Brasier can be achieved in much less than 10 years. This theory matches with the assumptions by Ross (1979) who named rapid growth as key characteristics for larger foraminifera and Beavington-Penny and Racey (2004) who estimated 1 to 5 years for the gigantic size of late Palaeogene foraminifer taxa. (Ferrández-Caňadell, 2012).

The isotopic oscillation discovered by Purton and Brasier in 1999 may be much shorter than only seasonal variations. Like those recently found in recent LBF like *H. depressa* and *Marginopora vertebralis* (Wefer et al., 1981; Saraswati et al., 1997; Saraswati, 2008), which have high similarity with symbiont bearing *Monastrea* (Dávalos-Dehullu et al., 2008). $\boldsymbol{\delta}^{18}$O values measured by Wefer et al. (1981) in *H. depressa* from the Bermudas show high similarity with results of Purton and Brasier (1999).

Therefore recent LBF can be used to reconstruct controlling factors that operate as underlying principles to chamber formation. Patterns oscillating around a fixed growth function can be established and those may reflect periodically recurring ecological signals in nature, such as tides, moon cycles or seasonality (Hohenegger et al., in press; Briguglio, in press).

Hence, this study tries to apply new techniques on the study of lifetime and periodic cyclicity to the well-known taxon *Heterostegina depressa*. Among the six recent *Nummulitid* species, *Heterostegina depressa* has one of the broadest depth distributions and geographical range and can be considered, as is the best-suited taxon for a large variety of applications.

Tasks of this works are the study how the ontogenetic growth of chamber and chamberlets is influenced by environmental events and the comparison of growth styles between naturally grown specimens and those cultivated under laboratory conditions, cultured by Röttger and Krüger in 1991. These cyclicities have been calculated and plotted in different taxa of larger benthic foraminifera, e.g. *Palaeonummulites venosus* (Hohenegger et al., in press) using MicroCT technology for volumetry. Therefore it was a firsthand opportunity to look not only into naturally grown individuals but also cultured specimens of *H. depressa* (Hohenegger, 2011).

## Materials and Methods

For this research 12 specimens were chosen (Tab.1). This sample consists of some naturally grown gamonts from Hawaii and Sesoko-Jima, some naturally grown agamonts also from Hawaii and Sesoko and some cultured gamonts cultivated by Röttger in 1991.

| Code | Origin | Sample No. | A/B | Depth in *m* | Gompertz prameter | Amplitude | Phase | Period | *p* | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| D1-68 | Maui, Kekaa Point | #68 | A | 40 | $k = 723{,}21$ $b = 12{,}016$ $c = -0{,}0105$ $R^2 = 0{,}998$ | $\alpha 1 = 0{,}289$ $\alpha 2 = 0{,}243$ $\alpha 3 = 0{,}213$ | $\varphi 1 = 3{,}02$ $\varphi 2 = -1{,}6$ $\varphi 3 = -0{,}822$ | $\tau 1 = 192{,}6$ $\tau 2 = 12{,}20$ $\tau 3 = 28{,}16$ | 0,00000009 | 0,54922000 |
| D2-68 | Maui, Kekaa Point | #68 | A | 40 | $k = 70184{,}09$ $b = -17{,}113$ $c = -0{,}008$ $R^2 = 0{,}996$ | $\alpha 1 = 0{,}252$ $\alpha 2 = 0{,}188$ $\alpha 3 = 0{,}156$ | $\varphi 1 = 3{,}10$ $\varphi 2 = -2{,}81$ $\varphi 3 = 2{,}63$ | $\tau 1 = 158{,}30$ $\tau 2 = 24{,}38$ $\tau 3 = 13{,}79$ | 0,00000006 | 0,60285000 |
| D3-68 | Maui, Kekaa Point | #69 | A | 40 | $k = 2{,}396$ $b = -8{,}946$ $c = -0{,}033$ $R^2 = 0{,}999$ | $\alpha 1 = 0{,}281$ $\alpha 2 = 0{,}331$ $\alpha 3 = 0{,}23$ | $\varphi 1 = 0{,}269$ $\varphi 2 = 3{,}03$ $\varphi 3 = 1{,}13$ | $\tau 1 = 32{,}33$ $\tau 2 = 14{,}27$ $\tau 3 = 10{,}29$ | 0,00000887 | 0,57488000 |
| B44 | Maui, Kekaa Point | P.1.10.91 | B | n.n | $k = 562{,}694$ $b = -16{,}118$ $c = -0{,}011$ $R^2 = 0{,}988$ | $\alpha 1 = 0{,}253$ $\alpha 2 = 0{,}241$ $\alpha 3 = 0{,}217$ $\alpha 4 = 0{,}196$ | $\varphi 1 = -2{,}47$ $\varphi 2 = -3{,}11$ $\varphi 3 = 1{,}22$ $\varphi 4 = -2{,}4$ | $\tau 1 = 36{,}02$ $\tau 2 = 178{,}3$ $\tau 3 = 26{,}19$ $\tau 4 = 13{,}48$ | 0,00000000 | 0,57470000 |
| A1 | Sesoko-Jima | Transect A | A | 20 | $k = 164{,}52$ $b = -13{,}271$ $c = -0{,}012$ $R^2 = 0{,}999$ | $\alpha 1 = 0{,}282$ $\alpha 2 = 0{,}202$ $\alpha 3 = 0{,}198$ $\alpha 4 = 0{,}17$ | $\varphi 1 = 2{,}74$ $\varphi 2 = 2{,}71$ $\varphi 3 = 0{,}402$ $\varphi 4 = 3{,}13$ | $\tau 1 = 62{,}24$ $\tau 2 = 34{,}6$ $\tau 3 = 26{,}75$ $\tau 4 = 12{,}20$ | 0,00000001 | 0,70263000 |
| A2 | Sesoko-Jima | Transect A | A | 20 | $k = 2{,}192$ $b = -10{,}794$ $c = -0{,}031$ $R^2 = 0{,}999$ | $\alpha 1 = 0{,}318$ $\alpha 2 = 0{,}115$ $\alpha 3 = 0{,}145$ $\alpha 4 = 0{,}0948$ | $\varphi 1 = -1{,}44$ $\varphi 2 = 0{,}697$ $\varphi 3 = -1{,}7$ $\varphi 4 = -1{,}32$ | $\tau 1 = 84{,}40$ $\tau 2 = 10{,}89$ $\tau 3 = 34{,}24$ $\tau 4 = 25{,}08$ | 0,000000003 | 0,75477000 |
| A3 | Sesoko-Jima | Transect A | A | 20 | $k = 0{,}693$ $b = -12{,}602$ $c = -0{,}0375$ $R^2 = 0{,}995$ | $\alpha 1 = 0{,}27$ $\alpha 2 = 0{,}23$ $\alpha 3 = 0{,}161$ $\alpha 4 = 0{,}137$ | $\varphi 1 = -1{,}29$ $\varphi 2 = 0{,}503$ $\varphi 3 = 2{,}11$ $\varphi 4 = 2{,}69$ | $\tau 1 = 74{,}32$ $\tau 2 = 22{,}69$ $\tau 3 = 10{,}12$ $\tau 4 = 35{,}92$ | 0,00785910 | 0,50903000 |
| B1 | Sesoko-Jima | Transect A | B | 20 | $k = 146482{,}1$ $b = -25{,}3$ $c = -0{,}009$ | $\alpha 1 = 0{,}309$ $\alpha 2 = 0{,}288$ $\alpha 3 = 0{,}263$ $\alpha 4 = 0{,}423$ | $\varphi 1 = -0{,}948$ $\varphi 2 = -1{,}08$ $\varphi 3 = -2{,}43$ $\varphi 4 = 3{,}01$ | $\tau 1 = 26{,}96$ $\tau 2 = 17{,}74$ $\tau 3 = 43{,}6$ $\tau 4 = 213{,}63$ | 0,00000000 | 0,78054000 |
| R1 | Universität Kiel | F1.27.1.91 | A | n.n. | $k = 0{,}573$ $b = -8{,}944$ $c = -0{,}05$ $R^2 = 0{,}987$ | $\alpha 1 = 0{,}741$ $\alpha 2 = 0{,}246$ $\alpha 3 = 0{,}16$ | $\varphi 1 = -2{,}45$ $\varphi 2 = 0{,}216$ $\varphi 3 = -2{,}11$ | $\tau 1 = 290{,}1$ $\tau 2 = 52$ $\tau 3 = 37$ | 0,00000000 | 0,87033000 |
| R2 | Universität Kiel | F1.27.1.92 | A | n.n. | $k = 7{,}269$ $b = -7{,}990$ $c = -0{,}015$ $R^2 = 0{,}976$ | $\alpha 1 = 1{,}13$ $\alpha 2 = 0{,}3$ $\alpha 3 = 0{,}115$ | $\varphi 1 = 1{,}75$ $\varphi 2 = 1{,}23$ $\varphi 3 = -2{,}56$ | $\tau 1 = 275{,}3{,}1$ $\tau 2 = 55{,}05$ $\tau 3 = 21{,}32$ | 0,00000000 | 0,98282300 |
| R3 | Universität Kiel | F1.27.1.93 | A | n.n. | $k = 0{,}548$ $b = -8{,}642$ $c = -0{,}046$ $R^2 = 0{,}988$ | $\alpha 1 = 1{,}22$ $\alpha 2 = 0{,}76$ $\alpha 3 = 0{,}699$ | $\varphi 1 = -2{,}13$ $\varphi 2 = -2{,}55$ $\varphi 3 = 1{,}22$ | $\tau 1 = 336{,}5{,}1$ $\tau 2 = 47{,}35$ $\tau 3 = 43{,}79$ | 0,00000000 | 0,90321000 |
| R6 | Universität Kiel | F1.27.1.94 | A | n.n. | $k = 1119289{,}97$ $b = -20{,}39$ $c = -0{,}005$ $R^2 = 0{,}996$ | $\alpha 1 = 0{,}674$ $\alpha 2 = 0{,}335$ $\alpha 3 = 0{,}36$ | $\varphi 1 = -2{,}73$ $\varphi 2 = 1{,}75$ $\varphi 3 = -2{,}62$ | $\tau 1 = 146{,}4{,}1$ $\tau 2 = 30{,}43$ $\tau 3 = 40{,}41$ | 0,00000000 | 0,83679000 |

Tab.1 List of the used specimens of *Heterostegina depressa*, showing Gompertz parameter, amplitudes, phases, periods as well as *p* and $R^2$ values.

The Hawaiian material originates from Maui, Kekaa Point (20° 55' 38.38" N, 156° 41' 55.91" E; Fig.1) and was sampled at 15 to 60 meters of water depth in 1991 by Röttger and Krüger (Krüger et al., 1994). The selected gamonts have been collected from Kekaa Point, Station 8, sample No. 68, the exact water depth (40 metres) is know, in this study named as D1-68, D2-68 and D3-68.

According to Krüger (1994), 113 agamonts were sampled at aforementioned locality and water depth and maintained at 22°C in clear "open ocean water" (Krüger, 1994). Afterwards, they were shipped to the University of Kiel and maintained at 25°C, 450 Lux and a day-night interval of 12/12 hours. Half synthetic seawater has been used as culture medium; the mixture was based on Helgolandian seawater with 30 to 33‰ of salinity and has been enriched with concentrated "simple synthetic seawater" (Hauenschild, 1962), enhancing the salinity to 35‰ (Krüger, 1994).

The laboratory cultured gamonts R1, R2, R3 and R6 originate from agamonts haltered from 12.08.91 to their reproduction at the 27.10.1991 after 76 days of captivity (Krüger, 1994).

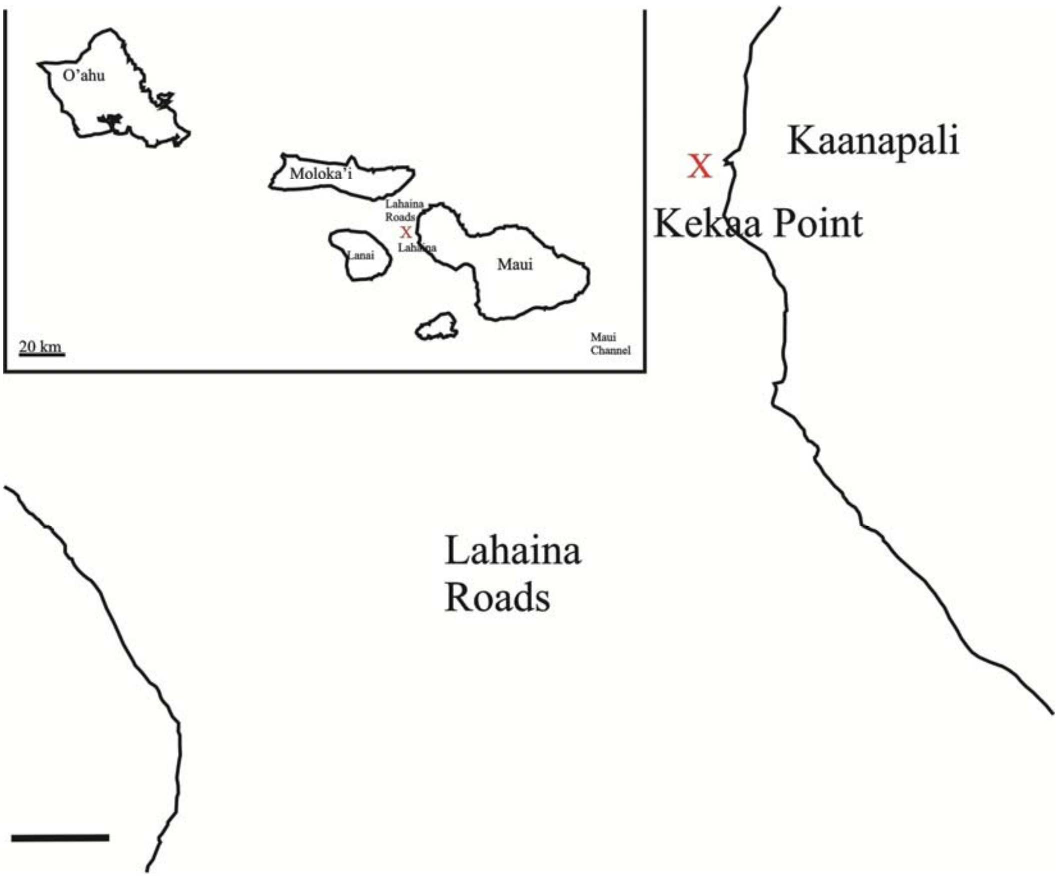



Fig.1 Sketch of western Maui coastline, the red X marks the sampling point, modified after Krüger, (1994).

The chosen specimens of Sesoko-Jima have been sampled in June and July 1996 at 20 metres water depth. The sampling was arranged in two transects around the northern coastline of Sesoko-Jima (Fig.2), whereof the northern transect is the origin of the specimen of *H. depressa* used in this study (known as transect A).  For more precise information on sampling, the reader should refer to Hohenegger et al. (1999).

**Environmental settings of localities**

The sampling environment around Kekaa Point is microtidal. The tide heights oscillate between 0,5 m above mean sea level at nip tides and around 0,7 m during spring tides (Fig.3).

The macroclimate of Hawaii is influenced by the trade winds coming from Northeast. The NE trade winds undulate during the year reaching their northern-most position during summer fully hitting the islands. Therefore, it generates a winter season of seven months from October to April and five months summer season from May through September. The climate on the

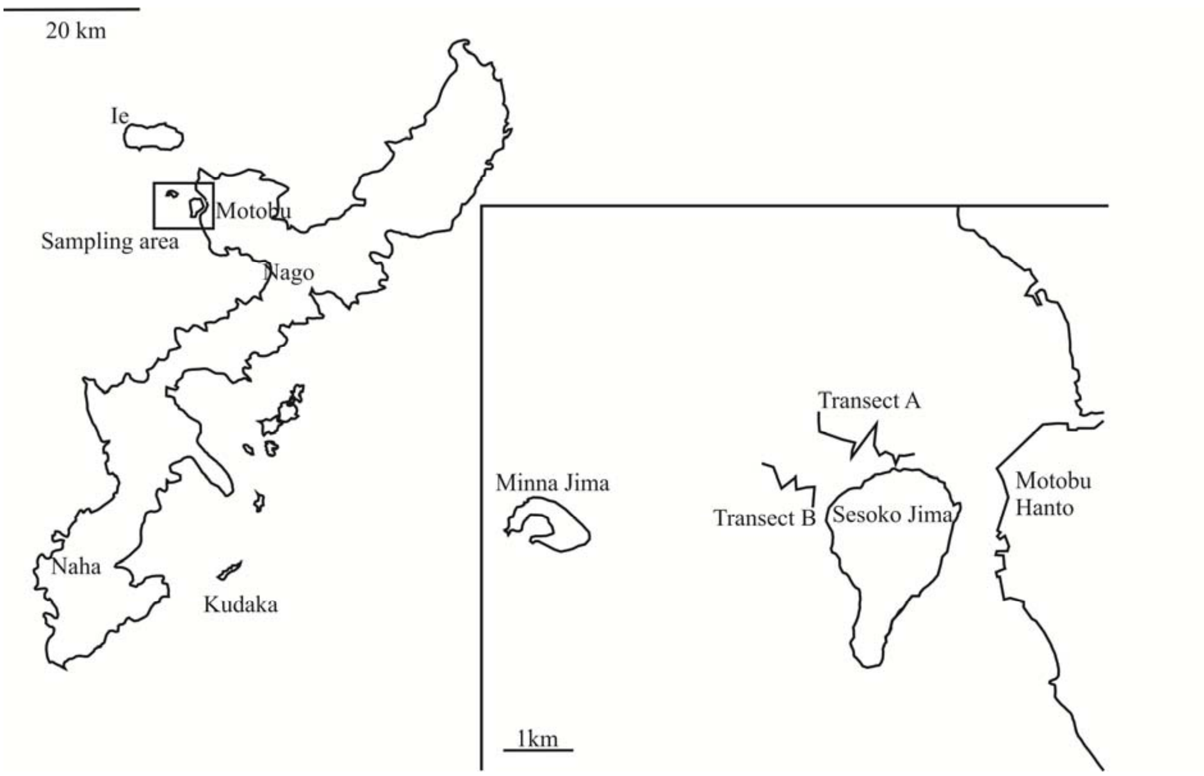



Fig.2 Sample locality Sesoko-Jima, Okinawa, showing Transect A and B, after Hohenegger et al., (1999).

western coast of Maui corresponds to the Kona Coast mesoclimate of Hawaii (Fig.3). It is the only region on the island where a rainfall peak in summer exists. Overall the mesoclimate is warmer and drier than trade-windward weather. Additionally the so-called Kona winds hit the Islands form October to March, consisting of heavy storms, rains and cold fronts. However, these winds aren't equally pronounced every year and the amount of events may vary between two to three or even six per season (Hartley and Chen, 2010).

The sampling points in Sesoko Jima also lie in a microtidal environment, but with much stronger tides reaching from 0.7 m at nip tides to 2 m at spring tides (Fig.4).

The macroclimate of Sesoko Jima shows distinctive seasonality. Rainfall regime and temperature variations depict a monsoon-influenced climate with two rainfall peaks during summer and a relative increase in temperature (Fig.4).

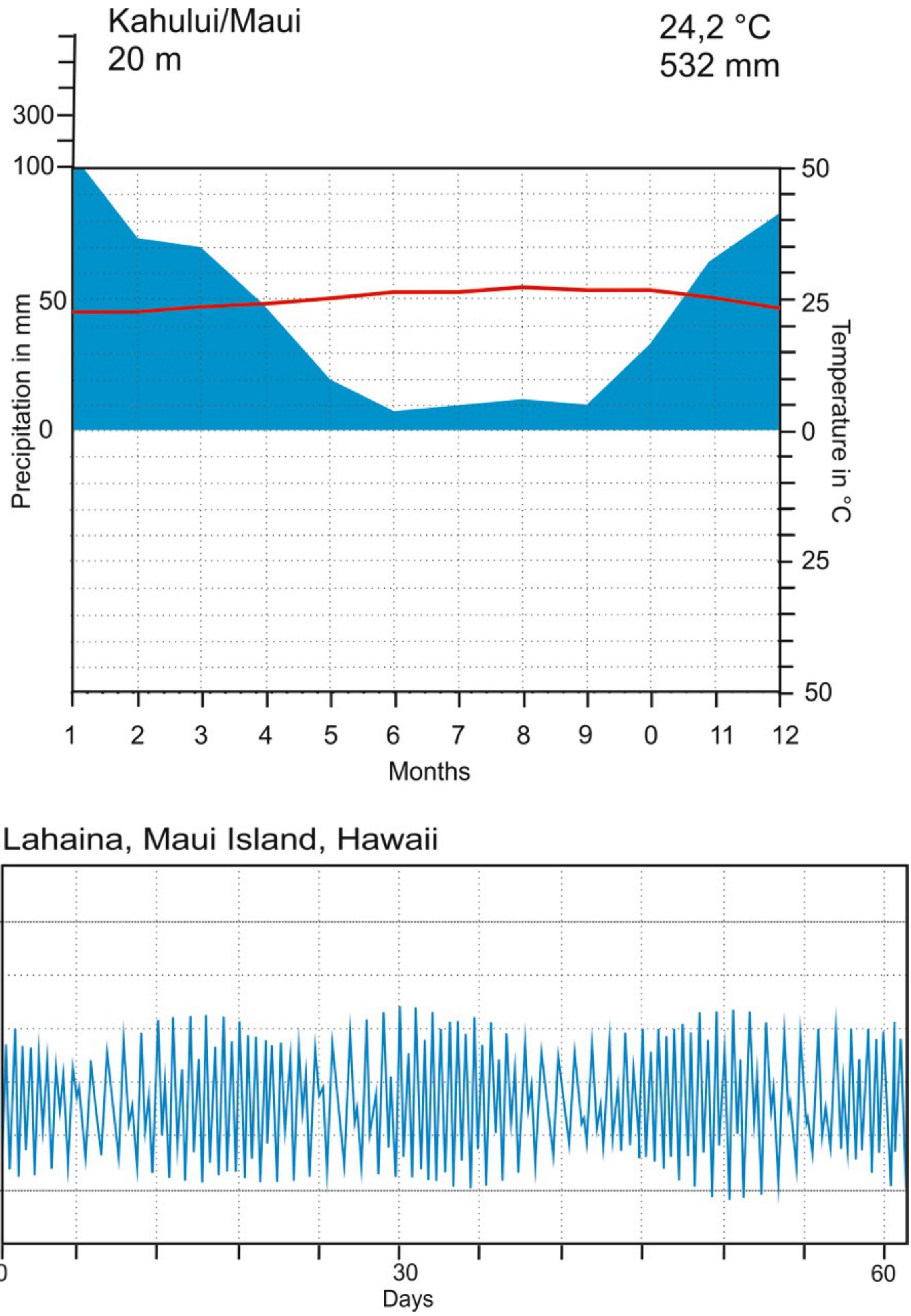



Fig.3 Climate diagram and tidal calendar of the nearest monitoring stations to Kekaa Point.

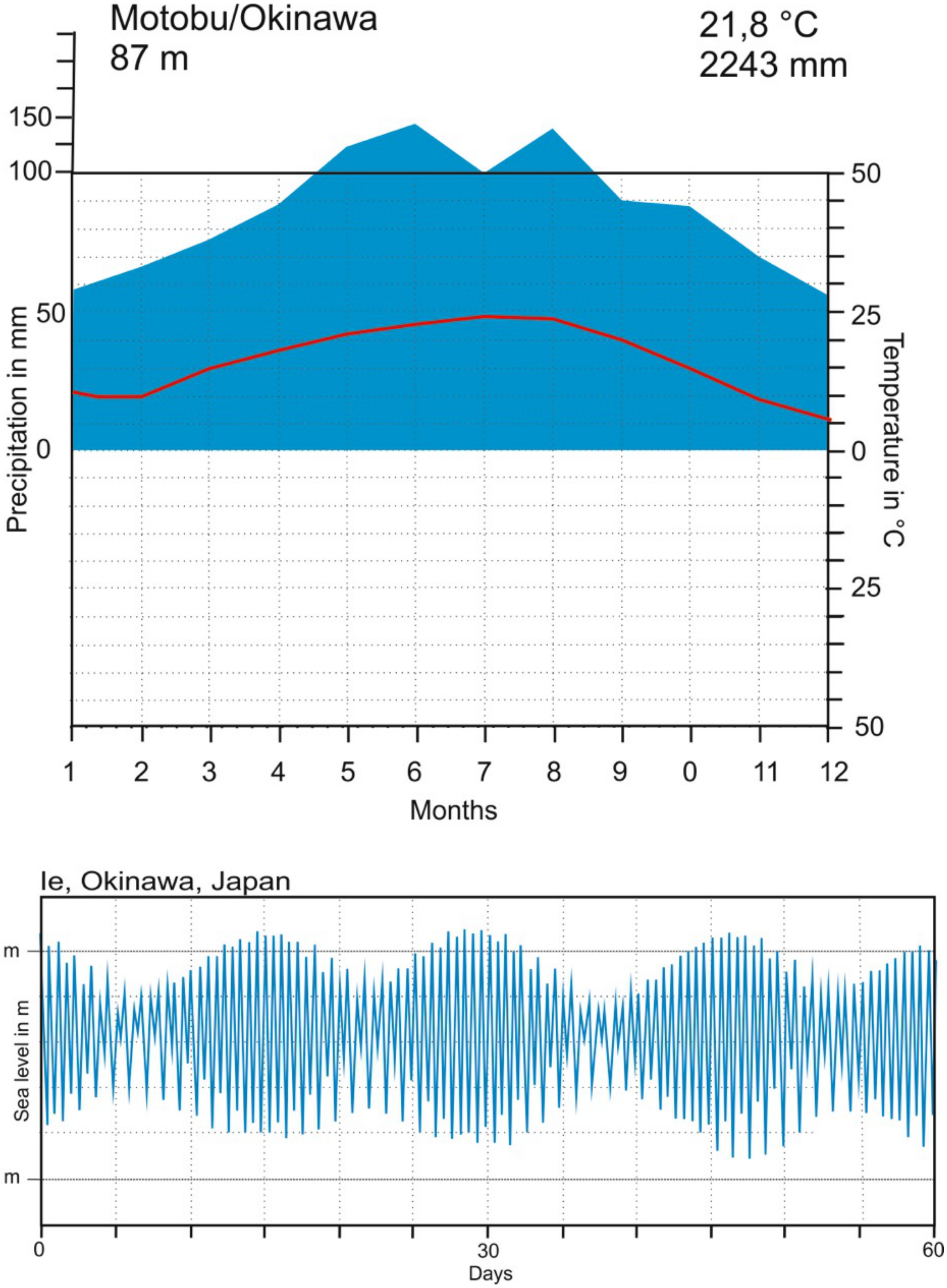



Fig.4 Climate diagram and tidal calendar of the nearest monitoring stations to Sesoko-Jima.

Beside this, there is a distinct seasonality of predominant wind directions. From autumn to spring NE winds are dominant while in summer the wind direction switches to south. This changes again after the crossing of the tropical front in September (Hohenegger et al., 1999). For the present investigation, the most complete specimens of *H. depressa* were chosen to collect the highest amount of data and to simplify afterwards the process of three-dimensional segmentation, since broken or thin-walled chambers had to be redrawn.

**Analysis**

Micro-computer-tomography (MicroCT) was used to take a closer look at the internal structure of *H. depressa* and to measure volumes of chamber sequences of each individual. The images were taken with the high-energy scanner Skyscan 1173 at the Department of Palaeontology of the University of Vienna.

All investigated specimens cultured by Röttger in 1991 show various internal test anomalies concerning formation of septa and septula and chamber formation. Using external views tools, such anomalies are only hardly visible; therefore, tomographic slices had to be used to get access to these teratologies (Hohenegger et al., in press).

Chamber volumes of each specimen were extracted and summed to get a cumulative sum, to represent the overall growth in volume. This dataset fits best to the Gompertz function equation (1), which has been estimated by using the following equation:

$$V_e = K \exp\left(b \exp\left(cj\right)\right) \qquad (1),$$

Where *K*, *b* and *c* are parameters to be estimated, *V* is the volume of the test and *j* is the number of the chamber. Afterwards the first derivatives of the $V_e$ values are computed (Eq. 2) for each chamber number to compare them to observed chamber volumes and prove the quality of fit of the Gompertz function.

$$v'_e = \frac{dV_e}{dj} = cV_e \ln(K / V_e) \qquad (2)$$

where $j$ represents the chamber number [ 3, 4, 5, 6 ...] and $v'$ the estimated volumes obtained by the Gompertz function.

Then, the residuals have been obtained by the equation (3) as follows:

$$d_j = \frac{(v_{mj} - v'_{ej})}{v'_{ej}} \qquad (3)$$

Where $d_j$ represents the standardized residuals, $v_{mj}$ the measured volumes and $v'_{mj}$ the derivative of the estimated volumes for the $j^{th}$ chamber. Residuals show how far the predicted data of the regression model deviates from the measured data and represent periodic or instantaneous deviations from the estimated growth function. By using the same equation (Eq. 3) for linearized volumes and derivatives the gained residuals are standardized and linearized ones.The standardized and linearized residuals are afterwards used to show oscillation and cyclicity patterns by plotting against the chamber-building rate.

The used chamber-building rate is based on laboratory observations of *Heterostegina depressa* made by Röttger (1972). Chamber building rates of larger benthic foraminifera aren't well researched yet and therefore estimation for building rates has been used, which is based on a power function (Hohenegger et al., in press).

$$j = 1.4t^{0.640} \qquad (4)$$

Where *t* is the time when chamber *j* has been build. The equation (4) has been inverted to gain the timing of chamber formation resulting in equation (5), which fits the timing of observed growth of *Heterostegian deperessa* best.

$$t = (j/1.4)^{(1/0.640)} \qquad (5)$$

For chamber building rates of agamonts, a theoretical growth function was estimated based on the growth of gamonts, even though the chamber building rate in agamonts should differ from that of gamonts at last due to some aspects. During earlier life phases it should display accelerated growth, while later life stages show adaptions to strict K-strategy. Therefore, starting from observed values of gamonts cultured by Röttger (1972), estimation for the agamonts has been calculated. Exponential regressions models were used to gain a function for chamber building rates of *H. depressa* for a theoretical life span of three year, since the actual length of an agamont's life is not known yet (Hohenegger et al., in press).

$$j = 3.7t^{0.5} \qquad (6)$$

Using the standardized linearized residuals (3), cyclic patterns were searched using sinusoidal regression model (Press et al., 1992) as well as REDFIT spectral analysis (Schulz and Mudelsee, 2002).

For better visualization values for the sinusoidal functions were summed up to contain all significant cycles and amplitudes $\alpha$ and phases $\phi$ as well as periods $\tau$. Additionally p and $R^2$ values for the summed functions are given.

For three dimensional analyses, Amira 5.4.3 VSG was used. Gompertz functions and parameters have been calculated in SPSS statistics v. 18.0. REDFIT spectral analysis and sinusoidal function were computed in PAST 2. 17c (Hammer et al., 2001) and for basal calculation Microsoft Office EXCEL 2003 have been used.

**Results**

In Table 1 the most significant cycles of each specimen with amplitudes $\alpha$, phases $\phi$ and periods $\tau$, as well as $R^2$ and $p$ values are given, which have been acquired by REDFIT spectral analysis. An oversampling rate of four was used to increase the number of points. Significant cycles exhibiting a power around the 80% $\chi^2$ false alarm level were then chosen. For the Hawaiian, Japanese and cultivated gamonts histograms on weighted frequencies and for the agamonts from Kekaa Point and Sesoko non-weighted histograms are given (Figs.5, 6).

Histograms of naturally grown gamonts and laboratory-cultured gamonts clearly show a triplet of significant periods. In the Hawaiian naturally grown specimens periods of the categories 10-15 (mean: 12.6), 20-35 (mean: 28.2) and 160-195 (mean: 175.4) days are the most significant, while in the Japanese gamonts categories of 10-15 (mean: 11.0), 20-40 (mean: 28.2) and 60-85 (mean 73.6) are dominant.

Those differences are neither based on weighting method or on chamber number (nearly equal among the samples), but on differences in amplitudes.

The significant periods of the laboratory cultivated gamonts differ quite evidently from those of naturally grown ones. The specimens show distinctive cycles at 40-50, 275-290 and 335-340 days with mean period lengths of 52, 282.7 and 336.5.

The agamonts of Kekaa point show three significant periods 28.0 days, 37.3 days and 191.9 days; they lack the shorter cycle of 12.6 days recorded by the gamonts, but show much longer periods.

In contrast, agamonts of Sesoko Jima show short-term cycles of 17.74 days. Other significant cycles take 26.96 days, 43.6 days and 213.6 days.

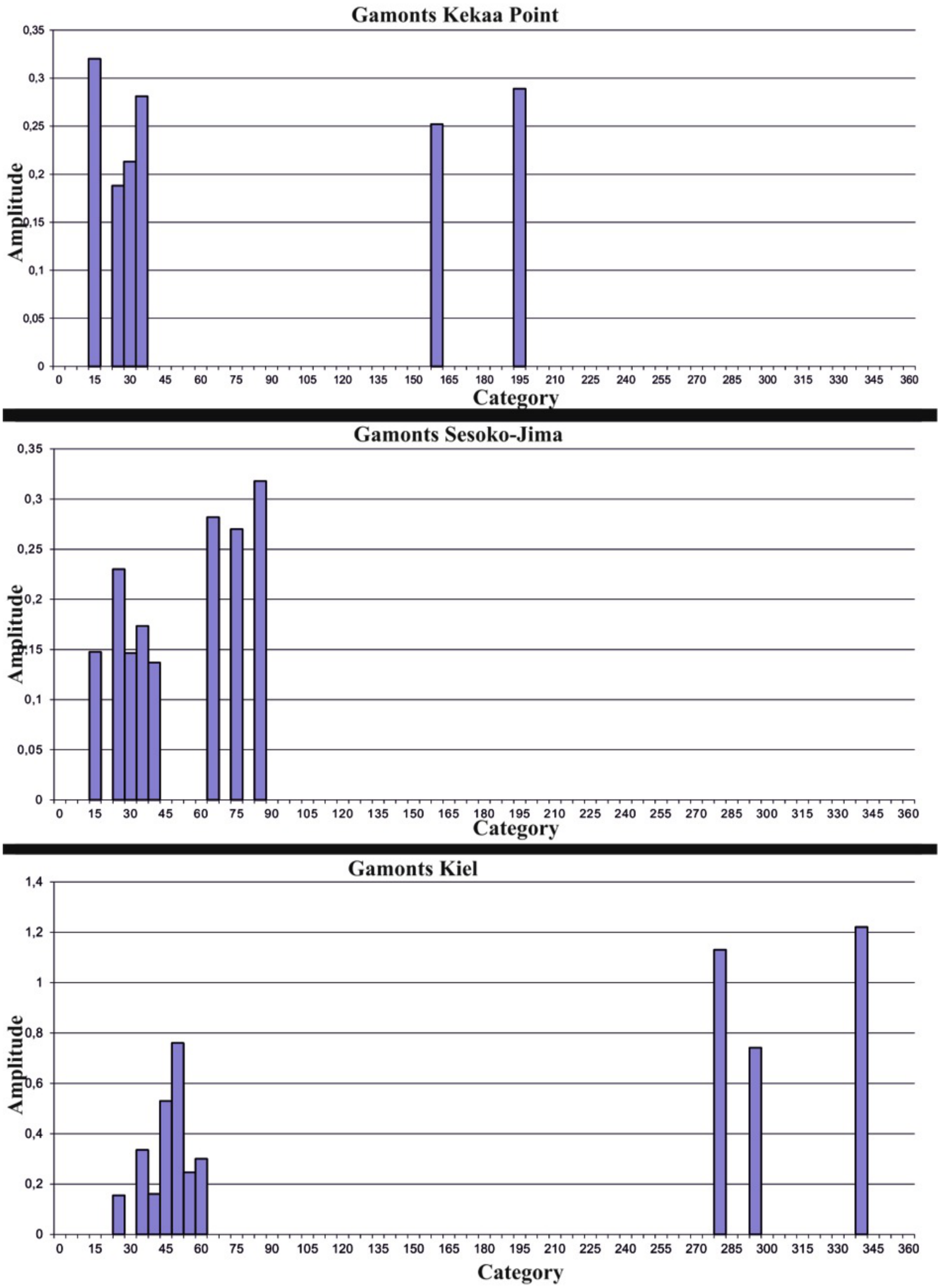



Fig.5 Histograms of the naturally grown gamonts of Kekaa Point and Sesoko-Jima, and laboratory-cultured gamonts from Kiel, weighted on frequency.

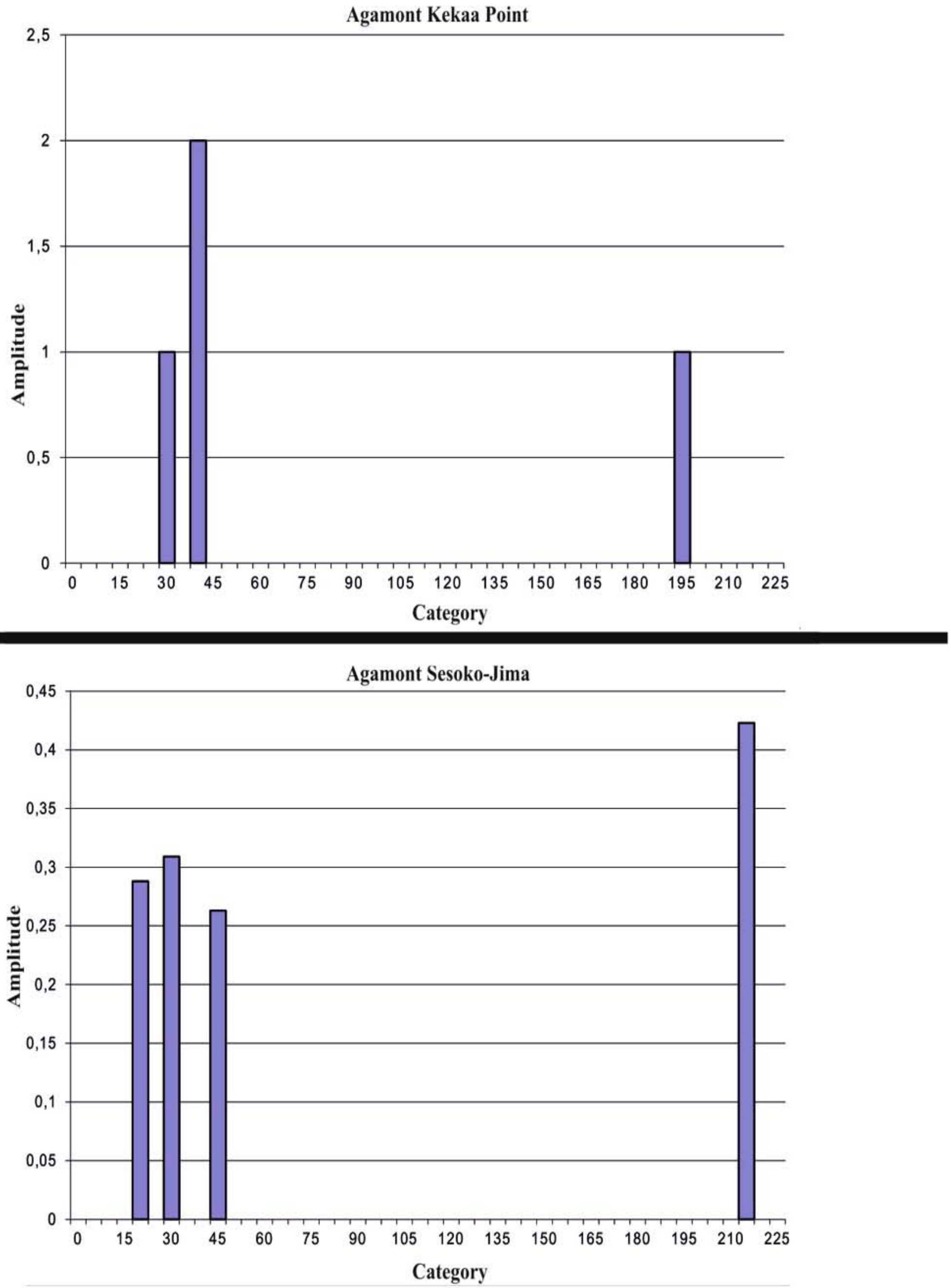



Fig.6 non-weighted histograms for the agamonts from Kekaa Point and Sesoko.

**Discussion**

All investigated specimens of naturally grown *Heterostegina depressa* show distinct cyclicity, which can be well approximated by a sum of sinusoidal functions. These resulting periods can be compared to orbital oscillations of the earth-moon system, e.g. lunar cycles and/or seasonal events. To connect such environmental cycles to oscillations in foraminiferal growth, an estimation of the estimated growth is mandatory. This has been presented here based on theoretical adaptation to the gamonts whose growth rate is much better known.

Using such growth rates, naturally grown gamonts show tendencies to record rather short-term periods. Longer-lived specimens (agamonts from Sesoko and Kekaa Point) with three years of estimated lifetime show similar periods over all, but the agamont from Kekaa Point misses the shortest time interval. This might be due to differences in tidal regimes of the two localities.

Periods around ~ 14 and 29 days are the most frequent with very high significance possibly proving the effects tides and lunar month. This dependency of moonlight possibly seen in larger foraminifera has been proven quite recently in animal and plant growth in shallow water and deep-sea metazoan (Mercier, 2011). This correlation of foraminiferal growth and full moon phases around each 29 days is relatively easy to explain considering the continuous positive activity of their endosymbiontic algae during full moon nights.

The shorter period of 14 days seem to depict the time interval between spring and neap tides. The tidal regime of Sesoko and Hawaii has semi-diurnal range with periodicity of half a lunar month ~14 days, which can be seen in the naturally grown specimens of both places.

For Sesoko Jima a tidal height of ~1.3 metres is known (Fig.4), thus creating strong and deep reaching tidal currents (Zuo et al., 2009). These currents run along the substrate layer influencing sessile benthic organisms like LBF and suspend a lot of fine-grained deposits, hence diminishing light intensity and increasing the nutrient availability affecting foraminiferal endosymbionts.

The tidal effect on the samples collected at Kekaa should be relatively reduced in respect to that on the Japanese material.

Besides these short-term cycles, naturally grown specimens from Sesoko show also intermediate term periods of ~ 60 to 85 days. These differences in period may seem to reflect meso to macroclimatic seasonal fluctuations of Sesoko. Sesoko-Jima's climate is dominated by the monsoon front as seen in figure 4. Therefore this region is influenced by two strong raining seasons and additionally relatively cold winter months. These factors might explain the period length of approximately 3 months. Additionally, the agamont from Sesoko shows a long-term period of 213.6 days, which possibly depicts the yearly shift of the wind regime during summer.

Agamonts and gamonts form Kekaa Point exhibit nearly the same long-term cycles from 175.4 to 191.9 days. Those cycles might correspond to a period of intense influence of the NE trade winds on the islands during the Hawaiian summer months.

Agamonts of both sampling localities show a 40 to 45 days cycle, which is quite hard to interpret since no fitting environmental signal could be found. This period might result due to constructive interferences within the sinusoidal function or to small incongruences caused by a different growth rate.

As expected, the laboratory-cultured gamonts show different cyclicity patterns, as those seen in naturally grown foraminifera. Since they have been cultured in petri dish a climate chamber at 25° C without strong temperature fluctuations, no ecological driven growth oscillations should be visible within their growth.

The cycle with the longest period ~ 300 days possibly reflects the complete lifetime of the gamonts or might be the result of the so-called tendency cycles. An interpretation for the 40 to 50 days cycle is hard to find and no evident reason could be determined. Additionally one should comment that it is the basic task of the used method to search for cycles within a certain data set. Most data set contain these periodic cycles which aren’t significant or are just artefacts of the statistical method used. Therefore they don't have to be necessarily ecological controlled.

## Conclusion

Larger benthic foraminifera show direct dependence of environmental variability during their growth and record short to long-term oscillation during their chamber formation expressed as chamber size variation. Special attention should be given to chamber building rates, which are estimated using power function approximating the Michaelis-Menten function and especially difference of the localities can alter these rates. The gained results confirm that naturally grown foraminifera are affected by lunar oscillations even though the exact factor controlling the 14 days period is yet to be found. For Sesoko-Jima strong tidal currents and connected disturbances as factor for the 14 days cycle may be true. But for Kekaa Point, where there are only slight water height differences between neap and spring tides, other factors have to be effective.

Investigation of laboratory cultured gamonts showed that significant cyclicities may still be valid, but are being expressed due to arbitrarily inflicted conditions. The approach of simulating complex environmental factors of natural marine habitats should be closely revised. Very acute developed teratologies support this view and create severe complications for further analysis using. Therefore the validity of many geochemical analyses and environmental proxies applied on cultivated foraminifera may be badly affected.

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# Appendix

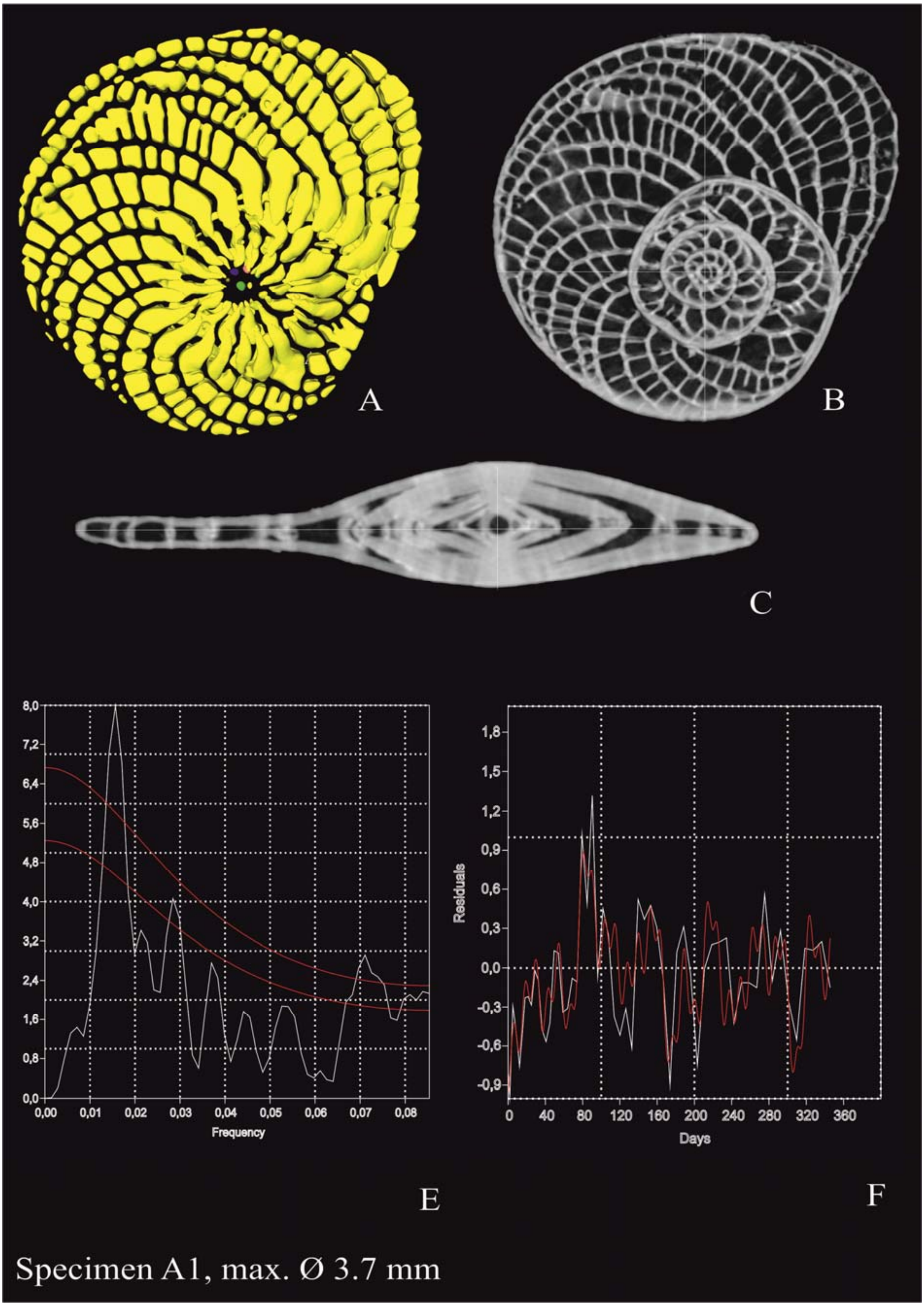
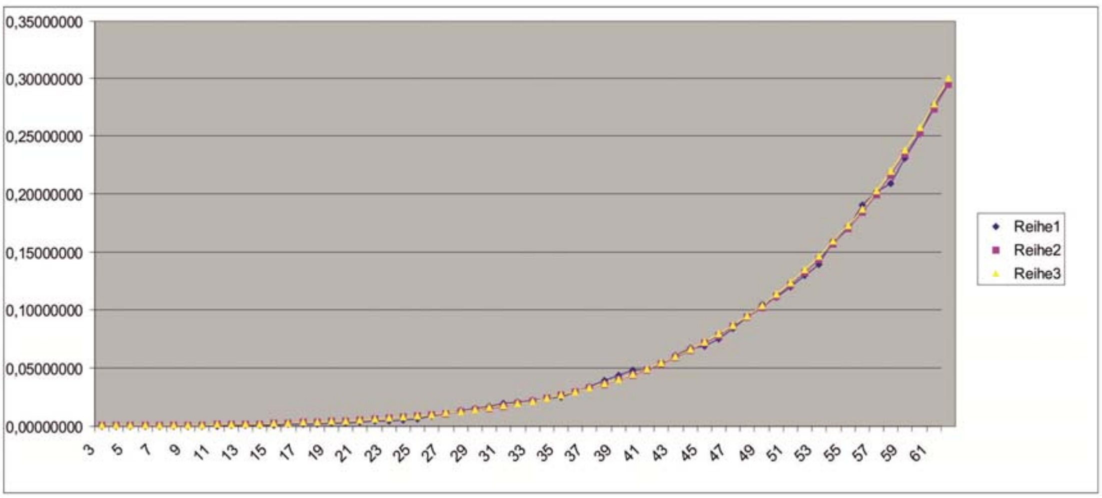



Fig.A1 Specimen A1, gamont from Sesoko Jima, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

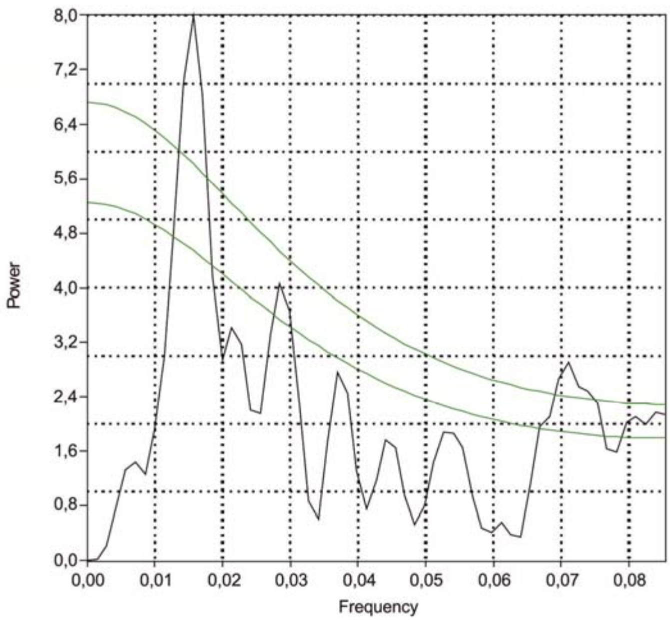
| days | chamber volume mm³ | | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,3323559 | 3 | 0,000007 | 0,00000700 | 0,0004526 | 0,00045341 | 0,00045341 | -0,98456151 | 0,00000233 | 0,00015114 | -0,98456151 |
| 1,153592 | 4 | 0,00001 | 0,00001700 | 0,000527 | 0,00052822 | 0,00007480 | -0,86631616 | 0,00000333 | 0,00002493 | -0,86631616 |
| 2,3888811 | 5 | 0,000001 | 0,00001800 | 0,0006125 | 0,00061424 | 0,00008602 | -0,98837540 | 0,00000033 | 0,00002867 | -0,98837540 |
| 4,0040645 | 6 | 0,000032 | 0,00005000 | 0,0007106 | 0,00071299 | 0,00009875 | -0,67594918 | 0,00001067 | 0,00003292 | -0,67594918 |
| 5,9770478 | 7 | 0,00008 | 0,00013000 | 0,0008229 | 0,00082615 | 0,00011316 | -0,29300714 | 0,00002667 | 0,00003772 | -0,29300714 |
| 8,2916959 | 8 | 0,000076 | 0,00020600 | 0,0009514 | 0,00095558 | 0,00012943 | -0,41282440 | 0,00002533 | 0,00004314 | -0,41282440 |
| 10,93541 | 9 | 0,000064 | 0,00027000 | 0,001098 | 0,00110337 | 0,00014779 | -0,56696593 | 0,00002133 | 0,00004926 | -0,56696593 |
| 13,897923 | 10 | 0,000041 | 0,00031100 | 0,0012651 | 0,00127184 | 0,00016847 | -0,75663232 | 0,00001367 | 0,00005616 | -0,75663232 |
| 17,170608 | 11 | 0,000094 | 0,00040500 | 0,0014551 | 0,00146355 | 0,00019171 | -0,50967481 | 0,00003133 | 0,00006390 | -0,50967481 |
| 20,746056 | 12 | 0,000168 | 0,00057300 | 0,0016709 | 0,00168134 | 0,00021779 | -0,22860923 | 0,00005600 | 0,00007260 | -0,22860923 |
| 24,617796 | 13 | 0,000193 | 0,00076600 | 0,0019155 | 0,00192834 | 0,00024700 | -0,21863481 | 0,00006433 | 0,00008233 | -0,21863481 |
| 28,780093 | 14 | 0,0002 | 0,00096600 | 0,0021924 | 0,00220802 | 0,00027968 | -0,28489057 | 0,00006667 | 0,00009323 | -0,28489057 |
| 33,22781 | 15 | 0,00031 | 0,00127600 | 0,0025053 | 0,00252418 | 0,00031616 | -0,01948189 | 0,00010333 | 0,00010539 | -0,01948189 |
| 37,956304 | 16 | 0,000324 | 0,00160000 | 0,0028583 | 0,00288101 | 0,00035683 | -0,09199637 | 0,00010800 | 0,00011894 | -0,09199637 |
| 42,961343 | 17 | 0,00021 | 0,00181000 | 0,0032559 | 0,00328309 | 0,00040209 | -0,47772475 | 0,00007000 | 0,00013403 | -0,47772475 |
| 48,239047 | 18 | 0,000196 | 0,00200600 | 0,0037032 | 0,00373547 | 0,00045238 | -0,56673411 | 0,00006533 | 0,00015079 | -0,56673411 |
| 53,785834 | 19 | 0,000294 | 0,00230000 | 0,0042054 | 0,00424364 | 0,00050817 | -0,42145570 | 0,00009800 | 0,00016939 | -0,42145570 |
| 59,598385 | 20 | 0,000646 | 0,00294600 | 0,0047685 | 0,00481362 | 0,00056997 | 0,13338444 | 0,00021533 | 0,00018999 | 0,13338444 |
| 65,673605 | 21 | 0,000712 | 0,00365800 | 0,0053989 | 0,00545195 | 0,00063833 | 0,11541582 | 0,00023733 | 0,00021278 | 0,11541582 |
| 72,008602 | 22 | 0,000472 | 0,00413000 | 0,0061037 | 0,00616575 | 0,00071381 | -0,33875912 | 0,00015733 | 0,00023794 | -0,33875912 |
| 78,600663 | 23 | 0,000549 | 0,00467900 | 0,0068904 | 0,00696280 | 0,00079704 | -0,31120180 | 0,00018300 | 0,00026568 | -0,31120180 |
| 85,447232 | 24 | 0,000819 | 0,00549800 | 0,0077674 | 0,00785147 | 0,00088868 | -0,07840745 | 0,00027300 | 0,00029623 | -0,07840745 |
| 92,545896 | 25 | 0,000883 | 0,00638100 | 0,0087435 | 0,00884090 | 0,00098943 | -0,10756411 | 0,00029433 | 0,00032981 | -0,10756411 |
| 99,894371 | 26 | 0,002222 | 0,00860300 | 0,0098284 | 0,00994093 | 0,00110003 | 1,01994739 | 0,00074067 | 0,00036668 | 1,01994739 |
| 107,49049 | 27 | 0,001818 | 0,01042100 | 0,0110326 | 0,01116220 | 0,00122127 | 0,48860887 | 0,00060600 | 0,00040709 | 0,48860887 |
| 115,33219 | 28 | 0,003137 | 0,01355800 | 0,0123673 | 0,01251620 | 0,00135400 | 1,31683823 | 0,00104567 | 0,00045133 | 1,31683823 |
| 123,41751 | 29 | 0,0014 | 0,01495800 | 0,0138447 | 0,01401530 | 0,00149909 | -0,06610028 | 0,00046667 | 0,00049970 | -0,06610028 |
| 131,74457 | 30 | 0,002404 | 0,01736200 | 0,0154778 | 0,01567277 | 0,00165748 | 0,45039779 | 0,00080133 | 0,00055249 | 0,45039779 |
| 140,31159 | 31 | 0,002279 | 0,01964100 | 0,0172806 | 0,01750291 | 0,00183014 | 0,24525946 | 0,00075967 | 0,00061005 | 0,24525946 |
| 149,11684 | 32 | 0,001261 | 0,02090200 | 0,0192682 | 0,01952103 | 0,00201812 | -0,37515984 | 0,00042033 | 0,00067271 | -0,37515984 |
| 158,15867 | 33 | 0,001072 | 0,02197400 | 0,0214566 | 0,02174352 | 0,00222249 | -0,51765747 | 0,00035733 | 0,00074083 | -0,51765747 |
| 167,4355 | 34 | 0,001681 | 0,02365500 | 0,0238631 | 0,02418791 | 0,00244439 | -0,31230286 | 0,00056033 | 0,00081480 | -0,31230286 |
| 176,94581 | 35 | 0,001025 | 0,02468000 | 0,0265059 | 0,02687292 | 0,00268501 | -0,61825160 | 0,00034167 | 0,00089500 | -0,61825160 |
| 186,68814 | 36 | 0,004481 | 0,02916100 | 0,0294047 | 0,02981852 | 0,00294560 | 0,52125022 | 0,00149367 | 0,00098187 | 0,52125022 |
| 196,66107 | 37 | 0,004415 | 0,03357600 | 0,0325803 | 0,03304598 | 0,00322745 | 0,36795158 | 0,00147167 | 0,00107582 | 0,36795158 |
| 206,86324 | 38 | 0,005213 | 0,03878900 | 0,0360549 | 0,03657789 | 0,00353191 | 0,47597004 | 0,00173767 | 0,00117730 | 0,47597004 |
| 217,29332 | 39 | 0,005044 | 0,04383300 | 0,0398521 | 0,04043828 | 0,00386039 | 0,30660345 | 0,00168133 | 0,00128680 | 0,30660345 |
| 227,95004 | 40 | 0,003839 | 0,04767200 | 0,0439967 | 0,04465262 | 0,00421434 | -0,08906259 | 0,00127967 | 0,00140478 | -0,08906259 |
| 238,83218 | 41 | 0,00048 | 0,04815200 | 0,0485154 | 0,04924789 | 0,00459527 | -0,89554483 | 0,00016000 | 0,00153176 | -0,89554483 |
| 249,93853 | 42 | 0,005604 | 0,05375600 | 0,0534359 | 0,05425265 | 0,00500475 | 0,11973557 | 0,00186800 | 0,00166825 | 0,11973557 |
| 261,26793 | 43 | 0,007151 | 0,06090700 | 0,0587881 | 0,05969704 | 0,00544440 | 0,31346077 | 0,00238367 | 0,00181480 | 0,31346077 |
| 272,81927 | 44 | 0,005671 | 0,06657800 | 0,0646029 | 0,06561291 | 0,00591587 | -0,04139156 | 0,00189033 | 0,00197196 | -0,04139156 |
| 284,59144 | 45 | 0,001621 | 0,06819900 | 0,0709134 | 0,07203379 | 0,00642088 | -0,74754252 | 0,00054033 | 0,00214029 | -0,74754252 |
| 296,58339 | 46 | 0,006919 | 0,07511800 | 0,0777541 | 0,07899500 | 0,00696121 | -0,00606340 | 0,00230633 | 0,00232040 | -0,00606340 |
| 308,79409 | 47 | 0,00887 | 0,08398800 | 0,0851615 | 0,08653366 | 0,00753865 | 0,17660252 | 0,00295667 | 0,00251288 | 0,17660252 |
| 321,22252 | 48 | 0,009729 | 0,09371700 | 0,0931737 | 0,09468873 | 0,00815508 | 0,19299908 | 0,00324300 | 0,00271836 | 0,19299908 |
| 333,86773 | 49 | 0,010812 | 0,10452900 | 0,1018309 | 0,10350111 | 0,00881238 | 0,22691077 | 0,00360400 | 0,00293746 | 0,22691077 |
| 346,72874 | 50 | 0,005483 | 0,11001200 | 0,111175 | 0,11301360 | 0,00951249 | -0,42360008 | 0,00182767 | 0,00317083 | -0,42360008 |
| 359,80464 | 51 | 0,009101 | 0,11911300 | 0,12125 | 0,12327101 | 0,01025740 | -0,11273844 | 0,00303367 | 0,00341913 | -0,11273844 |
| 373,09452 | 52 | 0,009812 | 0,12892500 | 0,1321017 | 0,13432013 | 0,01104912 | -0,11196585 | 0,00327067 | 0,00368304 | -0,11196585 |
| 386,59749 | 53 | 0,010102 | 0,13902700 | 0,1437781 | 0,14620983 | 0,01188970 | -0,15035723 | 0,00336733 | 0,00396323 | -0,15035723 |
| 400,3127 | 54 | 0,019955 | 0,15898200 | 0,1563292 | 0,15899105 | 0,01278122 | 0,56127560 | 0,00665167 | 0,00426041 | 0,56127560 |
| 414,2393 | 55 | 0,012361 | 0,17134300 | 0,1698069 | 0,17271682 | 0,01372577 | -0,09943104 | 0,00412033 | 0,00457526 | -0,09943104 |
| 428,37647 | 56 | 0,018923 | 0,19026600 | 0,1842654 | 0,18744230 | 0,01472549 | 0,28505100 | 0,00630767 | 0,00490850 | 0,28505100 |
| 442,72341 | 57 | 0,011795 | 0,20206100 | 0,1997609 | 0,20322482 | 0,01578252 | -0,25265408 | 0,00393167 | 0,00526084 | -0,25265408 |
| 457,27932 | 58 | 0,007544 | 0,20960500 | 0,2163518 | 0,22012385 | 0,01689903 | -0,55358375 | 0,00251467 | 0,00563301 | -0,55358375 |
| 472,04345 | 59 | 0,020809 | 0,23041400 | 0,2340985 | 0,23820103 | 0,01807719 | 0,15111935 | 0,00693633 | 0,00602573 | 0,15111935 |
| 487,01503 | 60 | 0,021929 | 0,25234300 | 0,2530638 | 0,25752022 | 0,01931918 | 0,13508938 | 0,00730967 | 0,00643973 | 0,13508938 |
| 502,19334 | 61 | 0,024735 | 0,27707800 | 0,2733124 | 0,27814742 | 0,02062720 | 0,19914470 | 0,00824500 | 0,00687573 | 0,19914470 |
| 517,57764 | 62 | 0,018694 | 0,29577200 | 0,2949112 | 0,30015085 | 0,02200343 | -0,15040514 | 0,00623133 | 0,00733448 | -0,15040514 |

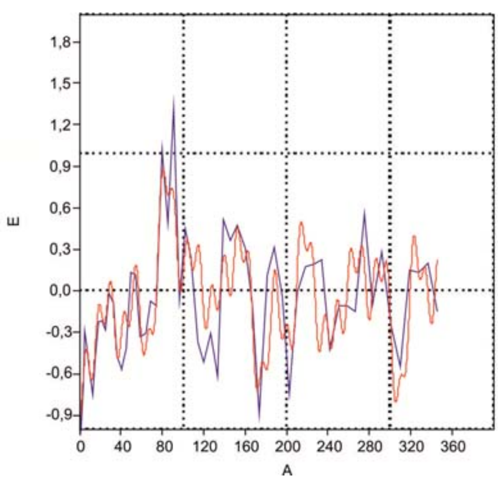



Tab.A1 showing raw data and the consensus of the cumulative sum, and the Gompertz function of A1.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 2,45E-30 | #DIV/0! | 3,56 | 5,2509 | 6,7279 | 8,1296 | 11,216 | 8,9254 |
| 0,0014225 | 0,01127 | 702,987698 | 3,55 | 5,244 | 6,719 | 8,1188 | 11,201 | 8,9136 |
| 0,0028449 | 0,20865 | 351,506204 | 3,54 | 5,2233 | 6,6925 | 8,0868 | 11,157 | 8,8784 |
| 0,0042674 | 0,79633 | 234,334724 | 3,51 | 5,1892 | 6,6489 | 8,0341 | 11,084 | 8,8205 |
| 0,0056898 | 1,3165 | 175,753102 | 3,48 | 5,1424 | 6,5889 | 7,9616 | 10,984 | 8,7409 |
| 0,0071123 | 1,4396 | 140,601493 | 3,44 | 5,0836 | 6,5136 | 7,8706 | 10,859 | 8,641 |
| 0,0085347 | 1,2547 | 117,168735 | 3,40 | 5,0139 | 6,4243 | 7,7627 | 10,71 | 8,5225 |
| 0,0099572 | 1,9196 | 100,42984 | 3,34 | 4,9344 | 6,3224 | 7,6396 | 10,54 | 8,3874 |
| 0,01138 | 3,0173 | 87,8734622 | 3,28 | 4,8463 | 6,2095 | 7,5032 | 10,352 | 8,2376 |
| 0,012802 | 4,7931 | 78,1127949 | 3,22 | 4,7509 | 6,0872 | 7,3554 | 10,148 | 8,0754 |
| 0,014225 | 7,0114 | 70,2987698 | 3,15 | 4,6494 | 5,9572 | 7,1983 | 9,9313 | 7,9029 |
| **0,015647** | **7,9984** | **63,9100147** | 3,08 | 4,5431 | 5,821 | 7,0338 | 9,7043 | 7,7223 |
| 0,017069 | 6,8306 | 58,5857402 | 3,00 | 4,4333 | 5,6803 | 6,8637 | 9,4697 | 7,5356 |
| 0,018492 | 4,17 | 54,0774389 | 2,93 | 4,321 | 5,5364 | 6,6899 | 9,2299 | 7,3447 |
| 0,019914 | 2,947 | 50,2159285 | 2,85 | 4,2073 | 5,3908 | 6,5139 | 8,987 | 7,1515 |
| 0,021337 | 3,4151 | 46,8669447 | 2,77 | 4,0932 | 5,2445 | 6,3371 | 8,7432 | 6,9575 |
| 0,022759 | 3,1713 | 43,9386616 | 2,69 | 3,9794 | 5,0988 | 6,161 | 8,5002 | 6,7641 |
| 0,024182 | 2,2094 | 41,3530725 | 2,62 | 3,8668 | 4,9544 | 5,9866 | 8,2596 | 6,5726 |
| 0,025604 | 2,1586 | 39,0563974 | 2,54 | 3,7558 | 4,8123 | 5,8148 | 8,0226 | 6,384 |
| 0,027027 | 3,3243 | 37,000037 | 2,47 | 3,6471 | 4,673 | 5,6466 | 7,7905 | 6,1993 |
| **0,028449** | **4,0614** | **35,1506204** | 2,40 | 3,5411 | 4,5372 | 5,4824 | 7,564 | 6,0191 |
| 0,029872 | 3,6632 | 33,476165 | 2,33 | 3,4381 | 4,4052 | 5,3229 | 7,3439 | 5,844 |
| 0,031294 | 2,2755 | 31,9550073 | 2,26 | 3,3383 | 4,2774 | 5,1685 | 7,1309 | 5,6744 |
| 0,032717 | 0,87038 | 30,5651496 | 2,20 | 3,2421 | 4,154 | 5,0194 | 6,9252 | 5,5108 |
| 0,034139 | 0,60472 | 29,2920121 | 2,13 | 3,1494 | 4,0353 | 4,876 | 6,7273 | 5,3532 |
| 0,035561 | 1,7342 | 28,120694 | 2,07 | 3,0604 | 3,9213 | 4,7382 | 6,5372 | 5,202 |
| **0,036984** | **2,7561** | **27,0387194** | 2,01 | 2,9752 | 3,812 | 4,6062 | 6,3551 | 5,0571 |
| 0,038406 | 2,4552 | 26,0375983 | 1,96 | 2,8937 | 3,7076 | 4,48 | 6,181 | 4,9186 |
| 0,039829 | 1,306 | 25,1073339 | 1,91 | 2,8159 | 3,6079 | 4,3596 | 6,0149 | 4,7863 |
| 0,041251 | 0,74114 | 24,2418366 | 1,86 | 2,7418 | 3,513 | 4,2449 | 5,8566 | 4,6604 |
| 0,042674 | 1,1798 | 23,4334724 | 1,81 | 2,6713 | 3,4227 | 4,1357 | 5,706 | 4,5406 |
| 0,044096 | 1,7664 | 22,6777939 | 1,76 | 2,6043 | 3,3369 | 4,0321 | 5,563 | 4,4267 |
| 0,045519 | 1,6445 | 21,9688482 | 1,72 | 2,5408 | 3,2555 | 3,9337 | 5,4273 | 4,3188 |
| 0,046941 | 0,95054 | 21,3033382 | 1,68 | 2,4806 | 3,1784 | 3,8406 | 5,2988 | 4,2165 |
| 0,048364 | 0,5214 | 20,6765363 | 1,64 | 2,4237 | 3,1055 | 3,7524 | 5,1772 | 4,1198 |
| 0,049786 | 0,80209 | 20,0859679 | 1,60 | 2,3699 | 3,0366 | 3,6692 | 5,0623 | 4,0283 |
| 0,051208 | 1,4368 | 19,5281987 | 1,57 | 2,3192 | 2,9716 | 3,5906 | 4,9539 | 3,9421 |
| 0,052631 | 1,8771 | 19,000209 | 1,54 | 2,2714 | 2,9103 | 3,5166 | 4,8518 | 3,8608 |
| 0,054053 | 1,8648 | 18,5003608 | 1,51 | 2,2264 | 2,8527 | 3,447 | 4,7557 | 3,7844 |
| 0,055476 | 1,6466 | 18,025813 | 1,48 | 2,1841 | 2,7985 | 3,3815 | 4,6654 | 3,7125 |
| 0,056898 | 0,92086 | 17,5753102 | 1,45 | 2,1445 | 2,7477 | 3,3202 | 4,5808 | 3,6452 |
| 0,058321 | 0,47412 | 17,1464824 | 1,43 | 2,1074 | 2,7002 | 3,2627 | 4,5015 | 3,5821 |
| 0,059743 | 0,40608 | 16,7383627 | 1,40 | 2,0727 | 2,6558 | 3,2091 | 4,4275 | 3,5232 |
| 0,061166 | 0,54997 | 16,348952 | 1,38 | 2,0404 | 2,6144 | 3,159 | 4,3585 | 3,4683 |
| 0,062588 | 0,37211 | 15,9775037 | 1,36 | 2,0104 | 2,5759 | 3,1125 | 4,2943 | 3,4172 |
| 0,064011 | 0,33283 | 15,6223149 | 1,34 | 1,9826 | 2,5402 | 3,0694 | 4,2349 | 3,3699 |
| 0,065433 | 1,1443 | 15,2828084 | 1,33 | 1,9569 | 2,5073 | 3,0296 | 4,1799 | 3,3262 |
| 0,066856 | 1,9549 | 14,9575206 | 1,31 | 1,9332 | 2,477 | 2,993 | 4,1294 | 3,286 |
| 0,068278 | 2,1078 | 14,646006 | 1,29 | 1,9115 | 2,4492 | 2,9595 | 4,0831 | 3,2492 |
| 0,0697 | 2,6576 | 14,3472023 | 1,28 | 1,8918 | 2,424 | 2,9289 | 4,041 | 3,2157 |
| **0,071123** | **2,9195** | **14,0601493** | 1,27 | 1,874 | 2,4011 | 2,9013 | 4,0029 | 3,1853 |
| 0,072545 | 2,5571 | 13,7845475 | 1,26 | 1,858 | 2,3806 | 2,8766 | 3,9687 | 3,1581 |
| 0,073968 | 2,4776 | 13,5193597 | 1,25 | 1,8438 | 2,3624 | 2,8546 | 3,9384 | 3,134 |
| 0,07539 | 2,3096 | 13,2643587 | 1,24 | 1,8313 | 2,3465 | 2,8353 | 3,9118 | 3,1129 |
| 0,076813 | 1,6309 | 13,0186297 | 1,23 | 1,8206 | 2,3327 | 2,8187 | 3,8889 | 3,0946 |
| 0,078235 | 1,5819 | 12,7820029 | 1,23 | 1,8116 | 2,3212 | 2,8048 | 3,8697 | 3,0793 |
| 0,079658 | 2,0207 | 12,5536669 | 1,22 | 1,8043 | 2,3118 | 2,7934 | 3,854 | 3,0668 |
| **0,08108** | **2,1136** | **12,3334978** | 1,22 | 1,7986 | 2,3045 | 2,7846 | 3,8418 | 3,0571 |
| 0,082503 | 1,9998 | 12,1207714 | 1,22 | 1,7945 | 2,2993 | 2,7783 | 3,8332 | 3,0503 |
| 0,083925 | 2,1762 | 11,9154007 | 1,21 | 1,7921 | 2,2962 | 2,7745 | 3,828 | 3,0461 |
| 0,085347 | 2,1364 | 11,7168735 | 1,21 | 1,7913 | 2,2951 | 2,7733 | 3,8262 | 3,0447 |

| Amp | Phas | Period | $R^2$ | p |
|---|---|---|---|---|
| **0,282** | **2,74** | **62,24** | 0,70263 | 0,00000001 |
| 3,7 | -1,35 | 193,9 | | |
| 3,73 | 1,93 | 190,8 | | |
| **0,202** | **2,71** | **34,6** | | |
| **0,198** | **0,402** | **26,75** | | |
| **0,17** | **3,13** | **12,20** | | |




Tab.A2 showing the data of the lomb periodogram and the sinusoidal function of A1.

**Log File A1**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 3)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\depressa\A1_2\original
Filename Prefix=depressa A1_2
Number of Files= 1600
Source Voltage (kV)=  88
Source Current (uA)=  87
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X=   0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)=    5.70
Object to Source (mm)=41.700
Camera to Source (mm)=364.000
Vertical Object Position (mm)=35.675
Optical Axis (line)=1110
Filter=User Filter
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)=   650
Rotation Step (deg)=0.150
Frame Averaging=ON (20)
Random Movement=ON (15)
Use 360 Rotation=NO
FF updating interval=89
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Dec 31, 2011  19:54:31
Scan duration=06:11:44
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.1
Program Home Directory=C:\Skyscan
Reconstruction engine=NReconServer
Engine version=Version: 1.6.4
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Option for additional F4F float format=OFF
Reconstruction mode=Standard
Dataset Origin=SkyScan1173
Dataset Prefix=depressa A1_2
Dataset Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\A1_2\original
Output Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\A1_2\original\depressa A1_2_Rec
Time and Date=Jan 02, 2012  15:30:57
First Section=884
Last Section=1801
Reconstruction duration per slice (seconds)=3.286492
Postalignment=49.00
Section to Section Step=1
Sections Count=918
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=980
Result Image Height (pixels)=1028
Pixel Size (um)=5.70145
Reconstruction Angular Range (deg)=240.00
Use 180+=OFF
Angular Step (deg)=0.1500
Smoothing=0
Ring Artifact Correction=0
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=2043
ROI Bottom (pixels)=1014
ROI Left (pixels)=757
ROI Right (pixels)=1737
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=30
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0000

Maximum for CS to Image Conversion=0.0731
HU Calibration=OFF
BMP LUT=0
Cone-beam Angle Horiz.(deg)=17.412422
Cone-beam Angle Vert.(deg)=17.412422
[File name convention]
Filename Index Length=4
Filename Prefix=depressa A1_2_rec_Tra
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Jan 03, 2012  10:09:20
Original configuration file=depressa A1_2_rec.log
Conversion description=...TRA. Rotated(deg): (280.404, 29.349, 78.315).
Image scale modified=0
HU calibration modified=0

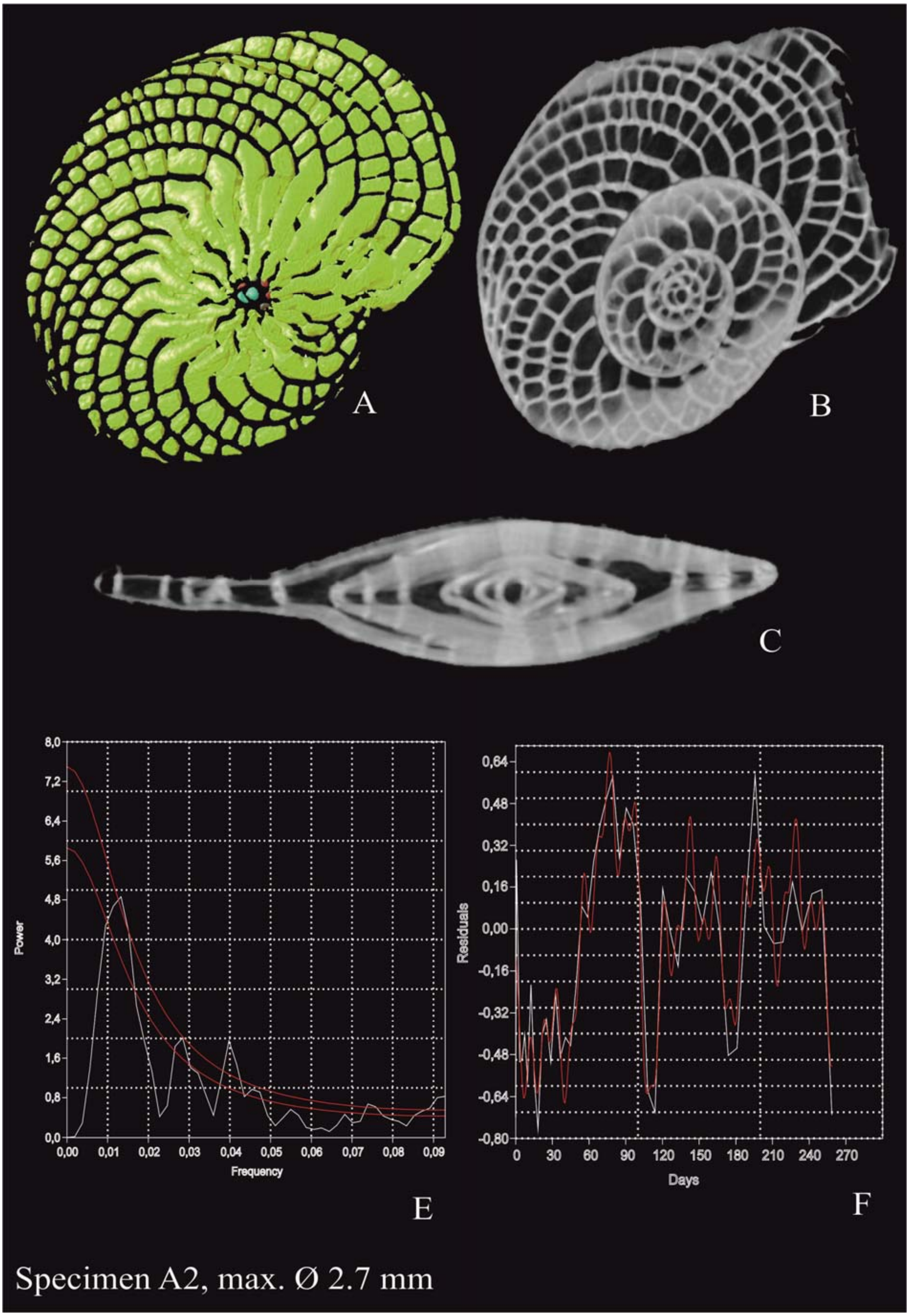
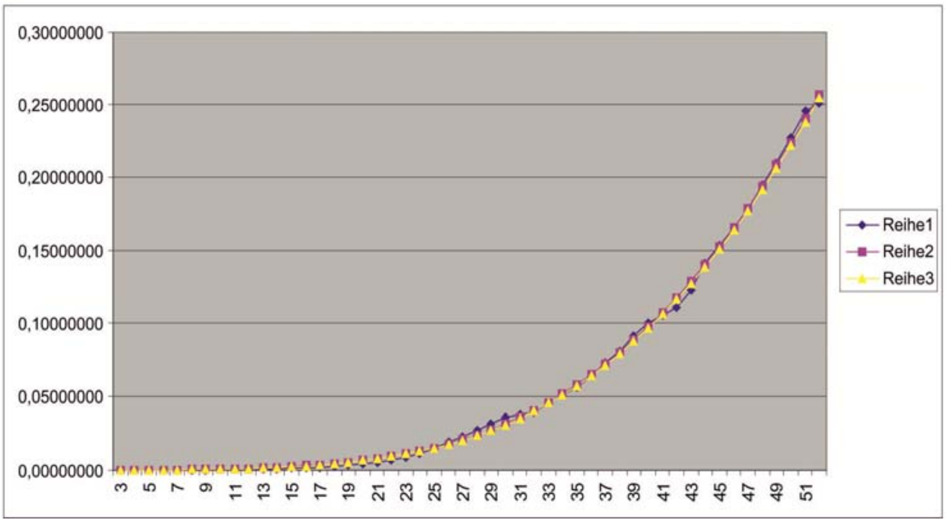



Fig.A2 Specimen A2, gamont from Sesoko Jima, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

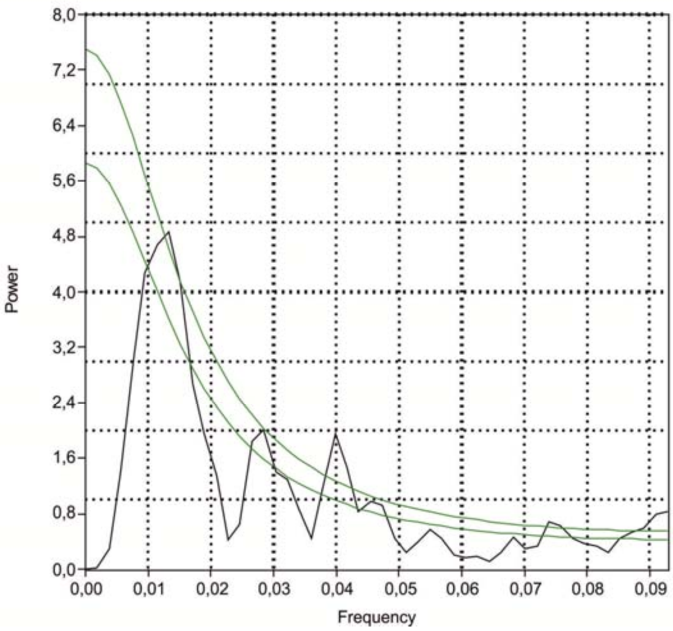
| day | chamber | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3 | 0,000033 | 0,00003300 | 0,0001177 | 0,00011732 | 0,00011732 | -0,71871720 | 0,00001100 | 0,00003911 | -0,71871720 |
| 0,3323559 | 4 | 0,000052 | 0,00008500 | 0,000159 | 0,00015840 | 0,00004108 | 0,26581480 | 0,00001733 | 0,00001369 | 0,26581480 |
| 1,153592 | 5 | 0,000053 | 0,00013800 | 0,0002129 | 0,00021191 | 0,00005351 | -0,00960255 | 0,00001767 | 0,00001784 | -0,00960255 |
| 2,3888811 | 6 | 0,000034 | 0,00017200 | 0,0002824 | 0,00028100 | 0,00006909 | -0,50785547 | 0,00001133 | 0,00002303 | -0,50785547 |
| 4,0040645 | 7 | 0,000044 | 0,00021600 | 0,0003715 | 0,00036941 | 0,00008841 | -0,50233107 | 0,00001467 | 0,00002947 | -0,50233107 |
| 5,9770478 | 8 | 0,000067 | 0,00028300 | 0,0004846 | 0,00048160 | 0,00011219 | -0,40280643 | 0,00002233 | 0,00003740 | -0,40280643 |
| 8,2916959 | 9 | 0,00006 | 0,00034300 | 0,000627 | 0,00062280 | 0,00014120 | -0,57507697 | 0,00002000 | 0,00004707 | -0,57507697 |
| 10,93541 | 10 | 0,000139 | 0,00048200 | 0,0008049 | 0,00079911 | 0,00017631 | -0,21159381 | 0,00004633 | 0,00005877 | -0,21159381 |
| 13,897923 | 11 | 0,000092 | 0,00057400 | 0,0010254 | 0,00101755 | 0,00021844 | -0,57883587 | 0,00003067 | 0,00007281 | -0,57883587 |
| 17,170608 | 12 | 0,000063 | 0,00063700 | 0,0012966 | 0,00128618 | 0,00026863 | -0,76547867 | 0,00002100 | 0,00008954 | -0,76547867 |
| 20,746056 | 13 | 0,000194 | 0,00083100 | 0,0016279 | 0,00161415 | 0,00032797 | -0,40847567 | 0,00006467 | 0,00010932 | -0,40847567 |
| 24,617796 | 14 | 0,000261 | 0,00109200 | 0,0020296 | 0,00201175 | 0,00039760 | -0,34355969 | 0,00008700 | 0,00013253 | -0,34355969 |
| 28,780093 | 15 | 0,000235 | 0,00132700 | 0,0025133 | 0,00249049 | 0,00047874 | -0,50912820 | 0,00007833 | 0,00015958 | -0,50912820 |
| 33,22781 | 16 | 0,000433 | 0,00176000 | 0,0030921 | 0,00306313 | 0,00057264 | -0,24385526 | 0,00014433 | 0,00019088 | -0,24385526 |
| 37,956304 | 17 | 0,000347 | 0,00210700 | 0,0037802 | 0,00374372 | 0,00068058 | -0,49014450 | 0,00011567 | 0,00022686 | -0,49014450 |
| 42,961343 | 18 | 0,000471 | 0,00257800 | 0,004593 | 0,00454758 | 0,00080386 | -0,41408040 | 0,00015700 | 0,00026795 | -0,41408040 |
| 48,239047 | 19 | 0,000523 | 0,00310100 | 0,0055473 | 0,00549135 | 0,00094377 | -0,44584037 | 0,00017433 | 0,00031459 | -0,44584037 |
| 53,785834 | 20 | 0,000865 | 0,00396600 | 0,0066614 | 0,00659293 | 0,00110157 | -0,21476042 | 0,00028833 | 0,00036719 | -0,21476042 |
| 59,598385 | 21 | 0,001389 | 0,00535500 | 0,0079546 | 0,00787143 | 0,00127850 | 0,08642722 | 0,00046300 | 0,00042617 | 0,08642722 |
| 65,673605 | 22 | 0,001543 | 0,00689800 | 0,0094473 | 0,00934715 | 0,00147572 | 0,04558915 | 0,00051433 | 0,00049191 | 0,04558915 |
| 72,008602 | 23 | 0,002133 | 0,00903100 | 0,0111613 | 0,01104148 | 0,00169432 | 0,25890937 | 0,00071100 | 0,00056477 | 0,25890937 |
| 78,600663 | 24 | 0,002702 | 0,01173300 | 0,0131191 | 0,01297677 | 0,00193529 | 0,39617107 | 0,00090067 | 0,00064510 | 0,39617107 |
| 85,447232 | 25 | 0,00329 | 0,01502300 | 0,0153442 | 0,01517627 | 0,00219950 | 0,49579379 | 0,00109667 | 0,00073317 | 0,49579379 |
| 92,545896 | 26 | 0,00394 | 0,01896300 | 0,0178609 | 0,01766395 | 0,00248768 | 0,58380304 | 0,00131333 | 0,00082923 | 0,58380304 |
| 99,894371 | 27 | 0,003558 | 0,02252100 | 0,0206939 | 0,02046438 | 0,00280042 | 0,27052247 | 0,00118600 | 0,00093347 | 0,27052247 |
| 107,49049 | 28 | 0,004591 | 0,02711200 | 0,0238685 | 0,02360251 | 0,00313814 | 0,46296924 | 0,00153033 | 0,00104605 | 0,46296924 |
| 115,33219 | 29 | 0,004905 | 0,03201700 | 0,0274101 | 0,02710359 | 0,00350107 | 0,40099975 | 0,00163500 | 0,00116702 | 0,40099975 |
| 123,41751 | 30 | 0,004343 | 0,03636000 | 0,0313442 | 0,03099286 | 0,00388928 | 0,11666038 | 0,00144767 | 0,00129643 | 0,11666038 |
| 131,74457 | 31 | 0,001649 | 0,03800900 | 0,0356961 | 0,03529547 | 0,00430261 | -0,61674442 | 0,00054967 | 0,00143420 | -0,61674442 |
| 140,31159 | 32 | 0,001422 | 0,03943100 | 0,0404908 | 0,04003622 | 0,00474074 | -0,70004696 | 0,00047400 | 0,00158025 | -0,70004696 |
| 149,11684 | 33 | 0,006006 | 0,04543700 | 0,0457527 | 0,04523934 | 0,00520313 | 0,15430547 | 0,00200200 | 0,00173438 | 0,15430547 |
| 158,15867 | 34 | 0,005625 | 0,05106200 | 0,0515054 | 0,05092838 | 0,00568904 | -0,01125591 | 0,00187500 | 0,00189635 | -0,01125591 |
| 167,4355 | 35 | 0,005315 | 0,05637700 | 0,0577716 | 0,05712591 | 0,00619753 | -0,14240031 | 0,00177167 | 0,00206584 | -0,14240031 |
| 176,94581 | 36 | 0,008059 | 0,06443600 | 0,0645728 | 0,06385340 | 0,00672749 | 0,19792018 | 0,00268633 | 0,00224250 | 0,19792018 |
| 186,68814 | 37 | 0,008332 | 0,07276800 | 0,0719293 | 0,07113103 | 0,00727762 | 0,14487908 | 0,00277733 | 0,00242587 | 0,14487908 |
| 196,66107 | 38 | 0,00802 | 0,08078800 | 0,0798598 | 0,07897748 | 0,00784645 | 0,02211770 | 0,00267333 | 0,00261548 | 0,02211770 |
| 206,86324 | 39 | 0,010265 | 0,09105300 | 0,0883812 | 0,08740984 | 0,00843236 | 0,21733444 | 0,00342167 | 0,00281079 | 0,21733444 |
| 217,29332 | 40 | 0,009083 | 0,10013600 | 0,0975088 | 0,09644341 | 0,00903357 | 0,00547194 | 0,00302767 | 0,00301119 | 0,00547194 |
| 227,95004 | 41 | 0,00498 | 0,10511600 | 0,1072559 | 0,10609160 | 0,00964819 | -0,48384125 | 0,00166000 | 0,00321606 | -0,48384125 |
| 238,83218 | 42 | 0,005596 | 0,11071200 | 0,1176339 | 0,11636584 | 0,01027424 | -0,45533660 | 0,00186533 | 0,00342475 | -0,45533660 |
| 249,93853 | 43 | 0,012074 | 0,12278600 | 0,1286518 | 0,12727544 | 0,01090960 | 0,10673154 | 0,00402467 | 0,00363653 | 0,10673154 |
| 261,26793 | 44 | 0,018313 | 0,14109900 | 0,1403166 | 0,13882757 | 0,01155213 | 0,58524854 | 0,00610433 | 0,00385071 | 0,58524854 |
| 272,81927 | 45 | 0,012307 | 0,15340600 | 0,152633 | 0,15102718 | 0,01219961 | 0,00880249 | 0,00410233 | 0,00406654 | 0,00880249 |
| 284,59144 | 46 | 0,012129 | 0,16553500 | 0,1656036 | 0,16387698 | 0,01284980 | -0,05609416 | 0,00404300 | 0,00428327 | -0,05609416 |
| 296,58339 | 47 | 0,012822 | 0,17835700 | 0,1792283 | 0,17737741 | 0,01350043 | -0,05025233 | 0,00427400 | 0,00450014 | -0,05025233 |
| 308,79409 | 48 | 0,016682 | 0,19503900 | 0,1935052 | 0,19152666 | 0,01414924 | 0,17900296 | 0,00556067 | 0,00471641 | 0,17900296 |
| 321,22252 | 49 | 0,014675 | 0,20971400 | 0,2084298 | 0,20632066 | 0,01479401 | -0,00804444 | 0,00489167 | 0,00493134 | -0,00804444 |
| 333,86773 | 50 | 0,017493 | 0,22720700 | 0,2239956 | 0,22175319 | 0,01543253 | 0,13351488 | 0,00583100 | 0,00514418 | 0,13351488 |
| 346,72874 | 51 | 0,018476 | 0,24568300 | 0,2401938 | 0,23781585 | 0,01606265 | 0,15024576 | 0,00615867 | 0,00535422 | 0,15024576 |
| | 52 | 0,004828 | 0,25051100 | 0,2570134 | 0,25449816 | 0,01668231 | -0,71059168 | 0,00160933 | 0,00556077 | -0,71059168 |

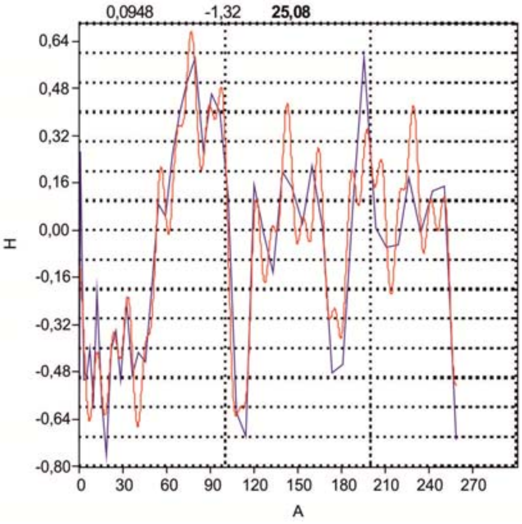



Tab.A3 showing raw data and the consensus of the cumulative sum, and the Gompertz function of A2**.**

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 5,05E-31 | #DIV/0! | 3,96 | 5,854 | 7,5007 | 9,0633 | 12,504 | 9,5539 |
| 0,0018949 | 0,014039 | 527,73233 | 3,91 | 5,7794 | 7,4051 | 8,9478 | 12,345 | 9,4322 |
| 0,0037898 | 0,29116 | 263,86617 | 3,77 | 5,5669 | 7,1328 | 8,6188 | 11,891 | 9,0854 |
| 0,0056847 | 1,4285 | 175,91078 | 3,55 | 5,2463 | 6,722 | 8,1225 | 11,206 | 8,5622 |
| 0,0075797 | 3,0107 | 131,93134 | 3,29 | 4,8564 | 6,2224 | 7,5187 | 10,373 | 7,9258 |
| 0,0094746 | 4,2815 | 105,54535 | 3,00 | 4,4349 | 5,6824 | 6,8662 | 9,4731 | 7,2379 |
| 0,011369 | 4,6742 | 87,958484 | 2,72 | 4,0122 | 5,1408 | 6,2118 | 8,5703 | 6,548 |
| **0,013264** | **4,8644** | **75,392039** | 2,44 | 3,609 | 4,6242 | 5,5876 | 7,7091 | 5,8901 |
| 0,015159 | 4,1511 | 65,967412 | 2,19 | 3,2373 | 4,148 | 5,0121 | 6,9151 | 5,2834 |
| 0,017054 | 2,6686 | 58,63727 | 1,97 | 2,9023 | 3,7187 | 4,4934 | 6,1995 | 4,7367 |
| 0,018949 | 1,9563 | 52,773233 | 1,76 | 2,6048 | 3,3375 | 4,0329 | 5,5641 | 4,2512 |
| 0,020844 | 1,3433 | 47,975437 | 1,59 | 2,3431 | 3,0022 | 3,6276 | 5,005 | 3,824 |
| 0,022739 | 0,42146 | 43,977308 | 1,43 | 2,114 | 2,7087 | 3,273 | 4,5157 | 3,4502 |
| 0,024634 | 0,64384 | 40,594301 | 1,30 | 1,9141 | 2,4525 | 2,9635 | 4,0886 | 3,1239 |
| 0,026529 | 1,8375 | 37,694598 | 1,18 | 1,7397 | 2,2291 | 2,6934 | 3,7161 | 2,8393 |
| **0,028424** | **2,0108** | **35,181537** | 1,08 | 1,5875 | 2,034 | 2,4578 | 3,3909 | 2,5908 |
| 0,030319 | 1,4106 | 32,982618 | 0,98 | 1,4544 | 1,8635 | 2,2517 | 3,1066 | 2,3736 |
| 0,032214 | 1,2973 | 31,042404 | 0,91 | 1,3378 | 1,7141 | 2,0712 | 2,8576 | 2,1833 |
| 0,034108 | 0,86422 | 29,318635 | 0,84 | 1,2354 | 1,5829 | 1,9126 | 2,6388 | 2,0162 |
| 0,036003 | 0,44456 | 27,775463 | 0,78 | 1,1452 | 1,4673 | 1,773 | 2,4461 | 1,869 |
| 0,037898 | 1,1767 | 26,386617 | 0,72 | 1,0655 | 1,3652 | 1,6497 | 2,276 | 1,739 |
| **0,039793** | **1,9571** | **25,130048** | 0,67 | 0,99498 | 1,2749 | 1,5405 | 2,1253 | 1,6238 |
| 0,041688 | 1,4762 | 23,987718 | 0,63 | 0,93235 | 1,1946 | 1,4435 | 1,9916 | 1,5216 |
| 0,043583 | 0,82195 | 22,944726 | 0,59 | 0,8766 | 1,1232 | 1,3572 | 1,8725 | 1,4306 |
| 0,045478 | 0,97014 | 21,988654 | 0,56 | 0,82685 | 1,0594 | 1,2801 | 1,7662 | 1,3494 |
| 0,047373 | 0,91484 | 21,109071 | 0,53 | 0,78236 | 1,0024 | 1,2113 | 1,6712 | 1,2768 |
| 0,049268 | 0,44496 | 20,29715 | 0,50 | 0,74248 | 0,95133 | 1,1495 | 1,586 | 1,2118 |
| 0,051163 | 0,23706 | 19,545375 | 0,48 | 0,70669 | 0,90547 | 1,0941 | 1,5095 | 1,1533 |
| 0,053058 | 0,39731 | 18,847299 | 0,46 | 0,67451 | 0,86424 | 1,0443 | 1,4408 | 1,1008 |
| 0,054953 | 0,56622 | 18,197369 | 0,44 | 0,64554 | 0,82712 | 0,99944 | 1,3789 | 1,0535 |
| 0,056847 | 0,44651 | 17,591078 | 0,42 | 0,61944 | 0,79368 | 0,95902 | 1,3231 | 1,0109 |
| 0,058742 | 0,19907 | 17,023595 | 0,40 | 0,5959 | 0,76352 | 0,92259 | 1,2729 | 0,97253 |
| 0,060637 | 0,16399 | 16,491581 | 0,39 | 0,57468 | 0,73633 | 0,88973 | 1,2275 | 0,9379 |
| 0,062532 | 0,19031 | 15,991812 | 0,38 | 0,55555 | 0,71182 | 0,86011 | 1,1867 | 0,90667 |
| 0,064427 | 0,11746 | 15,521443 | 0,36 | 0,53831 | 0,68973 | 0,83342 | 1,1499 | 0,87854 |
| 0,066322 | 0,24873 | 15,077953 | 0,35 | 0,5228 | 0,66985 | 0,8094 | 1,1167 | 0,85322 |
| 0,068217 | 0,46406 | 14,659103 | 0,34 | 0,50886 | 0,652 | 0,78783 | 1,087 | 0,83048 |
| 0,070112 | 0,29634 | 14,262894 | 0,34 | 0,49638 | 0,63601 | 0,76851 | 1,0603 | 0,81011 |
| 0,072007 | 0,32474 | 13,887539 | 0,33 | 0,48524 | 0,62174 | 0,75127 | 1,0365 | 0,79193 |
| **0,073902** | **0,67631** | **13,531434** | 0,32 | 0,47535 | 0,60906 | 0,73595 | 1,0154 | 0,77579 |
| 0,075797 | 0,61985 | 13,193134 | 0,32 | 0,46662 | 0,59788 | 0,72244 | 0,99673 | 0,76155 |
| 0,077692 | 0,43549 | 12,871338 | 0,31 | 0,45899 | 0,58809 | 0,71061 | 0,98042 | 0,74908 |
| 0,079586 | 0,36375 | 12,565024 | 0,31 | 0,45238 | 0,57963 | 0,70039 | 0,96631 | 0,7383 |
| 0,081481 | 0,32489 | 12,2728 | 0,30 | 0,44676 | 0,57242 | 0,69168 | 0,95429 | 0,72912 |
| 0,083376 | 0,23215 | 11,993859 | 0,30 | 0,44206 | 0,56641 | 0,68441 | 0,94427 | 0,72146 |
| 0,085271 | 0,44075 | 11,727316 | 0,30 | 0,43827 | 0,56155 | 0,67854 | 0,93617 | 0,71527 |
| 0,087166 | 0,52917 | 11,472363 | 0,29 | 0,43535 | 0,55781 | 0,67402 | 0,92993 | 0,71051 |
| 0,089061 | 0,58946 | 11,228259 | 0,29 | 0,43328 | 0,55516 | 0,67081 | 0,92551 | 0,70713 |
| **0,090956** | **0,80378** | **10,994327** | 0,29 | 0,43204 | 0,55357 | 0,6689 | 0,92287 | 0,70511 |
| 0,092851 | 0,83014 | 10,769943 | 0,29 | 0,43163 | 0,55305 | 0,66826 | 0,92199 | 0,70444 |

| Amp | Phas | Period | $R^2$ | p |
|---|---|---|---|---|
| 0,401 | -1,72 | 117,50 | 0,75477000 | 0,00000000 |
| 0,318 | -1,44 | **84,40** | | |
| 0,195 | -2,68 | 54,51 | | |
| 0,115 | 0,697 | **10,89** | | |
| 0,145 | -1,7 | **34,24** | | |
| 0,164 | 3,04 | 21,83 | | |
| 0,162 | -0,298 | 148,30 | | |
| 0,0948 | -1,32 | **25,08** | | |




Tab.A4. showing the data of the lomb periodogram and the sinusoidal function of A2.

**Log Files A2**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 3)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\depressa\A1_2\original
Filename Prefix=depressa A1_2
Number of Files= 1600
Source Voltage (kV)= 88
Source Current (uA)= 87
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 5.70
Object to Source (mm)=41.700
Camera to Source (mm)=364.000
Vertical Object Position (mm)=35.675
Optical Axis (line)=1110
Filter=User Filter
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 650
Rotation Step (deg)=0.150
Frame Averaging=ON (20)
Random Movement=ON (15)
Use 360 Rotation=NO
FF updating interval=89
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Dec 31, 2011 19:54:31
Scan duration=06:11:44
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.1
Program Home Directory=C:\Skyscan
Reconstruction engine=NReconServer
Engine version=Version: 1.6.4
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Option for additional F4F float format=OFF
Reconstruction mode=Standard
Dataset Origin=SkyScan1173
Dataset Prefix=depressa A1_2
Dataset Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\A1_2\original
Output Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\A1_2\original\depressa A1_2_Rec
Time and Date=Jan 02, 2012  15:30:57
First Section=884
Last Section=1801
Reconstruction duration per slice (seconds)=3.286492
Postalignment=49.00
Section to Section Step=1
Sections Count=918
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=980
Result Image Height (pixels)=1028
Pixel Size (um)=5.70145
Reconstruction Angular Range (deg)=240.00
Use 180+=OFF
Angular Step (deg)=0.1500
Smoothing=0
Ring Artifact Correction=0
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=2043
ROI Bottom (pixels)=1014
ROI Left (pixels)=757
ROI Right (pixels)=1737
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=30
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0000

Maximum for CS to Image Conversion=0.0731
HU Calibration=OFF
BMP LUT=0
Cone-beam Angle Horiz.(deg)=17.412422
Cone-beam Angle Vert.(deg)=17.412422
[File name convention]
Filename Index Length=4
Filename Prefix=depressa A1_2_rec_Sag
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Jan 03, 2012  10:12:32
Original configuration file=depressa A1_2_rec.log
Conversion description=...SAG. Rotated(deg): (273.118, 62.840, 90.180).
Image scale modified=0
HU calibration modified=0

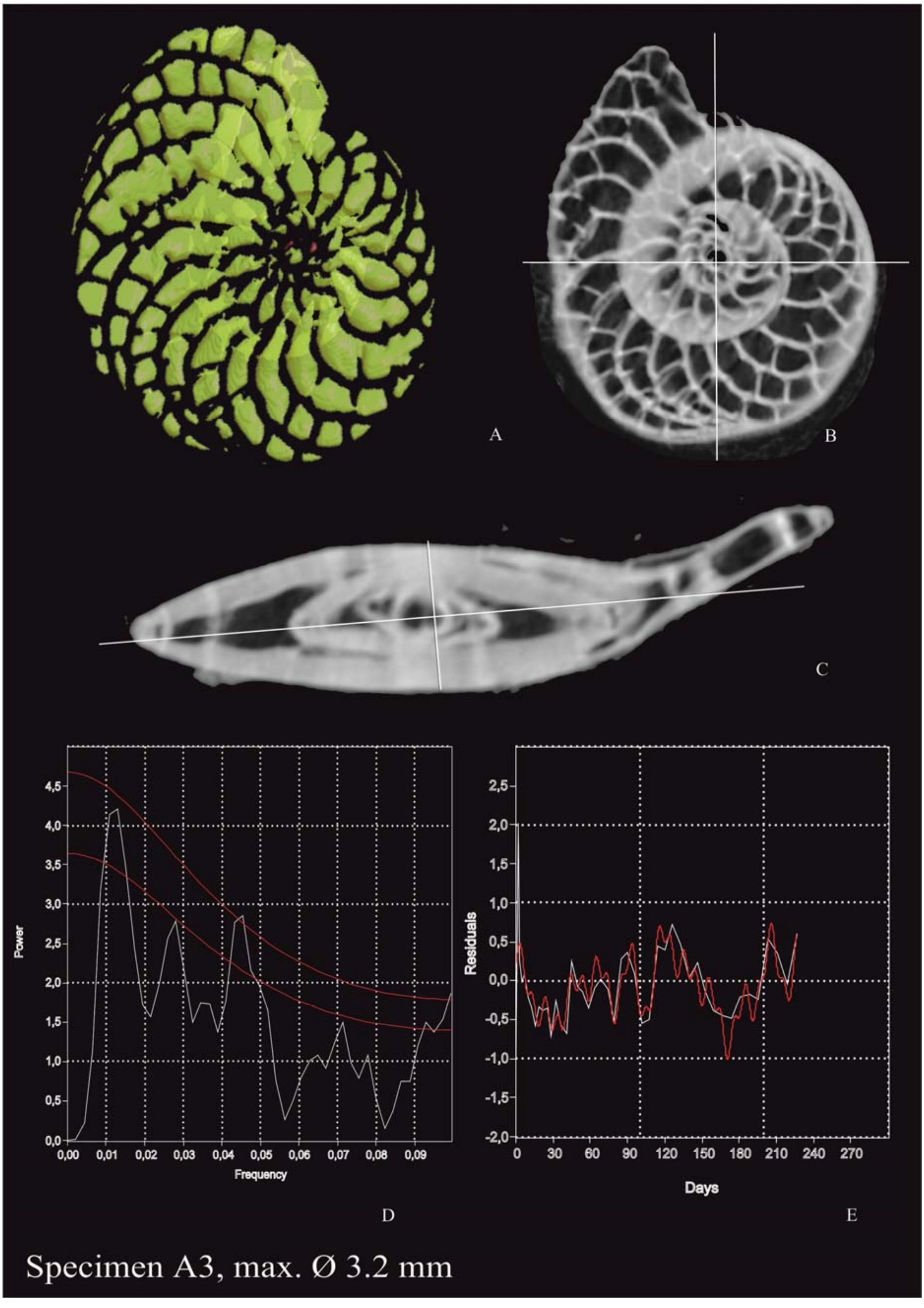
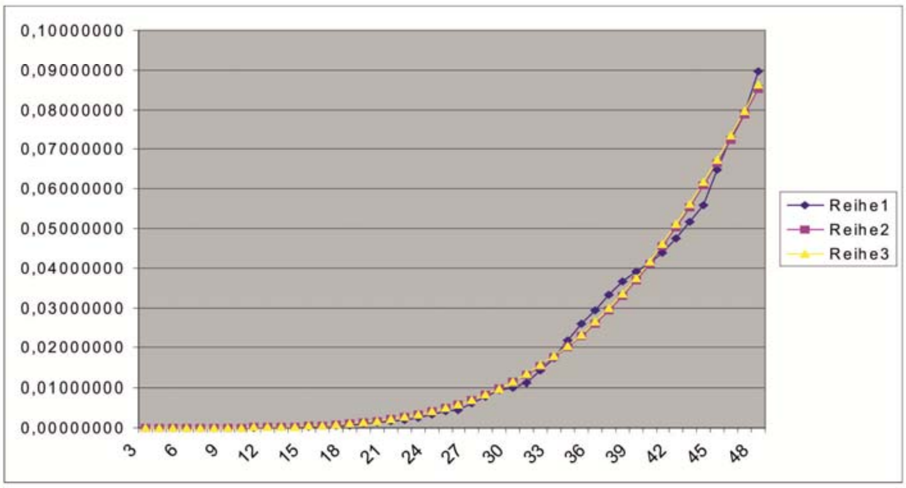



Fig.A3 Specimen A3, gamont from Sesoko Jima, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

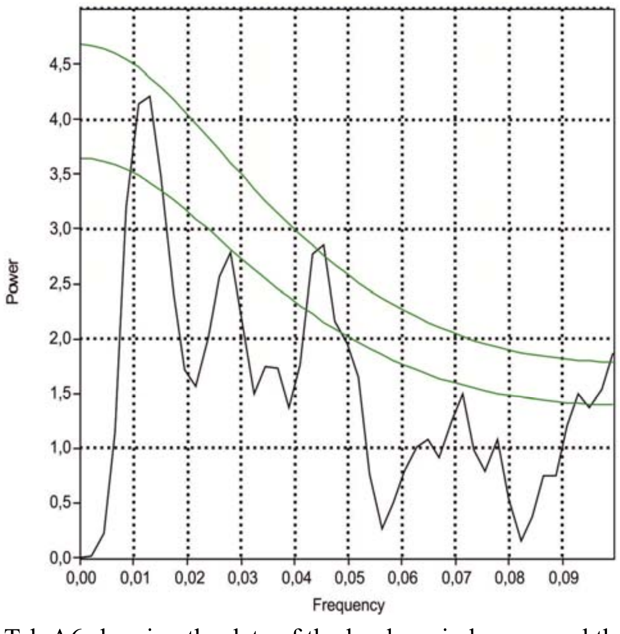
| days | chamber | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,33 | 3 | 0,00001 | 0,00001000 | 0,0000089 | 0,00000891 | 0,00000891 | 0,12177649 | 0,00000333 | 0,00000297 | 0,12177649 |
| 1,15 | 4 | 0 | 0,00001000 | 0,0000134 | 0,00001349 | 0,00000458 | -1,00000000 | 0,00000000 | 0,00000153 | -1,00000000 |
| 2,39 | 5 | 0,00002 | 0,00003000 | 0,00002 | 0,00002011 | 0,00000662 | 2,02103309 | 0,00000667 | 0,00000221 | 2,02103309 |
| 4,00 | 6 | 0,000012 | 0,00004200 | 0,0000293 | 0,00002954 | 0,00000943 | 0,27237034 | 0,00000400 | 0,00000314 | 0,27237034 |
| 5,98 | 7 | 0,000013 | 0,00005500 | 0,0000424 | 0,00004279 | 0,00001324 | -0,01840735 | 0,00000433 | 0,00000441 | -0,01840735 |
| 8,29 | 8 | 0,00002 | 0,00007500 | 0,0000606 | 0,00006113 | 0,00001834 | 0,09041792 | 0,00000667 | 0,00000611 | 0,09041792 |
| 10,94 | 9 | 0,00002 | 0,00009500 | 0,0000853 | 0,00008619 | 0,00002506 | -0,20206714 | 0,00000667 | 0,00000835 | -0,20206714 |
| 13,90 | 10 | 0,000022 | 0,00011700 | 0,0001187 | 0,00012001 | 0,00003381 | -0,34939444 | 0,00000733 | 0,00001127 | -0,34939444 |
| 17,17 | 11 | 0,000019 | 0,00013600 | 0,0001632 | 0,00016507 | 0,00004506 | -0,57831549 | 0,00000633 | 0,00001502 | -0,57831549 |
| 20,75 | 12 | 0,000039 | 0,00017500 | 0,0002217 | 0,00022439 | 0,00005933 | -0,34261438 | 0,00001300 | 0,00001978 | -0,34261438 |
| 24,62 | 13 | 0,000047 | 0,00022200 | 0,0002978 | 0,00030161 | 0,00007722 | -0,39135060 | 0,00001567 | 0,00002574 | -0,39135060 |
| 28,78 | 14 | 0,000064 | 0,00028600 | 0,0003958 | 0,00040102 | 0,00009940 | -0,35616903 | 0,00002133 | 0,00003313 | -0,35616903 |
| 33,23 | 15 | 0,000036 | 0,00032200 | 0,0005205 | 0,00052762 | 0,00012661 | -0,71565273 | 0,00001200 | 0,00004220 | -0,71565273 |
| 37,96 | 16 | 0,000118 | 0,00044000 | 0,0006777 | 0,00068722 | 0,00015960 | -0,26065837 | 0,00003933 | 0,00005320 | -0,26065837 |
| 42,96 | 17 | 0,000085 | 0,00052500 | 0,0008739 | 0,00088644 | 0,00019922 | -0,57332555 | 0,00002833 | 0,00006641 | -0,57332555 |
| 48,24 | 18 | 0,000078 | 0,00060300 | 0,0011165 | 0,00113274 | 0,00024630 | -0,68331542 | 0,00002600 | 0,00008210 | -0,68331542 |
| 53,79 | 19 | 0,000378 | 0,00098100 | 0,0014135 | 0,00143448 | 0,00030173 | 0,25275630 | 0,00012600 | 0,00010058 | 0,25275630 |
| 59,60 | 20 | 0,000338 | 0,00131900 | 0,0017742 | 0,00180086 | 0,00036639 | -0,07748102 | 0,00011267 | 0,00012213 | -0,07748102 |
| 65,67 | 21 | 0,000381 | 0,00170000 | 0,0022085 | 0,00224198 | 0,00044112 | -0,13629081 | 0,00012700 | 0,00014704 | -0,13629081 |
| 72,01 | 22 | 0,000341 | 0,00204100 | 0,002727 | 0,00276874 | 0,00052676 | -0,35264121 | 0,00011367 | 0,00017559 | -0,35264121 |
| 78,60 | 23 | 0,000562 | 0,00260300 | 0,0033413 | 0,00339280 | 0,00062406 | -0,09944919 | 0,00018733 | 0,00020802 | -0,09944919 |
| 85,45 | 24 | 0,00075 | 0,00335300 | 0,0040636 | 0,00412654 | 0,00073374 | 0,02216580 | 0,00025000 | 0,00024458 | 0,02216580 |
| 92,55 | 25 | 0,000762 | 0,00411500 | 0,0049067 | 0,00498292 | 0,00085638 | -0,11020778 | 0,00025400 | 0,00028546 | -0,11020778 |
| 99,89 | 26 | 0,00048 | 0,00459500 | 0,0058839 | 0,00597541 | 0,00099249 | -0,51636614 | 0,00016000 | 0,00033083 | -0,51636614 |
| 107,49 | 27 | 0,001469 | 0,00606400 | 0,0070088 | 0,00711783 | 0,00114242 | 0,28586255 | 0,00048967 | 0,00038081 | 0,28586255 |
| 115,33 | 28 | 0,001774 | 0,00783800 | 0,0082954 | 0,00842425 | 0,00130642 | 0,35790839 | 0,00059133 | 0,00043547 | 0,35790839 |
| 123,42 | 29 | 0,001611 | 0,00944900 | 0,0097577 | 0,00990881 | 0,00148456 | 0,08517216 | 0,00053700 | 0,00049485 | 0,08517216 |
| 131,74 | 30 | 0,000746 | 0,01019500 | 0,0114095 | 0,01158556 | 0,00167675 | -0,55509274 | 0,00024867 | 0,00055892 | -0,55509274 |
| 140,31 | 31 | 0,00093 | 0,01112500 | 0,0132646 | 0,01346833 | 0,00188277 | -0,50604728 | 0,00031000 | 0,00062759 | -0,50604728 |
| 149,12 | 32 | 0,003018 | 0,01414300 | 0,0153364 | 0,01557054 | 0,00210221 | 0,43563513 | 0,00100600 | 0,00070074 | 0,43563513 |
| 158,16 | 33 | 0,003271 | 0,01741400 | 0,0176376 | 0,01790503 | 0,00233449 | 0,40116192 | 0,00109033 | 0,00077816 | 0,40116192 |
| 167,44 | 34 | 0,004447 | 0,02186100 | 0,0201803 | 0,02048394 | 0,00257891 | 0,72437443 | 0,00148233 | 0,00085964 | 0,72437443 |
| 176,95 | 35 | 0,004146 | 0,02600700 | 0,0229757 | 0,02331852 | 0,00283458 | 0,46265035 | 0,00138200 | 0,00094486 | 0,46265035 |
| 186,69 | 36 | 0,003221 | 0,02922800 | 0,0260342 | 0,02641902 | 0,00310051 | 0,03886302 | 0,00107367 | 0,00103350 | 0,03886302 |
| 196,66 | 37 | 0,004146 | 0,03337400 | 0,0293649 | 0,02979457 | 0,00337555 | 0,22824550 | 0,00138200 | 0,00112518 | 0,22824550 |
| 206,86 | 38 | 0,003221 | 0,03659500 | 0,0329757 | 0,03345303 | 0,00365846 | -0,11957537 | 0,00107367 | 0,00121949 | -0,11957537 |
| 217,29 | 39 | 0,002428 | 0,03902300 | 0,0368734 | 0,03740094 | 0,00394791 | -0,38499169 | 0,00080933 | 0,00131597 | -0,38499169 |
| 227,95 | 40 | 0,002361 | 0,04138400 | 0,041063 | 0,04164343 | 0,00424249 | -0,44348733 | 0,00078700 | 0,00141416 | -0,44348733 |
| 238,83 | 41 | 0,002366 | 0,04375000 | 0,0455485 | 0,04618416 | 0,00454072 | -0,47893763 | 0,00078867 | 0,00151357 | -0,47893763 |
| 249,94 | 42 | 0,003812 | 0,04756200 | 0,0503322 | 0,05102526 | 0,00484110 | -0,21257616 | 0,00127067 | 0,00161370 | -0,21257616 |
| 261,27 | 43 | 0,004211 | 0,05177300 | 0,0554149 | 0,05616736 | 0,00514210 | -0,18107442 | 0,00140367 | 0,00171403 | -0,18107442 |
| 272,82 | 44 | 0,004145 | 0,05591800 | 0,0607959 | 0,06160956 | 0,00544220 | -0,23835887 | 0,00138167 | 0,00181407 | -0,23835887 |
| 284,59 | 45 | 0,008846 | 0,06476400 | 0,066473 | 0,06734943 | 0,00573987 | 0,54115060 | 0,00294867 | 0,00191329 | 0,54115060 |
| 296,58 | 46 | 0,008128 | 0,07289200 | 0,0724426 | 0,07338307 | 0,00603364 | 0,34711411 | 0,00270933 | 0,00201121 | 0,34711411 |
| 308,79 | 47 | 0,006021 | 0,07891300 | 0,0786995 | 0,07970514 | 0,00632208 | -0,04762330 | 0,00200700 | 0,00210736 | -0,04762330 |
| 321,22 | 48 | 0,010643 | 0,08955600 | 0,0852375 | 0,08630896 | 0,00660382 | 0,61164414 | 0,00354767 | 0,00220127 | 0,61164414 |

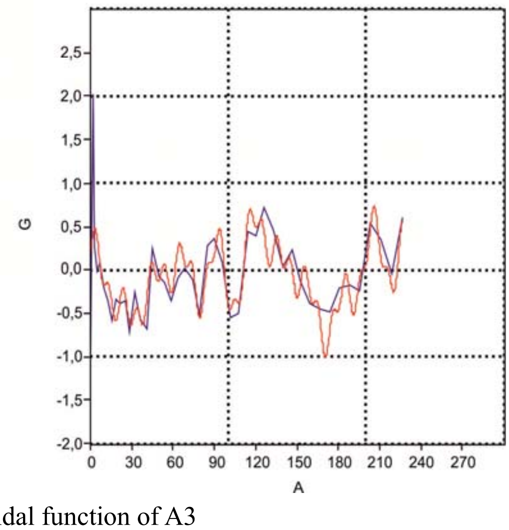



Tab.A5 showing raw data and the consensus of the cumulative sum, and the Gompertz function of A3

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 4,11E-31 | #DIV/0! | 2,47 | 3,648 | 4,67E+00 | 5,6479 | 7,7923 | 5,8385 |
| 0,0021608 | 0,011947 | 462,791559 | 2,47 | 3,6412 | 4,6654 | 5,6374 | 7,7778 | 5,8276 |
| 0,0043215 | 0,22867 | 231,401134 | 2,45 | 3,6209 | 4,6394 | 5,606 | 7,7344 | 5,7951 |
| 0,0064823 | 1,1555 | 154,266233 | 2,43 | 3,5877 | 4,5969 | 5,5545 | 7,6635 | 5,7419 |
| 0,008643 | 3,1988 | 115,700567 | 2,40 | 3,5424 | 4,5388 | 5,4844 | 7,5668 | 5,6695 |
| 0,010804 | 4,1365 | 92,5583117 | 2,36 | 3,4862 | 4,4668 | 5,3974 | 7,4467 | 5,5795 |
| **0,012965** | **4,2157** | **77,1307366** | 2,32 | 3,4204 | 4,3825 | 5,2955 | 7,3061 | 5,4741 |
| 0,015125 | 3,4704 | 66,1157025 | 2,27 | 3,3464 | 4,2877 | 5,1809 | 7,1481 | 5,3558 |
| 0,017286 | 2,4209 | 57,8502835 | 2,21 | 3,2658 | 4,1844 | 5,0562 | 6,9759 | 5,2268 |
| 0,019447 | 1,7169 | 51,4218131 | 2,15 | 3,1801 | 4,0746 | 4,9235 | 6,7928 | 5,0896 |
| 0,021608 | 1,5629 | 46,2791559 | 2,09 | 3,0907 | 3,9601 | 4,7851 | 6,6019 | 4,9465 |
| 0,023768 | 2,0045 | 42,073376 | 2,03 | 2,999 | 3,8426 | 4,6432 | 6,4061 | 4,7998 |
| 0,025929 | 2,5626 | 38,5668556 | 1,97 | 2,9063 | 3,7238 | 4,4996 | 6,208 | 4,6514 |
| **0,02809** | **2,7805** | **35,5998576** | 1,91 | 2,8136 | 3,605 | 4,356 | 6,0099 | 4,503 |
| 0,030251 | 2,1009 | 33,0567585 | 1,84 | 2,7217 | 3,4873 | 4,2138 | 5,8138 | 4,356 |
| 0,032411 | 1,4979 | 30,8537225 | 1,78 | 2,6316 | 3,3718 | 4,0743 | 5,6212 | 4,2118 |
| 0,034572 | 1,7414 | 28,9251417 | 1,72 | 2,5438 | 3,2593 | 3,9384 | 5,4337 | 4,0712 |
| 0,036733 | 1,7391 | 27,2234775 | 1,67 | 2,4588 | 3,1504 | 3,8068 | 5,2521 | 3,9352 |
| 0,038894 | 1,3781 | 25,7109066 | 1,61 | 2,377 | 3,0456 | 3,6801 | 5,0774 | 3,8043 |
| 0,041054 | 1,759 | 24,3581624 | 1,56 | 2,2986 | 2,9452 | 3,5588 | 4,91 | 3,6788 |
| 0,043215 | 2,7664 | 23,1401134 | 1,51 | 2,2239 | 2,8494 | 3,4431 | 4,7503 | 3,5592 |
| **0,045376** | **2,8506** | **22,0380818** | 1,46 | 2,1529 | 2,7585 | 3,3331 | 4,5987 | 3,4456 |
| 0,047537 | 2,1665 | 21,0362455 | 1,41 | 2,0857 | 2,6723 | 3,2291 | 4,4551 | 3,338 |
| 0,049697 | 1,9521 | 20,121939 | 1,37 | 2,0222 | 2,5911 | 3,1309 | 4,3196 | 3,2365 |
| 0,051858 | 1,6472 | 19,2834278 | 1,33 | 1,9625 | 2,5146 | 3,0385 | 4,1921 | 3,141 |
| 0,054019 | 0,76804 | 18,512005 | 1,29 | 1,9065 | 2,4428 | 2,9517 | 4,0725 | 3,0513 |
| 0,05618 | 0,26566 | 17,7999288 | 1,26 | 1,8541 | 2,3757 | 2,8706 | 3,9605 | 2,9674 |
| 0,05834 | 0,49685 | 17,1408982 | 1,22 | 1,8052 | 2,313 | 2,7948 | 3,856 | 2,8891 |
| 0,060501 | 0,7959 | 16,5286524 | 1,19 | 1,7596 | 2,2546 | 2,7243 | 3,7586 | 2,8162 |
| 0,062662 | 1,0091 | 15,9586352 | 1,16 | 1,7173 | 2,2004 | 2,6588 | 3,6683 | 2,7485 |
| 0,064823 | 1,0843 | 15,4266233 | 1,14 | 1,6782 | 2,1502 | 2,5982 | 3,5846 | 2,6858 |
| 0,066983 | 0,91644 | 14,9291611 | 1,11 | 1,642 | 2,1039 | 2,5422 | 3,5074 | 2,628 |
| 0,069144 | 1,2444 | 14,4625709 | 1,09 | 1,6088 | 2,0613 | 2,4907 | 3,4364 | 2,5748 |
| 0,071305 | 1,4963 | 14,024262 | 1,07 | 1,5783 | 2,0223 | 2,4436 | 3,3714 | 2,526 |
| 0,073466 | 0,9836 | 13,6117388 | 1,05 | 1,5506 | 1,9867 | 2,4006 | 3,3121 | 2,4816 |
| 0,075626 | 0,78904 | 13,2229656 | 1,03 | 1,5254 | 1,9545 | 2,3617 | 3,2583 | 2,4413 |
| 0,077787 | 1,0825 | 12,8556185 | 1,02 | 1,5027 | 1,9254 | 2,3266 | 3,2099 | 2,4051 |
| 0,079948 | 0,54226 | 12,5081303 | 1,00 | 1,4825 | 1,8995 | 2,2952 | 3,1666 | 2,3726 |
| 0,082109 | 0,15276 | 12,1789329 | 0,99 | 1,4646 | 1,8765 | 2,2675 | 3,1284 | 2,344 |
| 0,084269 | 0,37426 | 11,86676 | 0,98 | 1,4489 | 1,8565 | 2,2432 | 3,0949 | 2,3189 |
| 0,08643 | 0,753 | 11,5700567 | 0,97 | 1,4355 | 1,8392 | 2,2224 | 3,0662 | 2,2974 |
| 0,088591 | 0,75587 | 11,2878283 | 0,96 | 1,4242 | 1,8248 | 2,2049 | 3,0421 | 2,2793 |
| 0,090752 | 1,2079 | 11,0190409 | 0,96 | 1,415 | 1,813 | 2,1907 | 3,0225 | 2,2647 |
| 0,092912 | 1,4986 | 10,7628724 | 0,95 | 1,4079 | 1,8039 | 2,1798 | 3,0074 | 2,2533 |
| 0,095073 | 1,3767 | 10,5182334 | 0,95 | 1,4029 | 1,7975 | 2,1719 | 2,9966 | 2,2452 |
| 0,097234 | 1,5423 | 10,2844684 | 0,95 | 1,40 | 1,7936 | 2,1673 | 2,9901 | 2,2404 |
| **0,099395** | **1,8759** | **10,0608683** | 0,94726 | 1,3988 | 1,7923 | 2,1657 | 2,988 | 2,2388 |

| Amp | Phas | Period | $R^2$ | p |
|---|---|---|---|---|
| **0,27** | **-1,29** | **74,32** | 0,50903000 | 0,0078591 |
| 0,269 | -0,984 | 129,50 | | |
| **0,23** | **0,503** | **22,69** | | |
| **0,161** | **2,11** | **10,12** | | |
| 0,173 | 1,62 | 28,39 | | |
| **0,137** | **2,69** | **35,92** | | |




Tab.A6 showing the data of the lomb periodogram and the sinusoidal function of A3

**Log File A3**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 3)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\depressa\A3_4\original
Filename Prefix=depressa A3_Ven 4
Number of Files= 1600
Source Voltage (kV)= 87
Source Current (uA)= 91
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.06
Object to Source (mm)=44.313
Camera to Source (mm)=364.000
Vertical Object Position (mm)=35.303
Optical Axis (line)=1110
Filter=User Filter
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 650
Rotation Step (deg)=0.150
Frame Averaging=ON (20)
Random Movement=ON (15)
Use 360 Rotation=NO
FF updating interval=89
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Jan 02, 2012 19:03:13
Scan duration=06:11:50
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.1
Program Home Directory=C:\Skyscan
Reconstruction engine=NReconServer
Engine version=Version: 1.6.4
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Option for additional F4F float format=OFF
Reconstruction mode=Standard
Dataset Origin=SkyScan1173
Dataset Prefix=depressa A3_Ven 4
Dataset Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\A3_4\original
Output Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\A3_4\original\depressa A3_Ven 4_Rec
Time and Date=Jan 03, 2012 16:55:32
First Section=753
Last Section=1712
Reconstruction duration per slice (seconds)=3.021875
Postalignment=49.50
Section to Section Step=1
Sections Count=960
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=688
Result Image Height (pixels)=888
Pixel Size (um)=6.05771
Reconstruction Angular Range (deg)=240.00
Use 180+=OFF
Angular Step (deg)=0.1500
Smoothing=0
Ring Artifact Correction=0
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=1887
ROI Bottom (pixels)=996
ROI Left (pixels)=1032
ROI Right (pixels)=1721
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=20
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0000

Maximum for CS to Image Conversion=0.0580
HU Calibration=OFF
BMP LUT=0
Cone-beam Angle Horiz.(deg)=17.409575
Cone-beam Angle Vert.(deg)=17.409575
[File name convention]
Filename Index Length=4
Filename Prefix=depressa A3
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Jan 04, 2012  10:46:01
Original configuration file=depressa A3_Ven 4_rec.log
Conversion description=...SAG. Rotated(deg): (292.203, 317.019, 79.854).
Image scale modified=0
HU calibration modified=0

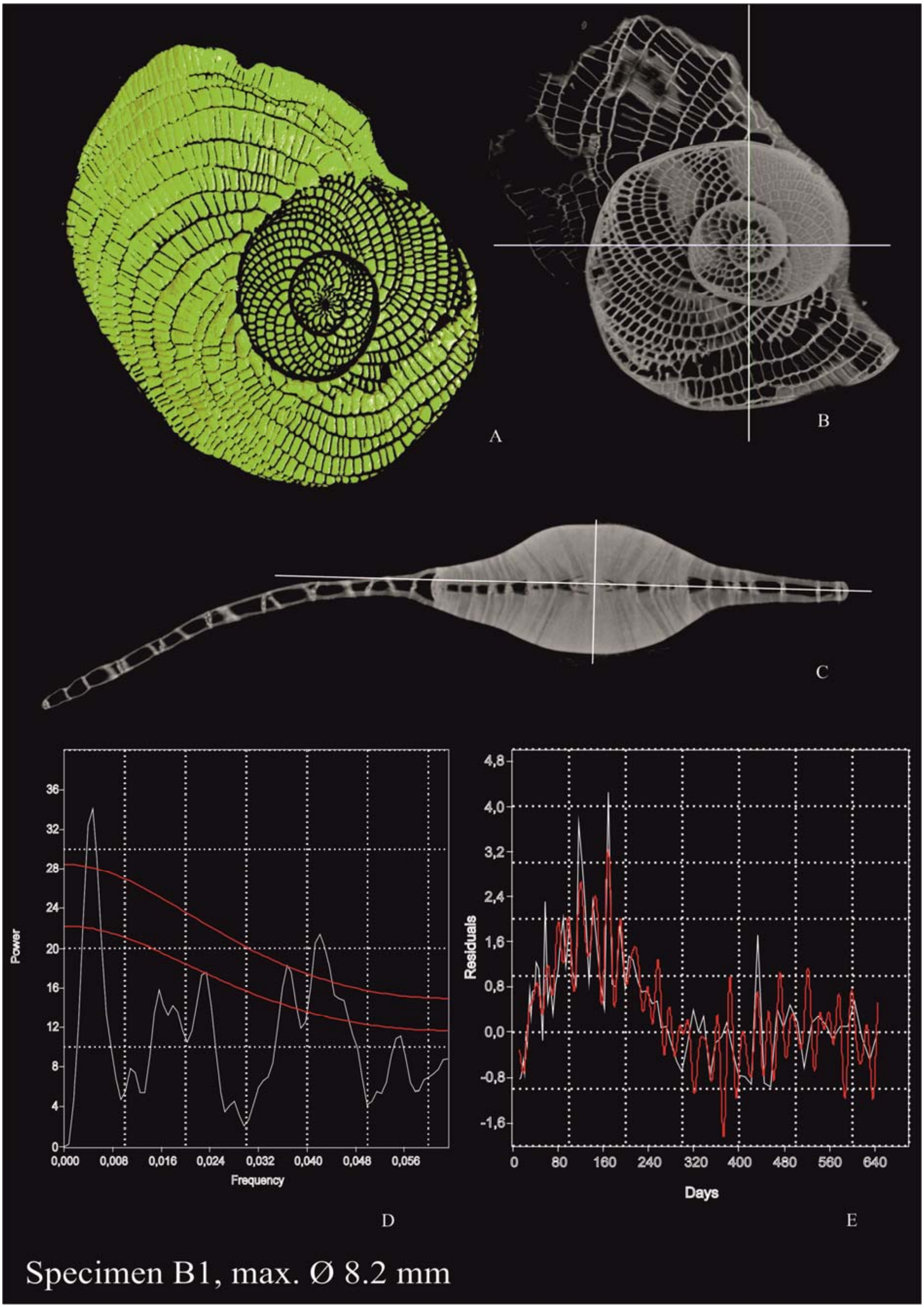
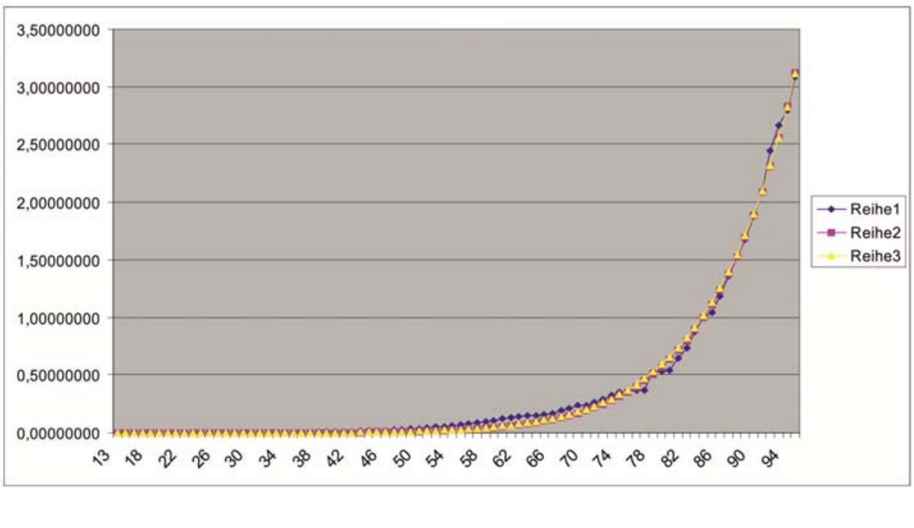



Fig.A4 Specimen B1, agamont from Sesoko Jima, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

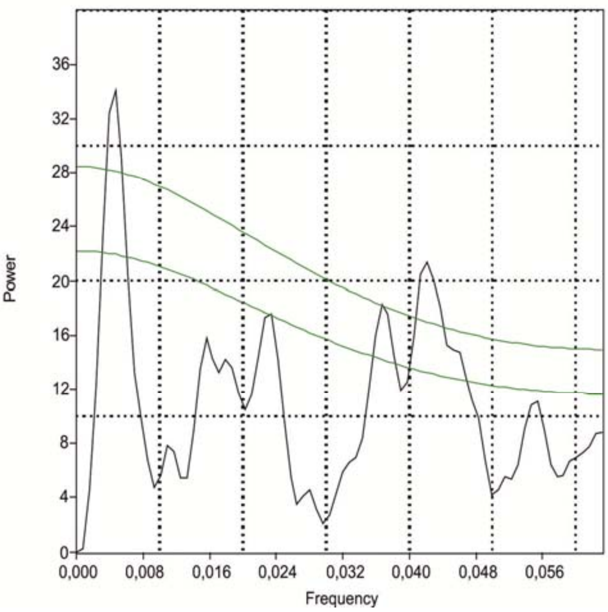
| days | chamber | Volume mm³ | comul. Vol | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|
| 12,34 | 13 | 0,000004 | 0,00000400 | 0,00001710 | 0,00002461 | 0,00002461 | -0,83748754 | 0,00000133 | 0,00000820 | -0,83748754 |
| 14,32 | 14 | 0,000001 | 0,00000500 | 0,00002100 | 0,00003011 | 0,00000550 | -0,81815319 | 0,00000033 | 0,00000183 | -0,81815319 |
| 16,44 | 15 | 0,000002 | 0,00000700 | 0,00002590 | 0,00003677 | 0,00000666 | -0,69975596 | 0,00000067 | 0,00000222 | -0,69975596 |
| 18,70 | 16 | 0,000004 | 0,00001100 | 0,00003180 | 0,00004483 | 0,00000805 | -0,50338023 | 0,00000133 | 0,00000268 | -0,50338023 |
| 21,11 | 18 | 0,000006 | 0,00001700 | 0,00004770 | 0,00006626 | 0,00002144 | -0,72008503 | 0,00000200 | 0,00000715 | -0,72008503 |
| 23,67 | 19 | 0,000013 | 0,00003000 | 0,00005830 | 0,00008035 | 0,00001409 | -0,07725458 | 0,00000433 | 0,00000470 | -0,07725458 |
| 26,37 | 20 | 0,000013 | 0,00004300 | 0,00007110 | 0,00009727 | 0,00001692 | -0,23147898 | 0,00000433 | 0,00000564 | -0,23147898 |
| 29,22 | 21 | 0,000035 | 0,00007800 | 0,00008650 | 0,00011754 | 0,00002028 | 0,72623867 | 0,00001167 | 0,00000676 | 0,72623867 |
| 32,21 | 22 | 0,000031 | 0,00010900 | 0,00010510 | 0,00014180 | 0,00002426 | 0,27777605 | 0,00001033 | 0,00000809 | 0,27777605 |
| 35,35 | 23 | 0,00005 | 0,00015900 | 0,00012750 | 0,00017078 | 0,00002898 | 0,72526787 | 0,00001667 | 0,00000966 | 0,72526787 |
| 38,64 | 24 | 0,000061 | 0,00022000 | 0,00015430 | 0,00020535 | 0,00003456 | 0,76496666 | 0,00002033 | 0,00001152 | 0,76496666 |
| 42,07 | 25 | 0,000092 | 0,00031200 | 0,00018650 | 0,00024649 | 0,00004115 | 1,23580946 | 0,00003067 | 0,00001372 | 1,23580946 |
| 45,65 | 26 | 0,000104 | 0,00041600 | 0,00022500 | 0,00029540 | 0,00004891 | 1,12634776 | 0,00003467 | 0,00001630 | 1,12634776 |
| 49,38 | 27 | 0,00008 | 0,00049600 | 0,00027090 | 0,00035345 | 0,00005804 | 0,37832694 | 0,00002667 | 0,00001935 | 0,37832694 |
| 53,25 | 28 | 0,000059 | 0,00055500 | 0,00032570 | 0,00042221 | 0,00006877 | -0,14202123 | 0,00001967 | 0,00002292 | -0,14202123 |
| 57,27 | 29 | 0,000269 | 0,00082400 | 0,00039090 | 0,00050356 | 0,00008134 | 2,30699684 | 0,00008967 | 0,00002711 | 2,30699684 |
| 61,43 | 30 | 0,000148 | 0,00097200 | 0,00046840 | 0,00059962 | 0,00009607 | 0,54059561 | 0,00004933 | 0,00003202 | 0,54059561 |
| 65,74 | 31 | 0,000212 | 0,00118400 | 0,00056030 | 0,00071290 | 0,00011328 | 0,87150308 | 0,00007067 | 0,00003776 | 0,87150308 |
| 70,20 | 32 | 0,000176 | 0,00136000 | 0,00066910 | 0,00084626 | 0,00013336 | 0,31968807 | 0,00005867 | 0,00004445 | 0,31968807 |
| 74,80 | 33 | 0,000292 | 0,00165200 | 0,00079780 | 0,00100304 | 0,00015677 | 0,86258263 | 0,00009733 | 0,00005226 | 0,86258263 |
| 79,55 | 34 | 0,000386 | 0,00203800 | 0,00094970 | 0,00118704 | 0,00018400 | 1,09777164 | 0,00012867 | 0,00006133 | 1,09777164 |
| 84,44 | 35 | 0,000569 | 0,00260700 | 0,00112880 | 0,00140268 | 0,00021564 | 1,63863648 | 0,00018967 | 0,00007188 | 1,63863648 |
| 89,48 | 36 | 0,00076 | 0,00336700 | 0,00133940 | 0,00165502 | 0,00025234 | 2,01182387 | 0,00025333 | 0,00008411 | 2,01182387 |
| 94,67 | 37 | 0,000638 | 0,00400500 | 0,00158690 | 0,00194986 | 0,00029484 | 1,16387308 | 0,00021267 | 0,00009828 | 1,16387308 |
| 100,00 | 38 | 0,001012 | 0,00501700 | 0,00187710 | 0,00229386 | 0,00034400 | 1,94189658 | 0,00033733 | 0,00011467 | 1,94189658 |
| 105,48 | 39 | 0,000845 | 0,00586200 | 0,00221710 | 0,00269462 | 0,00040076 | 1,10850336 | 0,00028167 | 0,00013359 | 1,10850336 |
| 111,10 | 40 | 0,000858 | 0,00672000 | 0,00261460 | 0,00316083 | 0,00046621 | 0,84036857 | 0,00028600 | 0,00015540 | 0,84036857 |
| 116,87 | 41 | 0,00255 | 0,00927000 | 0,00307880 | 0,00370240 | 0,00054158 | 3,70848535 | 0,00085000 | 0,00018053 | 3,70848535 |
| 122,79 | 42 | 0,00245 | 0,01172000 | 0,00362000 | 0,00433063 | 0,00062823 | 2,89985679 | 0,00081667 | 0,00020941 | 2,89985679 |
| 128,85 | 43 | 0,002355 | 0,01407500 | 0,00424990 | 0,00505835 | 0,00072772 | 2,23614140 | 0,00078500 | 0,00024257 | 2,23614140 |
| 135,06 | 44 | 0,001601 | 0,01567600 | 0,00498220 | 0,00590014 | 0,00084179 | 0,90190534 | 0,00053367 | 0,00028060 | 0,90190534 |
| 141,42 | 45 | 0,003219 | 0,01889500 | 0,00583210 | 0,00687253 | 0,00097239 | 2,31040463 | 0,00107300 | 0,00032413 | 2,31040463 |
| 147,92 | 46 | 0,002867 | 0,02176200 | 0,00681710 | 0,00799424 | 0,00112171 | 1,55591552 | 0,00095567 | 0,00037390 | 1,55591552 |
| 154,57 | 47 | 0,002419 | 0,02418100 | 0,00795720 | 0,00928644 | 0,00129221 | 0,87199286 | 0,00080633 | 0,00043074 | 0,87199286 |
| 161,36 | 48 | 0,002094 | 0,02627500 | 0,00927480 | 0,01077305 | 0,00148661 | 0,40857522 | 0,00069800 | 0,00049554 | 0,40857522 |
| 168,30 | 49 | 0,008963 | 0,03523800 | 0,01079530 | 0,01248103 | 0,00170797 | 4,24773734 | 0,00298767 | 0,00056932 | 4,24773734 |
| 175,38 | 50 | 0,003647 | 0,03888500 | 0,01254780 | 0,01444073 | 0,00195971 | 0,86099356 | 0,00121567 | 0,00065324 | 0,86099356 |
| 182,62 | 51 | 0,004036 | 0,04292100 | 0,01456460 | 0,01668632 | 0,00224559 | 0,79730014 | 0,00134533 | 0,00074853 | 0,79730014 |
| 189,99 | 52 | 0,007511 | 0,05043200 | 0,01688250 | 0,01925616 | 0,00256984 | 1,92275484 | 0,00250367 | 0,00085661 | 1,92275484 |
| 197,52 | 53 | 0,005239 | 0,05567100 | 0,01954280 | 0,02219327 | 0,00293711 | 0,78372528 | 0,00174633 | 0,00097904 | 0,78372528 |
| 205,19 | 54 | 0,007919 | 0,06359000 | 0,02259200 | 0,02554586 | 0,00335259 | 1,36205284 | 0,00263967 | 0,00111753 | 1,36205284 |
| 213,00 | 55 | 0,008728 | 0,07231800 | 0,02608240 | 0,02936787 | 0,00382201 | 1,28361814 | 0,00290933 | 0,00127400 | 1,28361814 |
| 220,96 | 56 | 0,008305 | 0,08062300 | 0,03007240 | 0,03371955 | 0,00435168 | 0,90845852 | 0,00276833 | 0,00145056 | 0,90845852 |
| 229,07 | 57 | 0,00845 | 0,08907300 | 0,03462760 | 0,03866815 | 0,00494860 | 0,70755271 | 0,00281667 | 0,00164953 | 0,70755271 |
| 237,33 | 58 | 0,009802 | 0,09887500 | 0,03982130 | 0,04428863 | 0,00562048 | 0,74398028 | 0,00326733 | 0,00187349 | 0,74398028 |
| 245,73 | 59 | 0,009588 | 0,10846300 | 0,04573540 | 0,05066441 | 0,00637578 | 0,50381603 | 0,00319600 | 0,00212526 | 0,50381603 |
| 254,27 | 60 | 0,011195 | 0,11965800 | 0,05246120 | 0,05788824 | 0,00722384 | 0,54973054 | 0,00373167 | 0,00240795 | 0,54973054 |
| 262,97 | 61 | 0,008874 | 0,12853200 | 0,06010070 | 0,06606313 | 0,00817488 | 0,08551997 | 0,00295800 | 0,00272496 | 0,08551997 |
| 271,80 | 62 | 0,010065 | 0,13859700 | 0,06876680 | 0,07530328 | 0,00924015 | 0,08926787 | 0,00335500 | 0,00308005 | 0,08926787 |
| 280,79 | 63 | 0,008148 | 0,14674500 | 0,07858560 | 0,08573522 | 0,01043194 | -0,21893701 | 0,00271600 | 0,00347731 | -0,21893701 |
| 289,92 | 64 | 0,005575 | 0,15232000 | 0,08969660 | 0,09749891 | 0,01176370 | -0,52608435 | 0,00185833 | 0,00392123 | -0,52608435 |
| 299,20 | 65 | 0,00404 | 0,15636000 | 0,10225470 | 0,11074904 | 0,01325013 | -0,69509738 | 0,00134667 | 0,00441671 | -0,69509738 |
| 308,62 | 66 | 0,011052 | 0,16741200 | 0,11643110 | 0,12565633 | 0,01490729 | -0,25861763 | 0,00368400 | 0,00496910 | -0,25861763 |
| 318,19 | 67 | 0,023211 | 0,19062300 | 0,13241530 | 0,14240898 | 0,01675265 | 0,38551211 | 0,00773700 | 0,00558422 | 0,38551211 |
| 327,90 | 68 | 0,019056 | 0,20967900 | 0,15041660 | 0,16121424 | 0,01880526 | 0,01333353 | 0,00635200 | 0,00626842 | 0,01333353 |
| 337,76 | 69 | 0,027148 | 0,23682700 | 0,17066570 | 0,18230006 | 0,02108582 | 0,28750051 | 0,00904933 | 0,00702861 | 0,28750051 |
| 347,77 | 70 | 0,00463 | 0,24145700 | 0,19341690 | 0,20591686 | 0,02361681 | -0,80395317 | 0,00154333 | 0,00787227 | -0,80395317 |
| 357,93 | 71 | 0,021382 | 0,26283900 | 0,21894980 | 0,23233948 | 0,02642262 | -0,19076902 | 0,00712733 | 0,00880754 | -0,19076902 |
| 368,22 | 72 | 0,026856 | 0,28969500 | 0,24757210 | 0,26186916 | 0,02952968 | -0,09054202 | 0,00895200 | 0,00984323 | -0,09054202 |
| 378,67 | 73 | 0,038167 | 0,32786200 | 0,27962110 | 0,29483574 | 0,03296659 | 0,15774802 | 0,01272233 | 0,01098886 | 0,15774802 |
| 389,26 | 74 | 0,02246 | 0,35032200 | 0,31546710 | 0,33160001 | 0,03676426 | -0,38908066 | 0,00748667 | 0,01225475 | -0,38908066 |
| 400,00 | 75 | 0,009274 | 0,35959600 | 0,35551530 | 0,37255610 | 0,04095610 | -0,77356240 | 0,00309133 | 0,01365203 | -0,77356240 |
| 410,88 | 76 | 0,010131 | 0,36972700 | 0,40020930 | 0,41813419 | 0,04557809 | -0,77772213 | 0,00337700 | 0,01519270 | -0,77772213 |
| 421,91 | 77 | 0,003388 | 0,37311500 | 0,45003360 | 0,46880322 | 0,05066903 | -0,93313470 | 0,00112933 | 0,01688968 | -0,93313470 |
| 433,09 | 78 | 0,153192 | 0,52630700 | 0,50551720 | 0,52507389 | 0,05627067 | 1,72241287 | 0,05106400 | 0,01875689 | 1,72241287 |

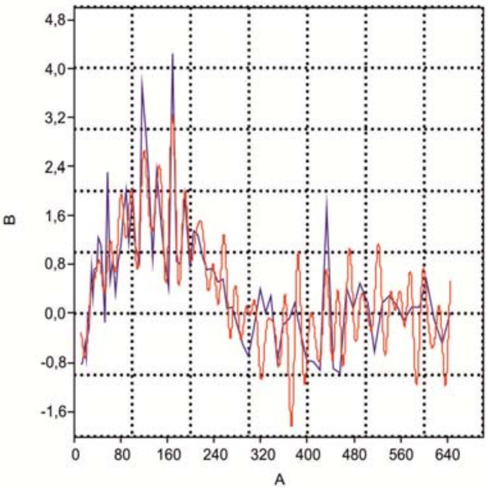



Tab.A7 showing raw data and the consensus of the cumulative sum, and the Gompertz function of B1.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0,00000 | 0,00000 | #DIV/0! | 15,04400 | 22,21600 | 28,46500 | 34,39500 | 47,45400 | 40,31200 |
| 0,00078 | 0,26321 | 1281,80 | 15,03900 | 22,20800 | 28,45500 | 34,38300 | 47,43800 | 40,29900 |
| 0,00156 | 4,58310 | 640,90 | 15,02400 | 22,18600 | 28,42600 | 34,34800 | 47,39000 | 40,25800 |
| 0,00234 | 12,21000 | 427,28 | 14,99800 | 22,14800 | 28,37800 | 34,29000 | 47,30900 | 40,18900 |
| 0,00312 | 22,95600 | 320,45 | 14,96300 | 22,09600 | 28,31100 | 34,20900 | 47,19800 | 40,09500 |
| 0,00390 | 32,46800 | 256,36 | 14,91800 | 22,02900 | 28,22600 | 34,10600 | 47,05500 | 39,97400 |
| **0,00468** | **34,13500** | **213,63** | 14,86300 | 21,94800 | 28,12200 | 33,98100 | 46,88300 | 39,82700 |
| 0,00546 | 29,14600 | 183,12 | 14,79900 | 21,85400 | 28,00100 | 33,83500 | 46,68200 | 39,65600 |
| 0,00624 | 20,44600 | 160,23 | 14,72600 | 21,74700 | 27,86400 | 33,66900 | 46,45200 | 39,46100 |
| 0,00702 | 13,27600 | 142,42 | 14,64500 | 21,62700 | 27,71000 | 33,48300 | 46,19500 | 39,24300 |
| 0,00780 | 9,88560 | 128,18 | 14,55600 | 21,49500 | 27,54100 | 33,27800 | 45,91300 | 39,00400 |
| 0,00858 | 6,80940 | 116,53 | 14,45900 | 21,35100 | 27,35700 | 33,05600 | 45,60700 | 38,74400 |
| 0,00936 | 4,72370 | 106,82 | 14,35400 | 21,19700 | 27,16000 | 32,81800 | 45,27800 | 38,46400 |
| 0,01014 | 5,61960 | 98,60 | 14,24300 | 21,03300 | 26,95000 | 32,56400 | 44,92800 | 38,16700 |
| 0,01092 | 7,80350 | 91,56 | 14,12600 | 20,86000 | 26,72800 | 32,29700 | 44,55900 | 37,85300 |
| 0,01170 | 7,40720 | 85,46 | 14,00300 | 20,67900 | 26,49600 | 32,01600 | 44,17200 | 37,52400 |
| 0,01248 | 5,46280 | 80,12 | 13,87500 | 20,49000 | 26,25400 | 31,72300 | 43,76800 | 37,18100 |
| 0,01326 | 5,45760 | 75,40 | 13,74300 | 20,29400 | 26,00300 | 31,42000 | 43,35000 | 36,82600 |
| 0,01404 | 8,89980 | 71,21 | 13,60600 | 20,09200 | 25,74400 | 31,10700 | 42,91800 | 36,45900 |
| 0,01482 | 13,54100 | 67,46 | 13,46600 | 19,88500 | 25,47900 | 30,78700 | 42,47600 | 36,08300 |
| 0,01560 | 15,80500 | 64,09 | 13,32300 | 19,67400 | 25,20700 | 30,45900 | 42,02400 | 35,69900 |
| 0,01638 | 14,28900 | 61,04 | 13,17700 | 19,45800 | 24,93100 | 30,12500 | 41,56300 | 35,30800 |
| 0,01716 | 13,19500 | 58,26 | 13,02900 | 19,23900 | 24,65100 | 29,78700 | 41,09600 | 34,91200 |
| 0,01794 | 14,20100 | 55,73 | 12,87900 | 19,01800 | 24,36800 | 29,44500 | 40,62400 | 34,51000 |
| 0,01872 | 13,58600 | 53,41 | 12,72800 | 18,79600 | 24,08300 | 29,10000 | 40,14800 | 34,10600 |
| 0,01950 | 11,71100 | 51,27 | 12,57600 | 18,57200 | 23,79600 | 28,75300 | 39,67000 | 33,70000 |
| 0,02028 | 10,45700 | 49,30 | 12,42400 | 18,34700 | 23,50800 | 28,40600 | 39,19100 | 33,29200 |
| 0,02106 | 11,64700 | 47,47 | 12,27200 | 18,12300 | 23,22000 | 28,05800 | 38,71100 | 32,88500 |
| 0,02184 | 14,40100 | 45,78 | 12,12100 | 17,89900 | 22,93300 | 27,71100 | 38,23300 | 32,47900 |
| 0,02262 | 17,27600 | 44,20 | 11,97000 | 17,67600 | 22,64800 | 27,36600 | 37,75600 | 32,07400 |
| **0,02340** | **17,61400** | **42,73** | 11,82000 | 17,45400 | 22,36400 | 27,02300 | 37,28300 | 31,67200 |
| 0,02419 | 14,24300 | 41,35 | 11,67100 | 17,23500 | 22,08300 | 26,68300 | 36,81400 | 31,27400 |
| 0,02497 | 9,51350 | 40,06 | 11,52400 | 17,01700 | 21,80400 | 26,34700 | 36,35000 | 30,88000 |
| 0,02575 | 5,46540 | 38,84 | 11,37800 | 16,80300 | 21,52900 | 26,01400 | 35,89100 | 30,49000 |
| 0,02653 | 3,50600 | 37,70 | 11,23500 | 16,59100 | 21,25800 | 25,68600 | 35,43900 | 30,10600 |
| 0,02731 | 4,09280 | 36,62 | 11,09400 | 16,38200 | 20,99100 | 25,36400 | 34,99400 | 29,72700 |
| 0,02809 | 4,53790 | 35,61 | 10,95500 | 16,17700 | 20,72800 | 25,04600 | 34,55600 | 29,35500 |
| 0,02887 | 3,19160 | 34,64 | 10,81900 | 15,97600 | 20,47000 | 24,73400 | 34,12600 | 28,99000 |
| 0,02965 | 2,07240 | 33,73 | 10,68500 | 15,77900 | 20,21700 | 24,42900 | 33,70400 | 28,63100 |
| 0,03043 | 2,74280 | 32,87 | 10,55400 | 15,58500 | 19,96900 | 24,12900 | 33,29100 | 28,28100 |
| 0,03121 | 4,26490 | 32,05 | 10,42600 | 15,39600 | 19,72700 | 23,83700 | 32,88700 | 27,93800 |
| 0,03199 | 5,88730 | 31,26 | 10,30100 | 15,21100 | 19,49000 | 23,55100 | 32,49300 | 27,60200 |
| 0,03277 | 6,61560 | 30,52 | 10,17900 | 15,03100 | 19,25900 | 23,27200 | 32,10800 | 27,27600 |
| 0,03355 | 6,92610 | 29,81 | 10,06000 | 14,85600 | 19,03500 | 23,00000 | 31,73300 | 26,95700 |
| 0,03433 | 8,39600 | 29,13 | 9,94430 | 14,68500 | 18,81600 | 22,73500 | 31,36800 | 26,64700 |
| 0,03511 | 11,97300 | 28,48 | 9,83190 | 14,51900 | 18,60300 | 22,47800 | 31,01300 | 26,34600 |
| 0,03589 | 15,93400 | 27,87 | 9,72260 | 14,35800 | 18,39600 | 22,22900 | 30,66800 | 26,05300 |
| **0,03667** | **18,23700** | **27,27** | 9,61670 | 14,20100 | 18,19600 | 21,98600 | 30,33400 | 25,76900 |
| 0,03745 | 17,57600 | 26,70 | 9,51410 | 14,05000 | 18,00100 | 21,75200 | 30,01000 | 25,49400 |
| 0,03823 | 14,38100 | 26,16 | 9,41470 | 13,90300 | 17,81400 | 21,52500 | 29,69700 | 25,22800 |
| 0,03901 | 11,89700 | 25,64 | 9,31870 | 13,76100 | 17,63200 | 21,30500 | 29,39400 | 24,97100 |
| 0,03979 | 12,56400 | 25,13 | 9,22610 | 13,62400 | 17,45700 | 21,09300 | 29,10200 | 24,72200 |
| 0,04057 | 15,87000 | 24,65 | 9,13670 | 13,49200 | 17,28700 | 20,88900 | 28,82000 | 24,48300 |
| 0,04135 | 20,53000 | 24,18 | 9,05060 | 13,36500 | 17,12500 | 20,69200 | 28,54900 | 24,25200 |
| **0,04213** | **21,39600** | **23,74** | 8,96790 | 13,24300 | 16,96800 | 20,50300 | 28,28800 | 24,03000 |
| 0,04291 | 20,07300 | 23,31 | 8,88840 | 13,12600 | 16,81800 | 20,32100 | 28,03700 | 23,81800 |
| 0,04369 | 18,09400 | 22,89 | 8,81220 | 13,01300 | 16,67400 | 20,14700 | 27,79700 | 23,61300 |
| 0,04447 | 15,26600 | 22,49 | 8,73930 | 12,90500 | 16,53500 | 19,98000 | 27,56700 | 23,41800 |
| 0,04525 | 14,93600 | 22,10 | 8,66950 | 12,80200 | 16,40400 | 19,82100 | 27,34700 | 23,23100 |
| 0,04603 | 14,72000 | 21,73 | 8,60300 | 12,70400 | 16,27800 | 19,66900 | 27,13700 | 23,05300 |
| 0,04681 | 12,72100 | 21,36 | 8,53970 | 12,61100 | 16,15800 | 19,52400 | 26,93700 | 22,88300 |
| 0,04759 | 11,18200 | 21,01 | 8,47950 | 12,52200 | 16,04400 | 19,38600 | 26,74700 | 22,72200 |
| 0,04837 | 9,83430 | 20,67 | 8,42240 | 12,43700 | 15,93600 | 19,25600 | 26,56700 | 22,56900 |
| 0,04915 | 6,75270 | 20,35 | 8,36840 | 12,35800 | 15,83400 | 19,13300 | 26,39700 | 22,42400 |
| 0,04993 | 4,21400 | 20,03 | 8,31750 | 12,28300 | 15,73800 | 19,01600 | 26,23600 | 22,28800 |

| Amp | Phase | Period | $R^2$ | p |
|---|---|---|---|---|
| 3,65 | 3,05 | 510,6 | 0,78054 | 0,00000000 |
| 3,64 | 0,518 | 465,5 | | |
| **0,309** | **-0,948** | **26,96** | | |
| **0,385** | **-2,89** | **23,8** | | |
| 0,379 | 0,889 | 21,77 | | |
| **0,288** | **-1,08** | **17,74** | | |
| **0,263** | **-2,43** | **43,6** | | |
| **0,423** | **3,01** | **213,63** | **0,086825** | **0,014** |




Tab.A8 showing the data of the lomb periodogram and the sinusoidal function of B1.

**Log File B1**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 3)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\depressa\B1\original
Filename Prefix=depressa B1
Number of Files= 1600
Source Voltage (kV)= 92
Source Current (uA)= 86
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.06
Object to Source (mm)=44.313
Camera to Source (mm)=364.000
Vertical Object Position (mm)=50.468
Optical Axis (line)=1110
Filter=User Filter
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 650
Rotation Step (deg)=0.150
Frame Averaging=ON (20)
Random Movement=ON (15)
Use 360 Rotation=NO
FF updating interval=89
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Dec 30, 2011 17:21:54
Scan duration=06:11:50
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.1
Program Home Directory=C:\Skyscan
Reconstruction engine=NReconServer
Engine version=Version: 1.6.4
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Option for additional F4F float format=OFF
Reconstruction mode=Standard
Dataset Origin=SkyScan1173
Dataset Prefix=depressa B1
Dataset Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\B1\original
Output Directory=C:\Users\Public\Briguglio\antonello to be reconstructed\depressa\B1\original\depressa B1_Rec
Time and Date=Jan 02, 2012 14:40:21
First Section=252
Last Section=1869
Reconstruction duration per slice (seconds)=3.138443
Postalignment=51.50
Section to Section Step=1
Sections Count=1618
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1704
Result Image Height (pixels)=544
Pixel Size (um)=6.05771
Reconstruction Angular Range (deg)=240.00
Use 180+=OFF
Angular Step (deg)=0.1500
Smoothing=0
Ring Artifact Correction=0
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=1552
ROI Bottom (pixels)=1005
ROI Left (pixels)=434
ROI Right (pixels)=2139
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=20
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0000

Maximum for CS to Image Conversion=0.0616
HU Calibration=OFF
BMP LUT=0
Cone-beam Angle Horiz.(deg)=17.409575
Cone-beam Angle Vert.(deg)=17.409575
[File name convention]
Filename Index Length=4
Filename Prefix=depressa B1_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Jan 03, 2012  10:23:35
Original configuration file=depressa B1_rec.log
Conversion description=...COR. Rotated(deg): (0.000, 359.357, 348.941).
Image scale modified=0
HU calibration modified=0

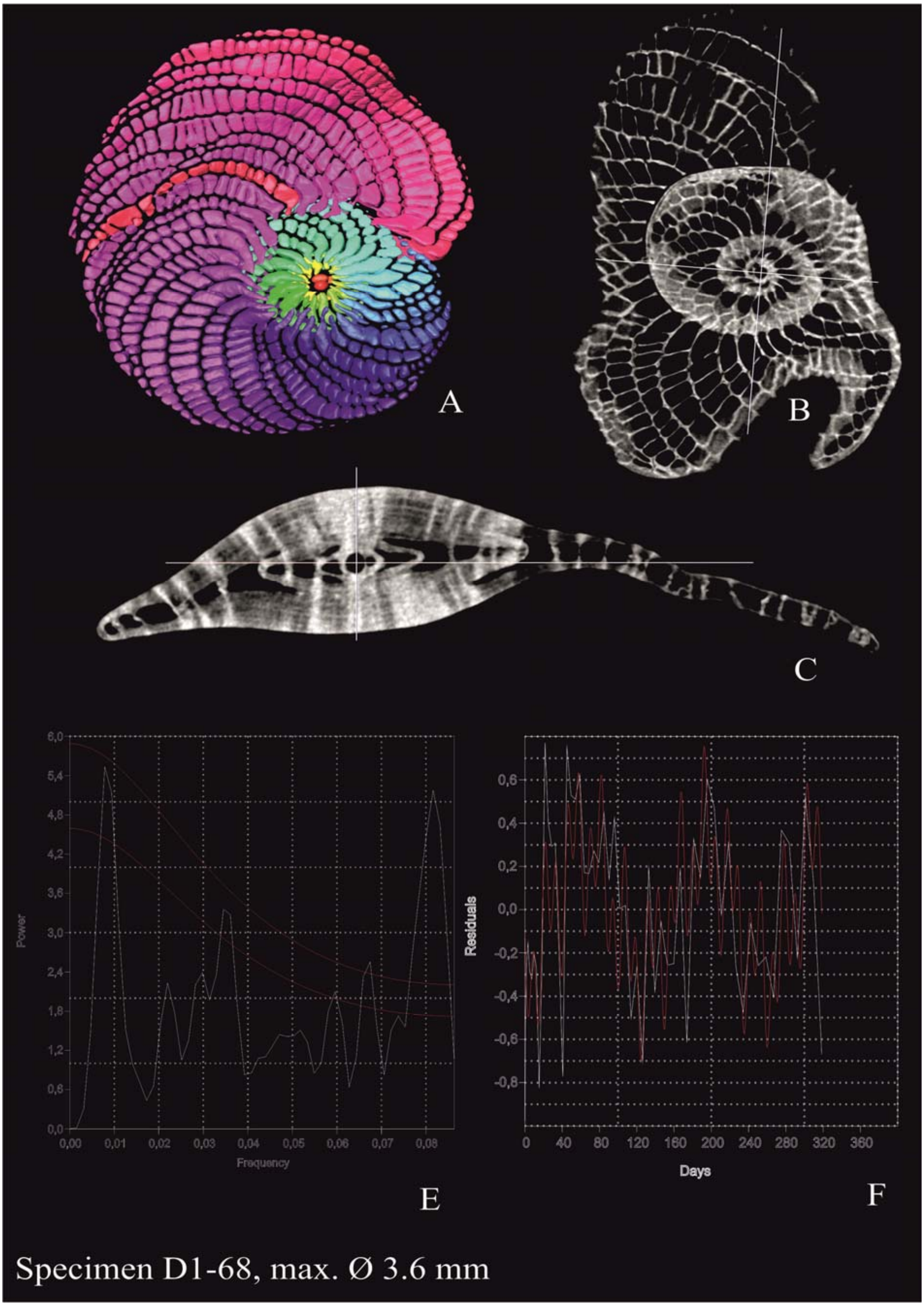
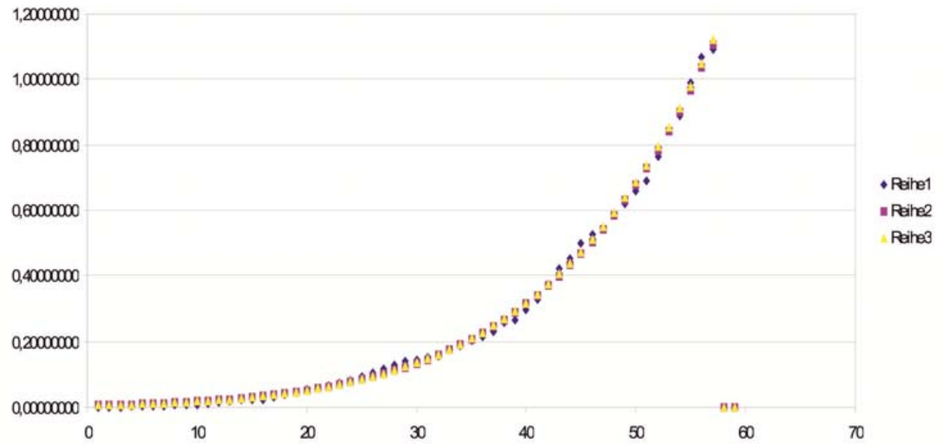


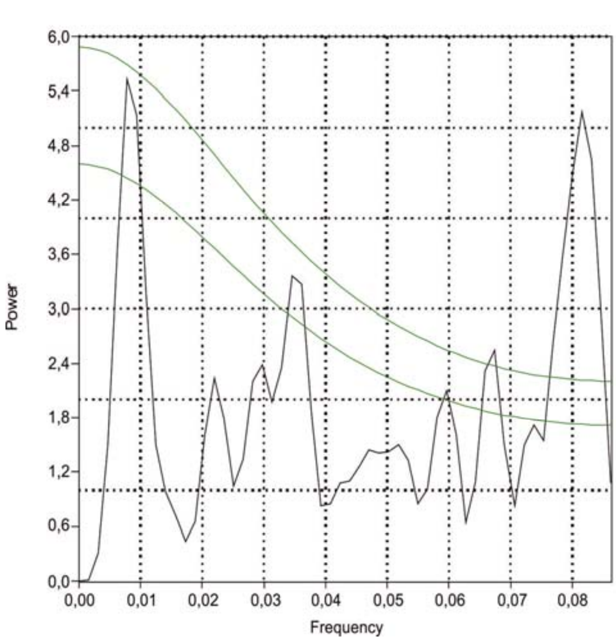

Fig.A5. Specimen D1-68, gamont from Kekaa Point, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram

| days | chamber | Volume | volume mm³ | comul. Vol | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 147769,906 | 0,00014777 | 0,00014777 | 0,00634150 | 0,00634749 | 0,00634749 | -0,97671995 | 0,00004926 | 0,00211583 | -0,97671995 |
| 0,33 | 4 | 436855,906 | 0,00043686 | 0,00058463 | 0,00715860 | 0,00716835 | 0,00082086 | -0,46780714 | 0,00014562 | 0,00027362 | -0,46780714 |
| 1,15 | 5 | 675646,688 | 0,00067565 | 0,00126027 | 0,00807080 | 0,00808509 | 0,00091674 | -0,26298760 | 0,00022522 | 0,00030558 | -0,26298760 |
| 2,39 | 6 | 867258,000 | 0,00086726 | 0,00212753 | 0,00908790 | 0,00910761 | 0,00102252 | -0,15184260 | 0,00028909 | 0,00034084 | -0,15184260 |
| 4,00 | 7 | 812289,375 | 0,00081229 | 0,00293982 | 0,01022050 | 0,01024669 | 0,00113908 | -0,28689274 | 0,00027076 | 0,00037969 | -0,28689274 |
| 5,98 | 8 | 861916,875 | 0,00086192 | 0,00380174 | 0,01148020 | 0,01151406 | 0,00126737 | -0,31991578 | 0,00028731 | 0,00042246 | -0,31991578 |
| 8,29 | 9 | 1127413,125 | 0,00112741 | 0,00492915 | 0,01287960 | 0,01292243 | 0,00140837 | -0,19949268 | 0,00037580 | 0,00046946 | -0,19949268 |
| 10,94 | 10 | 1143213,750 | 0,00114321 | 0,00607236 | 0,01443240 | 0,01448561 | 0,00156317 | -0,26865772 | 0,00038107 | 0,00052106 | -0,26865772 |
| 13,90 | 11 | 303996,500 | 0,00030400 | 0,00637636 | 0,01615310 | 0,01621851 | 0,00173291 | -0,82457420 | 0,00010133 | 0,00057764 | -0,82457420 |
| 17,17 | 12 | 1472580,500 | 0,00147258 | 0,00784894 | 0,01805780 | 0,01813731 | 0,00191879 | -0,23254881 | 0,00049086 | 0,00063960 | -0,23254881 |
| 20,75 | 13 | 3757895,250 | 0,00375790 | 0,01160684 | 0,02016380 | 0,02025943 | 0,00212213 | 0,77081436 | 0,00125263 | 0,00070738 | 0,77081436 |
| 24,62 | 14 | 3295446,750 | 0,00329545 | 0,01490228 | 0,02248940 | 0,02260372 | 0,00234429 | 0,40573607 | 0,00109848 | 0,00078143 | 0,40573607 |
| 28,78 | 15 | 3342403,750 | 0,00334240 | 0,01824469 | 0,02505490 | 0,02519044 | 0,00258672 | 0,29213754 | 0,00111413 | 0,00086224 | 0,29213754 |
| 33,23 | 16 | 3731412,500 | 0,00373141 | 0,02197610 | 0,02788160 | 0,02804144 | 0,00285099 | 0,30881252 | 0,00124380 | 0,00095033 | 0,30881252 |
| 37,96 | 17 | 2550366,000 | 0,00255037 | 0,02452646 | 0,03099280 | 0,03118016 | 0,00313872 | -0,18745040 | 0,00085012 | 0,00104624 | -0,18745040 |
| 42,96 | 18 | 789144,688 | 0,00078914 | 0,02531561 | 0,03441310 | 0,03463180 | 0,00345164 | -0,77137120 | 0,00026305 | 0,00115055 | -0,77137120 |
| 48,24 | 19 | 6641411,500 | 0,00664141 | 0,03195702 | 0,03816940 | 0,03842338 | 0,00379158 | 0,75162163 | 0,00221380 | 0,00126386 | 0,75162163 |
| 53,79 | 20 | 6363007,500 | 0,00636301 | 0,03832003 | 0,04229000 | 0,04258383 | 0,00416045 | 0,52940198 | 0,00212100 | 0,00138682 | 0,52940198 |
| 59,60 | 21 | 6886211,000 | 0,00688621 | 0,04520624 | 0,04680550 | 0,04714412 | 0,00456029 | 0,51003697 | 0,00229540 | 0,00152010 | 0,51003697 |
| 65,67 | 22 | 8110876,000 | 0,00811088 | 0,05331712 | 0,05174850 | 0,05213735 | 0,00499322 | 0,62437728 | 0,00270363 | 0,00166441 | 0,62437728 |
| 72,01 | 23 | 6391938,500 | 0,00639194 | 0,05970905 | 0,05715370 | 0,05759882 | 0,00546148 | 0,17036850 | 0,00213065 | 0,00182049 | 0,17036850 |
| 78,60 | 24 | 6960986,000 | 0,00696099 | 0,06667004 | 0,06305820 | 0,06356622 | 0,00596740 | 0,16650309 | 0,00232033 | 0,00198913 | 0,16650309 |
| 85,45 | 25 | 8292250,500 | 0,00829225 | 0,07496229 | 0,06950160 | 0,07007965 | 0,00651344 | 0,27309881 | 0,00276408 | 0,00217115 | 0,27309881 |
| 92,55 | 26 | 8650993,000 | 0,00865099 | 0,08361328 | 0,07652590 | 0,07718182 | 0,00710217 | 0,21807770 | 0,00288366 | 0,00236739 | 0,21807770 |
| 99,89 | 27 | 11204252,000 | 0,01120425 | 0,09481754 | 0,08417570 | 0,08491809 | 0,00773627 | 0,44827609 | 0,00373475 | 0,00257876 | 0,44827609 |
| 107,49 | 28 | 9591913,000 | 0,00959191 | 0,10440945 | 0,09249840 | 0,09333663 | 0,00841853 | 0,13938032 | 0,00319730 | 0,00280618 | 0,13938032 |
| 115,33 | 29 | 13013543,000 | 0,01301354 | 0,11742299 | 0,10154430 | 0,10248851 | 0,00915188 | 0,42195223 | 0,00433785 | 0,00305063 | 0,42195223 |
| 123,42 | 30 | 9977361,000 | 0,00997736 | 0,12740035 | 0,11136670 | 0,11242786 | 0,00993935 | 0,00382404 | 0,00332579 | 0,00331312 | 0,00382404 |
| 131,74 | 31 | 10998398,000 | 0,01099840 | 0,13839875 | 0,12202180 | 0,12321196 | 0,01078409 | 0,01987235 | 0,00366613 | 0,00359470 | 0,01987235 |
| 140,31 | 32 | 5831347,500 | 0,00583135 | 0,14423010 | 0,13356930 | 0,13490134 | 0,01168938 | -0,50114147 | 0,00194378 | 0,00389646 | -0,50114147 |
| 149,12 | 33 | 9339325,000 | 0,00933933 | 0,15356942 | 0,14607210 | 0,14755995 | 0,01265861 | -0,26221584 | 0,00311311 | 0,00421954 | -0,26221584 |
| 158,16 | 34 | 4106623,500 | 0,00410662 | 0,15767605 | 0,15959640 | 0,16125526 | 0,01369531 | -0,70014381 | 0,00136887 | 0,00456510 | -0,70014381 |
| 167,44 | 35 | 17674304,000 | 0,01767430 | 0,17535035 | 0,17421230 | 0,17605837 | 0,01480311 | 0,19395904 | 0,00589143 | 0,00493437 | 0,19395904 |
| 176,95 | 36 | 9958445,000 | 0,00995845 | 0,18530880 | 0,18999340 | 0,19204414 | 0,01598577 | -0,37704303 | 0,00331948 | 0,00532859 | -0,37704303 |
| 186,69 | 37 | 16284510,000 | 0,01628451 | 0,20159331 | 0,20701710 | 0,20929130 | 0,01724717 | -0,05581545 | 0,00542817 | 0,00574906 | -0,05581545 |
| 196,66 | 38 | 13842523,000 | 0,01384252 | 0,21543583 | 0,22536470 | 0,22788261 | 0,01859131 | -0,25543048 | 0,00461417 | 0,00619710 | -0,25543048 |
| 206,86 | 39 | 15014891,000 | 0,01501489 | 0,23045072 | 0,24512170 | 0,24790492 | 0,02002231 | -0,25009196 | 0,00500496 | 0,00667410 | -0,25009196 |
| 217,29 | 40 | 25508556,000 | 0,02550856 | 0,25595928 | 0,26637770 | 0,26944932 | 0,02154440 | 0,18399948 | 0,00850285 | 0,00718147 | 0,18399948 |
| 227,95 | 41 | 8921385,000 | 0,00892139 | 0,26488066 | 0,28922640 | 0,29261124 | 0,02316192 | -0,61482535 | 0,00297380 | 0,00772064 | -0,61482535 |
| 238,83 | 42 | 33012108,000 | 0,03301211 | 0,29789277 | 0,31376610 | 0,31749058 | 0,02487934 | 0,32688854 | 0,01100404 | 0,00829311 | 0,32688854 |
| 249,94 | 43 | 30667150,000 | 0,03066715 | 0,32855992 | 0,34009950 | 0,34419179 | 0,02670121 | 0,14853028 | 0,01022238 | 0,00890040 | 0,14853028 |
| 261,27 | 44 | 45799768,000 | 0,04579977 | 0,37435969 | 0,36833390 | 0,37282401 | 0,02863221 | 0,59958875 | 0,01526659 | 0,00954407 | 0,59958875 |
| 272,82 | 45 | 45127904,000 | 0,04512790 | 0,41948759 | 0,39858130 | 0,40350113 | 0,03067712 | 0,47106072 | 0,01504263 | 0,01022571 | 0,47106072 |
| 284,59 | 46 | 32017108,000 | 0,03201711 | 0,45150470 | 0,43095840 | 0,43634192 | 0,03284079 | -0,02508120 | 0,01067237 | 0,01094693 | -0,02508120 |
| 296,58 | 47 | 46040340,000 | 0,04604034 | 0,49754504 | 0,46558690 | 0,47147013 | 0,03512821 | 0,31063737 | 0,01534678 | 0,01170940 | 0,31063737 |
| 308,79 | 48 | 27694616,000 | 0,02769462 | 0,52523965 | 0,50259340 | 0,50901453 | 0,03754441 | -0,26235043 | 0,00923154 | 0,01251480 | -0,26235043 |
| 321,22 | 49 | 21046084,000 | 0,02104608 | 0,54628574 | 0,54210960 | 0,54910907 | 0,04009453 | -0,47508845 | 0,00701536 | 0,01336484 | -0,47508845 |
| 333,87 | 50 | 40091264,000 | 0,04009126 | 0,58637700 | 0,58427230 | 0,59189287 | 0,04278380 | -0,06293359 | 0,01336375 | 0,01426127 | -0,06293359 |
| 346,73 | 51 | 33851324,000 | 0,03385132 | 0,62022833 | 0,62922350 | 0,63751037 | 0,04561750 | -0,25793121 | 0,01128377 | 0,01520583 | -0,25793121 |
| 359,80 | 52 | 37962176,000 | 0,03796218 | 0,65819050 | 0,67711040 | 0,68611136 | 0,04860099 | -0,21890111 | 0,01265406 | 0,01620033 | -0,21890111 |
| 373,09 | 53 | 30876120,000 | 0,03087612 | 0,68906662 | 0,72808570 | 0,73785103 | 0,05173967 | -0,40324090 | 0,01029204 | 0,01724656 | -0,40324090 |
| 386,60 | 54 | 75296552,000 | 0,07529655 | 0,76436317 | 0,78230740 | 0,79289006 | 0,05503903 | 0,36805739 | 0,02509885 | 0,01834634 | 0,36805739 |
| 400,31 | 55 | 76450448,000 | 0,07645045 | 0,84081362 | 0,83993880 | 0,85139464 | 0,05850458 | 0,30674302 | 0,02548348 | 0,01950153 | 0,30674302 |
| 414,24 | 56 | 48333664,000 | 0,04833366 | 0,88914729 | 0,90114890 | 0,91353651 | 0,06214187 | -0,22220454 | 0,01611122 | 0,02071396 | -0,22220454 |
| 428,38 | 57 | 100243848,000 | 0,10024385 | 0,98939113 | 0,96611210 | 0,97949300 | 0,06595650 | 0,51984801 | 0,03341462 | 0,02198550 | 0,51984801 |
| 442,72 | 58 | 78815216,000 | 0,07881522 | 1,06820635 | 1,03500820 | 1,04944707 | 0,06995407 | 0,12667097 | 0,02627174 | 0,02331802 | 0,12667097 |
| 457,28 | 59 | 24453470,000 | 0,02445347 | 1,09265982 | 1,10802280 | 1,12358728 | 0,07414021 | -0,67017265 | 0,00815116 | 0,02471340 | -0,67017265 |

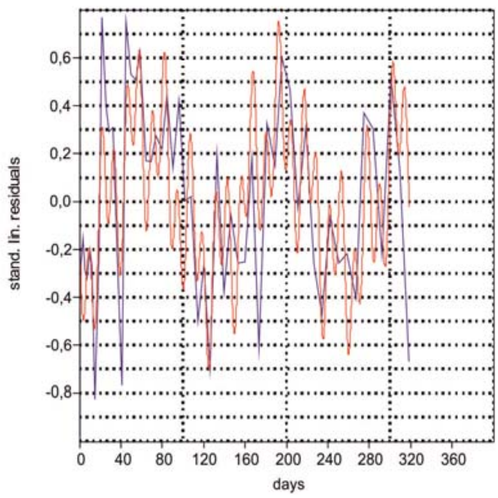



Tab.A9 showing raw data and the consensus of the cumulative sum, and the Gompertz function of D1-68.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0,0000 | 0,00000 | #DIV/0! | 3,1123 | 4,5960 | 5,8888 | 7,1157 | 9,8174 | 7,6935 |
| 0,0016 | 0,01449 | 637,14558777 | 3,1081 | 4,5898 | 5,8808 | 7,1060 | 9,8040 | 7,6830 |
| 0,0031 | 0,30552 | 318,58294307 | 3,0955 | 4,5711 | 5,8569 | 7,0771 | 9,7642 | 7,6518 |
| 0,0047 | 1,49780 | 212,38637329 | 3,0747 | 4,5405 | 5,8177 | 7,0297 | 9,6987 | 7,6005 |
| 0,0063 | 3,67120 | 159,28893420 | 3,0462 | 4,4984 | 5,7637 | 6,9645 | 9,6087 | 7,5300 |
| **0,0078** | **5,53360** | **127,43236527** | 3,0105 | 4,4456 | 5,6961 | 6,8828 | 9,4960 | 7,4416 |
| 0,0094 | 5,13790 | 106,19318665 | 2,9681 | 4,3831 | 5,6160 | 6,7860 | 9,3625 | 7,3370 |
| 0,0110 | 3,14400 | 91,02494083 | 2,9199 | 4,3119 | 5,5248 | 6,6758 | 9,2104 | 7,2178 |
| 0,0126 | 1,50710 | 79,64319847 | 2,8666 | 4,2332 | 5,4239 | 6,5539 | 9,0423 | 7,0861 |
| 0,0141 | 0,98192 | 70,79646018 | 2,8090 | 4,1481 | 5,3149 | 6,4222 | 8,8605 | 6,9437 |
| 0,0157 | 0,71309 | 63,71455878 | 2,7479 | 4,0579 | 5,1993 | 6,2825 | 8,6678 | 6,7926 |
| 0,0173 | 0,43358 | 57,92400371 | 2,6841 | 3,9636 | 5,0785 | 6,1365 | 8,4665 | 6,6348 |
| 0,0188 | 0,65245 | 53,09546565 | 2,6183 | 3,8665 | 4,9540 | 5,9861 | 8,2589 | 6,4722 |
| 0,0204 | 1,60760 | 49,01240014 | 2,5512 | 3,7674 | 4,8271 | 5,8328 | 8,0474 | 6,3064 |
| 0,0220 | 2,23170 | 45,51247042 | 2,4835 | 3,6674 | 4,6991 | 5,6780 | 7,8339 | 6,1391 |
| 0,0235 | 1,78690 | 42,47727466 | 2,4158 | 3,5674 | 4,5708 | 5,5231 | 7,6201 | 5,9716 |
| 0,0251 | 1,04860 | 39,82318506 | 2,3484 | 3,4679 | 4,4434 | 5,3692 | 7,4077 | 5,8051 |
| 0,0267 | 1,34430 | 37,47985458 | 2,2820 | 3,3698 | 4,3177 | 5,2172 | 7,1981 | 5,6408 |
| 0,0283 | 2,20340 | 35,39823009 | 2,2167 | 3,2735 | 4,1942 | 5,0680 | 6,9923 | 5,4796 |
| 0,0298 | 2,38680 | 33,53454058 | 2,1530 | 3,1794 | 4,0737 | 4,9224 | 6,7913 | 5,3221 |
| 0,0314 | 1,97500 | 31,85829431 | 2,0911 | 3,0879 | 3,9565 | 4,7808 | 6,5959 | 5,1690 |
| 0,0330 | 2,35670 | 30,34072636 | 2,0311 | 2,9993 | 3,8430 | 4,6436 | 6,4067 | 5,0207 |
| **0,0345** | **3,35740** | **28,96200185** | 1,9732 | 2,9139 | 3,7335 | 4,5113 | 6,2242 | 4,8777 |
| 0,0361 | 3,27180 | 27,70236578 | 1,9176 | 2,8317 | 3,6282 | 4,3841 | 6,0486 | 4,7401 |
| 0,0377 | 1,86770 | 26,54843762 | 1,8642 | 2,7529 | 3,5272 | 4,2620 | 5,8803 | 4,6081 |
| 0,0392 | 0,82783 | 25,48614828 | 1,8131 | 2,6775 | 3,4306 | 4,1453 | 5,7192 | 4,4819 |
| 0,0408 | 0,85236 | 24,50620007 | 1,7644 | 2,6055 | 3,3384 | 4,0339 | 5,5655 | 4,3615 |
| 0,0424 | 1,07870 | 23,59826317 | 1,7180 | 2,5370 | 3,2506 | 3,9278 | 5,4191 | 4,2468 |
| 0,0439 | 1,09940 | 22,75571737 | 1,6739 | 2,4719 | 3,1672 | 3,8270 | 5,2801 | 4,1378 |
| 0,04551 | 1,26130 | 21,97126159 | 1,63210 | 2,41010 | 3,08810 | 3,73140 | 5,14820 | 4,03440 |
| 0,04708 | 1,44190 | 21,23863733 | 1,59250 | 2,35170 | 3,01320 | 3,64090 | 5,02330 | 3,93660 |
| 0,04865 | 1,41240 | 20,55371714 | 1,55510 | 2,29640 | 2,94240 | 3,55540 | 4,90530 | 3,84410 |
| 0,05022 | 1,41750 | 19,91119607 | 1,51980 | 2,24430 | 2,87560 | 3,47470 | 4,79400 | 3,75680 |
| 0,05179 | 1,50370 | 19,30800124 | 1,48660 | 2,19520 | 2,81270 | 3,39870 | 4,68910 | 3,67470 |
| 0,05336 | 1,32990 | 18,73992729 | 1,45530 | 2,14910 | 2,75360 | 3,32730 | 4,59060 | 3,59750 |
| 0,05493 | 0,84440 | 18,20465675 | 1,42600 | 2,10580 | 2,69820 | 3,26030 | 4,49820 | 3,52500 |
| 0,05650 | 1,00790 | 17,69880179 | 1,39860 | 2,06530 | 2,64630 | 3,19760 | 4,41160 | 3,45720 |
| 0,05807 | 1,79920 | 17,22059583 | 1,37300 | 2,02750 | 2,59780 | 3,13900 | 4,33080 | 3,39380 |
| **0,05964** | **2,10110** | **16,76727029** | 1,34910 | 1,99220 | 2,55260 | 3,08430 | 4,25540 | 3,33480 |
| 0,06121 | 1,61910 | 16,33746671 | 1,32690 | 1,95940 | 2,51050 | 3,03360 | 4,18540 | 3,27990 |
| 0,06278 | 0,64058 | 15,92889342 | 1,30630 | 1,92900 | 2,47160 | 2,98650 | 4,12050 | 3,22910 |
| 0,06435 | 1,08760 | 15,54049854 | 1,28730 | 1,90100 | 2,43570 | 2,94310 | 4,06060 | 3,18210 |
| 0,06592 | 2,32270 | 15,17059332 | 1,26980 | 1,87520 | 2,40260 | 2,90320 | 4,00550 | 3,13890 |
| **0,06749** | **2,55340** | **14,81766859** | 1,25380 | 1,85160 | 2,37240 | 2,86660 | 3,95510 | 3,09940 |
| 0,06906 | 1,50650 | 14,48100093 | 1,23930 | 1,83010 | 2,34490 | 2,83340 | 3,90920 | 3,06350 |
| 0,07063 | 0,82548 | 14,15909155 | 1,22620 | 1,81070 | 2,32000 | 2,80330 | 3,86770 | 3,03100 |
| 0,07220 | 1,50740 | 13,85137475 | 1,21440 | 1,79330 | 2,29770 | 2,77640 | 3,83050 | 3,00180 |
| 0,07377 | 1,72190 | 13,55656477 | 1,20390 | 1,77780 | 2,27790 | 2,75250 | 3,79750 | 2,97600 |
| 0,07533 | 1,55480 | 13,27421881 | 1,19470 | 1,76430 | 2,26060 | 2,73150 | 3,76860 | 2,95330 |
| 0,07690 | 2,64400 | 13,00322480 | 1,18690 | 1,75260 | 2,24560 | 2,71350 | 3,74370 | 2,93380 |
| 0,07847 | 3,58770 | 12,74323653 | 1,18020 | 1,74280 | 2,23310 | 2,69830 | 3,72280 | 2,91740 |
| 0,08004 | 4,47840 | 12,49328486 | 1,17480 | 1,73490 | 2,22290 | 2,68600 | 3,70580 | 2,90410 |
| **0,08161** | **5,17530** | **12,25310003** | 1,17060 | 1,72870 | 2,21490 | 2,67640 | 3,69260 | 2,89370 |
| 0,08318 | 4,64540 | 12,02183165 | 1,16760 | 1,72430 | 2,20930 | 2,66960 | 3,68310 | 2,88630 |
| 0,08475 | 2,92710 | 11,79927081 | 1,16590 | 1,72160 | 2,20590 | 2,66550 | 3,67750 | 2,88190 |
| 0,08632 | 1,07490 | 11,58466654 | 1,16530 | 1,72080 | 2,20480 | 2,66410 | 3,67560 | 2,88050 |
| 0,06123 | 3,13920 | 16,33133002 | 16,33133 | 1,66340 | 2,45640 | 3,14730 | 3,80300 | 5,24700 |




| Amp | Phas | Period | p | R² |
|---|---|---|---|---|
| **0,289** | **3,020** | **192,60** | 0,00000009 | 0,54922 |
| **0,243** | **-1,600** | **12,22** | | |
| **0,213** | **-0,822** | **28,16** | | |




Tab.A10 showing the data of the lomb periodogram and the sinusoidal function of D1-68.

**Log File D1-68**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 12)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\v15-16\original
Filename Prefix=venosus v15-16
Number of Files= 1846
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.06
Object to Source (mm)=44.313
Camera to Source (mm)=364.000
Vertical Object Position (mm)=44.205
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.130
Frame Averaging=ON (2)
Random Movement=ON (20)
Use 360 Rotation=NO
FF updating interval=386
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Mar 22, 2013 12:29:03
Scan duration=01:34:24
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=venosus v15-16
Dataset Directory=C:\Users\Public\Briguglio\v15-16\original
Output Directory=C:\Users\Public\Briguglio\v15-16\original\venosus v15-16_Rec
Time and Date=Mar 22, 2013 13:34:40
First Section=667
Last Section=2119
Reconstruction duration per slice (seconds)=0.446662
Total reconstruction time (1453 slices) in seconds=649.000000
Postalignment=10.50
Section to Section Step=1
Sections Count=1453
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1684
Result Image Height (pixels)=1500
Pixel Size (um)=6.05771
Reconstruction Angular Range (deg)=239.98
Use 180+=OFF
Angular Step (deg)=0.1300
Smoothing=0
Ring Artifact Correction=13
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=2003
ROI Bottom (pixels)=503
ROI Left (pixels)=489
ROI Right (pixels)=2173
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=35
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0047
Maximum for CS to Image Conversion=0.0339
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.409575
Cone-beam Angle Vert.(deg)=17.409575
[File name convention]
Filename Index Length=4
Filename Prefix=venosus v15-16_IR_rec_Sag_depressa 1_68
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.3)
Conversion time=Apr 17, 2013  12:26:26
Original configuration file=venosus v15-16_IR_rec_Sag_depressa 1_68.log
Conversion description=...
Image scale modified=0
HU calibration modified=0

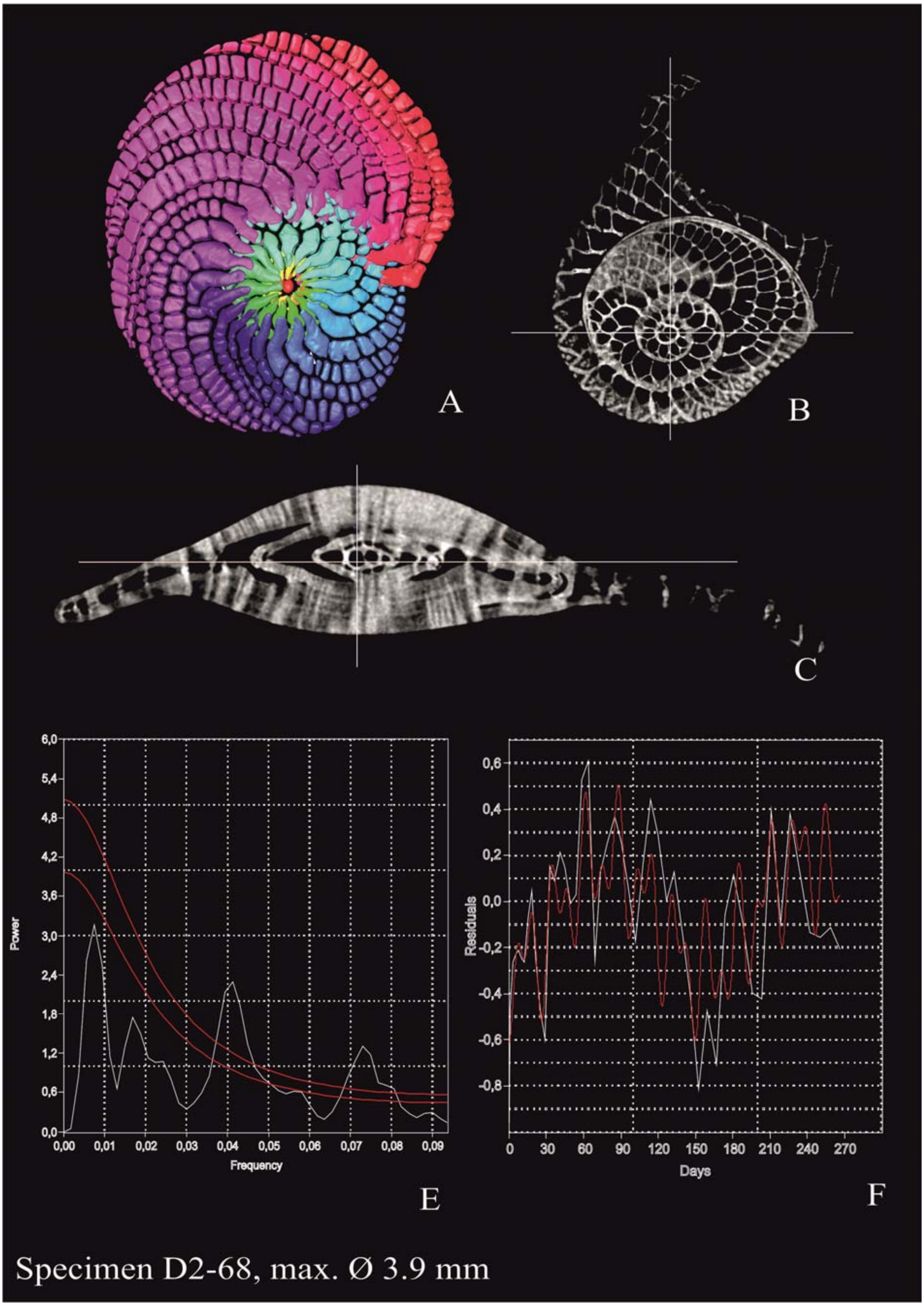
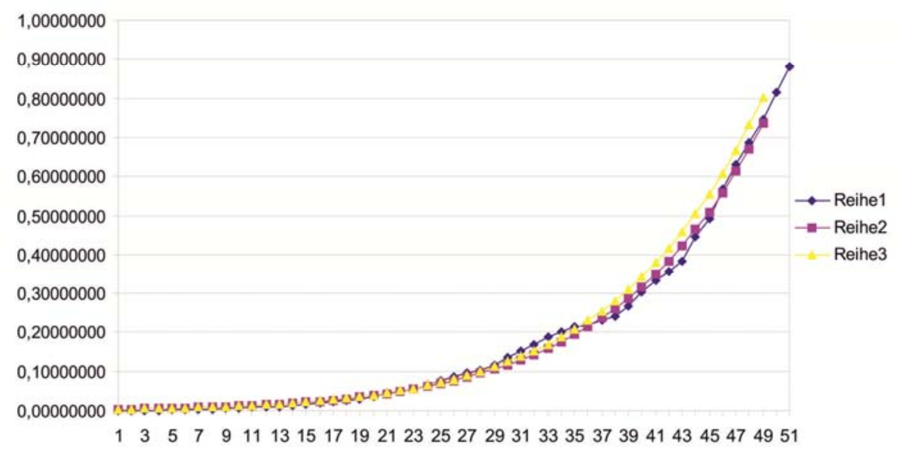


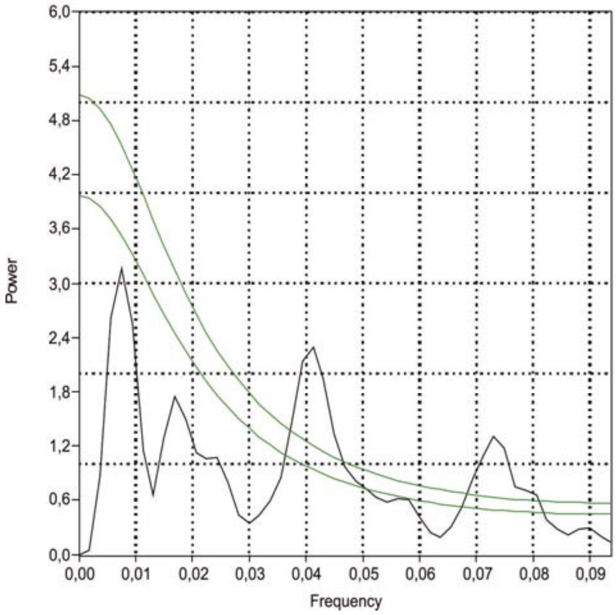

Fig.A6 Specimen D2-68, gamont from Kekaa Point, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

| day | chamber | Volume | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 160287,48 | 0,00016029 | 0,00016029 | 0,00386430 | 0,00389407 | 0,00389407 | -0,95883806 | 0,00005343 | 0,00129802 | -0,95883806 |
| 0,33 | 4 | 295344,53 | 0,00029534 | 0,00045563 | 0,00440380 | 0,00444855 | 0,00055448 | -0,46735242 | 0,00009845 | 0,00018483 | -0,46735242 |
| 1,15 | 5 | 376972,41 | 0,00037697 | 0,00083260 | 0,00501360 | 0,00507660 | 0,00062805 | -0,39977338 | 0,00012566 | 0,00020935 | -0,39977338 |
| 2,39 | 6 | 524088,09 | 0,00052409 | 0,00135669 | 0,00570200 | 0,00578723 | 0,00071063 | -0,26249763 | 0,00017470 | 0,00023688 | -0,26249763 |
| 4,00 | 7 | 619815,38 | 0,00061982 | 0,00197651 | 0,00647850 | 0,00659045 | 0,00080322 | -0,22833286 | 0,00020661 | 0,00026774 | -0,22833286 |
| 5,98 | 8 | 715171,56 | 0,00071517 | 0,00269168 | 0,00735330 | 0,00749737 | 0,00090693 | -0,21143424 | 0,00023839 | 0,00030231 | -0,21143424 |
| 8,29 | 9 | 769713,81 | 0,00076971 | 0,00346139 | 0,00833800 | 0,00852035 | 0,00102297 | -0,24757216 | 0,00025657 | 0,00034099 | -0,24757216 |
| 10,94 | 10 | 846703,75 | 0,00084670 | 0,00430810 | 0,00944520 | 0,00967304 | 0,00115269 | -0,26545354 | 0,00028223 | 0,00038423 | -0,26545354 |
| 13,90 | 11 | 1200672,00 | 0,00120067 | 0,00550877 | 0,01068910 | 0,01097057 | 0,00129754 | -0,07465186 | 0,00040022 | 0,00043251 | -0,07465186 |
| 17,17 | 12 | 1526812,38 | 0,00152681 | 0,00703558 | 0,01208500 | 0,01242968 | 0,00145911 | 0,04639750 | 0,00050894 | 0,00048637 | 0,04639750 |
| 20,75 | 13 | 1245567,25 | 0,00124557 | 0,00828115 | 0,01365020 | 0,01406886 | 0,00163917 | -0,24012487 | 0,00041519 | 0,00054639 | -0,24012487 |
| 24,62 | 14 | 977864,94 | 0,00097786 | 0,00925901 | 0,01540340 | 0,01590849 | 0,00183963 | -0,46844492 | 0,00032595 | 0,00061321 | -0,46844492 |
| 28,78 | 15 | 825740,25 | 0,00082574 | 0,01008475 | 0,01736540 | 0,01797106 | 0,00206257 | -0,59965528 | 0,00027525 | 0,00068752 | -0,59965528 |
| 33,23 | 16 | 2664779,25 | 0,00266478 | 0,01274953 | 0,01955890 | 0,02028134 | 0,00231028 | 0,15344431 | 0,00088826 | 0,00077009 | 0,15344431 |
| 37,96 | 17 | 2820428,75 | 0,00282043 | 0,01556996 | 0,02200900 | 0,02286657 | 0,00258523 | 0,09097648 | 0,00094014 | 0,00086174 | 0,09097648 |
| 42,96 | 18 | 3508329,25 | 0,00350833 | 0,01907829 | 0,02474320 | 0,02575671 | 0,00289013 | 0,21389810 | 0,00116944 | 0,00096338 | 0,21389810 |
| 48,24 | 19 | 3713141,00 | 0,00371314 | 0,02279143 | 0,02779160 | 0,02898463 | 0,00322792 | 0,15031933 | 0,00123771 | 0,00107597 | 0,15031933 |
| 53,79 | 20 | 3566767,50 | 0,00356677 | 0,02635820 | 0,03118730 | 0,03258642 | 0,00360178 | -0,00972224 | 0,00118892 | 0,00120059 | -0,00972224 |
| 59,60 | 21 | 4137606,00 | 0,00413761 | 0,03049581 | 0,03496630 | 0,03660160 | 0,00401519 | 0,03048932 | 0,00137920 | 0,00133840 | 0,03048932 |
| 65,67 | 22 | 6839118,00 | 0,00683912 | 0,03733492 | 0,03916810 | 0,04107348 | 0,00447188 | 0,52936183 | 0,00227971 | 0,00149063 | 0,52936183 |
| 72,01 | 23 | 8004727,00 | 0,00800473 | 0,04533965 | 0,04383600 | 0,04604940 | 0,00497592 | 0,60869198 | 0,00266824 | 0,00165864 | 0,60869198 |
| 78,60 | 24 | 4110891,50 | 0,00411089 | 0,04945054 | 0,04901690 | 0,05158112 | 0,00553172 | -0,25685108 | 0,00137030 | 0,00184391 | -0,25685108 |
| 85,45 | 25 | 6960075,50 | 0,00696008 | 0,05641062 | 0,05476240 | 0,05772514 | 0,00614402 | 0,13282111 | 0,00232003 | 0,00204801 | 0,13282111 |
| 92,55 | 26 | 8536978,00 | 0,00853698 | 0,06494760 | 0,06112830 | 0,06454310 | 0,00681796 | 0,25213176 | 0,00284566 | 0,00227265 | 0,25213176 |
| 99,89 | 27 | 10346520,00 | 0,01034652 | 0,07529412 | 0,06817560 | 0,07210216 | 0,00755906 | 0,36875739 | 0,00344884 | 0,00251969 | 0,36875739 |
| 107,49 | 28 | 10523689,00 | 0,01052369 | 0,08581780 | 0,07597040 | 0,08047546 | 0,00837330 | 0,25681462 | 0,00350790 | 0,00279110 | 0,25681462 |
| 115,33 | 29 | 9659176,00 | 0,00965918 | 0,09547698 | 0,08458490 | 0,08974256 | 0,00926710 | 0,04230786 | 0,00321973 | 0,00308903 | 0,04230786 |
| 123,42 | 30 | 8464811,00 | 0,00846481 | 0,10394179 | 0,09409710 | 0,09998994 | 0,01024738 | -0,17395341 | 0,00282160 | 0,00341579 | -0,17395341 |
| 131,74 | 31 | 13154704,00 | 0,01315470 | 0,11709650 | 0,10459180 | 0,11131149 | 0,01132155 | 0,16191755 | 0,00438490 | 0,00377385 | 0,16191755 |
| 140,31 | 32 | 18027704,00 | 0,01802770 | 0,13512420 | 0,11616100 | 0,12380908 | 0,01249759 | 0,44249470 | 0,00600923 | 0,00416586 | 0,44249470 |
| 149,12 | 33 | 17731616,00 | 0,01773162 | 0,15285582 | 0,12890400 | 0,13759313 | 0,01378405 | 0,28638614 | 0,00591054 | 0,00459468 | 0,28638614 |
| 158,16 | 34 | 15249944,00 | 0,01524994 | 0,16810576 | 0,14292860 | 0,15278324 | 0,01519011 | 0,00393875 | 0,00508331 | 0,00506337 | 0,00393875 |
| 167,44 | 35 | 18872366,00 | 0,01887237 | 0,18697813 | 0,15835110 | 0,16950883 | 0,01672558 | 0,12835313 | 0,00629079 | 0,00557519 | 0,12835313 |
| 176,95 | 36 | 15725240,00 | 0,01572524 | 0,20270337 | 0,17529720 | 0,18790980 | 0,01840097 | -0,14541242 | 0,00524175 | 0,00613366 | -0,14541242 |
| 186,69 | 37 | 12084080,00 | 0,01208408 | 0,21478745 | 0,19390260 | 0,20813729 | 0,02022749 | -0,40259136 | 0,00402803 | 0,00674250 | -0,40259136 |
| 196,66 | 38 | 4172483,50 | 0,00417248 | 0,21895993 | 0,21431370 | 0,23035444 | 0,02221715 | -0,81219536 | 0,00139083 | 0,00740572 | -0,81219536 |
| 206,86 | 39 | 12787379,00 | 0,01278738 | 0,23174731 | 0,23668790 | 0,25473716 | 0,02438272 | -0,47555575 | 0,00426246 | 0,00812757 | -0,47555575 |
| 217,29 | 40 | 7842770,00 | 0,00784277 | 0,23959008 | 0,26119520 | 0,28147502 | 0,02673786 | -0,70667918 | 0,00261426 | 0,00891262 | -0,70667918 |
| 227,95 | 41 | 27670554,00 | 0,02767055 | 0,26726063 | 0,28801800 | 0,31077209 | 0,02929707 | -0,05551810 | 0,00922352 | 0,00976569 | -0,05551810 |
| 238,83 | 42 | 35792528,00 | 0,03579253 | 0,30305316 | 0,31735260 | 0,34284792 | 0,03207583 | 0,11587230 | 0,01193084 | 0,01069194 | 0,11587230 |
| 249,94 | 43 | 31705196,00 | 0,03170520 | 0,33475836 | 0,34940980 | 0,37793848 | 0,03509056 | -0,09647506 | 0,01056840 | 0,01169685 | -0,09647506 |
| 261,27 | 44 | 23078614,00 | 0,02307861 | 0,35783697 | 0,38441600 | 0,41629721 | 0,03835873 | -0,39834779 | 0,00769287 | 0,01278624 | -0,39834779 |
| 272,82 | 45 | 24239586,00 | 0,02423959 | 0,38207656 | 0,42261360 | 0,45819608 | 0,04189887 | -0,42147397 | 0,00807986 | 0,01396629 | -0,42147397 |
| 284,59 | 46 | 63843948,00 | 0,06384395 | 0,44592050 | 0,46426270 | 0,50392671 | 0,04573064 | 0,39608705 | 0,02128132 | 0,01524355 | 0,39608705 |
| 296,58 | 47 | 45031692,00 | 0,04503169 | 0,49095220 | 0,50964160 | 0,55380157 | 0,04987486 | -0,09710640 | 0,01501056 | 0,01662495 | -0,09710640 |
| 308,79 | 48 | 75177792,00 | 0,07517779 | 0,56612999 | 0,55904830 | 0,60815517 | 0,05435360 | 0,38312451 | 0,02505926 | 0,01811787 | 0,38312451 |
| 321,22 | 49 | 65622880,00 | 0,06562288 | 0,63175287 | 0,61280110 | 0,66734535 | 0,05919018 | 0,10867855 | 0,02187429 | 0,01973006 | 0,10867855 |
| 333,87 | 50 | 55790804,00 | 0,05579080 | 0,68754367 | 0,67124020 | 0,73175461 | 0,06440926 | -0,13380778 | 0,01859693 | 0,02146975 | -0,13380778 |
| 346,73 | 51 | 59136804,00 | 0,05913680 | 0,74668048 | 0,73472880 | 0,80179152 | 0,07003691 | -0,15563370 | 0,01971227 | 0,02334564 | -0,15563370 |
| 359,80 | 52 | 67325568,00 | 0,06732557 | 0,81400604 | 0,80365430 | 0,87789211 | 0,07610059 | -0,11530824 | 0,02244186 | 0,02536686 | -0,11530824 |
| 373,09 | 53 | 65615644,00 | 0,06561564 | 0,87962169 | 0,87842950 | 0,96052142 | 0,08262931 | -0,20590352 | 0,02187188 | 0,02754310 | -0,20590352 |

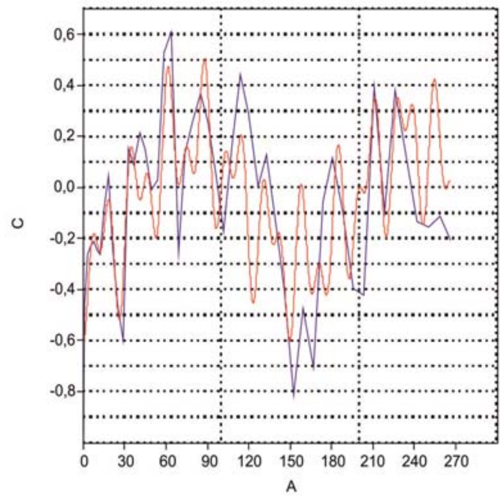



Tab.A11 showing raw data and the consensus of the cumulative sum, and the Gompertz function of D2-68.

| Freq | Power | Periode | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 6,42E-31 | #DIV/0! | 2,68880000 | 3,9705 | 5,0874 | 6,1472 | 8,4812 | 6,48 |
| 0,0018735 | 0,042235 | 533,7603416 | 2,66780000 | 3,9396 | 5,0478 | 6,0994 | 8,4153 | 6,4296 |
| 0,003747 | 0,86495 | 266,8801708 | 2,60710000 | 3,8499 | 4,9328 | 5,9605 | 8,2236 | 6,2831 |
| 0,0056205 | 2,6199 | 177,9201139 | 2,51190000 | 3,7094 | 4,7528 | 5,743 | 7,9235 | 6,0539 |
| **0,007494** | **3,1596** | **133,4400854** | 2,39030000 | 3,5298 | 4,5227 | 5,465 | 7,5399 | 5,7608 |
| 0,0093675 | 2,5577 | 106,7520683 | 2,25100000 | 3,324 | 4,259 | 5,1463 | 7,1002 | 5,4249 |
| 0,011241 | 1,1493 | 88,96005693 | 2,10210000 | 3,1042 | 3,9774 | 4,806 | 6,6308 | 5,0662 |
| 0,013115 | 0,66393 | 76,24857034 | 1,95090000 | 2,8809 | 3,6913 | 4,4603 | 6,1538 | 4,7018 |
| 0,014988 | 1,2908 | 66,7200427 | 1,80270000 | 2,662 | 3,4108 | 4,1214 | 5,6862 | 4,3445 |
| 0,016862 | 1,7448 | 59,30494603 | 1,66110000 | 2,453 | 3,143 | 3,7978 | 5,2397 | 4,0034 |
| 0,018735 | 1,5041 | 53,37603416 | 1,52860000 | 2,2573 | 2,8923 | 3,4948 | 4,8217 | 3,684 |
| 0,020609 | 1,1266 | 48,52249017 | 1,40630000 | 2,0767 | 2,6608 | 3,2151 | 4,4359 | 3,3892 |
| 0,022482 | 1,06 | 44,48002847 | 1,29450000 | 1,9116 | 2,4493 | 2,9596 | 4,0833 | 3,1198 |
| 0,024356 | 1,0743 | 41,05764493 | 1,19310000 | 1,7619 | 2,2574 | 2,7277 | 3,7634 | 2,8754 |
| 0,026229 | 0,80197 | 38,12573869 | 1,10160000 | 1,6267 | 2,0843 | 2,5185 | 3,4747 | 2,6548 |
| 0,028103 | 0,4384 | 35,58338967 | 1,01920000 | 1,5051 | 1,9284 | 2,3302 | 3,2149 | 2,4563 |
| 0,029976 | 0,34721 | 33,36002135 | 0,94521000 | 1,3958 | 1,7884 | 2,161 | 2,9815 | 2,278 |
| 0,03185 | 0,44126 | 31,39717425 | 0,87883000 | 1,2978 | 1,6628 | 2,0092 | 2,7721 | 2,118 |
| 0,033723 | 0,58683 | 29,65335231 | 0,81926000 | 1,2098 | 1,5501 | 1,8731 | 2,5842 | 1,9745 |
| 0,035597 | 0,85088 | 28,09225497 | 0,76580000 | 1,1309 | 1,449 | 1,7508 | 2,4156 | 1,8456 |
| 0,03747 | 1,4669 | 26,68801708 | 0,71778000 | 1,06 | 1,3581 | 1,641 | 2,2641 | 1,7299 |
| 0,039344 | 2,1359 | 25,41683611 | 0,67461000 | 0,9962 | 1,2764 | 1,5423 | 2,1279 | 1,6258 |
| **0,041217** | **2,2938** | 24,26183371 | 0,63574000 | 0,93881 | 1,2029 | 1,4535 | 2,0053 | 1,5322 |
| 0,043091 | 1,946 | 23,2067021 | 0,60072000 | 0,88709 | 1,1366 | 1,3734 | 1,8949 | 1,4478 |
| 0,044964 | 1,3295 | 22,24001423 | 0,56912000 | 0,84042 | 1,0768 | 1,3012 | 1,7952 | 1,3716 |
| 0,046838 | 0,96237 | 21,35018575 | 0,54057000 | 0,79826 | 1,0228 | 1,2359 | 1,7051 | 1,3028 |
| 0,048711 | 0,819 | 20,52924391 | 0,51474000 | 0,76013 | 0,97394 | 1,1768 | 1,6237 | 1,2406 |
| 0,050585 | 0,72248 | 19,76870614 | 0,49136000 | 0,7256 | 0,9297 | 1,1234 | 1,5499 | 1,1842 |
| 0,052458 | 0,63636 | 19,06286934 | 0,47018000 | 0,69432 | 0,88962 | 1,075 | 1,4831 | 1,1331 |
| 0,054332 | 0,57523 | 18,40535964 | 0,45096000 | 0,66594 | 0,85326 | 1,031 | 1,4225 | 1,0868 |
| 0,056205 | 0,62297 | 17,79201139 | 0,43353000 | 0,6402 | 0,82028 | 0,99117 | 1,3675 | 1,0448 |
| 0,058079 | 0,60019 | 17,21792731 | 0,41771000 | 0,61684 | 0,79035 | 0,955 | 1,3176 | 1,0067 |
| 0,059952 | 0,41174 | 16,68001068 | 0,40335000 | 0,59564 | 0,76318 | 0,92218 | 1,2723 | 0,9721 |
| 0,061826 | 0,24047 | 16,174425 | 0,39033000 | 0,5764 | 0,73854 | 0,8924 | 1,2312 | 0,94071 |
| 0,063699 | 0,19527 | 15,69883358 | 0,37852000 | 0,55897 | 0,7162 | 0,8654 | 1,194 | 0,91225 |
| 0,065573 | 0,30104 | 15,25017919 | 0,36783000 | 0,54318 | 0,69597 | 0,84096 | 1,1603 | 0,88648 |
| 0,067446 | 0,52187 | 14,82667616 | 0,35816000 | 0,5289 | 0,67768 | 0,81886 | 1,1298 | 0,86319 |
| 0,06932 | 0,83341 | 14,42585113 | 0,34945000 | 0,51603 | 0,66118 | 0,79893 | 1,1023 | 0,84218 |
| 0,071193 | 1,0944 | 14,04632478 | 0,34161000 | 0,50446 | 0,64636 | 0,78101 | 1,0775 | 0,82329 |
| **0,073067** | **1,3093** | 13,68606895 | 0,33459000 | 0,49409 | 0,63308 | 0,76497 | 1,0554 | 0,80638 |
| 0,07494 | 1,1726 | 13,34400854 | 0,32834000 | 0,48486 | 0,62125 | 0,75067 | 1,0357 | 0,79131 |
| 0,076814 | 0,75065 | 13,01846018 | 0,32281000 | 0,47669 | 0,61078 | 0,73803 | 1,0182 | 0,77798 |
| 0,078687 | 0,71356 | 12,70857956 | 0,31796000 | 0,46953 | 0,6016 | 0,72694 | 1,0029 | 0,76629 |
| 0,080561 | 0,65264 | 12,41295416 | 0,31375000 | 0,46332 | 0,59365 | 0,71732 | 0,98968 | 0,75615 |
| 0,082434 | 0,37926 | 12,13091685 | 0,31016000 | 0,45802 | 0,58686 | 0,70912 | 0,97836 | 0,74751 |
| 0,084308 | 0,28081 | 11,86127058 | 0,30717000 | 0,4536 | 0,58119 | 0,70227 | 0,9689 | 0,74028 |
| 0,086181 | 0,2204 | 11,60348569 | 0,30474000 | 0,45002 | 0,5766 | 0,69672 | 0,96126 | 0,73444 |
| 0,088055 | 0,28235 | 11,35653853 | 0,30287000 | 0,44725 | 0,57306 | 0,69245 | 0,95536 | 0,72993 |
| 0,089928 | 0,29822 | 11,12000712 | 0,30155000 | 0,4453 | 0,57055 | 0,68942 | 0,95117 | 0,72674 |
| 0,091802 | 0,20808 | 10,89300887 | 0,30075000 | 0,44413 | 0,56905 | 0,6876 | 0,94868 | 0,72483 |
| 0,093675 | 0,13585 | | 0,30049000 | 0,44374 | 0,56855 | 0,687 | 0,94784 | 0,72419 |




| Amp | Phas | Period | p | $R^2$ |
|---|---|---|---|---|
| **0,252** | **3,10** | **158,3** | 0,00000 | 0,60285 |
| **0,188** | **-2,81** | **24,38** | | |
| **0,156** | **2,63** | **13,79** | | |




Tab.A12. showing the data of the lomb periodogram and the sinusoidal function of D2-68.

**Log Files D2-68**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 12)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\v17-19\original
Filename Prefix=venosus v17-19
Number of Files= 1846
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 5.70
Object to Source (mm)=41.700
Camera to Source (mm)=364.000
Vertical Object Position (mm)=44.840
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.130
Frame Averaging=ON (2)
Random Movement=ON (20)
Use 360 Rotation=NO
FF updating interval=386
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Mar 22, 2013 14:41:46
Scan duration=01:34:22
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=venosus v17-19
Dataset Directory=C:\Users\Public\Briguglio\v17-19\original
Output Directory=C:\Users\Public\Briguglio\v17-19\original\venosus v17-19_Rec
Time and Date=Mar 22, 2013 15:29:25
First Section=546
Last Section=1843
Reconstruction duration per slice (seconds)=0.261941
Total reconstruction time (1298 slices) in seconds=340.000000
Postalignment=16.00
Section to Section Step=1
Sections Count=1298
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1448
Result Image Height (pixels)=1272
Pixel Size (um)=5.70145
Reconstruction Angular Range (deg)=239.98
Use 180+=OFF
Angular Step (deg)=0.1300
Smoothing=0
Ring Artifact Correction=29
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=2018
ROI Bottom (pixels)=743
ROI Left (pixels)=711
ROI Right (pixels)=2161
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=45
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0037
Maximum for CS to Image Conversion=0.0321
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.412422
Cone-beam Angle Vert.(deg)=17.412422
[File name convention]
Filename Index Length=4
Filename Prefix=venosus v17-19_IR_rec_Tra_depressa 2_68
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Mar 22, 2013 15:34:17
Original configuration file=venosus v17-19_IR_rec.log
Conversion description=...VOI(946,915,265) @ (460,127,673). Rotated(deg): (59.574, 323.460, 308.855).
Image scale modified=0
HU calibration modified=0

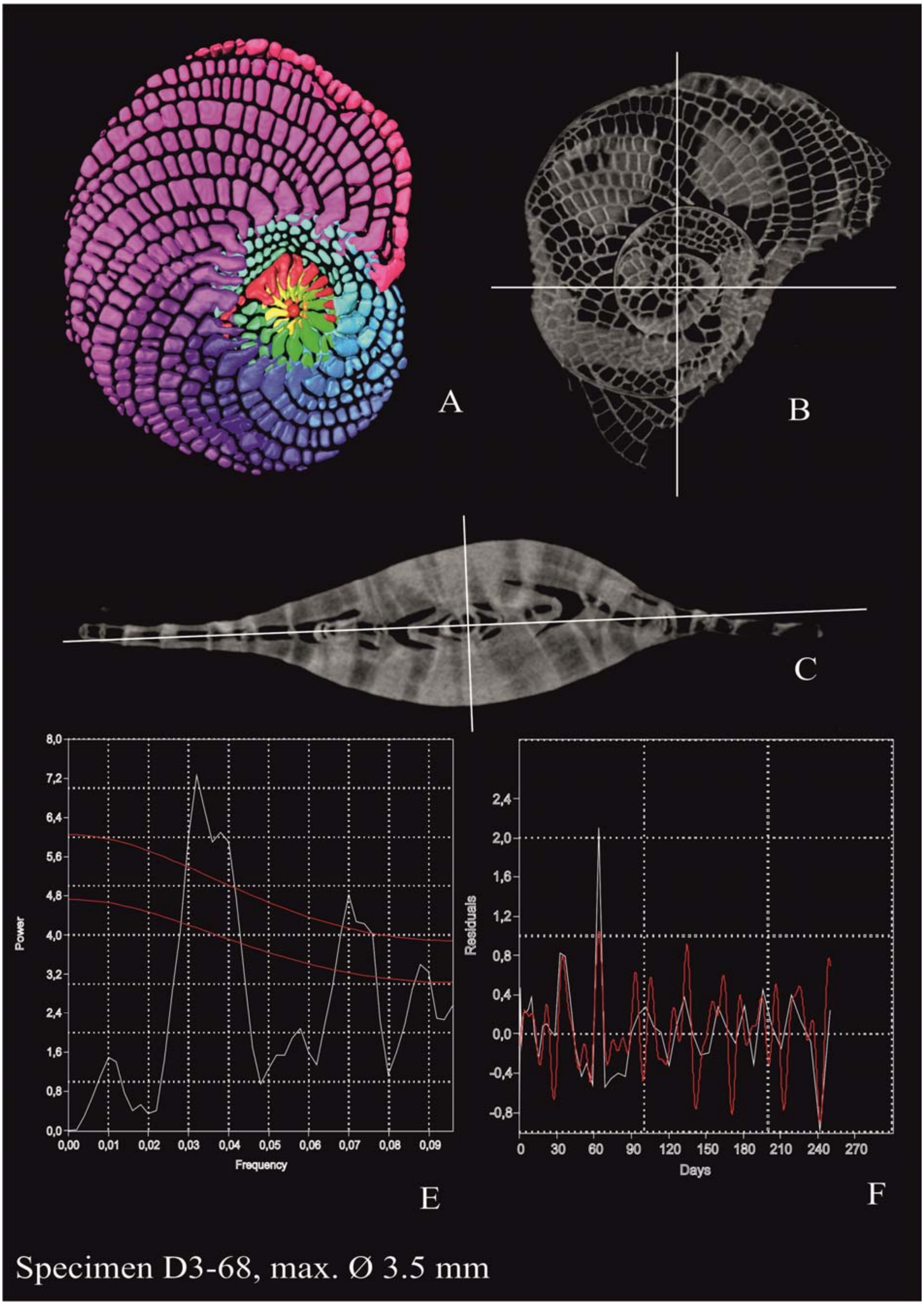
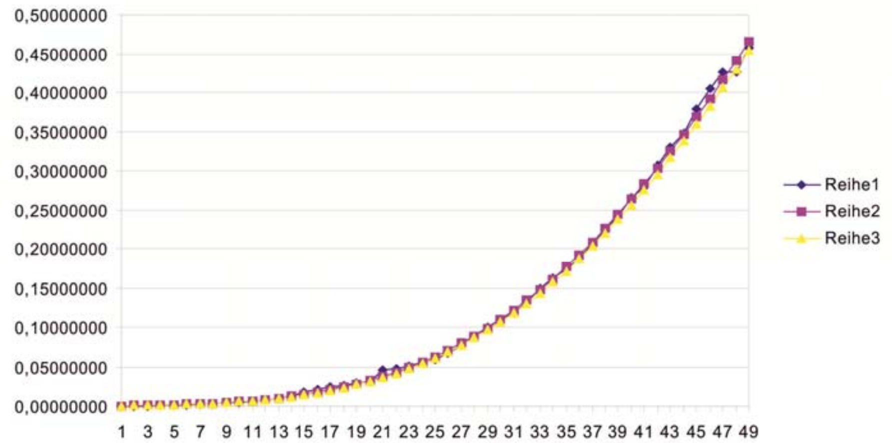


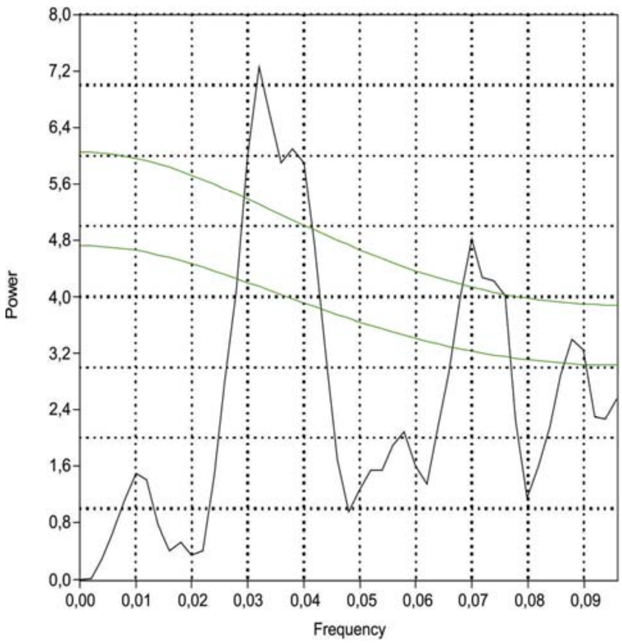

Fig.A7 Specimen D3-68, gamont from Kekaa Point, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

| day | chamber | Volume | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 125005,2812500 | 0,00012501 | 0,00012501 | 0,0007306 | 0,00072526 | #BEZUG! | #BEZUG! | 0,00004167 | #BEZUG! | #BEZUG! |
| 0,33 | 4 | 320754,2812500 | 0,00032075 | 0,00044576 | 0,0009524 | 0,00094347 | 0,00021821 | 0,46996614 | 0,00010692 | 0,00007274 | 0,46996614 |
| 1,15 | 5 | 247232,6718750 | 0,00024723 | 0,00069299 | 0,0012309 | 0,00121689 | 0,00027342 | -0,09577838 | 0,00008241 | 0,00009114 | -0,09577838 |
| 2,39 | 6 | 411869,2500000 | 0,00041187 | 0,00110486 | 0,0015775 | 0,00155664 | 0,00033975 | 0,21228684 | 0,00013729 | 0,00011325 | 0,21228684 |
| 4,00 | 7 | 511873,4687500 | 0,00051187 | 0,00161673 | 0,0020053 | 0,00197538 | 0,00041875 | 0,22239167 | 0,00017062 | 0,00013958 | 0,22239167 |
| 5,98 | 8 | 643916,0625000 | 0,00064392 | 0,00226065 | 0,0025291 | 0,00248747 | 0,00051208 | 0,25744569 | 0,00021464 | 0,00017069 | 0,25744569 |
| 8,29 | 9 | 857814,0000000 | 0,00085781 | 0,00311847 | 0,0031657 | 0,00310895 | 0,00062148 | 0,38027376 | 0,00028594 | 0,00020716 | 0,38027376 |
| 10,94 | 10 | 742253,5625000 | 0,00074225 | 0,00386072 | 0,0039334 | 0,00385767 | 0,00074873 | -0,00864447 | 0,00024742 | 0,00024958 | -0,00864447 |
| 13,90 | 11 | 677806,4375000 | 0,00067781 | 0,00453853 | 0,0048526 | 0,00475330 | 0,00089563 | -0,24320672 | 0,00022594 | 0,00029854 | -0,24320672 |
| 17,17 | 12 | 1156900,7500000 | 0,00115690 | 0,00569543 | 0,0059457 | 0,00581731 | 0,00106401 | 0,08730488 | 0,00038563 | 0,00035467 | 0,08730488 |
| 20,75 | 13 | 1390984,6250000 | 0,00139098 | 0,00708641 | 0,0072366 | 0,00707296 | 0,00125565 | 0,10777999 | 0,00046366 | 0,00041855 | 0,10777999 |
| 24,62 | 14 | 1510063,7500000 | 0,00151006 | 0,00859647 | 0,0087513 | 0,00854525 | 0,00147229 | 0,02565412 | 0,00050335 | 0,00049076 | 0,02565412 |
| 28,78 | 15 | 1679145,0000000 | 0,00167915 | 0,01027562 | 0,0105174 | 0,01026084 | 0,00171558 | -0,02124032 | 0,00055972 | 0,00057186 | -0,02124032 |
| 33,23 | 16 | 3630894,0000000 | 0,00363089 | 0,01390651 | 0,0125641 | 0,01224789 | 0,00198706 | 0,82727372 | 0,00121030 | 0,00066235 | 0,82727372 |
| 37,96 | 17 | 4099988,0000000 | 0,00409999 | 0,01800650 | 0,0149218 | 0,01453598 | 0,00228809 | 0,79188352 | 0,00136666 | 0,00076270 | 0,79188352 |
| 42,96 | 18 | 3541260,7500000 | 0,00354126 | 0,02154776 | 0,0176224 | 0,01715587 | 0,00261989 | 0,35168353 | 0,00118042 | 0,00087330 | 0,35168353 |
| 48,24 | 19 | 2564738,0000000 | 0,00256474 | 0,02411250 | 0,0206988 | 0,02013933 | 0,00298346 | -0,14034682 | 0,00085491 | 0,00099449 | -0,14034682 |
| 53,79 | 20 | 1924710,8750000 | 0,00192471 | 0,02603721 | 0,0241843 | 0,02351889 | 0,00337956 | -0,43048499 | 0,00064157 | 0,00112652 | -0,43048499 |
| 59,60 | 21 | 2682520,7500000 | 0,00268252 | 0,02871973 | 0,0281131 | 0,02732761 | 0,00380872 | -0,29568985 | 0,00089417 | 0,00126957 | -0,29568985 |
| 65,67 | 22 | 2030456,1250000 | 0,00203046 | 0,03075019 | 0,0325195 | 0,03159879 | 0,00427118 | -0,52461512 | 0,00067682 | 0,00142373 | -0,52461512 |
| 72,01 | 23 | 14823034,0000000 | 0,01482303 | 0,04557322 | 0,0374375 | 0,03636571 | 0,00476691 | 2,10956574 | 0,00494101 | 0,00158897 | 2,10956574 |
| 78,60 | 24 | 2436399,2500000 | 0,00243640 | 0,04800962 | 0,0429009 | 0,04166129 | 0,00529559 | -0,53991878 | 0,00081213 | 0,00176520 | -0,53991878 |
| 85,45 | 25 | 3219024,7500000 | 0,00321902 | 0,05122865 | 0,0489427 | 0,04751786 | 0,00585657 | -0,45035661 | 0,00107301 | 0,00195219 | -0,45035661 |
| 92,55 | 26 | 3880904,7500000 | 0,00388090 | 0,05510955 | 0,055595 | 0,05396681 | 0,00644894 | -0,39821079 | 0,00129363 | 0,00214965 | -0,39821079 |
| 99,89 | 27 | 4034615,0000000 | 0,00403462 | 0,05914417 | 0,0628883 | 0,06103830 | 0,00707149 | -0,42945331 | 0,00134487 | 0,00235716 | -0,42945331 |
| 107,49 | 28 | 7859961,5000000 | 0,00785996 | 0,06700413 | 0,0708518 | 0,06876100 | 0,00772270 | 0,01777322 | 0,00261999 | 0,00257423 | 0,01777322 |
| 115,33 | 29 | 10137280,0000000 | 0,01013728 | 0,07714141 | 0,0795126 | 0,07716181 | 0,00840081 | 0,20670233 | 0,00337909 | 0,00280027 | 0,20670233 |
| 123,42 | 30 | 11606601,0000000 | 0,01160660 | 0,08874801 | 0,0888956 | 0,08626560 | 0,00910378 | 0,27492052 | 0,00386887 | 0,00303459 | 0,27492052 |
| 131,74 | 31 | 10535260,0000000 | 0,01053526 | 0,09928327 | 0,0990234 | 0,09609495 | 0,00982935 | 0,07181624 | 0,00351175 | 0,00327645 | 0,07181624 |
| 140,31 | 32 | 10782307,0000000 | 0,01078231 | 0,11006557 | 0,109916 | 0,10666999 | 0,01057504 | 0,01959954 | 0,00359410 | 0,00352501 | 0,01959954 |
| 149,12 | 33 | 7696621,5000000 | 0,00769662 | 0,11776220 | 0,1215903 | 0,11800818 | 0,01133818 | -0,32117690 | 0,00256554 | 0,00377939 | -0,32117690 |
| 158,16 | 34 | 12938324,0000000 | 0,01293832 | 0,13070052 | 0,1340606 | 0,13012414 | 0,01211596 | 0,06787451 | 0,00431277 | 0,00403865 | 0,06787451 |
| 167,44 | 35 | 17835754,0000000 | 0,01783575 | 0,14853627 | 0,147338 | 0,14302955 | 0,01290541 | 0,38203675 | 0,00594525 | 0,00430180 | 0,38203675 |
| 176,95 | 36 | 13805768,0000000 | 0,01380577 | 0,16234204 | 0,1614302 | 0,15673304 | 0,01370349 | 0,00746367 | 0,00460192 | 0,00456783 | 0,00746367 |
| 186,69 | 37 | 11486041,0000000 | 0,01148604 | 0,17382808 | 0,1763418 | 0,17124011 | 0,01450707 | -0,20824518 | 0,00382868 | 0,00483569 | -0,20824518 |
| 196,66 | 38 | 12403302,0000000 | 0,01240330 | 0,18623139 | 0,1920742 | 0,18655309 | 0,01531298 | -0,19001403 | 0,00413443 | 0,00510433 | -0,19001403 |
| 206,86 | 39 | 20662354,0000000 | 0,02066235 | 0,20689374 | 0,2086254 | 0,20267115 | 0,01611806 | 0,28193778 | 0,00688745 | 0,00537269 | 0,28193778 |
| 217,29 | 40 | 18052430,0000000 | 0,01805243 | 0,22494617 | 0,2259901 | 0,21959030 | 0,01691915 | 0,06698206 | 0,00601748 | 0,00563972 | 0,06698206 |
| 227,95 | 41 | 16066049,0000000 | 0,01606605 | 0,24101222 | 0,24416 | 0,23730344 | 0,01771314 | -0,09298674 | 0,00535535 | 0,00590438 | -0,09298674 |
| 238,83 | 42 | 23785634,0000000 | 0,02378563 | 0,26479785 | 0,2631233 | 0,25580042 | 0,01849698 | 0,28591986 | 0,00792854 | 0,00616566 | 0,28591986 |
| 249,94 | 43 | 13177779,0000000 | 0,01317778 | 0,27797563 | 0,2828656 | 0,27506816 | 0,01926774 | -0,31607028 | 0,00439259 | 0,00642258 | -0,31607028 |
| 261,27 | 44 | 29010300,0000000 | 0,02901030 | 0,30698593 | 0,3033694 | 0,29509074 | 0,02002258 | 0,44887903 | 0,00967010 | 0,00667419 | 0,44887903 |
| 272,82 | 45 | 22249644,0000000 | 0,02224964 | 0,32923558 | 0,3246145 | 0,31584956 | 0,02075882 | 0,07181645 | 0,00741655 | 0,00691961 | 0,07181645 |
| 284,59 | 46 | 18276884,0000000 | 0,01827688 | 0,34751246 | 0,3465781 | 0,33732347 | 0,02147391 | -0,14887945 | 0,00609229 | 0,00715797 | -0,14887945 |
| 296,58 | 47 | 31054460,0000000 | 0,03105446 | 0,37856692 | 0,3692352 | 0,35948894 | 0,02216547 | 0,40102858 | 0,01035149 | 0,00738849 | 0,40102858 |
| 308,79 | 48 | 25866464,0000000 | 0,02586646 | 0,40443338 | 0,3925584 | 0,38232026 | 0,02283132 | 0,13293788 | 0,00862215 | 0,00761044 | 0,13293788 |
| 321,22 | 49 | 21578874,0000000 | 0,02157887 | 0,42601226 | 0,4165182 | 0,40578969 | 0,02346943 | -0,08055411 | 0,00719296 | 0,00782314 | -0,08055411 |
| 333,87 | 50 | 524837,0000000 | 0,00052484 | 0,42653709 | 0,4410837 | 0,42986770 | 0,02407801 | -0,97820264 | 0,00017495 | 0,00802600 | -0,97820264 |
| 346,73 | 51 | 30598514,0000000 | 0,03059851 | 0,45713561 | 0,4662221 | 0,45452312 | 0,02465542 | 0,24104598 | 0,01019950 | 0,00821847 | 0,24104598 |

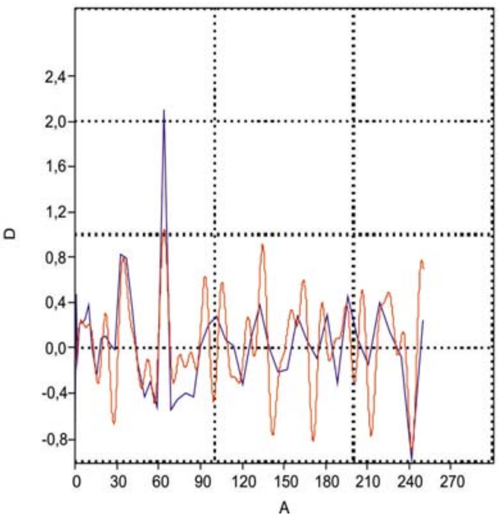



Tab.A13 showing raw data and the consensus of the cumulative sum, and the Gompertz function of D3-68.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 2,27E-31 | #DIV/0! | 3,2 | 4,7255 | 6,0547 | 7,3161 | 10,094 | 7,6389 |
| 0,0019969 | 0,019225 | 500,7762 | 3,1981 | 4,7226 | 6,0511 | 7,3117 | 10,088 | 7,6343 |
| 0,0039938 | 0,29932 | 250,3881 | 3,1924 | 4,7142 | 6,0403 | 7,2987 | 10,07 | 7,6207 |
| 0,0059907 | 0,69042 | 166,9254 | 3,1829 | 4,7003 | 6,0224 | 7,2771 | 10,04 | 7,5982 |
| 0,0079876 | 1,1242 | 125,19405 | 3,1699 | 4,681 | 5,9977 | 7,2472 | 9,9988 | 7,567 |
| 0,0099845 | 1,4951 | 100,15524 | 3,1533 | 4,6565 | 5,9664 | 7,2094 | 9,9466 | 7,5275 |
| 0,011981 | 1,4122 | 83,465487 | 3,1335 | 4,6272 | 5,9288 | 7,164 | 9,884 | 7,4801 |
| 0,013978 | 0,77293 | 71,540993 | 3,1105 | 4,5933 | 5,8854 | 7,1115 | 9,8116 | 7,4253 |
| 0,015975 | 0,41708 | 62,597809 | 3,0847 | 4,5552 | 5,8366 | 7,0525 | 9,7302 | 7,3637 |
| 0,017972 | 0,52635 | 55,64211 | 3,0563 | 4,5133 | 5,7828 | 6,9876 | 9,6407 | 7,2959 |
| 0,019969 | 0,34656 | 50,07762 | 3,0256 | 4,4679 | 5,7247 | 6,9174 | 9,5438 | 7,2226 |
| 0,021966 | 0,42091 | 45,524902 | 2,9928 | 4,4196 | 5,6627 | 6,8424 | 9,4404 | 7,1444 |
| 0,023963 | 1,4731 | 41,731002 | 2,9583 | 4,3686 | 5,5974 | 6,7635 | 9,3315 | 7,0619 |
| 0,02596 | 2,811 | 38,520801 | 2,9223 | 4,3154 | 5,5293 | 6,6812 | 9,218 | 6,976 |
| 0,027957 | 4,0821 | 35,769217 | 2,8851 | 4,2605 | 5,459 | 6,5962 | 9,1007 | 6,8873 |
| 0,029953 | 6,0113 | 33,385637 | 2,8471 | 4,2043 | 5,3869 | 6,5092 | 8,9806 | 6,7964 |
| **0,03195** | **7,2552** | **31,298905** | 2,8083 | 4,1471 | 5,3136 | 6,4206 | 8,8584 | 6,7039 |
| 0,033947 | 6,5913 | 29,457684 | 2,7692 | 4,0893 | 5,2396 | 6,3312 | 8,735 | 6,6105 |
| 0,035944 | 5,9074 | 27,821055 | 2,7299 | 4,0313 | 5,1653 | 6,2414 | 8,6111 | 6,5168 |
| 0,037941 | 6,0918 | 26,356712 | 2,6907 | 3,9734 | 5,0911 | 6,1517 | 8,4874 | 6,4232 |
| 0,039938 | 5,9024 | 25,03881 | 2,6518 | 3,9159 | 5,0174 | 6,0627 | 8,3646 | 6,3302 |
| 0,041935 | 4,7573 | 23,846429 | 2,6133 | 3,8591 | 4,9446 | 5,9747 | 8,2432 | 6,2383 |
| 0,043932 | 3,1711 | 22,762451 | 2,5754 | 3,8031 | 4,8729 | 5,8881 | 8,1237 | 6,1479 |
| 0,045929 | 1,6971 | 21,772736 | 2,5383 | 3,7483 | 4,8027 | 5,8033 | 8,0067 | 6,0593 |
| 0,047926 | 0,96226 | 20,865501 | 2,5021 | 3,6949 | 4,7342 | 5,7205 | 7,8924 | 5,9729 |
| 0,049922 | 1,2617 | 20,031249 | 2,4669 | 3,6429 | 4,6676 | 5,64 | 7,7815 | 5,8889 |
| 0,051919 | 1,5411 | 19,260772 | 2,4328 | 3,5926 | 4,6032 | 5,5621 | 7,674 | 5,8076 |
| 0,053916 | 1,5496 | 18,54737 | 2,4 | 3,5441 | 4,541 | 5,487 | 7,5703 | 5,7291 |
| 0,055913 | 1,8883 | 17,884928 | 2,3684 | 3,4975 | 4,4812 | 5,4148 | 7,4707 | 5,6538 |
| 0,05791 | 2,0808 | 17,268175 | 2,3382 | 3,4528 | 4,4241 | 5,3457 | 7,3754 | 5,5816 |
| 0,059907 | 1,6011 | 16,69254 | 2,3094 | 3,4103 | 4,3695 | 5,2798 | 7,2845 | 5,5128 |
| 0,061904 | 1,3423 | 16,154045 | 2,282 | 3,3698 | 4,3177 | 5,2172 | 7,1981 | 5,4474 |
| 0,063901 | 2,1234 | 15,649207 | 2,2561 | 3,3316 | 4,2687 | 5,158 | 7,1164 | 5,3856 |
| 0,065898 | 2,9288 | 15,174967 | 2,2317 | 3,2956 | 4,2226 | 5,1023 | 7,0395 | 5,3274 |
| 0,067894 | 4,0023 | 14,728842 | 2,2088 | 3,2618 | 4,1793 | 5,05 | 6,9674 | 5,2728 |
| **0,069891** | **4,8112** | **14,307994** | 2,1875 | 3,2304 | 4,139 | 5,0013 | 6,9002 | 5,222 |
| 0,071888 | 4,2712 | 13,910527 | 2,1678 | 3,2012 | 4,1017 | 4,9562 | 6,8379 | 5,1749 |
| 0,073885 | 4,2304 | 13,534547 | 2,1496 | 3,1744 | 4,0673 | 4,9146 | 6,7806 | 5,1315 |
| 0,075882 | 4,012 | 13,178356 | 2,133 | 3,1499 | 4,0359 | 4,8767 | 6,7283 | 5,0919 |
| 0,077879 | 2,2362 | 12,840432 | 2,118 | 3,1277 | 4,0075 | 4,8424 | 6,6809 | 5,056 |
| 0,079876 | 1,1465 | 12,519405 | 2,1046 | 3,1079 | 3,9821 | 4,8117 | 6,6386 | 5,024 |
| 0,081873 | 1,6074 | 12,214039 | 2,0928 | 3,0904 | 3,9597 | 4,7846 | 6,6012 | 4,9957 |
| 0,08387 | 2,1666 | 11,923214 | 2,0825 | 3,0752 | 3,9403 | 4,7612 | 6,5689 | 4,9712 |
| 0,085867 | 2,893 | 11,645918 | 2,0738 | 3,0624 | 3,9238 | 4,7413 | 6,5415 | 4,9505 |
| 0,087863 | 3,403 | 11,381355 | 2,0667 | 3,0519 | 3,9104 | 4,7251 | 6,5191 | 4,9336 |
| **0,08986** | **3,2415** | **11,128422** | 2,0612 | 3,0438 | 3,9 | 4,7125 | 6,5017 | 4,9204 |
| 0,091857 | 2,3019 | 10,886487 | 2,0573 | 3,038 | 3,8925 | 4,7035 | 6,4893 | 4,911 |
| 0,093854 | 2,2646 | 10,654847 | 2,0549 | 3,0345 | 3,8881 | 4,6981 | 6,4818 | 4,9054 |




| Amp | Phas | Period | p | R² |
|---|---|---|---|---|
| **0,281** | **0,269** | **32,33** | 0,00000887 | 0,57488 |
| **0,331** | **3,03** | **14,27** | | |
| 0,259 | -2,48 | 23,81 | | |
| **0,23** | **1,13** | **10,29** | | |




Tab.A14 showing the data of the lomb periodogram and the sinusoidal function of D3-68.

**Log File D3-68**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 12)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\rögl\original
Filename Prefix=roegl
Number of Files= 1846
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 5.70
Object to Source (mm)=41.700
Camera to Source (mm)=364.000
Vertical Object Position (mm)=43.767
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.130
Frame Averaging=ON (2)
Random Movement=ON (20)
Use 360 Rotation=NO
FF updating interval=386
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Mar 22, 2013 16:45:27
Scan duration=01:34:24
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=roegl
Dataset Directory=C:\Users\Public\Briguglio\rögl\original
Output Directory=C:\Users\Public\Briguglio\rögl\original\roegl_Rec
Time and Date=Mar 22, 2013 17:16:04
First Section=414
Last Section=1731
Reconstruction duration per slice (seconds)=0.296662
Total reconstruction time (1318 slices) in seconds=391.000000
Postalignment=11.00
Section to Section Step=1
Sections Count=1318
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1448
Result Image Height (pixels)=1272
Pixel Size (um)=5.70145
Reconstruction Angular Range (deg)=239.98
Use 180+=OFF
Angular Step (deg)=0.1300
Smoothing=0
Ring Artifact Correction=33
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=2089
ROI Bottom (pixels)=814
ROI Left (pixels)=687
ROI Right (pixels)=2137
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=35
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0043
Maximum for CS to Image Conversion=0.0324
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.412422
Cone-beam Angle Vert.(deg)=17.412422
[File name convention]
Filename Index Length=4
Filename Prefix=roegl_IR_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Mar 22, 2013  17:22:10
Original configuration file=roegl_IR_rec.log
Conversion description=...COR. VOI(840,220,840) @ (249,406,107). Rotated(deg): (4.644, 21.571, 0.028).
Image scale modified=0
HU calibration **modified=0**

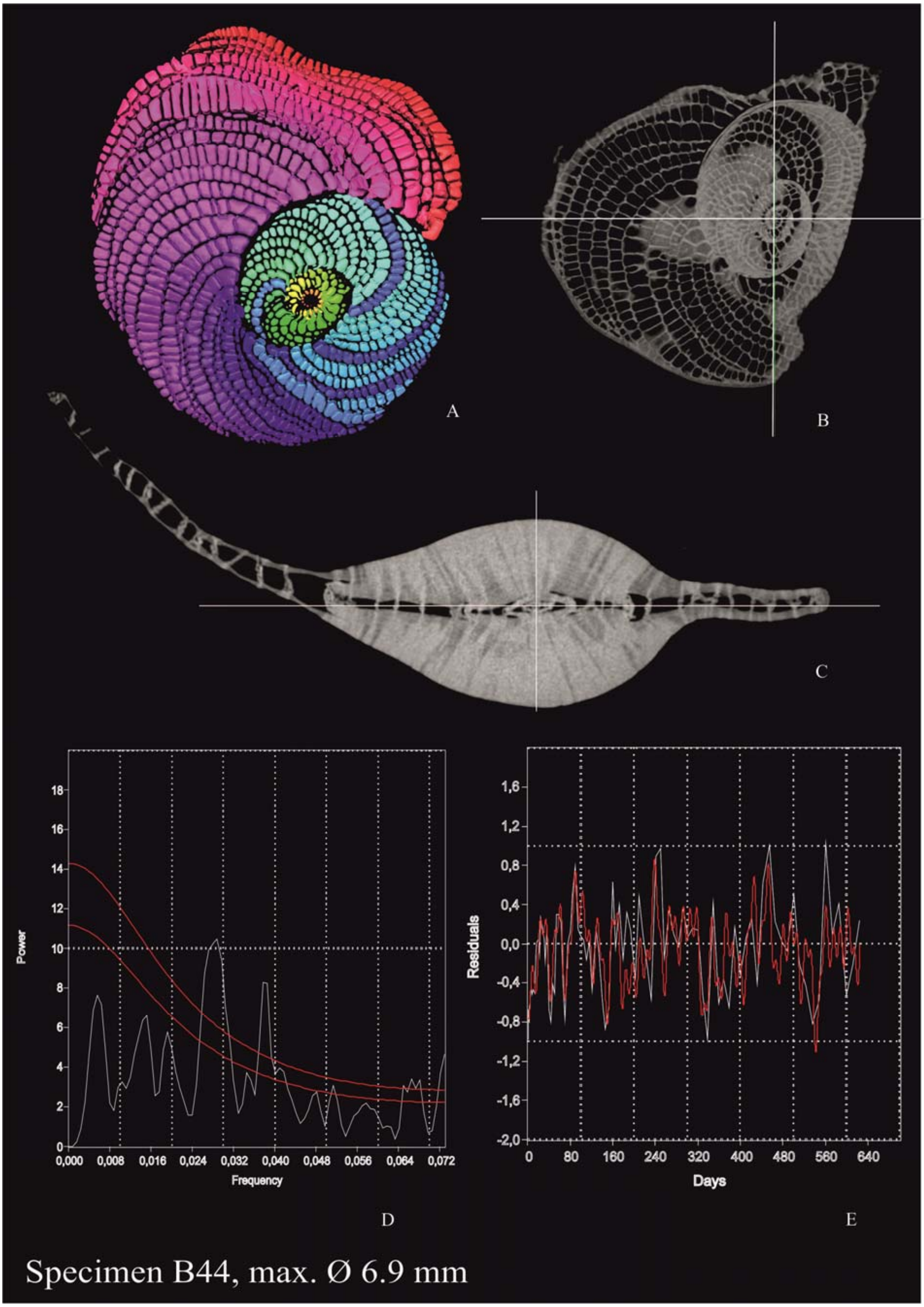
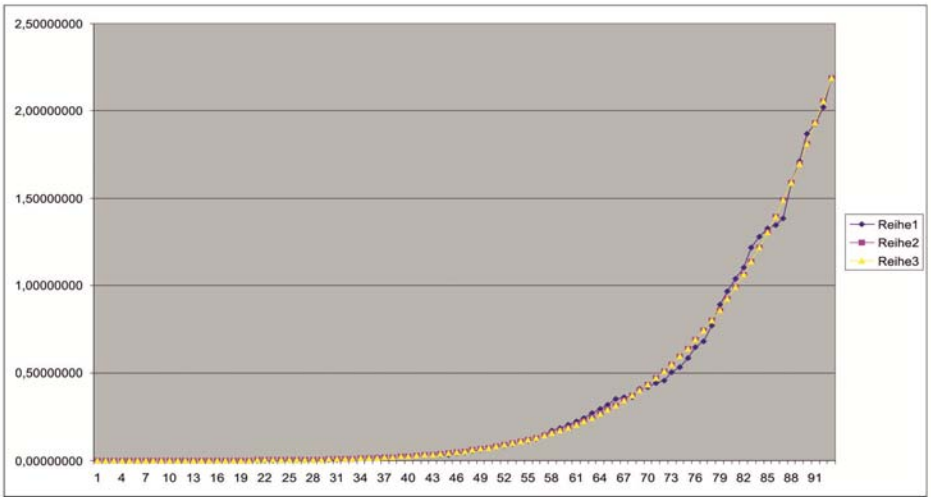


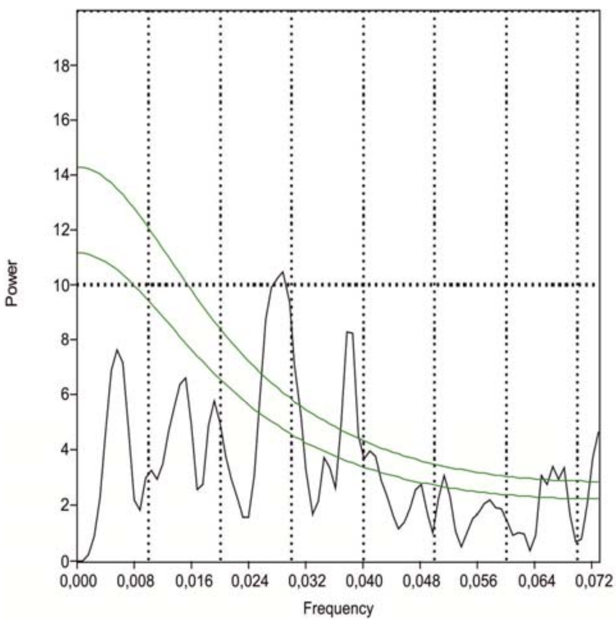

Fig.A8 Specimen B44, agamont from Kekaa Point, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

| days | chamber | Volume µm³ | volume mm³ | comul. Vol | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,17 | 4 | 1580,25 | 0,00000158 | 0,00000158 | 0,00011330 | 0,00011329 | 0,00011329 | -0,98605120 | 0,00000053 | 0,00003776 | -0,98605120 |
| 1,83 | 5 | 2107,00 | 0,00000211 | 0,00000369 | 0,00013430 | 0,00013431 | 0,00002103 | -0,89978900 | 0,00000070 | 0,00000701 | -0,89978900 |
| 2,63 | 6 | 8164,62 | 0,00000816 | 0,00001185 | 0,00015890 | 0,00015894 | 0,00002463 | -0,66849249 | 0,00000272 | 0,00000821 | -0,66849249 |
| 3,58 | 7 | 5530,87 | 0,00000553 | 0,00001738 | 0,00018770 | 0,00018774 | 0,00002880 | -0,80792589 | 0,00000184 | 0,00000960 | -0,80792589 |
| 4,67 | 8 | 11851,86 | 0,00001185 | 0,00002923 | 0,00022130 | 0,00022134 | 0,00003361 | -0,64731860 | 0,00000395 | 0,00001120 | -0,64731860 |
| 5,92 | 9 | 15539,11 | 0,00001554 | 0,00004477 | 0,00026050 | 0,00026049 | 0,00003915 | -0,60304949 | 0,00000518 | 0,00001305 | -0,60304949 |
| 7,30 | 10 | 19753,10 | 0,00001975 | 0,00006453 | 0,00030600 | 0,00030601 | 0,00004552 | -0,56604478 | 0,00000658 | 0,00001517 | -0,56604478 |
| 8,84 | 11 | 29497,96 | 0,00002950 | 0,00009402 | 0,00035880 | 0,00035884 | 0,00005283 | -0,44168750 | 0,00000983 | 0,00001761 | -0,44168750 |
| 10,52 | 12 | 29497,96 | 0,00002950 | 0,00012352 | 0,00042010 | 0,00042006 | 0,00006122 | -0,51814006 | 0,00000983 | 0,00002041 | -0,51814006 |
| 12,34 | 13 | 37662,58 | 0,00003766 | 0,00016119 | 0,00049090 | 0,00049087 | 0,00007081 | -0,46808573 | 0,00001255 | 0,00002360 | -0,46808573 |
| 14,32 | 14 | 41613,20 | 0,00004161 | 0,00020280 | 0,00057260 | 0,00057262 | 0,00008176 | -0,49100160 | 0,00001387 | 0,00002725 | -0,49100160 |
| 16,44 | 15 | 46617,32 | 0,00004662 | 0,00024942 | 0,00066690 | 0,00066686 | 0,00009424 | -0,50531478 | 0,00001554 | 0,00003141 | -0,50531478 |
| 18,70 | 16 | 96395,14 | 0,00009640 | 0,00034581 | 0,00077530 | 0,00077530 | 0,00010844 | -0,11106997 | 0,00003213 | 0,00003615 | -0,11106997 |
| 21,11 | 17 | 125893,10 | 0,00012589 | 0,00047170 | 0,00089990 | 0,00089987 | 0,00012457 | 0,01058189 | 0,00004196 | 0,00004152 | 0,01058189 |
| 23,67 | 18 | 148806,70 | 0,00014881 | 0,00062051 | 0,00104270 | 0,00104275 | 0,00014287 | 0,04151982 | 0,00004960 | 0,00004762 | 0,04151982 |
| 26,37 | 19 | 145646,20 | 0,00014565 | 0,00076616 | 0,00120630 | 0,00120634 | 0,00016359 | -0,10971293 | 0,00004855 | 0,00005453 | -0,10971293 |
| 29,22 | 20 | 236247,09 | 0,00023625 | 0,00100240 | 0,00139340 | 0,00139336 | 0,00018702 | 0,26323974 | 0,00007875 | 0,00006234 | 0,26323974 |
| 32,21 | 21 | 248625,72 | 0,00024863 | 0,00125103 | 0,00160680 | 0,00160681 | 0,00021345 | 0,16479247 | 0,00008288 | 0,00007115 | 0,16479247 |
| 35,35 | 22 | 254946,70 | 0,00025495 | 0,00150598 | 0,00185000 | 0,00185004 | 0,00024324 | 0,04814708 | 0,00008498 | 0,00008108 | 0,04814708 |
| 38,64 | 23 | 228345,86 | 0,00022835 | 0,00173432 | 0,00212680 | 0,00212679 | 0,00027674 | -0,17488243 | 0,00007612 | 0,00009225 | -0,17488243 |
| 42,07 | 24 | 371621,69 | 0,00037162 | 0,00210594 | 0,00244120 | 0,00244117 | 0,00031438 | 0,18207668 | 0,00012387 | 0,00010479 | 0,18207668 |
| 45,65 | 25 | 118518,61 | 0,00011852 | 0,00222446 | 0,00279780 | 0,00279776 | 0,00035659 | -0,66763318 | 0,00003951 | 0,00011886 | -0,66763318 |
| 49,38 | 26 | 79012,41 | 0,00007901 | 0,00230348 | 0,00320160 | 0,00320161 | 0,00040385 | -0,80435434 | 0,00002634 | 0,00013462 | -0,80435434 |
| 53,25 | 27 | 267852,06 | 0,00026785 | 0,00257133 | 0,00365830 | 0,00365831 | 0,00045670 | -0,41350575 | 0,00008928 | 0,00015223 | -0,41350575 |
| 57,27 | 28 | 254156,58 | 0,00025416 | 0,00282548 | 0,00417400 | 0,00417401 | 0,00051570 | -0,50715903 | 0,00008472 | 0,00017190 | -0,50715903 |
| 61,43 | 29 | 755622,00 | 0,00075562 | 0,00358111 | 0,00475550 | 0,00475547 | 0,00058146 | 0,29951856 | 0,00025187 | 0,00019382 | 0,29951856 |
| 65,74 | 30 | 851227,00 | 0,00085123 | 0,00443233 | 0,00541010 | 0,00541014 | 0,00065467 | 0,30024282 | 0,00028374 | 0,00021822 | 0,30024282 |
| 70,20 | 31 | 895737,31 | 0,00089574 | 0,00532807 | 0,00614620 | 0,00614617 | 0,00073603 | 0,21697797 | 0,00029858 | 0,00024534 | 0,21697797 |
| 74,80 | 32 | 490930,44 | 0,00049093 | 0,00581900 | 0,00697250 | 0,00697252 | 0,00082634 | -0,40589949 | 0,00016364 | 0,00027545 | -0,40589949 |
| 79,55 | 33 | 210963,13 | 0,00021096 | 0,00602996 | 0,00789890 | 0,00789895 | 0,00092643 | -0,77228451 | 0,00007032 | 0,00030881 | -0,77228451 |
| 84,44 | 34 | 1032955,63 | 0,00103296 | 0,00706292 | 0,00893620 | 0,00893616 | 0,00103721 | -0,00410128 | 0,00034432 | 0,00034574 | -0,00410128 |
| 89,48 | 35 | 1321877,63 | 0,00132188 | 0,00838480 | 0,01009580 | 0,01009580 | 0,00115964 | 0,13990075 | 0,00044063 | 0,00038655 | 0,13990075 |
| 94,67 | 36 | 1935277,25 | 0,00193528 | 0,01032007 | 0,01139060 | 0,01139057 | 0,00129477 | 0,49468435 | 0,00064509 | 0,00043159 | 0,49468435 |
| 100,00 | 37 | 2593450,50 | 0,00259345 | 0,01291352 | 0,01283430 | 0,01283429 | 0,00144371 | 0,79637291 | 0,00086448 | 0,00048124 | 0,79637291 |
| 105,48 | 38 | 1847310,13 | 0,00184731 | 0,01476083 | 0,01444190 | 0,01444195 | 0,00160766 | 0,14906844 | 0,00061577 | 0,00053589 | 0,14906844 |
| 111,10 | 39 | 1923162,00 | 0,00192316 | 0,01668400 | 0,01622980 | 0,01622982 | 0,00178788 | 0,07566854 | 0,00064105 | 0,00059596 | 0,07566854 |
| 116,87 | 40 | 2056166,25 | 0,00205617 | 0,01874016 | 0,01821550 | 0,01821555 | 0,00198572 | 0,03547594 | 0,00068539 | 0,00066191 | 0,03547594 |
| 122,79 | 41 | 1843359,50 | 0,00184336 | 0,02058352 | 0,02041820 | 0,02041818 | 0,00220264 | -0,16311172 | 0,00061445 | 0,00073421 | -0,16311172 |
| 128,85 | 42 | 2481779,75 | 0,00248178 | 0,02306530 | 0,02285830 | 0,02285833 | 0,00244015 | 0,01706021 | 0,00082726 | 0,00081338 | 0,01706021 |
| 135,06 | 43 | 1410898,25 | 0,00141090 | 0,02447620 | 0,02555820 | 0,02555822 | 0,00269989 | -0,47742413 | 0,00047030 | 0,00089996 | -0,47742413 |
| 141,42 | 44 | 3457056,25 | 0,00345706 | 0,02793326 | 0,02854180 | 0,02854180 | 0,00298358 | 0,15869353 | 0,00115235 | 0,00099453 | 0,15869353 |
| 147,92 | 45 | 3070949,00 | 0,00307095 | 0,03100421 | 0,03183480 | 0,03183484 | 0,00329304 | -0,06744273 | 0,00102365 | 0,00109768 | -0,06744273 |
| 154,57 | 46 | 1500972,38 | 0,00150097 | 0,03250518 | 0,03546500 | 0,03546504 | 0,00363019 | -0,58653114 | 0,00050032 | 0,00121006 | -0,58653114 |
| 161,36 | 47 | 520428,41 | 0,00052043 | 0,03302561 | 0,03946210 | 0,03946211 | 0,00399707 | -0,86979763 | 0,00017348 | 0,00133236 | -0,86979763 |
| 168,30 | 48 | 1632659,75 | 0,00163266 | 0,03465827 | 0,04385790 | 0,04385793 | 0,00439582 | -0,62858771 | 0,00054422 | 0,00146527 | -0,62858771 |
| 175,38 | 49 | 7879380,50 | 0,00787938 | 0,04253765 | 0,04868660 | 0,04868660 | 0,00482867 | 0,63179092 | 0,00262646 | 0,00160956 | 0,63179092 |
| 182,62 | 50 | 5077337,50 | 0,00507734 | 0,04761498 | 0,05398460 | 0,05398460 | 0,00529800 | -0,04165058 | 0,00169245 | 0,00176600 | -0,04165058 |
| 189,99 | 51 | 8109043,50 | 0,00810904 | 0,05572403 | 0,05979090 | 0,05979089 | 0,00580629 | 0,39659634 | 0,00270301 | 0,00193543 | 0,39659634 |
| 197,52 | 52 | 5382852,00 | 0,00538285 | 0,06110688 | 0,06614700 | 0,06614702 | 0,00635613 | -0,15312439 | 0,00179428 | 0,00211871 | -0,15312439 |
| 205,19 | 53 | 9180715,00 | 0,00918072 | 0,07028759 | 0,07309730 | 0,07309726 | 0,00695024 | 0,32092049 | 0,00306024 | 0,00231675 | 0,32092049 |
| 213,00 | 54 | 8636320,00 | 0,00863632 | 0,07892391 | 0,08068870 | 0,08068872 | 0,00759146 | 0,13763663 | 0,00287877 | 0,00253049 | 0,13763663 |
| 220,96 | 55 | 5329387,00 | 0,00532939 | 0,08425330 | 0,08897150 | 0,08897146 | 0,00828274 | -0,35656728 | 0,00177646 | 0,00276091 | -0,35656728 |
| 229,07 | 56 | 13313854,00 | 0,01331385 | 0,09756716 | 0,09799860 | 0,09799864 | 0,00902718 | 0,47486352 | 0,00443795 | 0,00300906 | 0,47486352 |
| 237,33 | 57 | 10906873,00 | 0,01090687 | 0,10847403 | 0,10782660 | 0,10782661 | 0,00982797 | 0,10977866 | 0,00363562 | 0,00327599 | 0,10977866 |
| 245,73 | 58 | 8072698,00 | 0,00807270 | 0,11654673 | 0,11851510 | 0,11851507 | 0,01068846 | -0,24472753 | 0,00269090 | 0,00356282 | -0,24472753 |
| 254,27 | 59 | 4964086,00 | 0,00496409 | 0,12151081 | 0,13012720 | 0,13012716 | 0,01161209 | -0,57250724 | 0,00165470 | 0,00387070 | -0,57250724 |
| 262,97 | 60 | 23873072,00 | 0,02387307 | 0,14538388 | 0,14272960 | 0,14272962 | 0,01260246 | 0,89431825 | 0,00795769 | 0,00420082 | 0,89431825 |
| 271,80 | 61 | 26937700,00 | 0,02693770 | 0,17232158 | 0,15639290 | 0,15639289 | 0,01366327 | 0,97154181 | 0,00897923 | 0,00455442 | 0,97154181 |
| 280,79 | 62 | 12588257,00 | 0,01258826 | 0,18490984 | 0,17119120 | 0,17119122 | 0,01479834 | -0,14934653 | 0,00419609 | 0,00493278 | -0,14934653 |
| 289,92 | 63 | 21555376,00 | 0,02155538 | 0,20646522 | 0,18720290 | 0,18720285 | 0,01601163 | 0,34623281 | 0,00718513 | 0,00533721 | 0,34623281 |
| 299,20 | 64 | 19013282,00 | 0,01901328 | 0,22547850 | 0,20451010 | 0,20451005 | 0,01730720 | 0,09857630 | 0,00633776 | 0,00576907 | 0,09857630 |
| 308,62 | 65 | 18048542,00 | 0,01804854 | 0,24352704 | 0,22319930 | 0,22319931 | 0,01868925 | -0,03428240 | 0,00601618 | 0,00622975 | -0,03428240 |
| 318,19 | 66 | 27566640,00 | 0,02756664 | 0,27109368 | 0,24336140 | 0,24336139 | 0,02016209 | 0,36725133 | 0,00918888 | 0,00672070 | 0,36725133 |
| 327,90 | 67 | 23229122,00 | 0,02322912 | 0,29432280 | 0,26509150 | 0,26509151 | 0,02173011 | 0,06898293 | 0,00774304 | 0,00724337 | 0,06898293 |
| 337,76 | 68 | 27074918,00 | 0,02707492 | 0,32139772 | 0,28848940 | 0,28848937 | 0,02339786 | 0,15715340 | 0,00902497 | 0,00779929 | 0,15715340 |

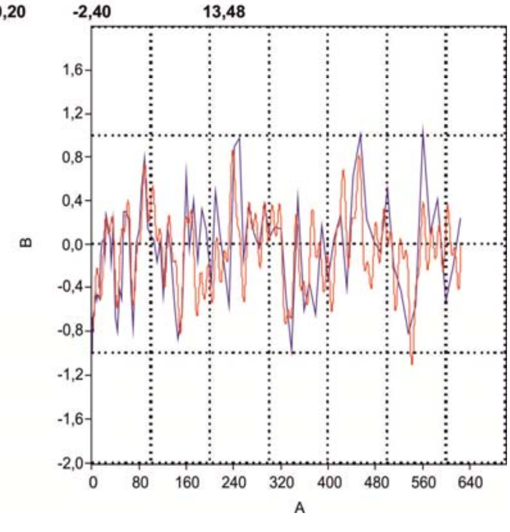



Tab.A15 showing raw data and the consensus of the cumulative sum, and the Gompertz function of B44.

| Freq | Period | Power | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0,00000000 | #DIV/0! | 0,00000000 | 7,55630000 | 11,15900000 | 14,29700000 | 17,27600000 | 23,83500000 | 20,71600000 |
| 0,00080080 | 1248,75124875 | 0,00983980 | 7,54730000 | 11,14500000 | 14,28000000 | 17,25500000 | 23,80700000 | 20,69100000 |
| 0,00160160 | 624,37562438 | 0,21003000 | 7,52040000 | 11,10500000 | 14,22900000 | 17,19400000 | 23,72200000 | 20,61700000 |
| 0,00240240 | 416,25041625 | 0,87293000 | 7,47600000 | 11,04000000 | 14,14500000 | 17,09200000 | 23,58200000 | 20,49500000 |
| 0,00320320 | 312,18781219 | 2,24540000 | 7,41480000 | 10,95000000 | 14,03000000 | 16,95200000 | 23,38900000 | 20,32800000 |
| 0,00400400 | 249,75024975 | 4,67390000 | 7,33770000 | 10,83600000 | 13,88400000 | 16,77600000 | 23,14600000 | 20,11600000 |
| 0,00480480 | 208,12520813 | 6,89230000 | 7,24580000 | 10,70000000 | 13,71000000 | 16,56600000 | 22,85600000 | 19,86400000 |
| **0,00560560** | **178,39303554** | **7,62880000** | 7,14040000 | 10,54400000 | 13,51000000 | 16,32500000 | 22,52300000 | 19,57500000 |
| 0,00640640 | 156,09390609 | 7,17080000 | 7,02280000 | 10,37100000 | 13,28800000 | 16,05600000 | 22,15200000 | 19,25300000 |
| 0,00720720 | 138,75013875 | 4,73860000 | 6,89450000 | 10,18100000 | 13,04500000 | 15,76300000 | 21,74800000 | 18,90100000 |
| 0,00800800 | 124,87512488 | 2,16440000 | 6,75710000 | 9,97830000 | 12,78500000 | 15,44900000 | 21,31400000 | 18,52500000 |
| 0,00880880 | 113,52284080 | 1,83460000 | 6,61200000 | 9,76400000 | 12,51100000 | 15,11700000 | 20,85600000 | 18,12700000 |
| 0,00960960 | 104,06260406 | 2,97450000 | 6,46070000 | 9,54060000 | 12,22400000 | 14,77100000 | 20,37900000 | 17,71200000 |
| 0,01041000 | 96,06147935 | 3,26890000 | 6,30470000 | 9,31020000 | 11,92900000 | 14,41400000 | 19,88700000 | 17,28400000 |
| 0,01121100 | 89,19810900 | 2,90750000 | 6,14520000 | 9,07480000 | 11,62700000 | 14,05000000 | 19,38400000 | 16,84700000 |
| 0,01201200 | 83,25008325 | 3,46810000 | 5,98360000 | 8,83610000 | 11,32200000 | 13,68000000 | 18,87400000 | 16,40400000 |
| 0,01281300 | 78,04573480 | 4,67010000 | 5,82100000 | 8,59590000 | 11,01400000 | 13,30800000 | 18,36100000 | 15,95800000 |
| 0,01361400 | 73,45379756 | 5,51160000 | 5,65830000 | 8,35560000 | 10,70600000 | 12,93600000 | 17,84800000 | 15,51200000 |
| 0,01441400 | 69,37699459 | 6,35220000 | 5,49650000 | 8,11670000 | 10,40000000 | 12,56600000 | 17,33800000 | 15,06900000 |
| 0,01521500 | 65,72461387 | 6,62030000 | 5,33630000 | 7,88020000 | 10,09700000 | 12,20000000 | 16,83300000 | 14,63000000 |
| 0,01601600 | 62,43756244 | 4,86070000 | 5,17850000 | 7,64720000 | 9,79830000 | 11,84000000 | 16,33500000 | 14,19700000 |
| 0,01681700 | 59,46363799 | 2,57610000 | 5,02370000 | 7,41850000 | 9,50520000 | 11,48500000 | 15,84600000 | 13,77200000 |
| 0,01761800 | 56,76013168 | 2,73610000 | 4,87210000 | 7,19470000 | 9,21850000 | 11,13900000 | 15,36800000 | 13,35700000 |
| 0,01841800 | 54,29471170 | 4,88430000 | 4,72440000 | 6,97650000 | 8,93890000 | 10,80100000 | 14,90200000 | 12,95200000 |
| 0,01921900 | 52,03184349 | 5,75270000 | 4,58060000 | 6,76430000 | 8,66700000 | 10,47300000 | 14,44900000 | 12,55800000 |
| 0,02002000 | 49,95004995 | 4,98910000 | 4,44120000 | 6,55840000 | 8,40310000 | 10,15400000 | 14,00900000 | 12,17600000 |
| 0,02082100 | 48,02843283 | 3,75260000 | 4,30620000 | 6,35900000 | 8,14760000 | 9,84510000 | 13,58300000 | 11,80500000 |
| 0,02162200 | 46,24919064 | 2,95210000 | 4,17570000 | 6,16620000 | 7,90070000 | 9,54670000 | 13,17100000 | 11,44800000 |
| 0,02242200 | 44,59905450 | 2,27090000 | 4,04970000 | 5,98030000 | 7,66250000 | 9,25880000 | 12,77400000 | 11,10200000 |
| 0,02322300 | 43,06075873 | 1,59230000 | 3,92840000 | 5,80110000 | 7,43290000 | 8,98140000 | 12,39200000 | 10,77000000 |
| 0,02402400 | 41,62504163 | 1,59730000 | 3,81170000 | 5,62870000 | 7,21200000 | 8,71450000 | 12,02300000 | 10,45000000 |
| 0,02482500 | 40,28197382 | 3,05510000 | 3,69950000 | 5,46300000 | 6,99970000 | 8,45800000 | 11,66900000 | 10,14200000 |
| 0,02562600 | 39,02286740 | 5,95870000 | 3,59170000 | 5,30390000 | 6,79580000 | 8,21160000 | 11,32900000 | 9,84670000 |
| 0,02642600 | 37,84151972 | 8,72860000 | 3,48830000 | 5,15130000 | 6,60020000 | 7,97530000 | 11,00300000 | 9,56330000 |
| 0,02722700 | 36,72824770 | 9,89210000 | 3,38920000 | 5,00490000 | 6,41270000 | 7,74870000 | 10,69100000 | 9,29150000 |
| 0,02802800 | 35,67860711 | 10,26100000 | 3,29420000 | 4,86470000 | 6,23300000 | 7,53160000 | 10,39100000 | 9,03120000 |
| **0,02882900** | **34,68729404** | **10,44900000** | 3,20330000 | 4,73040000 | 6,06090000 | 7,32360000 | 10,10400000 | 8,78190000 |
| 0,02963000 | 33,74957813 | 9,36390000 | 3,11630000 | 4,60180000 | 5,89630000 | 7,12460000 | 9,82970000 | 8,54320000 |
| 0,03043000 | 32,86230693 | 7,13150000 | 3,03300000 | 4,47880000 | 5,73870000 | 6,93420000 | 9,56700000 | 8,31490000 |
| 0,03123100 | 32,01946784 | 5,16420000 | 2,95330000 | 4,36120000 | 5,58800000 | 6,75210000 | 9,31580000 | 8,09660000 |
| 0,03203200 | 31,21878122 | 3,29640000 | 2,87720000 | 4,24880000 | 5,44390000 | 6,57800000 | 9,07560000 | 7,88780000 |
| 0,03283300 | 30,45716200 | 1,66720000 | 2,80440000 | 4,14130000 | 5,30610000 | 6,41160000 | 8,84590000 | 7,68820000 |
| 0,03363400 | 29,73181899 | 2,12760000 | 2,73480000 | 4,03850000 | 5,17450000 | 6,25250000 | 8,62650000 | 7,49750000 |
| 0,03443400 | 29,04106406 | 3,72990000 | 2,66830000 | 3,94040000 | 5,04870000 | 6,10050000 | 8,41680000 | 7,31520000 |
| 0,03523500 | 28,38087129 | 3,36880000 | 2,60480000 | 3,84660000 | 4,92860000 | 5,95540000 | 8,21650000 | 7,14110000 |
| 0,03603600 | 27,75002775 | 2,57990000 | 2,54420000 | 3,75700000 | 4,81380000 | 5,81670000 | 8,02520000 | 6,97480000 |
| 0,03683700 | 27,14661889 | 4,98360000 | 2,48620000 | 3,67150000 | 4,70420000 | 5,68420000 | 7,84240000 | 6,81600000 |
| **0,03763800** | **26,56889314** | **8,27950000** | 2,43090000 | 3,58980000 | 4,59950000 | 5,55780000 | 7,66790000 | 6,66440000 |
| 0,03843800 | 26,01592174 | 8,22220000 | 2,37810000 | 3,51180000 | 4,49960000 | 5,43700000 | 7,50130000 | 6,51960000 |
| 0,03923900 | 25,48484926 | 4,50800000 | 2,32770000 | 3,43730000 | 4,40420000 | 5,32170000 | 7,34230000 | 6,38130000 |
| 0,04004000 | 24,97502498 | 3,65010000 | 2,27960000 | 3,36620000 | 4,31310000 | 5,21170000 | 7,19050000 | 6,24940000 |
| 0,04084100 | 24,48519870 | 3,94020000 | 2,23360000 | 3,29840000 | 4,22620000 | 5,10670000 | 7,04560000 | 6,12340000 |
| 0,04164200 | 24,01421642 | 3,76410000 | 2,18980000 | 3,23370000 | 4,14330000 | 5,00640000 | 6,90730000 | 6,00330000 |
| 0,04244200 | 23,56156637 | 2,88440000 | 2,14800000 | 3,17190000 | 4,06410000 | 4,91080000 | 6,77530000 | 5,88860000 |
| 0,04324300 | 23,12513008 | 2,30500000 | 2,10810000 | 3,11300000 | 3,98860000 | 4,81960000 | 6,64950000 | 5,77920000 |
| 0,04404400 | 22,70456816 | 1,65480000 | 2,07000000 | 3,05680000 | 3,91660000 | 4,73260000 | 6,52950000 | 5,67490000 |
| 0,04484500 | 22,29902999 | 1,17410000 | 2,03370000 | 3,00320000 | 3,84800000 | 4,64970000 | 6,41500000 | 5,57540000 |
| 0,04564600 | 21,90772466 | 1,40470000 | 1,99910000 | 2,95220000 | 3,78260000 | 4,57060000 | 6,30600000 | 5,48060000 |
| 0,04644600 | 21,53037937 | 1,84470000 | 1,96620000 | 2,90350000 | 3,72020000 | 4,49520000 | 6,20200000 | 5,39030000 |
| 0,04724700 | 21,16536500 | 2,55560000 | 1,93480000 | 2,85710000 | 3,66080000 | 4,42350000 | 6,10300000 | 5,30420000 |
| 0,04804800 | 20,81252081 | 2,75700000 | 1,90490000 | 2,81300000 | 3,60430000 | 4,35520000 | 6,00870000 | 5,22230000 |
| 0,04884900 | 20,47124813 | 1,75240000 | 1,87650000 | 2,77100000 | 3,55040000 | 4,29010000 | 5,91900000 | 5,14430000 |
| 0,04965000 | 20,14098691 | 1,03900000 | 1,84940000 | 2,73100000 | 3,49930000 | 4,22830000 | 5,83370000 | 5,07020000 |
| 0,05045000 | 19,82160555 | 2,23730000 | 1,82370000 | 2,69310000 | 3,45060000 | 4,16950000 | 5,75250000 | 4,99960000 |
| 0,05125100 | 19,51181440 | 3,06850000 | 1,79930000 | 2,65700000 | 3,40440000 | 4,11360000 | 5,67550000 | 4,93270000 |
| 0,05205200 | 19,21155767 | 2,33790000 | 1,77610000 | 2,62270000 | 3,36050000 | 4,06060000 | 5,60230000 | 4,86910000 |




| Amp | Phas | Period | R² | p |
|---|---|---|---|---|
| **0,25** | **-2,47** | **36,02** | 0,57473 | 0,00000000 |
| **0,24** | **-3,11** | **178,30** | | |
| **0,22** | **1,22** | **26,19** | | |
| 0,21 | 2,90 | 67,61 | | |
| **0,20** | **-2,40** | **13,48** | | |




Tab.A16 showing the data of the lomb periodogram and the sinusoidal function of B44.

**Log Files B44**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 8)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=C:\Results\nello\cotton\TDP 12-5\original
Filename Prefix=TDP 12-5
Number of Files= 1846
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.41
Object to Source (mm)=46.913
Camera to Source (mm)=364.000
Vertical Object Position (mm)=41.750
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.130
Frame Averaging=ON (3)
Random Movement=ON (5)
Use 360 Rotation=NO
FF updating interval=484
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Jan 23, 2013 17:14:30
Scan duration=01:34:11
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=TDP 12-5
Dataset Directory=C:\Users\Public\Briguglio\cotton\TDP 12-5\original
Output Directory=C:\Users\Public\Briguglio\cotton\TDP 12-5\original\TDP 12-5_Rec
Time and Date=Jan 23, 2013  17:59:55
First Section=505
Last Section=1946
Reconstruction duration per slice (seconds)=0.303745
Total reconstruction time (1442 slices) in seconds=438.000000
Postalignment=14.00
Section to Section Step=1
Sections Count=1442
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1528
Result Image Height (pixels)=1240
Pixel Size (um)=6.41412
Reconstruction Angular Range (deg)=239.98
Use 180+=OFF
Angular Step (deg)=0.1300
Smoothing=0
Ring Artifact Correction=23
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=1813
ROI Bottom (pixels)=573
ROI Left (pixels)=624
ROI Right (pixels)=2155
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=65
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0030
Maximum for CS to Image Conversion=0.0241
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.412216
Cone-beam Angle Vert.(deg)=17.412216
[File name convention]
Filename Index Length=4
Filename Prefix=TDP 12-5_IR_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Jan 23, 2013 18:05:26
Original configuration file=TDP 12-5_IR_rec.log
Conversion description=...COR. VOI(1099,500,1200) @ (152,460,223). Rotated(deg): (19.719, 33.218, 316.430).
Image scale modified=0
HU calibration modified=0

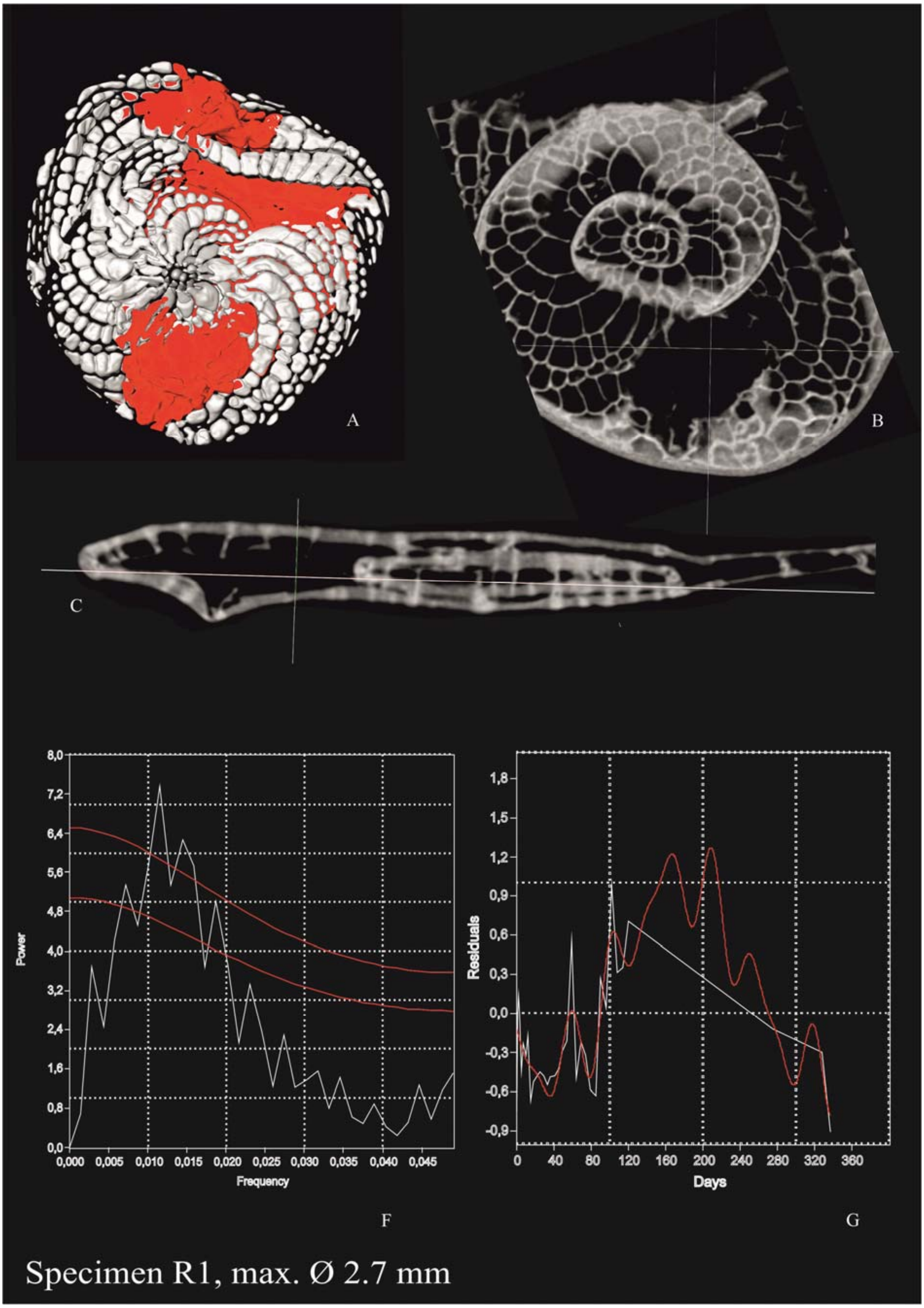
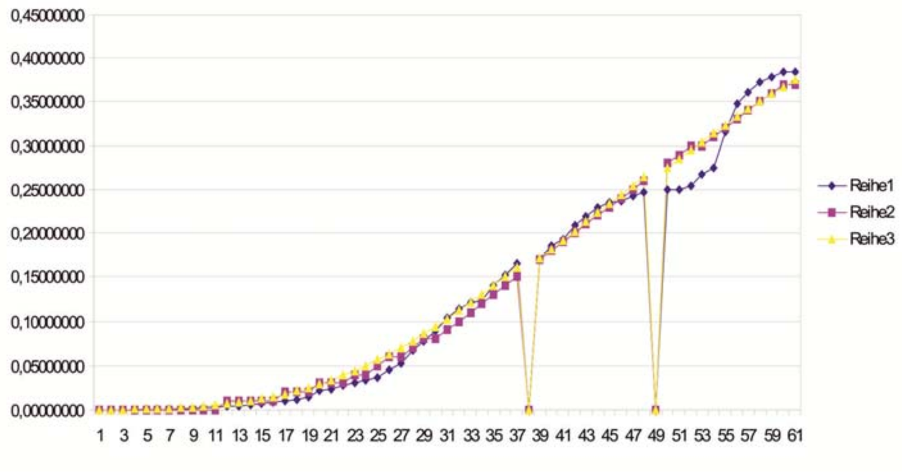



**Fig.A9 Specimen R1, gamont from Kiel, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.**

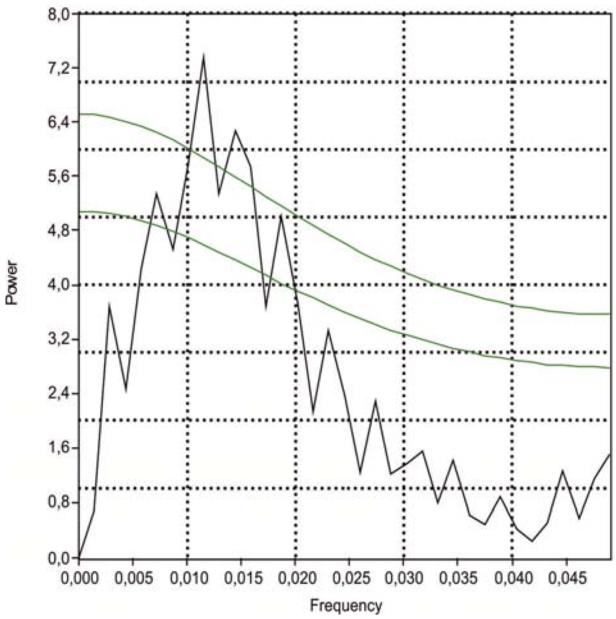
| days | chamber | Volume µm³ | volume mm³ | comul. Vol | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 65990,64725 | 0,00006599 | 0,00006599 | 0,00000000 | 0,00025994 | 0,00025994 | -0,74613581 | 0,00002200 | 0,00008665 | -0,74613581 |
| 0,33 | 4 | 116037,24550 | 0,00011604 | 0,00018203 | 0,00000000 | 0,00037839 | 0,00011844 | -0,02029225 | 0,00003868 | 0,00003948 | -0,02029225 |
| 1,15 | 5 | 183578,00863 | 0,00018358 | 0,00036561 | 0,00000000 | 0,00054080 | 0,00016241 | 0,13031483 | 0,00006119 | 0,00005414 | 0,13031483 |
| 2,39 | 6 | 219452,11888 | 0,00021945 | 0,00058506 | 0,00000000 | 0,00075958 | 0,00021878 | 0,00307516 | 0,00007315 | 0,00007293 | 0,00307516 |
| 4,00 | 7 | 160104,82538 | 0,00016010 | 0,00074516 | 0,00000000 | 0,00104933 | 0,00028976 | -0,44744929 | 0,00005337 | 0,00009659 | -0,44744929 |
| 5,98 | 8 | 288764,44300 | 0,00028876 | 0,00103393 | 0,00000000 | 0,00142696 | 0,00037762 | -0,23530790 | 0,00009625 | 0,00012587 | -0,23530790 |
| 8,29 | 9 | 327517,33988 | 0,00032752 | 0,00136144 | 0,00000000 | 0,00191160 | 0,00048464 | -0,32420820 | 0,00010917 | 0,00016155 | -0,32420820 |
| 10,94 | 10 | 504451,99475 | 0,00050445 | 0,00186590 | 0,00000000 | 0,00252458 | 0,00061298 | -0,17705521 | 0,00016815 | 0,00020433 | -0,17705521 |
| 13,90 | 11 | 251561,66200 | 0,00025156 | 0,00211746 | 0,00000000 | 0,00328921 | 0,00076463 | -0,67100012 | 0,00008385 | 0,00025488 | -0,67100012 |
| 17,17 | 12 | 447319,15250 | 0,00044732 | 0,00256478 | 0,00000000 | 0,00423048 | 0,00094127 | -0,52476978 | 0,00014911 | 0,00031376 | -0,52476978 |
| 20,75 | 13 | 590815,59350 | 0,00059082 | 0,00315559 | 0,00000000 | 0,00537473 | 0,00114425 | -0,48366746 | 0,00019694 | 0,00038142 | -0,48366746 |
| 24,62 | 14 | 752913,42500 | 0,00075291 | 0,00390851 | 0,01000000 | 0,00674922 | 0,00137449 | -0,45222304 | 0,00025097 | 0,00045816 | -0,45222304 |
| 28,78 | 15 | 841934,36525 | 0,00084193 | 0,00475044 | 0,01000000 | 0,00838160 | 0,00163238 | -0,48423050 | 0,00028064 | 0,00054413 | -0,48423050 |
| 33,23 | 16 | 865186,10338 | 0,00086519 | 0,00561563 | 0,01000000 | 0,01029942 | 0,00191782 | -0,54886885 | 0,00028840 | 0,00063927 | -0,54886885 |
| 37,96 | 17 | 1139113,72300 | 0,00113911 | 0,00675474 | 0,01000000 | 0,01252951 | 0,00223009 | -0,48920730 | 0,00037970 | 0,00074336 | -0,48920730 |
| 42,96 | 18 | 1337750,00013 | 0,00133775 | 0,00809249 | 0,01000000 | 0,01509746 | 0,00256795 | -0,47905991 | 0,00044592 | 0,00085598 | -0,47905991 |
| 48,24 | 19 | 1682097,16950 | 0,00168210 | 0,00977459 | 0,02000000 | 0,01802706 | 0,00292960 | -0,42582668 | 0,00056070 | 0,00097653 | -0,42582668 |
| 53,79 | 20 | 2341339,30663 | 0,00234134 | 0,01211593 | 0,02000000 | 0,02133976 | 0,00331270 | -0,29322308 | 0,00078045 | 0,00110423 | -0,29322308 |
| 59,60 | 21 | 2939241,14413 | 0,00293924 | 0,01505517 | 0,02000000 | 0,02505423 | 0,00371447 | -0,20870413 | 0,00097975 | 0,00123816 | -0,20870413 |
| 65,67 | 22 | 6404635,90525 | 0,00640464 | 0,02145980 | 0,03000000 | 0,02918593 | 0,00413170 | 0,55011947 | 0,00213488 | 0,00137723 | 0,55011947 |
| 72,01 | 23 | 2306793,86713 | 0,00230679 | 0,02376660 | 0,03000000 | 0,03374683 | 0,00456090 | -0,49422384 | 0,00076893 | 0,00152030 | -0,49422384 |
| 78,60 | 24 | 3905184,77938 | 0,00390518 | 0,02767178 | 0,03000000 | 0,03874512 | 0,00499829 | -0,21869526 | 0,00130173 | 0,00166610 | -0,21869526 |
| 85,45 | 25 | 3665581,15413 | 0,00366558 | 0,03133736 | 0,04000000 | 0,04418506 | 0,00543995 | -0,32617361 | 0,00122186 | 0,00181332 | -0,32617361 |
| 92,55 | 26 | 2415080,53325 | 0,00241508 | 0,03375244 | 0,04000000 | 0,05006696 | 0,00588190 | -0,58940459 | 0,00080503 | 0,00196063 | -0,58940459 |
| 99,89 | 27 | 2318530,45875 | 0,00231853 | 0,03607097 | 0,05000000 | 0,05638712 | 0,00632016 | -0,63315326 | 0,00077284 | 0,00210672 | -0,63315326 |
| 107,49 | 28 | 8566604,66063 | 0,00856660 | 0,04463758 | 0,06000000 | 0,06313798 | 0,00675086 | 0,26896582 | 0,00285553 | 0,00225029 | 0,26896582 |
| 115,33 | 29 | 7459379,03563 | 0,00745938 | 0,05209696 | 0,06000000 | 0,07030824 | 0,00717027 | 0,04032123 | 0,00248646 | 0,00239009 | 0,04032123 |
| 123,42 | 30 | 14983862,93800 | 0,01498386 | 0,06708082 | 0,07000000 | 0,07788315 | 0,00757490 | 0,97809351 | 0,00499462 | 0,00252497 | 0,97809351 |
| 131,74 | 31 | 10461510,59525 | 0,01046151 | 0,07754233 | 0,08000000 | 0,08584470 | 0,00796155 | 0,31400361 | 0,00348717 | 0,00265385 | 0,31400361 |
| 140,31 | 32 | 11244319,11213 | 0,01124432 | 0,08878665 | 0,08000000 | 0,09417203 | 0,00832734 | 0,35029022 | 0,00374811 | 0,00277578 | 0,35029022 |
| 149,12 | 33 | 14767289,60575 | 0,01476729 | 0,10355394 | 0,09000000 | 0,10284174 | 0,00866971 | 0,70332006 | 0,00492243 | 0,00288990 | 0,70332006 |
| 158,16 | 34 | 10543888,18175 | 0,01054389 | 0,11409783 | 0,10000000 | 0,11182826 | 0,00898651 | 0,17330126 | 0,00351463 | 0,00299550 | 0,17330126 |
| 167,44 | 35 | 7031325,60900 | 0,00703133 | 0,12112915 | 0,11000000 | 0,12110423 | 0,00927597 | -0,24198496 | 0,00234378 | 0,00309199 | -0,24198496 |
| 176,95 | 36 | 2080476,94938 | 0,00208048 | 0,12320963 | 0,12000000 | 0,13064092 | 0,00953669 | -0,78184491 | 0,00069349 | 0,00317890 | -0,78184491 |
| 186,69 | 37 | 16340878,66400 | 0,01634088 | 0,13955051 | 0,13000000 | 0,14040857 | 0,00976765 | 0,67295907 | 0,00544696 | 0,00325588 | 0,67295907 |
| 196,66 | 38 | 12533572,62988 | 0,01253357 | 0,15208408 | 0,14000000 | 0,15037678 | 0,00996821 | 0,25735436 | 0,00417786 | 0,00332274 | 0,25735436 |
| 206,86 | 39 | 13616882,18138 | 0,01361688 | 0,16570097 | 0,15000000 | 0,16051484 | 0,01013807 | 0,34314382 | 0,00453896 | 0,00337936 | 0,34314382 |
| 217,29 | | | | | | | | | | | |
| 227,95 | 40 | 3824135,86363 | 0,00382414 | 0,16952510 | 0,17000000 | 0,17079209 | 0,17079209 | -0,97760941 | 0,00127471 | 0,05693070 | -0,97760941 |
| 238,83 | 41 | 15690272,88675 | 0,01569027 | 0,18521537 | 0,18000000 | 0,18117814 | 0,01038605 | 0,51070602 | 0,00523009 | 0,00346202 | 0,51070602 |
| 249,94 | 42 | 7805497,76600 | 0,00780550 | 0,19302087 | 0,19000000 | 0,19164322 | 0,01046508 | -0,25413894 | 0,00260183 | 0,00348836 | -0,25413894 |
| 261,27 | 43 | 15933419,63400 | 0,01593342 | 0,20895429 | 0,20000000 | 0,20215837 | 0,01051515 | 0,51528215 | 0,00531114 | 0,00350505 | 0,51528215 |
| 272,82 | 44 | 10700449,88513 | 0,01070045 | 0,21965474 | 0,21000000 | 0,21269565 | 0,01053728 | 0,01548524 | 0,00356682 | 0,00351243 | 0,01548524 |
| 284,59 | 45 | 9174028,63850 | 0,00917403 | 0,22882877 | 0,22000000 | 0,22322831 | 0,01053266 | -0,12899214 | 0,00305801 | 0,00351089 | -0,12899214 |
| 296,58 | 46 | 6216186,10388 | 0,00621619 | 0,23504496 | 0,23000000 | 0,23373094 | 0,01050263 | -0,40813053 | 0,00207206 | 0,00350088 | -0,40813053 |
| 308,79 | 47 | 1740558,68250 | 0,00174056 | 0,23678551 | 0,24000000 | 0,24417958 | 0,01044864 | -0,83341767 | 0,00058019 | 0,00348288 | -0,83341767 |
| 321,22 | 48 | 6019542,83288 | 0,00601954 | 0,24280506 | 0,25000000 | 0,25455180 | 0,01037222 | -0,41964758 | 0,00200651 | 0,00345741 | -0,41964758 |
| 333,87 | 49 | 4337002,77313 | 0,00433700 | 0,24714206 | 0,26000000 | 0,26482676 | 0,01027496 | -0,57790575 | 0,00144567 | 0,00342499 | -0,57790575 |
| 346,73 | 50 | 2192749,62775 | 0,00219275 | 0,24933481 | 0,28000000 | 0,27498526 | 0,27498526 | -0,99202594 | 0,00073092 | 0,09166175 | -0,99202594 |
| 359,80 | 51 | 1135127,71075 | 0,00113513 | 0,25046994 | 0,29000000 | 0,28500972 | 0,01002447 | -0,88676426 | 0,00037838 | 0,00334149 | -0,88676426 |
| 373,09 | 52 | 3877061,24850 | 0,00387706 | 0,25434700 | 0,30000000 | 0,29488423 | 0,00987451 | -0,60736653 | 0,00129235 | 0,00329150 | -0,60736653 |
| 386,60 | 53 | 12658689,12550 | 0,01265869 | 0,26700569 | 0,30000000 | 0,30459446 | 0,00971024 | 0,30364381 | 0,00421956 | 0,00323675 | 0,30364381 |
| 400,31 | 54 | 8393656,01800 | 0,00839366 | 0,27539934 | 0,31000000 | 0,31412771 | 0,00953324 | -0,11953811 | 0,00279789 | 0,00317775 | -0,11953811 |
| 414,24 | 55 | 40709807,44463 | 0,04070981 | 0,31610915 | 0,32000000 | 0,32347277 | 0,00934506 | 3,35629162 | 0,01356994 | 0,00311502 | 3,35629162 |
| 428,38 | 56 | 31473774,17113 | 0,03147377 | 0,34758293 | 0,33000000 | 0,33261994 | 0,00914717 | 2,44081962 | 0,01049126 | 0,00304906 | 2,44081962 |
| 442,72 | 57 | 13966322,58863 | 0,01396632 | 0,36154925 | 0,34000000 | 0,34156094 | 0,00894100 | 0,56205375 | 0,00465544 | 0,00298033 | 0,56205375 |
| 457,28 | 58 | 10941825,07138 | 0,01094183 | 0,37249107 | 0,35000000 | 0,35028883 | 0,00872789 | 0,25366242 | 0,00364728 | 0,00290930 | 0,25366242 |
| 472,04 | 59 | 5339484,85400 | 0,00533948 | 0,37783056 | 0,36000000 | 0,35879794 | 0,00850911 | -0,37249795 | 0,00177983 | 0,00283637 | -0,37249795 |
| 487,02 | 60 | 5766431,05500 | 0,00576643 | 0,38359699 | 0,37000000 | 0,36708381 | 0,00828587 | -0,30406426 | 0,00192214 | 0,00276196 | -0,30406426 |
| 499,47 | 61 | 705524,16825 | 0,00070552 | 0,38430251 | 0,37000000 | 0,37514308 | 0,00805927 | -0,91245808 | 0,00023517 | 0,00268642 | -0,91245808 |

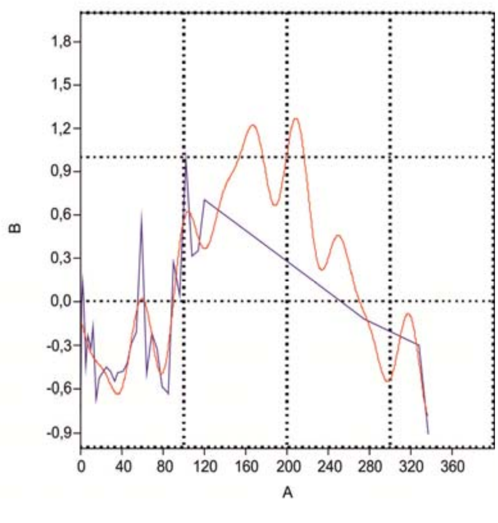



Tab.A17 showing raw data and the consensus of the cumulative sum, and the Gompertz function of R1.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 2,23E-31 | #DIV/0! | 3,4431 | 5,0844 | 6,5146 | 7,8718 | 10,861 | 7,5595 |
| 0,001442 | 0,69354 | 693,4813 | 3,437 | 5,0755 | 6,5032 | 7,858 | 10,842 | 7,5462 |
| 0,0028841 | 3,6802 | 346,7286 | 3,419 | 5,0489 | 6,4691 | 7,8168 | 10,785 | 7,5067 |
| 0,0043261 | 2,451 | 231,1551 | 3,3896 | 5,0054 | 6,4134 | 7,7495 | 10,692 | 7,442 |
| 0,0057681 | 4,2267 | 173,3673 | 3,3495 | 4,9463 | 6,3376 | 7,658 | 10,566 | 7,3542 |
| **0,0072101** | **5,3474** | **138,6943** | 3,3 | 4,8732 | 6,2439 | 7,5447 | 10,409 | 7,2454 |
| 0,0086522 | 4,52 | 115,5775 | 3,2422 | 4,7879 | 6,1346 | 7,4127 | 10,227 | 7,1186 |
| 0,010094 | 5,7913 | 99,0688 | 3,1776 | 4,6925 | 6,0124 | 7,265 | 10,023 | 6,9767 |
| **0,011536** | **7,3642** | **86,6852** | 3,1076 | 4,5891 | 5,8799 | 7,1049 | 9,8025 | 6,8231 |
| 0,012978 | 5,349 | 77,0535 | 3,0337 | 4,4799 | 5,74 | 6,9358 | 9,5692 | 6,6607 |
| **0,01442** | **6,2735** | **69,3481** | 2,9571 | 4,3668 | 5,5951 | 6,7608 | 9,3277 | 6,4925 |
| 0,015862 | 5,7356 | 63,0438 | 2,8792 | 4,2517 | 5,4477 | 6,5826 | 9,0819 | 6,3214 |
| 0,017304 | 3,6887 | 57,7901 | 2,801 | 4,1363 | 5,2998 | 6,4039 | 8,8353 | 6,1498 |
| **0,018746** | **4,9989** | **53,3447** | 2,7236 | 4,0219 | 5,1533 | 6,2269 | 8,5911 | 5,9798 |
| 0,020188 | 3,7223 | 49,5344 | 2,6477 | 3,9099 | 5,0097 | 6,0534 | 8,3518 | 5,8132 |
| 0,02163 | 2,139 | 46,2321 | 2,5741 | 3,8012 | 4,8704 | 5,8851 | 8,1196 | 5,6516 |
| **0,023072** | **3,3165** | **43,3426** | 2,5033 | 3,6967 | 4,7365 | 5,7232 | 7,8962 | 5,4962 |
| 0,024514 | 2,36 | 40,7930 | 2,44E+00 | 3,5969 | 4,6086 | 5,5687 | 7,6831 | 5,3478 |
| 0,025957 | 1,2418 | 38,5253 | 2,3717 | 3,5023 | 4,4875 | 5,4224 | 7,4811 | 5,2072 |
| 0,027399 | 2,278 | 36,4977 | 2,3115 | 3,4134 | 4,3735 | 5,2846 | 7,2911 | 5,075 |
| 0,028841 | 1,2278 | 34,6729 | 2,2552 | 3,3302 | 4,267 | 5,1559 | 7,1135 | 4,9514 |
| 0,030283 | 1,3864 | 33,0218 | 2,2029 | 3,253 | 4,1681 | 5,0364 | 6,9487 | 4,8366 |
| 0,031725 | 1,5534 | 31,5209 | 2,1547 | 3,1819 | 4,0769 | 4,9263 | 6,7967 | 4,7308 |
| 0,033167 | 0,80564 | 30,1505 | 2,1106 | 3,1168 | 3,9935 | 4,8255 | 6,6576 | 4,6341 |
| 0,034609 | 1,4318 | 28,8942 | 2,0706 | 3,0577 | 3,9178 | 4,734 | 6,5315 | 4,5462 |
| 0,036051 | 0,6314 | 27,7385 | 2,0347 | 3,0046 | 3,8498 | 4,6518 | 6,418 | 4,4673 |
| 0,037493 | 0,48586 | 26,6716 | 2,0027 | 2,9574 | 3,7893 | 4,5787 | 6,3172 | 4,3971 |
| 0,038935 | 0,88141 | 25,6838 | 1,9747 | 2,916 | 3,7363 | 4,5146 | 6,2288 | 4,3355 |
| 0,040377 | 0,42381 | 24,7666 | 1,9505 | 2,8804 | 3,6906 | 4,4594 | 6,1526 | 4,2825 |
| 0,041819 | 0,24173 | 23,9126 | 1,9302 | 2,8503 | 3,6521 | 4,413 | 6,0885 | 4,2379 |
| 0,043261 | 0,51228 | 23,1155 | 1,9136 | 2,8259 | 3,6208 | 4,3751 | 6,0363 | 4,2015 |
| 0,044703 | 1,2571 | 22,3699 | 1,9008 | 2,807 | 3,5965 | 4,3458 | 5,9958 | 4,1734 |
| 0,046145 | 0,58608 | 21,6708 | 1,8917 | 2,7935 | 3,5792 | 4,3249 | 5,967 | 4,1533 |
| 0,047587 | 1,1638 | 21,0141 | 1,8862 | 2,7854 | 3,5689 | 4,3124 | 5,9497 | 4,1413 |
| 0,049029 | 1,5014 | 20,3961 | 1,8844 | 2,7827 | 3,5654 | 4,3082 | 5,944 | 4,1373 |

| Amp | Phas | Period | R² | p |
|---|---|---|---|---|
| 0,741 | -2,45 | 290,1 | 0,87033 | 0,00000000 |
| 0,246 | 0,216 | 52 | | |
| 0,16 | -2,11 | 37 | | |




Tab.A18 showing the data of the lomb periodogram and the sinusoidal function of R1.

**Log File R1**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 8)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=\\CLUSTER-PC-1\Users\Public\Briguglio\cotton\TDP 17-3\original
Filename Prefix=TDP17-3
Number of Files= 2000
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.06
Object to Source (mm)=44.313
Camera to Source (mm)=364.000
Vertical Object Position (mm)=42.475
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.120
Frame Averaging=ON (3)
Random Movement=ON (5)
Use 360 Rotation=NO
FF updating interval=484
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Nov 08, 2012 13:58:22
Scan duration=02:08:10
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=TDP17-3
Dataset Directory=C:\Users\Public\Briguglio\cotton\depressa1\original
Output Directory=C:\Users\Public\Briguglio\cotton\depressa1\original\TDP17-3_Rec
Time and Date=Nov 29, 2012  17:50:53
First Section=1047
Last Section=1871
Reconstruction duration per slice (seconds)=0.420606
Total reconstruction time (825 slices) in seconds=347.000000
Postalignment=19.00
Section to Section Step=1
Sections Count=825
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1268
Result Image Height (pixels)=688
Pixel Size (um)=6.05771
Reconstruction Angular Range (deg)=240.00
Use 180+=OFF
Angular Step (deg)=0.1200
Smoothing=0
Ring Artifact Correction=23
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=1370
ROI Bottom (pixels)=681
ROI Left (pixels)=109
ROI Right (pixels)=1380
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=30
CS Static Rotation (deg)=49.0
Minimum for CS to Image Conversion=0.0021
Maximum for CS to Image Conversion=0.0273
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.409575
Cone-beam Angle Vert.(deg)=17.409575
[File name convention]
Filename Index Length=4
Filename Prefix=TDP17-3_IR_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Nov 29, 2012  18:15:00
Original configuration file=TDP17-3_IR_rec.log
Conversion description=...COR. VOI(714,120,600) @ (301,239,55). Rotated(deg): (0.000, 36.404, 0.000).
Image scale modified=0
HU calibration modified=0

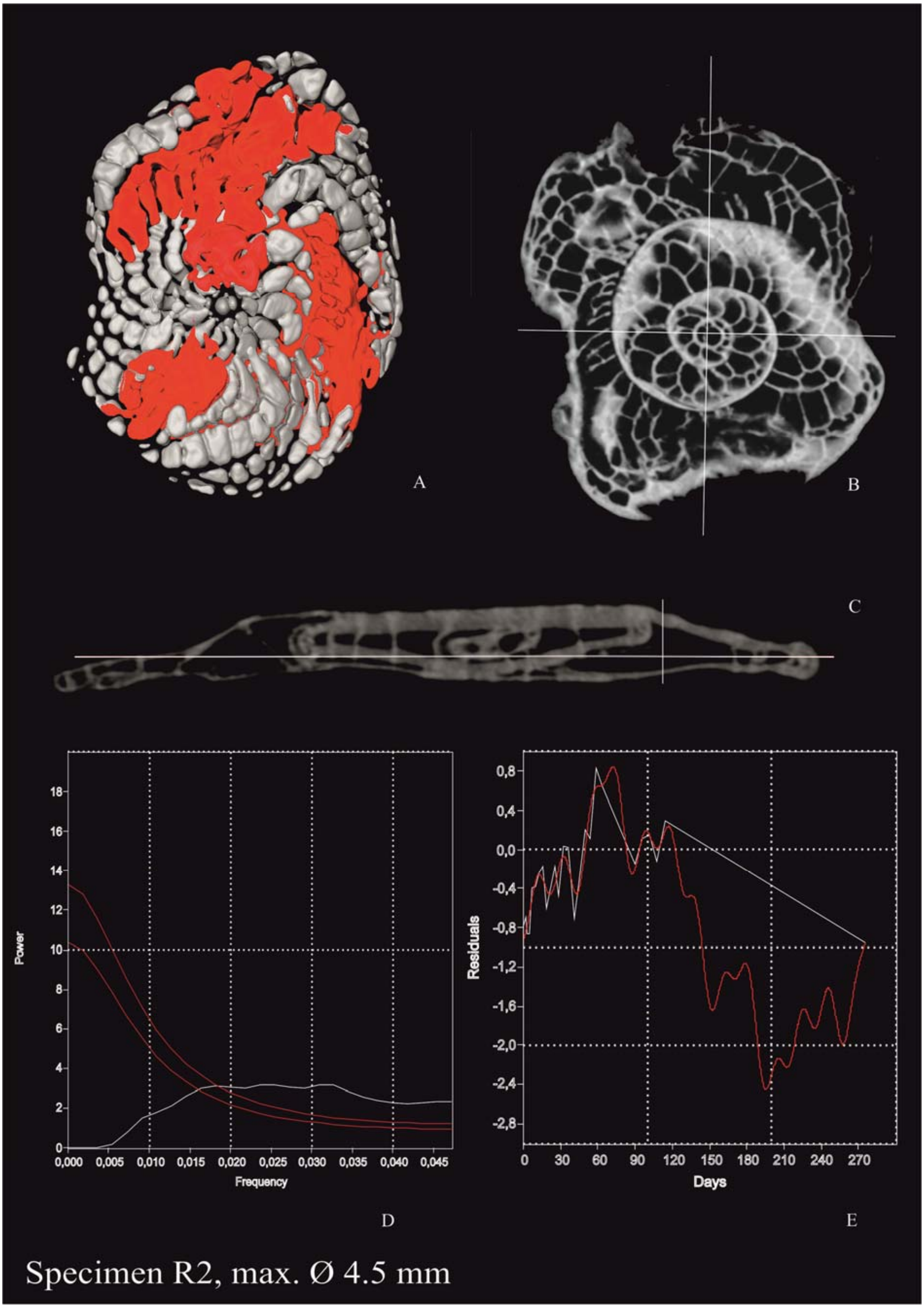
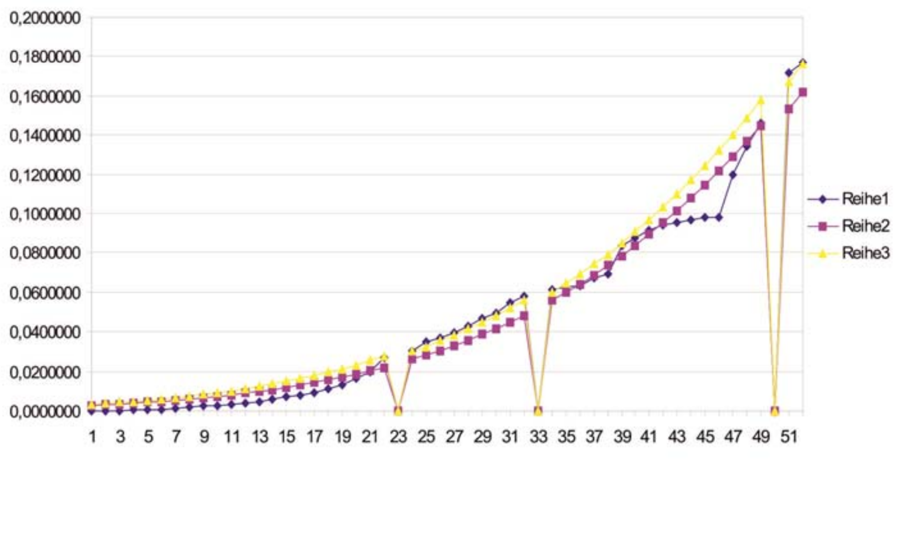



Fig.A10 Specimen R2, gamont from Kiel, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

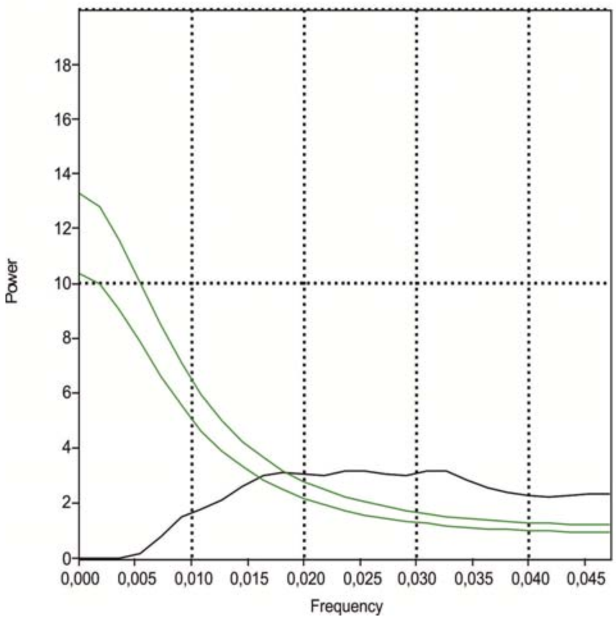
| days | chamber | Volume | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 46503,4727 | 0,0000465 | 0,0000465 | 0,00277910 | 0,00350067 | 0,00350067 | -0,98671583 | 0,00001550 | 0,00116689 | -0,98671583 |
| 0,33 | 4 | 89906,7188 | 0,0000899 | 0,0001364 | 0,0031133 | 0,00392229 | 0,00042162 | -0,78675877 | 0,00002997 | 0,00014054 | -0,78675877 |
| 1,15 | 5 | 141281,984 | 0,0001413 | 0,0002777 | 0,003482 | 0,00438725 | 0,00046497 | -0,69614507 | 0,00004709 | 0,00015499 | -0,69614507 |
| 2,39 | 6 | 71969,6641 | 0,0000720 | 0,0003497 | 0,0038881 | 0,00489916 | 0,00051191 | -0,85940850 | 0,00002399 | 0,00017064 | -0,85940850 |
| 4,00 | 7 | 75512,7813 | 0,0000755 | 0,0004252 | 0,0043347 | 0,00546181 | 0,00056265 | -0,86579185 | 0,00002517 | 0,00018755 | -0,86579185 |
| 5,98 | 8 | 370477,688 | 0,0003705 | 0,0007957 | 0,004825 | 0,00607924 | 0,00061743 | -0,39996386 | 0,00012349 | 0,00020581 | -0,39996386 |
| 8,29 | 9 | 419195,594 | 0,0004192 | 0,0012148 | 0,0053624 | 0,00675568 | 0,00067644 | -0,38029286 | 0,00013973 | 0,00022548 | -0,38029286 |
| 10,94 | 10 | 565127,938 | 0,0005651 | 0,0017800 | 0,0059506 | 0,00749561 | 0,00073993 | -0,23623782 | 0,00018838 | 0,00024664 | -0,23623782 |
| 13,90 | 11 | 667878,438 | 0,0006679 | 0,0024479 | 0,0065934 | 0,00830372 | 0,00080811 | -0,17352962 | 0,00022263 | 0,00026937 | -0,17352962 |
| 17,17 | 12 | 345897,281 | 0,0003459 | 0,0027938 | 0,0072949 | 0,00918494 | 0,00088122 | -0,60747949 | 0,00011530 | 0,00029374 | -0,60747949 |
| 20,75 | 13 | 552948,438 | 0,0005529 | 0,0033467 | 0,0080592 | 0,01014443 | 0,00095949 | -0,42370866 | 0,00018432 | 0,00031983 | -0,42370866 |
| 24,62 | 14 | 858321,25 | 0,0008583 | 0,0042050 | 0,0088908 | 0,01118760 | 0,00104317 | -0,17719541 | 0,00028611 | 0,00034772 | -0,17719541 |
| 28,78 | 15 | 600780,625 | 0,0006008 | 0,0048058 | 0,0097944 | 0,01232007 | 0,00113247 | -0,46949479 | 0,00020026 | 0,00037749 | -0,46949479 |
| 33,23 | 16 | 1271095 | 0,0012711 | 0,0060769 | 0,0107747 | 0,01354771 | 0,00122764 | 0,03539640 | 0,00042370 | 0,00040921 | 0,03539640 |
| 37,96 | 17 | 1360115,88 | 0,0013601 | 0,0074370 | 0,0118368 | 0,01487663 | 0,00132892 | 0,02347709 | 0,00045337 | 0,00044297 | 0,02347709 |
| 42,96 | 18 | 425617,5 | 0,0004256 | 0,0078626 | 0,0129859 | 0,01631316 | 0,00143653 | -0,70371837 | 0,00014187 | 0,00047884 | -0,70371837 |
| 48,24 | 19 | 1051200 | 0,0010512 | 0,0089138 | 0,0142276 | 0,01786387 | 0,00155071 | -0,32211813 | 0,00035040 | 0,00051690 | -0,32211813 |
| 53,79 | 20 | 2003414 | 0,0020034 | 0,0109172 | 0,0155675 | 0,01953556 | 0,00167169 | 0,19843434 | 0,00066780 | 0,00055723 | 0,19843434 |
| 59,60 | 21 | 2007400 | 0,0020074 | 0,0129246 | 0,0170115 | 0,02133526 | 0,00179970 | 0,11541114 | 0,00066913 | 0,00059990 | 0,11541114 |
| 65,67 | 22 | 3545336,25 | 0,0035453 | 0,0164700 | 0,0185656 | 0,02327020 | 0,00193494 | 0,83227216 | 0,00118178 | 0,00064498 | 0,83227216 |
| 72,01 | 23 | 3415791 | 0,0034158 | 0,0198858 | 0,0202361 | 0,02534784 | 0,00207764 | 0,64407174 | 0,00113860 | 0,00069255 | 0,64407174 |
| 78,60 | 24 | 7086686,5 | 0,0070867 | 0,0269725 | 0,0220296 | 0,02757584 | 0,00222801 | 2,18072876 | 0,00236223 | 0,00074267 | 2,18072876 |
| 85,45 | | | | | | | | | | | |
| 92,55 | 25 | 3590954 | 0,0035910 | 0,0305634 | 0,0260121 | 0,02996208 | 0,00238624 | 0,50485938 | 0,00119698 | 0,00079541 | 0,50485938 |
| 99,89 | 26 | 4417608,5 | 0,0044176 | 0,0349810 | 0,028215 | 0,03251461 | 0,00255253 | 0,73067899 | 0,00147254 | 0,00085084 | 0,73067899 |
| 107,49 | 27 | 1912178,5 | 0,0019122 | 0,0368932 | 0,0305686 | 0,03524167 | 0,00272706 | -0,29881365 | 0,00063739 | 0,00090902 | -0,29881365 |
| 115,33 | 28 | 2473320,5 | 0,0024733 | 0,0393665 | 0,0330803 | 0,03815168 | 0,00291001 | -0,15006496 | 0,00082444 | 0,00097000 | -0,15006496 |
| 123,42 | 29 | 3434835,25 | 0,0034348 | 0,0428014 | 0,0357575 | 0,04125323 | 0,00310154 | 0,10746073 | 0,00114495 | 0,00103385 | 0,10746073 |
| 131,74 | 30 | 3797340,75 | 0,0037973 | 0,0465987 | 0,0386081 | 0,04455503 | 0,00330180 | 0,15008029 | 0,00126578 | 0,00110060 | 0,15008029 |
| 140,31 | 31 | 3071886,5 | 0,0030719 | 0,0496706 | 0,0416398 | 0,04806597 | 0,00351094 | -0,12505363 | 0,00102396 | 0,00117031 | -0,12505363 |
| 149,12 | 32 | 4807352 | 0,0048074 | 0,0544779 | 0,0448605 | 0,05179506 | 0,00372908 | 0,28915134 | 0,00160245 | 0,00124303 | 0,28915134 |
| 158,16 | 33 | 3706548,25 | 0,0037065 | 0,0581845 | 0,0482785 | 0,05575140 | 0,00395634 | -0,06313711 | 0,00123552 | 0,00131878 | -0,06313711 |
| 167,44 | | | | | | | | | | | |
| 176,95 | 34 | 3124812 | 0,0031248 | 0,0613093 | 0,0557388 | 0,05994421 | 0,00419282 | -0,25472232 | 0,00104160 | 0,00139761 | -0,25472232 |
| 186,69 | 35 | 1128262,88 | 0,0011283 | 0,0624376 | 0,0597979 | 0,06438281 | 0,00443860 | -0,74580637 | 0,00037609 | 0,00147953 | -0,74580637 |
| 196,66 | 36 | 899288,625 | 0,0008993 | 0,0633368 | 0,0640876 | 0,06907656 | 0,00469375 | -0,80840733 | 0,00029976 | 0,00156458 | -0,80840733 |
| 206,86 | 37 | 3479345,75 | 0,0034793 | 0,0668162 | 0,0686163 | 0,07403490 | 0,00495834 | -0,29828438 | 0,00115978 | 0,00165278 | -0,29828438 |
| 217,29 | 38 | 2443868,25 | 0,0024439 | 0,0692601 | 0,0733927 | 0,07926731 | 0,00523240 | -0,53293574 | 0,00081462 | 0,00174413 | -0,53293574 |
| 227,95 | 39 | 14073280 | 0,0140733 | 0,0833333 | 0,0784254 | 0,08478326 | 0,00551596 | 1,55137489 | 0,00469109 | 0,00183865 | 1,55137489 |
| 238,83 | 40 | 3838308,25 | 0,0038383 | 0,0871716 | 0,083723 | 0,09059228 | 0,00580902 | -0,33925014 | 0,00127944 | 0,00193634 | -0,33925014 |
| 249,94 | 41 | 3950138 | 0,0039501 | 0,0911218 | 0,0892941 | 0,09670385 | 0,00611157 | -0,35366237 | 0,00131671 | 0,00203719 | -0,35366237 |
| 261,27 | 42 | 3221583,5 | 0,0032216 | 0,0943434 | 0,0951475 | 0,10312744 | 0,00642359 | -0,49847597 | 0,00107386 | 0,00214120 | -0,49847597 |
| 272,82 | 43 | 901060,188 | 0,0009011 | 0,0952444 | 0,1012918 | 0,10987247 | 0,00674503 | -0,86641114 | 0,00030035 | 0,00224834 | -0,86641114 |
| 284,59 | 44 | 1725721,75 | 0,0017257 | 0,0969702 | 0,1077354 | 0,11694829 | 0,00707582 | -0,75611002 | 0,00057524 | 0,00235861 | -0,75611002 |
| 296,58 | 45 | 776165,125 | 0,0007762 | 0,0977463 | 0,1144871 | 0,12436418 | 0,00741589 | -0,89533762 | 0,00025872 | 0,00247196 | -0,89533762 |
| 308,79 | 46 | 368927,563 | 0,0003689 | 0,0981152 | 0,1215551 | 0,13212933 | 0,00776515 | -0,95248931 | 0,00012298 | 0,00258838 | -0,95248931 |
| 321,22 | 47 | 21587134 | 0,0215871 | 0,1197024 | 0,128948 | 0,14025280 | 0,00812347 | 1,65737886 | 0,00719571 | 0,00270782 | 1,65737886 |
| 333,87 | 48 | 14595226 | 0,0145952 | 0,1342976 | 0,136674 | 0,14874352 | 0,00849072 | 0,71896179 | 0,00486508 | 0,00283024 | 0,71896179 |
| 346,73 | 49 | 11489015 | 0,0114890 | 0,1457866 | 0,1447414 | 0,15761028 | 0,00886676 | 0,29574028 | 0,00382967 | 0,00295559 | 0,29574028 |
| 368,25 | 50 | 26013600 | 0,0260136 | 0,1718002 | 0,1531581 | 0,16686169 | 0,00925141 | 1,81185255 | 0,00867120 | 0,00308380 | 1,81185255 |
| 380,02 | 51 | 5062235,5 | 0,0050622 | 0,1768625 | 0,161932 | 0,17650618 | 0,00964449 | -0,47511653 | 0,00168741 | 0,00321483 | -0,47511653 |

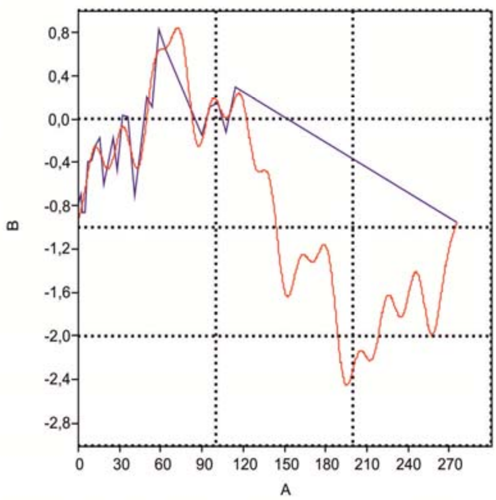



Tab.A19 showing raw data and the consensus of the cumulative sum, and the Gompertz function of R2.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 8,01E-31 | #DIV/0! | 7,014 | 10,358 | 13,271 | 16,036 | 22,124 | 14,329 |
| 0,0018164 | 0,0011951 | 550,53953 | 6,7703 | 9,9979 | 12,81 | 15,479 | 21,356 | 13,832 |
| 0,0036328 | 0,024332 | 275,26976 | 6,1342 | 9,0584 | 11,606 | 14,024 | 19,349 | 12,532 |
| 0,0054493 | 0,18013 | 183,50981 | 5,3106 | 7,8422 | 10,048 | 12,141 | 16,751 | 10,849 |
| 0,0072657 | 0,7702 | 137,63299 | 4,4807 | 6,6167 | 8,4778 | 10,244 | 14,134 | 9,1539 |
| 0,0090821 | 1,4914 | 110,10669 | 3,7433 | 5,5278 | 7,0826 | 8,56E+00 | 11,808 | 7,6475 |
| 0,010899 | 1,7808 | 91,751537 | 3,1294 | 4,6212 | 5,921 | 7,1546 | 9,871 | 6,3932 |
| 0,012715 | 2,1184 | 78,647267 | 2,634 | 3,8897 | 4,9838 | 6,0221 | 8,3086 | 5,3813 |
| 0,014531 | 2,6066 | 68,818388 | 2,2394 | 3,307 | 4,2372 | 5,12 | 7,0639 | 4,5751 |
| 0,016348 | 2,9841 | 61,169562 | 1,9258 | 2,8438 | 3,6438 | 4,4029 | 6,0746 | 3,9344 |
| 0,018164 | **3,1029** | **55,053953** | 1,6757 | 2,4746 | 3,1706 | 3,8311 | 5,2858 | 3,4235 |
| 0,019981 | 3,0327 | 50,047545 | 1,4752 | 2,1784 | 2,7911 | 3,3726 | 4,6531 | 3,0137 |
| 0,021797 | 3,0258 | 45,877873 | 1,3132 | 1,9393 | 2,4847 | 3,0024 | 4,1424 | 2,6829 |
| 0,023613 | 3,1635 | 42,349553 | 1,1816 | 1,7449 | 2,2357 | 2,7015 | 3,7272 | 2,414 |
| 0,02543 | **3,1876** | **39,323634** | 1,074 | 1,5859 | 2,032 | 2,4554 | 3,3876 | 2,1941 |
| 0,027246 | 3,033 | 36,702635 | 0,98549 | 1,4553 | 1,8646 | 2,2531 | 3,1086 | 2,0133 |
| 0,029063 | 3,0202 | 34,40801 | 0,91253 | 1,3475 | 1,7266 | 2,0863 | 2,8784 | 1,8643 |
| 0,030879 | 3,1803 | 32,384468 | 0,85226 | 1,2585 | 1,6126 | 1,9485 | 2,6883 | 1,7412 |
| 0,032696 | 3,1527 | 30,584781 | 0,80252 | 1,1851 | 1,5184 | 1,8348 | 2,5314 | 1,6395 |
| 0,034512 | 2,857 | 28,975429 | 0,76163 | 1,1247 | 1,4411 | 1,7413 | 2,4024 | 1,556 |
| 0,036328 | 2,5689 | 27,526976 | 0,7283 | 1,0755 | 1,378 | 1,6651 | 2,2973 | 1,4879 |
| 0,038145 | 2,4008 | 26,215756 | 0,70152 | 1,0359 | 1,3273 | 1,6039 | 2,2128 | 1,4332 |
| 0,039961 | 2,2833 | 25,024399 | 0,68053 | 1,005 | 1,2876 | 1,5559 | 2,1466 | 1,3903 |
| 0,041778 | 2,2247 | 23,936043 | 0,66476 | 0,98165 | 1,2578 | 1,5198 | 2,0969 | 1,3581 |
| 0,043594 | 2,2734 | 22,938937 | 0,65377 | 0,96543 | 1,237 | 1,4947 | 2,0622 | 1,3356 |
| 0,045411 | **2,3506** | **22,021096** | 0,64729 | 0,95585 | 1,2247 | 1,4799 | 2,0418 | 1,3224 |
| 0,047227 | 2,3227 | 21,174328 | 0,64514 | 0,95269 | 1,2207 | 1,475 | 2,035 | 1,318 |

| Amp | Phas | Period | $R^2$ | p |
|---|---|---|---|---|
| 1,13 | 1,75 | 275,3 | 0,92823 | 0,0000 |
| **0,3** | **1,23** | **55,05** | | |
| **0,155** | **-2,56** | **21,32** | | |




Tab.A20 showing the data of the lomb periodogram and the sinusoidal function of R2.

**Log Files R2**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 8)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=\\CLUSTER-PC-1\Users\Public\Briguglio\cotton\TDP 17-4\original
Filename Prefix=TDP17-3
Number of Files= 1600
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.06
Object to Source (mm)=44.313
Camera to Source (mm)=364.000
Vertical Object Position (mm)=39.595
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.150
Frame Averaging=ON (3)
Random Movement=ON (5)
Use 360 Rotation=NO
FF updating interval=484
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Nov 08, 2012 16:00:02
Scan duration=01:42:31
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=TDP17-3
Dataset Directory=C:\Users\Public\Briguglio\cotton\depressa2\original
Output Directory=C:\Users\Public\Briguglio\cotton\depressa2\original\TDP17-3_Rec
Time and Date=Nov 29, 2012 18:33:43
First Section=1483
Last Section=2160
Reconstruction duration per slice (seconds)=0.194690
Total reconstruction time (678 slices) in seconds=132.000000
Postalignment=19.00
Section to Section Step=1
Sections Count=678
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1256
Result Image Height (pixels)=588
Pixel Size (um)=6.05771
Reconstruction Angular Range (deg)=240.00
Use 180+=OFF
Angular Step (deg)=0.1500
Smoothing=0
Ring Artifact Correction=29
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=1152
ROI Bottom (pixels)=562
ROI Left (pixels)=236
ROI Right (pixels)=1493
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=28
CS Static Rotation (deg)=41.0
Minimum for CS to Image Conversion=0.0024
Maximum for CS to Image Conversion=0.0325
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.409575
Cone-beam Angle Vert.(deg)=17.409575
[File name convention]
Filename Index Length=4
Filename Prefix=TDP17-3_IR_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Nov 29, 2012  19:27:00
Original configuration file=TDP17-3_IR_rec.log
Conversion description=...COR. VOI(475,113,515) @ (360,230,40). Rotated(deg): (0.000, 335.886, 2.819).
Image scale modified=0
HU calibration modified=0

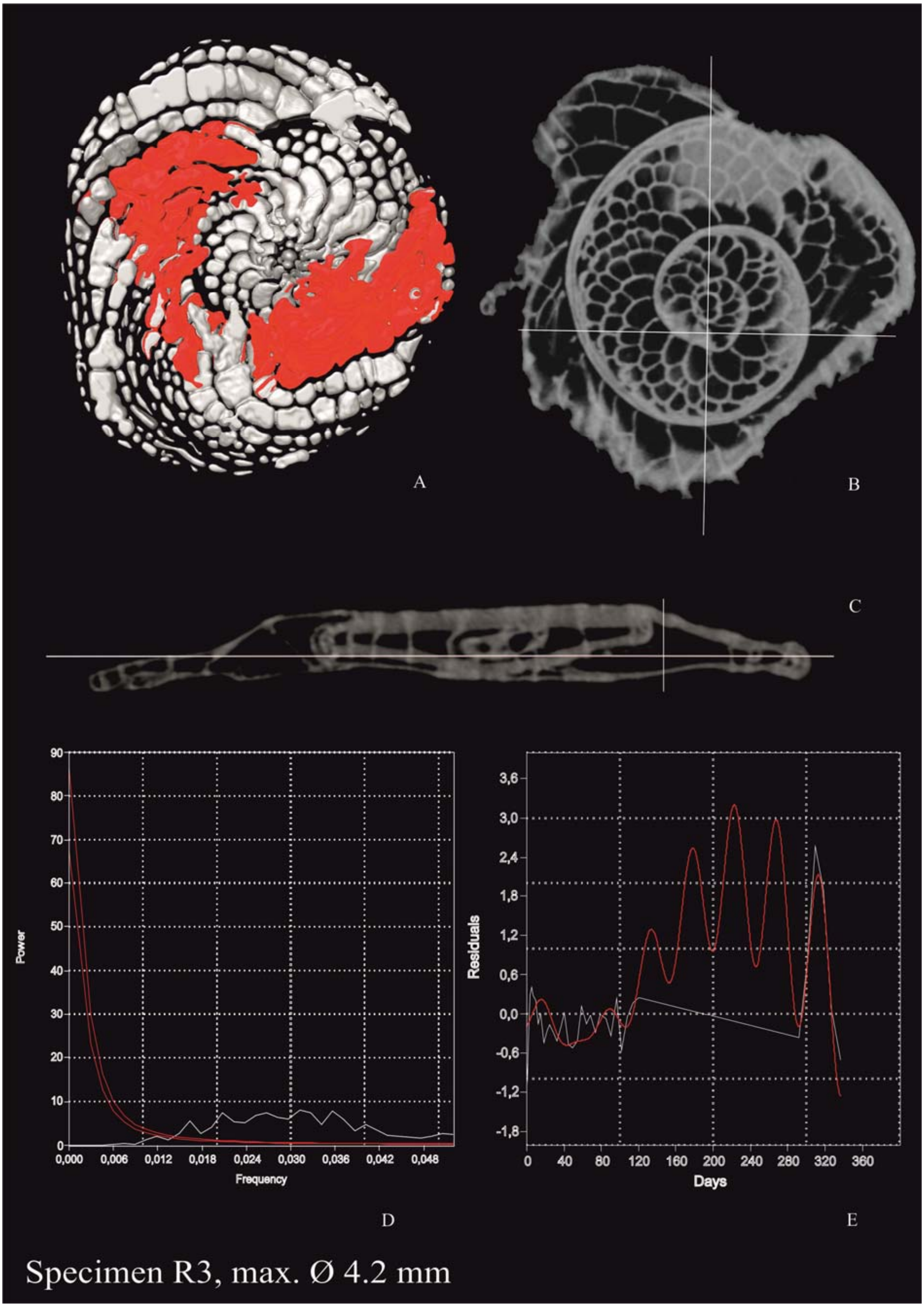
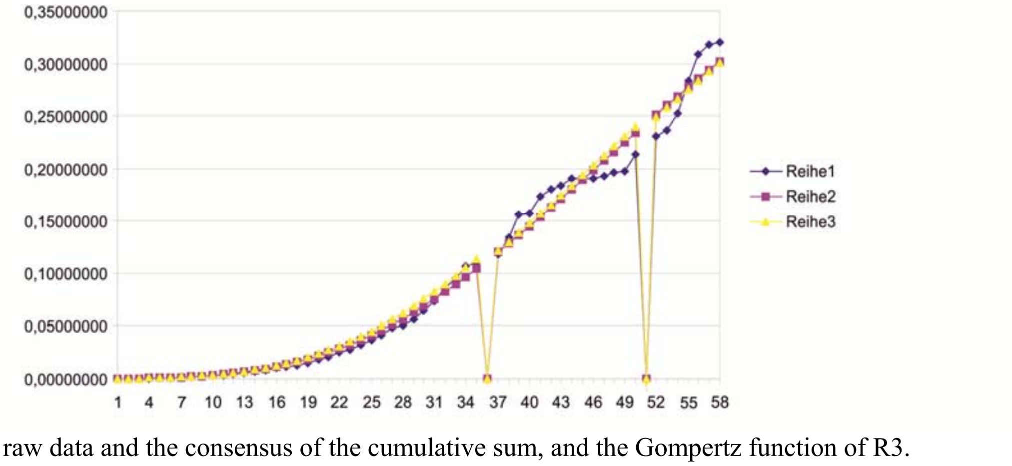



Fig.A11 Specimen R3, gamont from Kiel, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

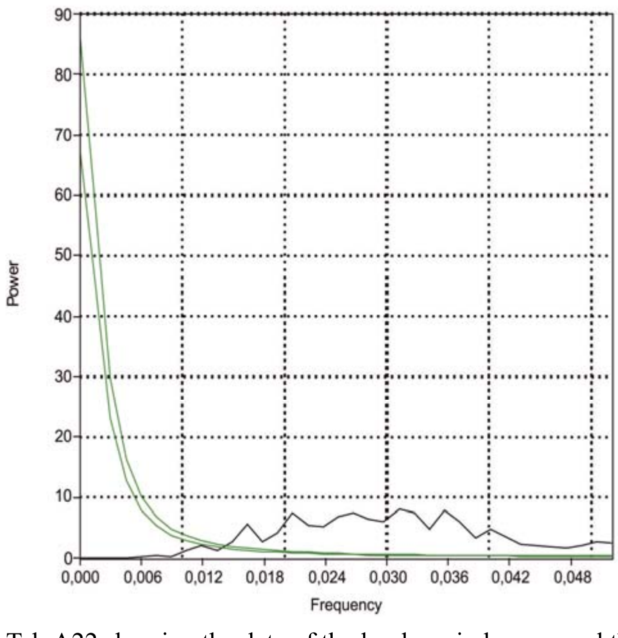
| days | chamber | Volume | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 69090,883 | 0,00006909 | 0,00006909 | 0,0002854 | 0,00029471 | 0,00029471 | -0,76556406 | 0,00002303 | 0,00009824 | -0,76556406 |
| 0,33 | 4 | 1771,5612 | 0,00000177 | 0,00007086 | 0,0003969 | 0,00041341 | 0,00011870 | -0,98507524 | 0,00000059 | 0,00003957 | -0,98507524 |
| 1,15 | 5 | 91899,734 | 0,00009190 | 0,00016276 | 0,000544 | 0,00057116 | 0,00015775 | -0,41743580 | 0,00003063 | 0,00005258 | -0,41743580 |
| 2,39 | 6 | 267505,75 | 0,00026751 | 0,00043027 | 0,0007355 | 0,00077772 | 0,00020656 | 0,29504454 | 0,00008917 | 0,00006885 | 0,29504454 |
| 4,00 | 7 | 374020,84 | 0,00037402 | 0,00080429 | 0,0009813 | 0,00104439 | 0,00026667 | 0,40256851 | 0,00012467 | 0,00008889 | 0,40256851 |
| 5,98 | 8 | 432703,81 | 0,00043270 | 0,00123699 | 0,0012931 | 0,00138403 | 0,00033964 | 0,27401418 | 0,00014423 | 0,00011321 | 0,27401418 |
| 8,29 | 9 | 518624,53 | 0,00051862 | 0,00175562 | 0,0016834 | 0,00181105 | 0,00042702 | 0,21452567 | 0,00017287 | 0,00014234 | 0,21452567 |
| 10,94 | 10 | 444440,41 | 0,00044444 | 0,00220006 | 0,0021666 | 0,00234134 | 0,00053029 | -0,16189156 | 0,00014815 | 0,00017676 | -0,16189156 |
| 13,90 | 11 | 652598,81 | 0,00065260 | 0,00285266 | 0,0027579 | 0,00299215 | 0,00065082 | 0,00273988 | 0,00021753 | 0,00021694 | 0,00273988 |
| 17,17 | 12 | 440897,28 | 0,00044090 | 0,00329355 | 0,0034737 | 0,00378194 | 0,00078979 | -0,44175197 | 0,00014697 | 0,00026326 | -0,44175197 |
| 20,75 | 13 | 703088,31 | 0,00070309 | 0,00399664 | 0,0043317 | 0,00473012 | 0,00094818 | -0,25848438 | 0,00023436 | 0,00031606 | -0,25848438 |
| 24,62 | 14 | 932505,5 | 0,00093251 | 0,00492915 | 0,0053497 | 0,00585681 | 0,00112669 | -0,17235208 | 0,00031084 | 0,00037556 | -0,17235208 |
| 28,78 | 15 | 935605,75 | 0,00093561 | 0,00586475 | 0,0065464 | 0,00718255 | 0,00132574 | -0,29427787 | 0,00031187 | 0,00044191 | -0,29427787 |
| 33,23 | 16 | 906817,88 | 0,00090682 | 0,00677157 | 0,0079407 | 0,00872795 | 0,00154540 | -0,41321497 | 0,00030227 | 0,00051513 | -0,41321497 |
| 37,96 | 17 | 1448472,8 | 0,00144847 | 0,00822004 | 0,0095511 | 0,01051335 | 0,00178539 | -0,18871006 | 0,00048282 | 0,00059513 | -0,18871006 |
| 42,96 | 18 | 2076712,6 | 0,00207671 | 0,01029676 | 0,0113959 | 0,01255844 | 0,00204509 | 0,01546065 | 0,00069224 | 0,00068170 | 0,01546065 |
| 48,24 | 19 | 1239428,5 | 0,00123943 | 0,01153618 | 0,0134928 | 0,01488195 | 0,00232351 | -0,46657117 | 0,00041314 | 0,00077450 | -0,46657117 |
| 53,79 | 20 | 1255372,5 | 0,00125537 | 0,01279156 | 0,0158582 | 0,01750127 | 0,00261932 | -0,52072584 | 0,00041846 | 0,00087311 | -0,52072584 |
| 59,60 | 21 | 1684311,8 | 0,00168431 | 0,01447587 | 0,0185075 | 0,02043214 | 0,00293087 | -0,42531978 | 0,00056144 | 0,00097696 | -0,42531978 |
| 65,67 | 22 | 3664031,3 | 0,00366403 | 0,01813990 | 0,0214543 | 0,02368836 | 0,00325622 | 0,12524208 | 0,00122134 | 0,00108541 | 0,12524208 |
| 72,01 | 23 | 3053728,5 | 0,00305373 | 0,02119363 | 0,0247106 | 0,02728153 | 0,00359317 | -0,15013078 | 0,00101791 | 0,00119772 | -0,15013078 |
| 78,60 | 24 | 3819264,5 | 0,00381926 | 0,02501289 | 0,0282863 | 0,03122088 | 0,00393935 | -0,03048264 | 0,00127309 | 0,00131312 | -0,03048264 |
| 85,45 | 25 | 3032027 | 0,00303203 | 0,02804492 | 0,032189 | 0,03551305 | 0,00429217 | -0,29359173 | 0,00101068 | 0,00143072 | -0,29359173 |
| 92,55 | 26 | 4580814,5 | 0,00458081 | 0,03262573 | 0,0364243 | 0,04016204 | 0,00464899 | -0,01466478 | 0,00152694 | 0,00154966 | -0,01466478 |
| 99,89 | 27 | 4614917 | 0,00461492 | 0,03724065 | 0,0409953 | 0,04516912 | 0,00500707 | -0,07832032 | 0,00153831 | 0,00166902 | -0,07832032 |
| 107,49 | 28 | 3540022 | 0,00354002 | 0,04078067 | 0,0459025 | 0,05053280 | 0,00536368 | -0,34000173 | 0,00118001 | 0,00178789 | -0,34000173 |
| 115,33 | 29 | 7059892,5 | 0,00705989 | 0,04784057 | 0,0511444 | 0,05624893 | 0,00571613 | 0,23508307 | 0,00235330 | 0,00190538 | 0,23508307 |
| 123,42 | 30 | 2663985 | 0,00266399 | 0,05050455 | 0,0567167 | 0,06231072 | 0,00606179 | -0,56052824 | 0,00088800 | 0,00202060 | -0,56052824 |
| 131,74 | 31 | 6102142,5 | 0,00610214 | 0,05660669 | 0,0626132 | 0,06870889 | 0,00639817 | -0,04626788 | 0,00203405 | 0,00213272 | -0,04626788 |
| 140,31 | 32 | 7859531 | 0,00785953 | 0,06446622 | 0,068825 | 0,07543183 | 0,00672294 | 0,16906186 | 0,00261984 | 0,00224098 | 0,16906186 |
| 149,12 | 33 | 8792701 | 0,00879270 | 0,07325893 | 0,0753417 | 0,08246576 | 0,00703393 | 0,25004085 | 0,00293090 | 0,00234464 | 0,25004085 |
| 158,16 | 34 | 12757455 | 0,01275746 | 0,08601638 | 0,0821507 | 0,08979496 | 0,00732920 | 0,74063403 | 0,00425249 | 0,00244307 | 0,74063403 |
| 167,44 | 35 | 9322841 | 0,00932284 | 0,09533922 | 0,0892376 | 0,09740198 | 0,00760702 | 0,22555757 | 0,00310761 | 0,00253567 | 0,22555757 |
| 176,95 | 36 | 11494553 | 0,01149455 | 0,10683377 | 0,0965867 | 0,10526788 | 0,00786590 | 0,46131429 | 0,00383152 | 0,00262197 | 0,46131429 |
| 186,69 | 37 | 3264987,3 | 0,00326499 | 0,11009876 | 0,1041807 | 0,11337247 | 0,00810459 | -0,59714362 | 0,00108833 | 0,00270153 | -0,59714362 |
| 196,66 | | | | | | | | | | | |
| 206,86 | 38 | 7946116 | 0,00794612 | 0,11804488 | 0,1200299 | 0,12169457 | 0,00832209 | -0,04517826 | 0,00264871 | 0,00277403 | -0,04517826 |
| 217,29 | 39 | 15983246 | 0,01598325 | 0,13402812 | 0,128246 | 0,13021220 | 0,00851764 | 0,87648836 | 0,00532775 | 0,00283921 | 0,87648836 |
| 227,95 | 40 | 22606670 | 0,02260667 | 0,15663479 | 0,1366293 | 0,13890289 | 0,00869069 | 1,60125098 | 0,00753556 | 0,00289690 | 1,60125098 |
| 238,83 | 41 | 112051,24 | 0,00011205 | 0,15674685 | 0,1451592 | 0,14774385 | 0,00884095 | -0,98732588 | 0,00003735 | 0,00294698 | -0,98732588 |
| 249,94 | 42 | 16136043 | 0,01613604 | 0,17288289 | 0,1538148 | 0,15671217 | 0,00896832 | 0,79922686 | 0,00537868 | 0,00298944 | 0,79922686 |
| 261,27 | 43 | 6758063 | 0,00675806 | 0,17964095 | 0,1625754 | 0,16578507 | 0,00907290 | -0,25513737 | 0,00225269 | 0,00302430 | -0,25513737 |
| 272,82 | 44 | 3978705 | 0,00397871 | 0,18361966 | 0,1714202 | 0,17494003 | 0,00915497 | -0,56540469 | 0,00132624 | 0,00305166 | -0,56540469 |
| 284,59 | 45 | 6403086,5 | 0,00640309 | 0,19002274 | 0,1803291 | 0,18415499 | 0,00921496 | -0,30514249 | 0,00213436 | 0,00307165 | -0,30514249 |
| 296,58 | 46 | 795209,5 | 0,00079521 | 0,19081795 | 0,1892823 | 0,19340847 | 0,00925348 | -0,91406372 | 0,00026507 | 0,00308449 | -0,91406372 |
| 308,79 | 47 | 93006,961 | 0,00009301 | 0,19091096 | 0,1982606 | 0,20267970 | 0,00927122 | -0,98996821 | 0,00003100 | 0,00309041 | -0,98996821 |
| 321,22 | 48 | 2170383,8 | 0,00217038 | 0,19308134 | 0,2072454 | 0,21194871 | 0,00926902 | -0,76584529 | 0,00072346 | 0,00308967 | -0,76584529 |
| 333,87 | 49 | 3089824 | 0,00308982 | 0,19617117 | 0,216219 | 0,22119648 | 0,00924777 | -0,66588433 | 0,00102994 | 0,00308259 | -0,66588433 |
| 346,73 | 50 | 1572482 | 0,00157248 | 0,19774365 | 0,2251645 | 0,23040494 | 0,00920846 | -0,82923505 | 0,00052416 | 0,00306949 | -0,82923505 |
| 359,80 | 51 | 15558736 | 0,01555874 | 0,21330239 | 0,2340658 | 0,23955707 | 0,00915213 | 0,70001271 | 0,00518625 | 0,00305071 | 0,70001271 |
| 373,09 | | | | | | | | | | | |
| 386,60 | 52 | 17683060 | 0,01768306 | 0,23098545 | 0,2516768 | 0,24863693 | 0,00907986 | 0,94750380 | 0,00589435 | 0,00302662 | 0,94750380 |
| 400,31 | 53 | 5725685,5 | 0,00572569 | 0,23671113 | 0,2603592 | 0,25762968 | 0,00899276 | -0,36330026 | 0,00190856 | 0,00299759 | -0,36330026 |
| 414,24 | 54 | 15766451 | 0,01576645 | 0,25247758 | 0,2689429 | 0,26652163 | 0,00889194 | 0,77311650 | 0,00525548 | 0,00296398 | 0,77311650 |
| 428,38 | 55 | 31244138 | 0,03124414 | 0,28372172 | 0,2774169 | 0,27530017 | 0,00877855 | 2,55914728 | 0,01041471 | 0,00292618 | 2,55914728 |
| 442,72 | 56 | 25075340 | 0,02507534 | 0,30879706 | 0,285771 | 0,28395386 | 0,00865368 | 1,89764916 | 0,00835845 | 0,00288456 | 1,89764916 |
| 451,83 | 57 | 8978936 | 0,00897894 | 0,31777600 | 0,293996 | 0,29247232 | 0,00851846 | 0,05405622 | 0,00299298 | 0,00283949 | 0,05405622 |
| 464,68 | 58 | 2410430,5 | 0,00241043 | 0,32018643 | 0,3020836 | 0,30084627 | 0,00837395 | -0,71215147 | 0,00080348 | 0,00279132 | -0,71215147 |

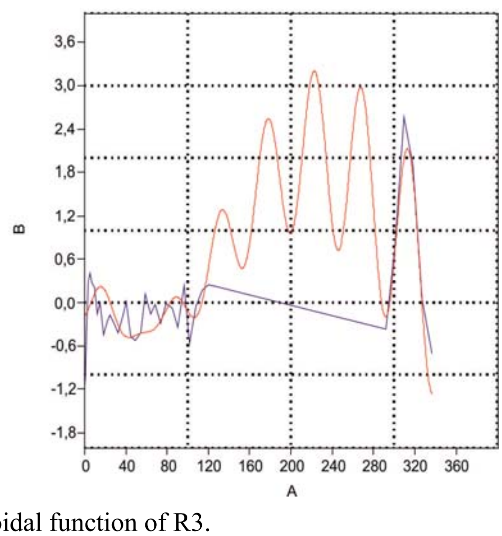



Tab.A21 showing raw data and the consensus of the cumulative sum, and the Gompertz function of R3.

| Freq | Power | Periode | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 9,50E-31 | #DIV/0! | 45,535 | 67,242 | 86,157 | 104,11 | 143,63 | 101,44 |
| 0,0014857 | 0,01459 | 673,0834 | 30,859 | 45,57 | 58,389 | 70,553 | 97,34 | 68,748 |
| 0,0029715 | 0,06849 | 336,53037 | 15,71 | 23,199 | 29,725 | 35,918 | 49,555 | 34,999 |
| 0,0044572 | 0,042903 | 224,3561 | 8,6614 | 12,79 | 16,388 | 19,802 | 27,321 | 19,296 |
| 0,0059429 | 0,23211 | 168,26802 | 5,3365 | 7,8804 | 10,097 | 12,201 | 16,833 | 11,888 |
| 0,0074286 | 0,48448 | 134,61487 | 3,5857 | 5,2951 | 6,7845 | 8,198 | 11,311 | 7,9882 |
| 0,0089144 | 0,3083 | 112,17805 | 2,5694 | 3,7943 | 4,8615 | 5,8744 | 8,1048 | 5,7241 |
| 0,0104 | 1,3326 | 96,153846 | 1,9326 | 2,8539 | 3,6566 | 4,4184 | 6,096 | 4,3054 |
| 0,011886 | **2,1559** | **84,132593** | 1,5092 | 2,2287 | 2,8556 | 3,4506 | 4,7607 | 3,3623 |
| 0,013372 | 1,2385 | 74,783129 | 1,2144 | 1,7933 | 2,2977 | 2,7764 | 3,8306 | 2,7054 |
| 0,014857 | 2,675 | 67,30834 | 1,0012 | 1,4785 | 1,8944 | 2,2891 | 3,1582 | 2,2305 |
| 0,016343 | **5,594** | **61,188276** | 0,84239 | 1,244 | 1,5939 | 1,9259 | 2,6572 | 1,8767 |
| 0,017829 | 2,6633 | 56,088395 | 0,72102 | 1,0647 | 1,3642 | 1,6484 | 2,2743 | 1,6063 |
| 0,019314 | 4,1282 | 51,775914 | 0,6263 | 0,92487 | 1,185 | 1,4319 | 1,9756 | 1,3953 |
| 0,0208 | **7,3431** | **48,076923** | 0,55108 | 0,81379 | 1,0427 | 1,2599 | 1,7383 | 1,2277 |
| 0,022286 | 5,3174 | 44,87122 | 0,49043 | 0,72423 | 0,92794 | 1,1213 | 1,547 | 1,0926 |
| 0,023772 | 5,2324 | 42,066296 | 0,4409 | 0,65109 | 0,83423 | 1,008 | 1,3908 | 0,98224 |
| 0,025257 | 6,8981 | 39,592984 | 0,40001 | 0,5907 | 0,75686 | 0,91454 | 1,2618 | 0,89114 |
| 0,026743 | **7,434** | **37,392963** | 0,36594 | 0,54038 | 0,69239 | 0,83663 | 1,1543 | 0,81523 |
| 0,028229 | 6,3626 | 35,424563 | 0,33732 | 0,49812 | 0,63824 | 0,7712 | 1,064 | 0,75147 |
| 0,029715 | 5,996 | 33,653037 | 0,31312 | 0,4624 | 0,59246 | 0,71589 | 0,9877 | 0,69757 |
| 0,0312 | **8,161** | **32,051282** | 0,29257 | 0,43204 | 0,55356 | 0,66889 | 0,92285 | 0,65178 |
| 0,032686 | 7,3763 | 30,594138 | 0,27503 | 0,40614 | 0,52038 | 0,6288 | 0,86754 | 0,61271 |
| 0,034172 | 4,7825 | 29,263725 | 0,26003 | 0,38399 | 0,492 | 0,5945 | 0,82022 | 0,57929 |
| 0,035657 | **7,8367** | **28,044984** | 0,24719 | 0,36502 | 0,4677 | 0,56513 | 0,77971 | 0,55068 |
| 0,037143 | 5,9227 | 26,922973 | 0,23619 | 0,34879 | 0,44689 | 0,54 | 0,74502 | 0,52618 |
| 0,038629 | 3,3785 | 25,887287 | 0,2268 | 0,33492 | 0,42913 | 0,51853 | 0,7154 | 0,50526 |
| 0,040115 | **4,7642** | **24,928331** | 0,21882 | 0,32313 | 0,41402 | 0,50027 | 0,69022 | 0,48747 |
| 0,0416 | 3,4843 | 24,038462 | 0,21208 | 0,31318 | 0,40128 | 0,48487 | 0,66897 | 0,47247 |
| 0,043086 | 2,2829 | 23,209395 | 0,20646 | 0,30489 | 0,39065 | 0,47204 | 0,65126 | 0,45996 |
| 0,044572 | 2,1327 | 22,43561 | 0,20187 | 0,2981 | 0,38195 | 0,46152 | 0,63676 | 0,44972 |
| 0,046058 | 1,8627 | 21,711755 | 0,19821 | 0,29269 | 0,37502 | 0,45315 | 0,62521 | 0,44156 |
| 0,047543 | 1,714 | 21,033591 | 0,19542 | 0,28858 | 0,36975 | 0,44678 | 0,61642 | 0,43535 |
| 0,049029 | 2,0856 | 20,396092 | 0,19346 | 0,28569 | 0,36605 | 0,44231 | 0,61024 | 0,43099 |
| 0,050515 | **2,6054** | **19,7961** | 0,1923 | 0,28397 | 0,36385 | 0,43965 | 0,60658 | 0,4284 |
| 0,052 | 2,4404 | 19,230769 | 0,19191 | 0,2834 | 0,36312 | 0,43877 | 0,60536 | 0,42754 |

| Amp | Phas | Period | R² | p |
|---|---|---|---|---|
| 1,22 | -2,13 | 336,5 | 0,90321 | 0,00000000 |
| 0,76 | -2,55 | 47,35 | | |
| 0,699 | 1,22 | 43,79 | | |




Tab.A22 showing the data of the lomb periodogram and the sinusoidal function of R3.

**Log Files R3**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 8)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=\\CLUSTER-PC-1\Users\Public\Briguglio\cotton\TDP 17-5\original
Filename Prefix=TDP17-5
Number of Files= 1846
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 6.06
Object to Source (mm)=44.313
Camera to Source (mm)=364.000
Vertical Object Position (mm)=44.635
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.130
Frame Averaging=ON (2)
Random Movement=ON (5)
Use 360 Rotation=NO
FF updating interval=700
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Nov 08, 2012 17:49:41
Scan duration=01:34:55
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=TDP17-5
Dataset Directory=C:\Users\Public\Briguglio\cotton\depressa3\original
Output Directory=C:\Users\Public\Briguglio\cotton\depressa3\original\TDP17-5_Rec
Time and Date=Nov 29, 2012 16:26:23
First Section=866
Last Section=1667
Reconstruction duration per slice (seconds)=0.380299
Total reconstruction time (802 slices) in seconds=305.000000
Postalignment=17.00
Section to Section Step=1
Sections Count=802
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1008
Result Image Height (pixels)=164
Pixel Size (um)=6.05771
Reconstruction Angular Range (deg)=239.98
Use 180+=OFF
Angular Step (deg)=0.1300
Smoothing=0
Ring Artifact Correction=23
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=1707
ROI Bottom (pixels)=1542
ROI Left (pixels)=247
ROI Right (pixels)=1257
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=30
CS Static Rotation (deg)=136.0
Minimum for CS to Image Conversion=0.0016
Maximum for CS to Image Conversion=0.0436
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.409575
Cone-beam Angle Vert.(deg)=17.409575
[File name convention]
Filename Index Length=4
Filename Prefix=TDP17-5_IR_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Nov 29, 2012  18:08:04
Original configuration file=TDP17-5_IR_rec.log
Conversion description=...COR. VOI(670,117,802) @ (128,16,0). Rotated(deg): (0.000, 1.637, 1.580).
Image scale modified=0
HU calibration modified=0

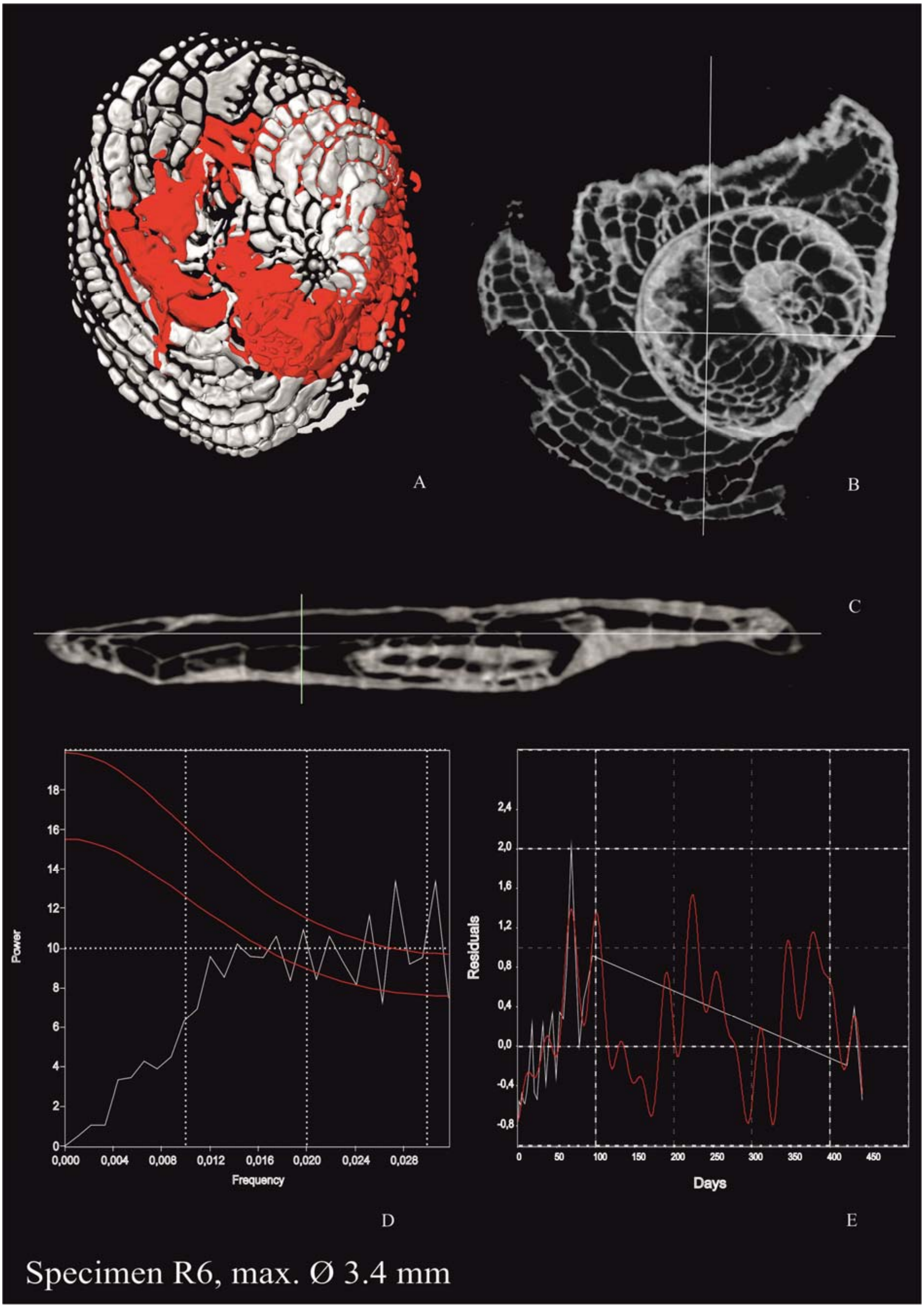


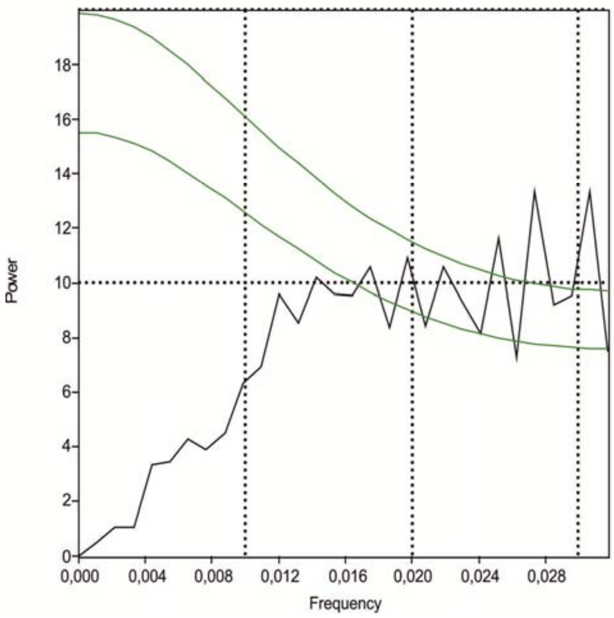

Fig.A12 Specimen R6, gamont from Kiel, A = 3D reconstruction, B = equatorial slice, C = transaxial slice, E = simusoidal function, F = lomb periodogram.

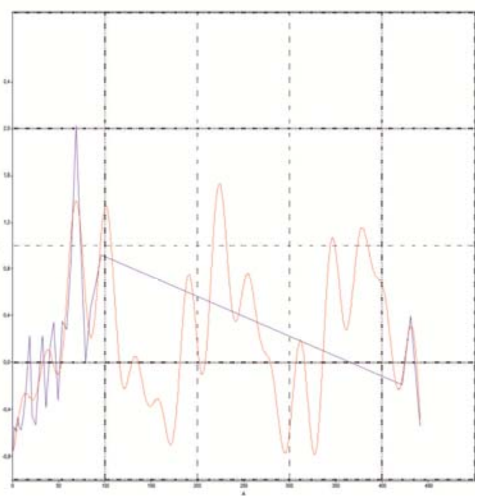
| days | chamber | volume | volume mm³ | comul. Sum | Gomp SPSS | Gomp Excel | Derivate | Residuals | lin vol | lin derivate | stand lin res |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 3 | 36853,4102 | 0,00003685 | 0,00003685 | 0,0016465 | 0,00211600 | 0,00211600 | -0,98258346 | 0,00001228 | 0,00070533 | -0,98258346 |
| 0,33 | 4 | 54817,1289 | 0,00005482 | 0,00009167 | 0,0018227 | 0,00233897 | 0,00022297 | -0,75414605 | 0,00001827 | 0,00007432 | -0,75414605 |
| 1,15 | 5 | 110930,609 | 0,00011093 | 0,00020260 | 0,0020169 | 0,00258414 | 0,00024517 | -0,54753415 | 0,00003698 | 0,00008172 | -0,54753415 |
| 2,39 | 6 | 111115,797 | 0,00011112 | 0,00031372 | 0,0022307 | 0,00285358 | 0,00026945 | -0,58761757 | 0,00003704 | 0,00008982 | -0,58761757 |
| 4,00 | 7 | 157969,641 | 0,00015797 | 0,00047169 | 0,0024661 | 0,00314957 | 0,00029599 | -0,46629253 | 0,00005266 | 0,00009866 | -0,46629253 |
| 5,98 | 8 | 146858,063 | 0,00014686 | 0,00061854 | 0,0027251 | 0,00347455 | 0,00032498 | -0,54809511 | 0,00004895 | 0,00010833 | -0,54809511 |
| 8,29 | 9 | 152413,844 | 0,00015241 | 0,00077096 | 0,0030099 | 0,00383118 | 0,00035663 | -0,57262760 | 0,00005080 | 0,00011888 | -0,57262760 |
| 10,94 | 10 | 217601,781 | 0,00021760 | 0,00098856 | 0,0033229 | 0,00422235 | 0,00039118 | -0,44372510 | 0,00007253 | 0,00013039 | -0,44372510 |
| 13,90 | 11 | 339829,156 | 0,00033983 | 0,00132839 | 0,0036669 | 0,00465121 | 0,00042886 | -0,20760138 | 0,00011328 | 0,00014295 | -0,20760138 |
| 17,17 | 12 | 574468,688 | 0,00057447 | 0,00190286 | 0,0040446 | 0,00512116 | 0,00046995 | 0,22240618 | 0,00019149 | 0,00015665 | 0,22240618 |
| 20,75 | 13 | 277048,75 | 0,00027705 | 0,00217991 | 0,0044593 | 0,00563589 | 0,00051473 | -0,46175443 | 0,00009235 | 0,00017158 | -0,46175443 |
| 24,62 | 14 | 265937,156 | 0,00026594 | 0,00244584 | 0,0049143 | 0,00619939 | 0,00056350 | -0,52806049 | 0,00008865 | 0,00018783 | -0,52806049 |
| 28,78 | 15 | 555023,438 | 0,00055502 | 0,00300087 | 0,0054133 | 0,00681599 | 0,00061660 | -0,09986301 | 0,00018501 | 0,00020553 | -0,09986301 |
| 33,23 | 16 | 825960,813 | 0,00082596 | 0,00382683 | 0,0059604 | 0,00749037 | 0,00067438 | 0,22476447 | 0,00027532 | 0,00022479 | 0,22476447 |
| 37,96 | 17 | 458723,094 | 0,00045872 | 0,00428555 | 0,0065598 | 0,00822760 | 0,00073724 | -0,37777931 | 0,00015291 | 0,00024575 | -0,37777931 |
| 42,96 | 18 | 919298,125 | 0,00091930 | 0,00520485 | 0,0072164 | 0,00903317 | 0,00080557 | 0,14118160 | 0,00030643 | 0,00026852 | 0,14118160 |
| 48,24 | 19 | 1177827,5 | 0,00117783 | 0,00638268 | 0,0079353 | 0,00991299 | 0,00087982 | 0,33871287 | 0,00039261 | 0,00029327 | 0,33871287 |
| 53,79 | 20 | 654842,5 | 0,00065484 | 0,00703752 | 0,008722 | 0,01087346 | 0,00096047 | -0,31820819 | 0,00021828 | 0,00032016 | -0,31820819 |
| 59,60 | 21 | 1413578,25 | 0,00141358 | 0,00845110 | 0,0095826 | 0,01192150 | 0,00104803 | 0,34879127 | 0,00047119 | 0,00034934 | 0,34879127 |
| 65,67 | 22 | 1463580,38 | 0,00146358 | 0,00991468 | 0,0105235 | 0,01306455 | 0,00114305 | 0,28041644 | 0,00048786 | 0,00038102 | 0,28041644 |
| 72,01 | 23 | 2318801,75 | 0,00231880 | 0,01223348 | 0,011552 | 0,01431066 | 0,00124611 | 0,86083068 | 0,00077293 | 0,00041537 | 0,86083068 |
| 78,60 | 24 | 4111655,25 | 0,00411166 | 0,01634514 | 0,0126755 | 0,01566851 | 0,00135785 | 2,02807285 | 0,00137055 | 0,00045262 | 2,02807285 |
| 85,45 | 25 | 3062166,5 | 0,00306217 | 0,01940730 | 0,0139024 | 0,01714743 | 0,00147893 | 1,07053054 | 0,00102072 | 0,00049298 | 1,07053054 |
| 92,55 | 26 | 1618031,38 | 0,00161803 | 0,02102533 | 0,0152417 | 0,01875752 | 0,00161008 | 0,00493700 | 0,00053934 | 0,00053669 | 0,00493700 |
| 99,89 | 27 | 2585850 | 0,00258585 | 0,02361118 | 0,016703 | 0,02050960 | 0,00175208 | 0,47587355 | 0,00086195 | 0,00058403 | 0,47587355 |
| 107,49 | 28 | 3183467,75 | 0,00318347 | 0,02679465 | 0,0182967 | 0,02241535 | 0,00190575 | 0,67045236 | 0,00106116 | 0,00063525 | 0,67045236 |
| 115,33 | 29 | 3977019,75 | 0,00397702 | 0,03077167 | 0,0200342 | 0,02448733 | 0,00207198 | 0,91942937 | 0,00132567 | 0,00069066 | 0,91942937 |
| 123,42 | 30 | 3120502,25 | 0,00312050 | 0,03389217 | 0,0219276 | 0,02673904 | 0,00225171 | 0,38583524 | 0,00104017 | 0,00075057 | 0,38583524 |
| 131,74 | | | | | | | | | | | |
| 140,31 | 31 | 653916,5 | 0,00065392 | 0,03454609 | 0,0262358 | 0,02918500 | 0,00244596 | -0,73265435 | 0,00021797 | 0,00081532 | -0,73265435 |
| 149,12 | 32 | 1555065,75 | 0,00155507 | 0,03610115 | 0,0286801 | 0,03184080 | 0,00265580 | -0,41446433 | 0,00051836 | 0,00088527 | -0,41446433 |
| 158,16 | 33 | 1855819,13 | 0,00185582 | 0,03795697 | 0,0313393 | 0,03472319 | 0,00288239 | -0,35615232 | 0,00061861 | 0,00096080 | -0,35615232 |
| 167,44 | 34 | 175007,391 | 0,00017501 | 0,03813198 | 0,0342312 | 0,03785014 | 0,00312695 | -0,94403263 | 0,00005834 | 0,00104232 | -0,94403263 |
| 176,95 | 35 | 564097,875 | 0,00056410 | 0,03869608 | 0,037375 | 0,04124095 | 0,00339081 | -0,83363909 | 0,00018803 | 0,00113027 | -0,83363909 |
| 186,69 | 36 | 1086342,13 | 0,00108634 | 0,03978242 | 0,0407911 | 0,04491630 | 0,00367535 | -0,70442478 | 0,00036211 | 0,00122512 | -0,70442478 |
| 196,66 | 37 | 726882,563 | 0,00072688 | 0,04050930 | 0,0445018 | 0,04889837 | 0,00398207 | -0,81746103 | 0,00024229 | 0,00132736 | -0,81746103 |
| 206,86 | 38 | 348348,063 | 0,00034835 | 0,04085765 | 0,0485307 | 0,05321092 | 0,00431255 | -0,91922460 | 0,00011612 | 0,00143752 | -0,91922460 |
| 217,29 | 39 | 4926319 | 0,00492632 | 0,04578397 | 0,0529035 | 0,05787941 | 0,00466849 | 0,05522759 | 0,00164211 | 0,00155616 | 0,05522759 |
| 227,95 | 40 | 4857057 | 0,00485706 | 0,05064103 | 0,0576475 | 0,06293109 | 0,00505168 | -0,03852652 | 0,00161902 | 0,00168389 | -0,03852652 |
| 238,83 | 41 | 9752079 | 0,00975208 | 0,06039311 | 0,0627925 | 0,06839513 | 0,00546404 | 0,78477517 | 0,00325069 | 0,00182135 | 0,78477517 |
| 249,94 | | | | | | | | | | | |
| 261,27 | 42 | 4909837 | 0,00490984 | 0,06530294 | 0,0744139 | 0,07430272 | 0,00590759 | -0,16889411 | 0,00163661 | 0,00196920 | -0,16889411 |
| 272,82 | 43 | 13081849 | 0,01308185 | 0,07838479 | 0,0809609 | 0,08068724 | 0,00638451 | 1,04899684 | 0,00436062 | 0,00212817 | 1,04899684 |
| 284,59 | 44 | 9983755 | 0,00998376 | 0,08836855 | 0,08805 | 0,08758433 | 0,00689709 | 0,44753119 | 0,00332792 | 0,00229903 | 0,44753119 |
| 296,58 | 45 | 7008629,5 | 0,00700863 | 0,09537718 | 0,0957233 | 0,09503209 | 0,00744777 | -0,05896219 | 0,00233621 | 0,00248259 | -0,05896219 |
| 308,79 | 46 | 2084717,75 | 0,00208472 | 0,09746190 | 0,1040256 | 0,10307122 | 0,00803913 | -0,74067858 | 0,00069491 | 0,00267971 | -0,74067858 |
| 321,22 | 47 | 17281842 | 0,01728184 | 0,11474374 | 0,1130052 | 0,11174514 | 0,00867392 | 0,99239136 | 0,00576061 | 0,00289131 | 0,99239136 |
| 333,87 | 48 | 10017645 | 0,01001765 | 0,12476138 | 0,1227135 | 0,12110020 | 0,00935506 | 0,07082669 | 0,00333922 | 0,00311835 | 0,07082669 |
| 346,73 | 49 | 15248607 | 0,01524861 | 0,14000999 | 0,1332058 | 0,13118583 | 0,01008563 | 0,51191447 | 0,00508287 | 0,00336188 | 0,51191447 |
| 359,80 | 50 | 1182272,13 | 0,00118227 | 0,14119226 | 0,1445412 | 0,14205473 | 0,01086890 | -0,89122435 | 0,00039409 | 0,00362297 | -0,89122435 |
| 373,09 | 51 | 12250703 | 0,01225070 | 0,15344296 | 0,1567828 | 0,15376308 | 0,01170835 | 0,04632186 | 0,00408357 | 0,00390278 | 0,04632186 |
| 386,60 | 52 | 17347030 | 0,01734703 | 0,17078999 | 0,1699981 | 0,16637072 | 0,01260764 | 0,37591443 | 0,00578234 | 0,00420255 | 0,37591443 |
| 400,31 | 53 | 12299408 | 0,01229941 | 0,18308940 | 0,1842594 | 0,17994136 | 0,01357065 | -0,09367570 | 0,00409980 | 0,00452355 | -0,09367570 |
| 414,24 | 54 | 11551414 | 0,01155141 | 0,19464082 | 0,1996437 | 0,19454286 | 0,01460149 | -0,20888805 | 0,00385047 | 0,00486716 | -0,20888805 |
| 428,38 | 55 | 27500792 | 0,02750079 | 0,22214161 | 0,2162335 | 0,21024737 | 0,01570451 | 0,75113967 | 0,00916693 | 0,00523484 | 0,75113967 |
| 442,72 | 56 | 13583352 | 0,01358335 | 0,23572496 | 0,2341166 | 0,22713167 | 0,01688430 | -0,19550398 | 0,00452778 | 0,00562810 | -0,19550398 |
| 456,02 | 57 | 25240696 | 0,02524070 | 0,26096566 | 0,2533869 | 0,24527738 | 0,01814571 | 0,39100071 | 0,00841357 | 0,00604857 | 0,39100071 |
| 469,84 | 58 | 8914636 | 0,00891464 | 0,26988029 | 0,2741444 | 0,26477124 | 0,01949387 | -0,54269536 | 0,00297155 | 0,00649796 | -0,54269536 |


Tab.A23 showing raw data and the consensus of the cumulative sum, and the Gompertz function of R6.

| Freq | Power | Period | Theor.AR(1) | chi2 80% | chi2 90% | chi2 95% | chi2 99% | chi2 crit. |
|---|---|---|---|---|---|---|---|---|
| 0 | 5,57E-30 | #DIV/0! | 10,522 | 15,537 | 19,908 | 24,055 | 33,189 | 22,352 |
| 0,0010949 | 0,52263 | 913,32542 | 10,489 | 15,49 | 19,847 | 23,982 | 33,087 | 22,283 |
| 0,0021898 | 1,0614 | 456,66271 | 10,394 | 15,349 | 19,667 | 23,764 | 32,787 | 22,081 |
| 0,0032847 | 1,0527 | 304,44181 | 10,241 | 15,122 | 19,376 | 23,413 | 32,302 | 21,755 |
| 0,0043796 | 3,3594 | 228,33135 | 10,035 | 14,819 | 18,988 | 22,943 | 31,655 | 21,319 |
| 0,0054744 | 3,4273 | 182,66842 | 9,787 | 14,453 | 18,518 | 22,376 | 30,872 | 20,791 |
| 0,0065693 | 4,2649 | 152,22322 | 9,5054 | 14,037 | 17,985 | 21,732 | 29,983 | 20,193 |
| 0,0076642 | 3,869 | 130,47676 | 9,1999 | 13,586 | 17,407 | 21,033 | 29,019 | 19,544 |
| 0,0087591 | 4,4805 | 114,16698 | 8,8799 | 13,113 | 16,802 | 20,302 | 28,01 | 18,864 |
| 0,009854 | 6,3028 | 101,48163 | 8,5536 | 12,631 | 16,184 | 19,556 | 26,981 | 18,171 |
| 0,010949 | 6,9038 | 91,332542 | 8,2282 | 12,151 | 15,569 | 18,812 | 25,954 | 17,48 |
| 0,012044 | 9,6117 | 83,028894 | 7,9095 | 11,68 | 14,965 | 18,083 | 24,949 | 16,803 |
| 0,013139 | 8,5258 | 76,109293 | 7,6021 | 11,226 | 14,384 | 17,38 | 23,979 | 16,15 |
| 0,014234 | 10,2 | 70,254321 | 7,3092 | 10,794 | 13,83 | 16,711 | 23,056 | 15,527 |
| 0,015328 | 9,6014 | 65,240084 | 7,0335 | 10,386 | 13,308 | 16,08 | 22,186 | 14,942 |
| 0,016423 | 9,5464 | 60,890215 | 6,7763 | 10,007 | 12,821 | 15,493 | 21,375 | 14,395 |
| **0,017518** | **10,573** | **57,084142** | 6,5386 | 9,6557 | 12,372 | 14,949 | 20,625 | 13,89 |
| 0,018613 | 8,3504 | 53,725891 | 6,3209 | 9,3341 | 11,96 | 14,451 | 19,938 | 13,428 |
| **0,019708** | **10,941** | **50,740816** | 6,123 | 9,0418 | 11,585 | 13,999 | 19,314 | 13,007 |
| 0,020803 | 8,4232 | 48,06999 | 5,9447 | 8,7786 | 11,248 | 13,591 | 18,752 | 12,629 |
| **0,021898** | **10,605** | **45,666271** | 5,7857 | 8,5438 | 10,947 | 13,228 | 18,25 | 12,291 |
| 0,022993 | 9,3558 | 43,491497 | 5,6454 | 8,3366 | 10,682 | 12,907 | 17,807 | 11,993 |
| 0,024088 | 8,1373 | 41,514447 | 5,5233 | 8,1562 | 10,45 | 12,628 | 17,422 | 11,733 |
| **0,025182** | **11,644** | **39,710905** | 5,4187 | 8,0019 | 10,253 | 12,389 | 17,092 | 11,511 |
| 0,026277 | 7,2835 | 38,056095 | 5,3312 | 7,8727 | 10,087 | 12,189 | 16,816 | 11,325 |
| **0,027372** | **13,371** | **36,533684** | 5,2604 | 7,768 | 9,9531 | 12,027 | 16,593 | 11,175 |
| 0,028467 | 9,197 | 35,128394 | 5,2057 | 7,6873 | 9,8496 | 11,902 | 16,42 | 11,059 |
| 0,029562 | 9,5516 | 33,827211 | 5,1668 | 7,6299 | 9,7761 | 11,813 | 16,298 | 10,976 |
| **0,030657** | **13,38** | **32,618978** | 5,1436 | 7,5957 | 9,7322 | 11,76 | 16,225 | 10,927 |
| 0,031752 | 7,4671 | 31,494079 | 5,1359 | 7,5843 | 9,7176 | 11,742 | 16,2 | 10,911 |

| Amp | Phas | Period | R² | p |
|---|---|---|---|---|
| **0,674** | **-2,73** | **146,4** | 0,83679 | 0,0000 |
| **0,335** | **1,75** | **30,43** | | |
| **0,36** | **-2,62** | **40,41** | | |



Tab.A24 showing the data of the lomb periodogram and the sinusoidal function of R6

**Log File R6**

Scanner=SkyScan1173
Instrument S/N=10C05009
Hardware version=A
Software=Version 1. 6 (build 8)
Home directory=C:\Skyscan
Source Type=Hamamatsu 130/300
Camera=FlatPanel Sensor
Camera Pixel Size (um)=50.0
CameraXYRatio=1.0050
Incl.in lifting (um/mm)=0.8800
[Acquisition]
Data directory=\\CLUSTER-PC-1\Users\Public\Briguglio\cotton\TDP 17-8\original
Filename Prefix=TDP17-8
Number of Files= 1846
Source Voltage (kV)= 100
Source Current (uA)= 80
Number of Rows= 2240
Number of Columns= 2240
Image crop origin X= 0
Image crop origin Y=0
Camera binning=1x1
Image Rotation=-0.2600
Gantry direction=CC
Number of connected scans=1
Image Pixel Size (um)= 5.70
Object to Source (mm)=41.700
Camera to Source (mm)=364.000
Vertical Object Position (mm)=40.430
Optical Axis (line)=1110
Filter=Al 1.0mm
Image Format=TIFF
Depth (bits)=16
Screen LUT=0
Exposure (ms)= 750
Rotation Step (deg)=0.130
Frame Averaging=ON (3)
Random Movement=ON (5)
Use 360 Rotation=NO
FF updating interval=484
Geometrical Correction=OFF
Camera Offset=OFF
Median Filtering=OFF
Flat Field Correction=ON
Rotation Direction=CC
Scanning Trajectory=ROUND
Type Of Motion=STEP AND SHOOT
Study Date and Time=Nov 09, 2012 12:19:44
Scan duration=01:57:50
[Reconstruction]

Reconstruction Program=NRecon
Program Version=Version: 1.6.4.8
Program Home Directory=C:\Skyscan
Reconstruction engine=InstaRecon
Engine version=Version: 1.3.8.5
Reconstruction from batch=Yes
Reconstruction servers= CLUSTER-PC-1
Dataset Origin=SkyScan1173
Dataset Prefix=TDP17-8
Dataset Directory=C:\Users\Public\Briguglio\cotton\depressa6\original
Output Directory=C:\Users\Public\Briguglio\cotton\depressa6\original\TDP17-8_Rec
Time and Date=Nov 30, 2012 12:34:06
First Section=1319
Last Section=2163
Reconstruction duration per slice (seconds)=0.649704
Total reconstruction time (845 slices) in seconds=549.000000
Postalignment=18.00
Section to Section Step=1
Sections Count=845
Result File Type=TIF
Result File Header Length (bytes)=12
Result Image Width (pixels)=1148
Result Image Height (pixels)=716
Pixel Size (um)=5.70145
Reconstruction Angular Range (deg)=239.98
Use 180+=OFF
Angular Step (deg)=0.1300
Smoothing=0
Ring Artifact Correction=19
Draw Scales=OFF
Object Bigger than FOV=OFF
Reconstruction from ROI=ON
ROI Top (pixels)=985
ROI Bottom (pixels)=268
ROI Left (pixels)=873
ROI Right (pixels)=2024
ROI reference length=2240
Filter cutoff relative to Nyquisit frequency=100
Filter type=0
Filter type meaning(1)=0: Hamming (Ramp in case of optical scanner); 1: Hann; 2: Ramp; 3: Almost Ramp;
Filter type meaning(2)=11: Cosine; 12: Shepp-Logan; [100,200]: Generalized Hamming, alpha=(iFilter-100)/100
Undersampling factor=1
Threshold for defect pixel mask (%)=0
Beam Hardening Correction (%)=30
CS Static Rotation (deg)=0.0
Minimum for CS to Image Conversion=0.0026
Maximum for CS to Image Conversion=0.0317
HU Calibration=OFF
BMP LUT=0

Cone-beam Angle Horiz.(deg)=17.412422
Cone-beam Angle Vert.(deg)=17.412422
[File name convention]
Filename Index Length=4
Filename Prefix=TDP17-8_IR_rec_Cor
[CS image conversion 1]
Converted by=Dataviewer (Version: 1.4.4)
Conversion time=Nov 30, 2012  12:38:02
Original configuration file=TDP17-8_IR_rec.log
Conversion description=...COR. VOI(625,200,700) @ (222,315,30). Rotated(deg): (348.863, 353.959, 6.365).
Image scale modified=0
HU calibration modified=0

**Curriculum vitae**

**Education:**

[2004-2008] Bundesoberstufenrealgymnasium (senior high school, scientific focus), 2700 Wiener Neustadt, Herzog-Leopold-Straße 32, AUT, Austrian Matura

[2008-2012] Bachelor's degree in Biology (Paleobiology) at the University of Vienna.

Fossil diaspores of the Köflach-Voitsberger brown coal field 2011, guidance: Ao Prof. Dr. Christa Hofmann

stratigraphy and fauna of an extraordinary triassic-jurassic section 2012, guidance: Ao. Prof. Dr. Leopold Krystyn

[July 2012] internship OMV Austria E&P GmbH

[2012- expected October 2013] Master study in Paleobiology at the University of Vienna. Topic: depth distribution of *Heterostegina depressa* under guidance of Ao. Prof. Dr. Johann Hohenegger and Dr. Antonino Briguglio.

**Publications:**

Johann Hohenegger, Antonino Briguglio, Wolfgang Eder; The natural laboratory of symbiont-bearing benthic foraminifera: Studying individual growth and population dynamics in the sublittoral (in prep.)

**Additional skills**:

Languages: native language: German, good command of English

EDV: Proficient in Microsoft Office, PAST, SPSS, Amira, Corel Graphic Suite

**Danksagung**

Ohne die Hilfe einiger Leute hätte diese Arbeit vermutlich nie ihr Ende gefunden.
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