FREQUENCIES OF THE EARTH

Klaus Piontzik, Claude Bärtels

1.0 – Earth magnetic field

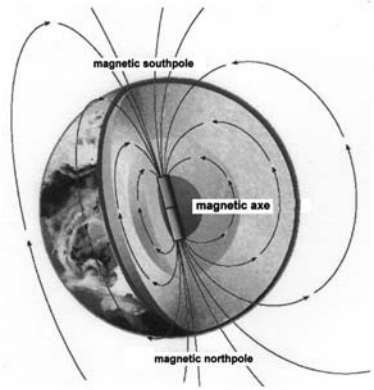


Illustration 1.0.1 – dipole field

From the school and from the media, we always know the earth's magnetic field as a field that corresponds to the field of a bar magnet. It is due to the so called dipole field.
Historical this view of the earth's magnetic field explains the behavior of a needle of inclination.
It is available at the pole perpendicular to the earth's surface and at the equator level parallel to the surface of the earth.

Taking measured values of the field, ít can be shown graphically that four magnetic poles (Illustration 3.4.2) exist and that the dipole model is not sufficient to explain exactly the real earth's magnetic field.

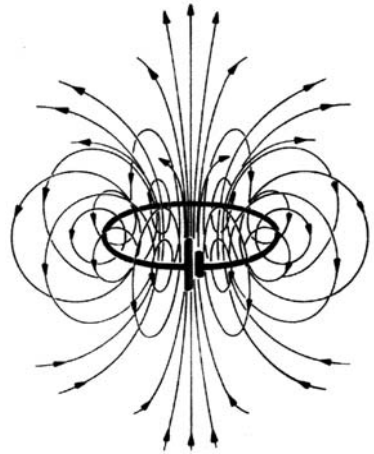


Illustration 1.0.2 – current loop

The physical approach for such a dipole field is the contemplation of the magnetic field of a so called **current loop**.

The mathematical derivation leads to a differential equation in which a so-called **elliptic integral** occurs, for which no closed mathematical solution - in the form of an equation - exists.

The mathematically commonly used approach is **converting** the appearing term in the integral in an **infinite sequence:**

Simplified can be written:

$$a_1 \cdot x + a_2 \cdot x^2 + a_3 \cdot x^3 + a_4 \cdot x^4 + \ldots$$

Then just **cut off this sequences after the first link**. Now integrate the rest, so the general equation for the dipole field, which only depends on the geographical latitude φ is created.

1.0.1 - Equation:

$$B = \frac{\mu_0 \cdot m}{4 \cdot \pi \cdot r^3} \cdot \sqrt{1 + 3 \cdot \cos^2(90 - \varphi)} \qquad \mu T$$

The mathematical approach presented here to the achievement of the dipole equation can be considered due to the cut off limbs of the rest, merely as a **first approximation**.

If you start to integrate the remaining limbs of the infinite sequence (from the current loop consideration), so you get the quadrupole field, the Octupole field, etc. Overall, this is called **multi pole forming**.

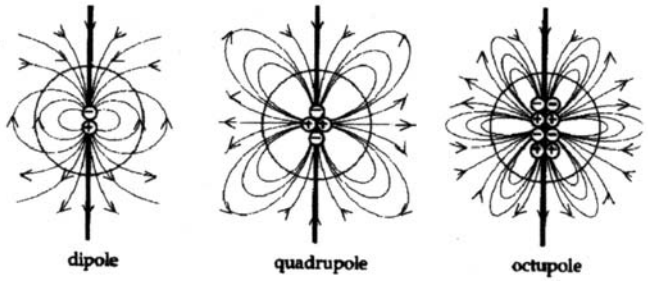


Illustration 1.0.3 – multipole forming

1.1 – Gauß and Weber

Already Gauß and Weber recognized in 1838, in their experiments with the earth's magnetic field, that the magnetic field can not be explained just by the model of a rod magnet or a current loop.

In 1838 appeared the "general theory of terrestrial magnetism" of C.F. Gauß and W. Weber where they specify the following potential equation for the magnetic field of the earth:

1.1.1 - Equation:

$$V(\varphi,\lambda,r,t) = a \cdot \sum_{n=1}^{N} \sum_{m=0}^{n} \left(g_n^m(t) \cdot \cos(m\lambda) + h_n^m(t) \cdot \sin(m\lambda) \right) \cdot \left(\frac{a}{r} \right)^{n+1} \cdot P_n^m \cdot \sin\varphi$$

The magnetic flux density **B** can be derived as a vector through the gradient from the potential equation:

1.1.2 - Equation:

$$B(\varphi,\lambda,r,t) = -\nabla V(\varphi,\lambda,r,t)$$

According to equation 4.1.2 the magnetic flux density B is depending on the latitude φ, the longitude λ, distance **r** from the center and the time **t**.

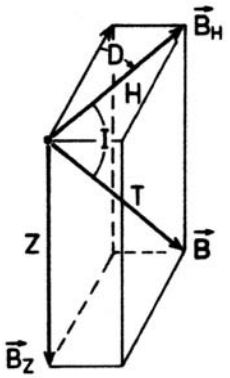


Illustration 1.1.1 – field elements

The so called **field elements of the magnetic field** can be generated from this vector. So, the declination, inclination, and the total intensity, etc.

The equations of Gauß and Weber for the earth magnetic field are used till this day.

From the potential equation or also the theory the really appearing coefficients cannot be determined in the potential equation. This happens about a **measurement** of the real magnetic field of the earth.

Comment:
If one dissolves the brackets in the potential equation, merely products of sine or cosine functions appear in the equation of Gauß, so tesseral spherical harmonics or grids.
That is: Already Gauß and Weber based their considerations of the earth magnetic field on **spherical harmonics**!!!

1.2 – Measuring stations

The magnetic field of the earth is recorded worldwide by more than 200 measuring stations.

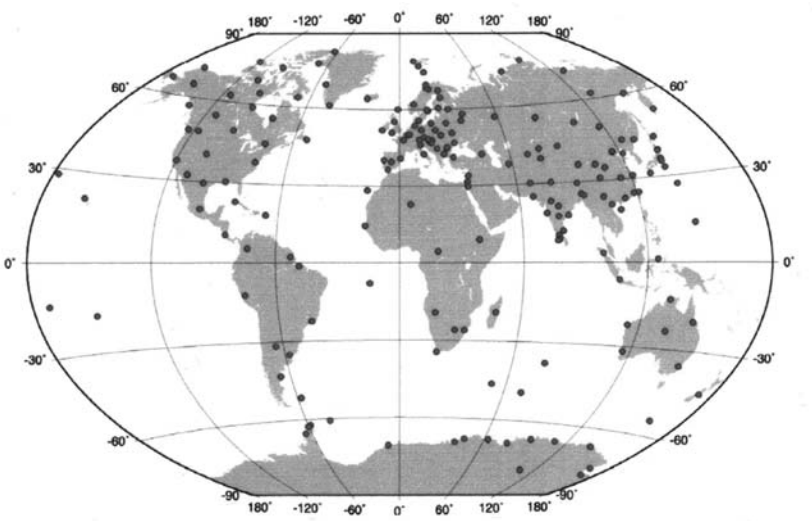


Illustration 1.2.1 – measuring stations

For some decades the field will also measure from satellites. The first satellite was Magsat which registered in 1980 during six months the intensity and the whole magnetic field.

Since 1999, the Danish satellite Ørstedt is located on an orbit and since July 2000, the German Champ satellite works.

All accumulated data about the earth's magnetic field are recorded by the IUGG and the ÌÅGA and evaluated. These values are used among others as a basis for creating the models **IGRF** and **WMM**.

These models are issued as flashcards for declination, total intensity, largest total changes, horizontal intensity, inclination, intensity of North, East intensity and vertical intensity.

1.3 – Total intensity – WMM 2005

The "world magnetic model" (WMM) is a product of the U.S. National Geospatial-Intelligence Agency (NGA).

You can relate the WMM 2005 about the „National Geophysical Data Center“ (NGDC) now also via the Internet.

The NGDC and the British Geological Survey (BGS) made the WMM with the support of the NGA in the United States, together with the „Defence Geographic Imagery“ and the „Intelligence Agency“ (DGIA) from Great Britain.

The WMM is used as a standard model for the US Department of Defense, the UK Ministry of Defence, the North Atlantic Treaty Organization (NATO), and the World Hydrographic Office (WHO).

It is widely used in the civilian navigation. The model, the accompanying software and documentation are managed by the NGDC and the NGA. The model is made for every 5 years.

The card of the total intensity is important to this investigation, as a particular type of evaluation is possible.
So the total field total intensity at the earth's surface for the **World Magnetic Model 2005** can be seen in the following illustration 1.3.1.

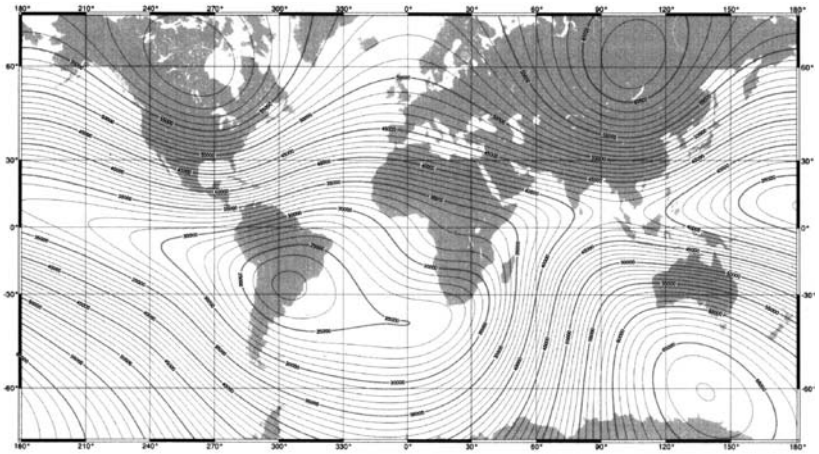


Illustration 1.3.1 – WMM 2005

The **four** extremes of the field here are striking (and not just two as a rod magnet or dipole model), where three Maxima and a minimum exist. In addition a saddle point appears (in the region of Indonesia)

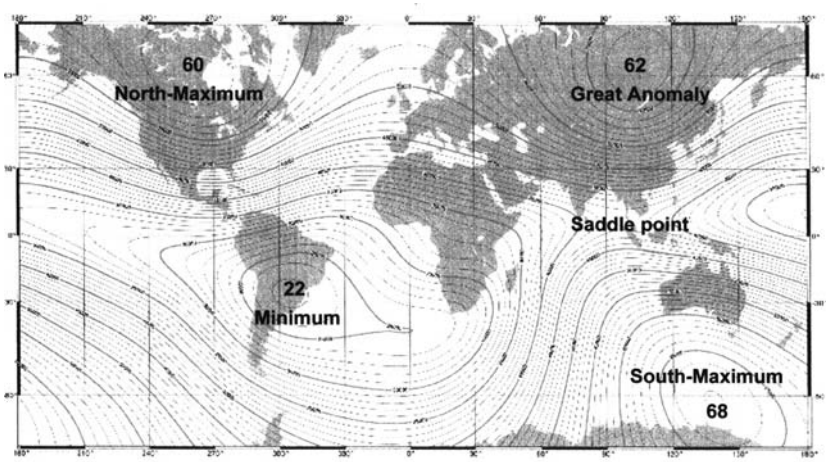


Illustration 1.3.2 – extreme values of the field

The names of the extreme values of the magnetic field is so commonplace in geophysics.

The formation of four poles is no longer explained by the dipole theory.

And when using the multi pole model:

Through the conversion of the terms in an infinite sequence, the whole process is a **mathematically approximate**, the solution only a **mathematical approximation**.
The question of **physical relevance** remains completely open! It is therefore right to doubt that nature here has used the same implementation.

1.4 – Temporary stability

The whole magnetic field changes its shape - in the long term. This slow change is called secular variation and results in the course of time that the magnetic field in its polarity reverses.
According to Geoforschungszentrum Potsdam, the last pole reversal is back about 750,000 years.

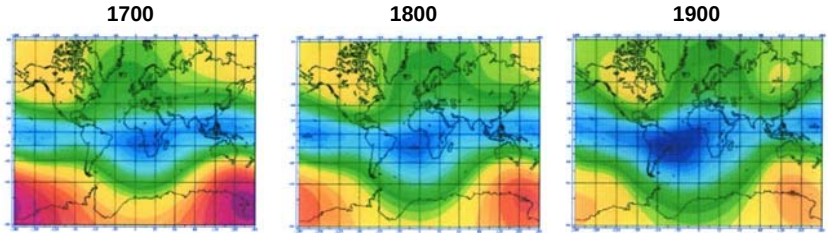


Illustration 1.4.1 – earth magnetic field

In the illustrations of the „World Data Center for Geomagnetism“ in Kyoto, the situation for the last three hundred years can be seen. These images are based on geological findings and long-term back calculations of the earth's magnetic field.
Comparing the illustrations with the today's models from 2005, so virtually no change in the **structure** can be determined. Intensities change and also the extremes change their location, but also no major change in the **field structure** can be determined.

The field of total intensity is so temporary over time more or less constant.

It is therefore ideally suited for a general analysis of the earth's field.

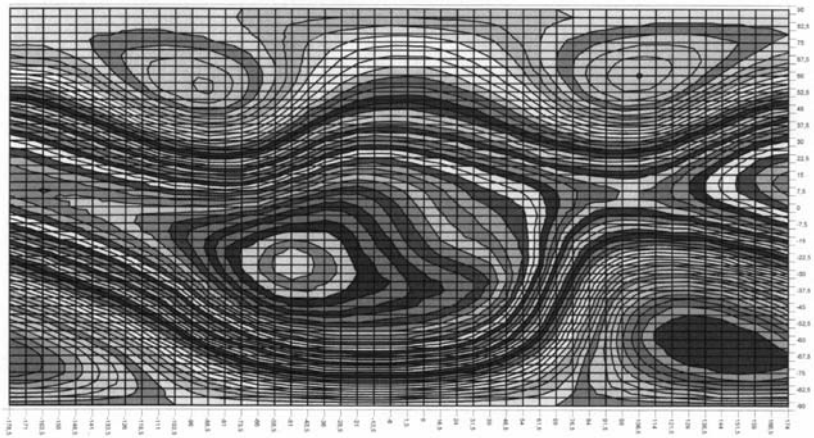


Illustration 1.4.2 – total intensity 1980

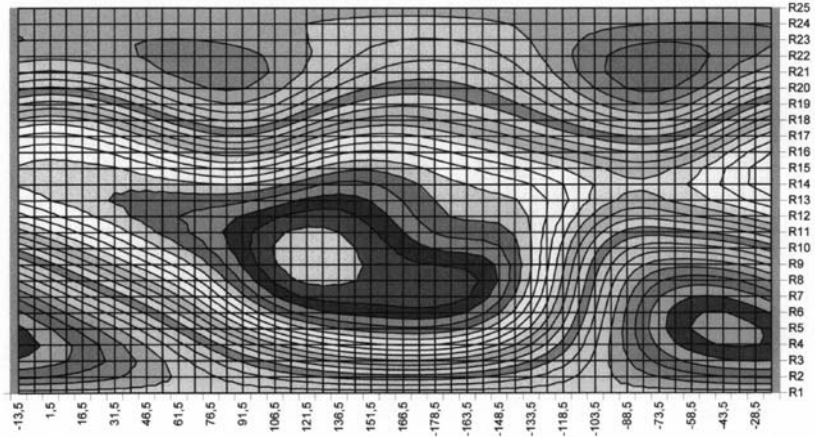


Illustration 1.4.3 – total intensity 2012

The comparison of the illustrations shows that there are no major differences between 1980 and 2012 in the structure of the field.
The magnetic field (total intensity) has remained sufficiently constant during the past 30 years.

1.5 – Fourier-analysis of the earth magnetic field

The approach here shall find an oscillation base for the earth's magnetic field.
It exists a mathematical method, namely the Fourier analysis. With it a given periodic function can be decomposed as a sum of sine and cosine functions.

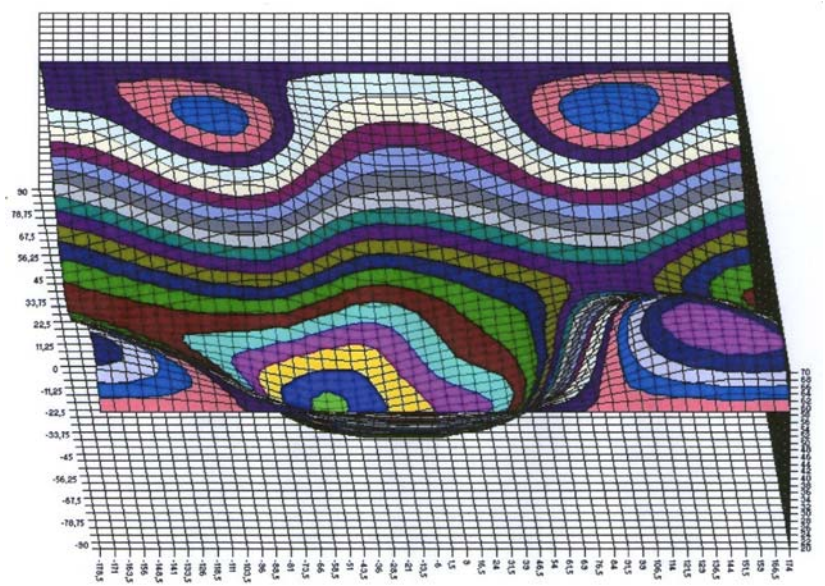


Illustration 1.5.1 – total intensity

The illustration 1.5.1 is converted into a **table** of total intensities. And so, the possibility of an evaluation is given.
Also a 3D representation of the earth's magnetic field at the earth's surface is possible.

Here, the evaluation is made via a **two-dimensional Fourier analysis.**
A Fourier analysis provides a decomposition of a given function as a sum of sine and cosine functions. A two-dimensional Fourier analysis receives a sum of **spherical harmonics**.

And with the earth's magnetic field actually can be made a decomposition into spherical harmonics.

1.5.1 – Fourier-analysis

The total field is decomposed into single - in this case horizontal – **cuts**. With each cut, a one-dimensional Fourier analysis can be done.

Each section runs along a **parallel**. The cuts are created by + 90 North to - 90 South at a distance of 7.5 degrees. The results are 25 sections. (7.5 Degrees = 800 km)

Considering a one-dimensional (numeric) Fourier analysis to every cut with the variable λ and the step of 7,5 degrees, i.e. with 48 points per cut. There are total 1106 Points for the analysis of the earth's field.

A **numeric** (one-dimensional) harmonic procedure serves as a basis, or an analysis tool, as described in the book „Mathematics for engineers“ by Brauch/Dreyer/Haacke and as **Algorithm of Goertzel** (and Reinsch) is known.

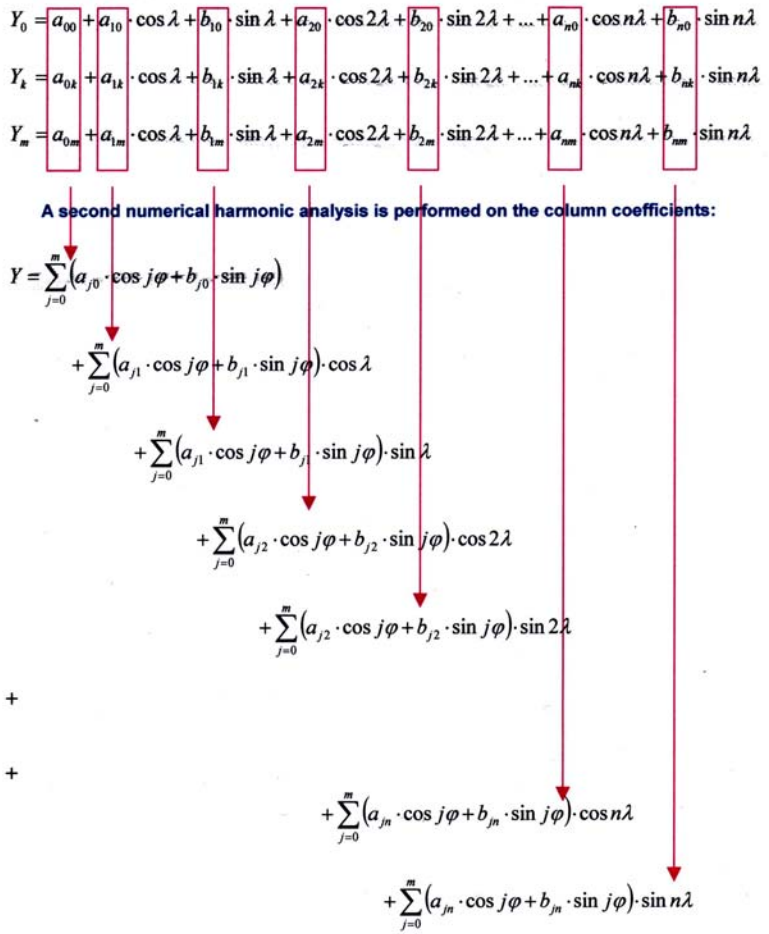
Then, the 25 slices from the Fourier analysis generally can be represented:

$$Y_0 = \sum_{i=0}^{n} \left(a_{i0} \cdot \cos i\lambda + b_{i0} \cdot \sin i\lambda\right) \quad \text{bis} \quad Y_m = \sum_{i=0}^{n} \left(a_{im} \cdot \cos i\lambda + b_{im} \cdot \sin i\lambda\right)$$

The result is a system of equations with **m+1** equations with each **n+1** elements.

The generated coefficient matrix with the $\mathbf{A_m}$ and $\mathbf{B_m}$ can be performed as **one more** Fourier analysis, with the variable φ. Every point on the earth with the coordinates λ,φ qualifies as:

$$Y = \sum_{j=0}^{m} \left(a_{j0} \cdot \cos j\varphi + b_{j0} \cdot \sin j\varphi\right) + \sum_{i=1}^{n} \sum_{j=0}^{m} \left(a_{ji} \cdot \cos j\varphi + b_{ji} \cdot \sin j\varphi\right) \cdot \left(\cos i\lambda + \sin i\lambda\right)$$



The first term for Y (the zonal, sectorial part) can be still complemented so:

$$\sum_{j=0}^{m}\left(a_{j0}\cdot\cos j\varphi+b_{j0}\cdot\sin j\varphi\right)$$

$$=\sum_{j=0}^{m}\left(a_{j0}\cdot\cos j\varphi+b_{j0}\cdot\sin j\varphi\right)\cdot\cos 0+\sum_{j=0}^{m}\left(a_{j0}\cdot\cos j\varphi+b_{j0}\cdot\sin j\varphi\right)\cdot\sin 0$$

Due to the quantitative analysis on the one hand and the mathematical

methods, on the other hand, the following total equation for the magnetic flux density at the earth's surface can be created:

1.5.1.1 - Equation:

$$B=\sum_{i=0}^{n}\sum_{j=0}^{m}\left(a_{ji}\cdot\cos j\varphi+b_{ji}\cdot\sin j\varphi\right)\cdot\left(\cos i\lambda+\sin i\lambda\right)$$

If one solves the brackets, just **tesseral spherical harmonics**, so **grids**, appear.

1.5.1.2 - Theorem:

The magnetic field of the earth (on the ear-suace)can be completely described by a sum of grids.

At the same time, this function represents a solution of the angle part of Laplace's equation. In the consequence is then:

1.5.1.3 - Theorem:

Magnetic field of the Earth (on the surface) = two-dimensional oscillation structure

Here arises the question whether there is a relation between the two-dimensional magnetic oscillation model and the earth oscillation structure?

Because of the general approach of the Fourier analysis and of the equation 4.5.1.1 the following general statement can be made:

1.5.1.4 - Theorem:

Each oscillation structure on or around a sphere can be completely described by a sum of tesseral spherical harmonics.

Considering the statements and equations in chapter 2.11.1 the following can be said:

1.5.1.5 - Theorem:

Each oscillation phenomenon around a sphere can be represented as a solution of the angular part of the Laplace equation.

1.5.2 – Quantitative Fourier-analysis

The quantitative **numeric** Fourier analysis of the earth's magnetic field (IGRF 1984) yields the following result for the magnetic flux density at the earth's surface:

1.5.2.1 - Equation:

in µT — Static — Zonal

$$B = 47{,}2183 + 2{,}1544\cos\varphi + 11{,}3642\cos 2\varphi - 1{,}7435\cos 3\varphi - 1{,}0949\cos 4\varphi - 1{,}0496\cos 5\varphi$$

$$-2{,}0121\cos 2\lambda + 0{,}0354\cos 4\lambda - 0{,}0159\cos 6\lambda$$
$$-1{,}7028\sin 2\lambda + 0{,}3562\sin 4\lambda - 0{,}0195\sin 6\lambda \quad \text{Sectorial}$$

$$+ (-8{,}4184\sin\varphi + 8{,}8172\sin 2\varphi - 5{,}2834\sin 3\varphi - 0{,}2577\sin 4\varphi + \ldots)\cos\lambda$$
$$+ (+3{,}5852\sin\varphi - 2{,}8201\sin 2\varphi - 0{,}5036\sin 3\varphi + 1{,}1381\sin 4\varphi + \ldots)\sin\lambda$$

$$+(-1{,}6626\cos\varphi + 0{,}6739\cos 2\varphi + 1{,}6343\cos 3\varphi + 1{,}0912\cos 4\varphi + \ldots)\cos 2\lambda$$
$$+(-0{,}5851\cos\varphi + 0{,}4514\cos 2\varphi + 0{,}4037\cos 3\varphi + 1{,}1604\cos 4\varphi + \ldots)\sin 2\lambda$$

$$+(0{,}9031\sin\varphi - 0{,}8500\sin 2\varphi + 0{,}5205\sin 3\varphi + 0{,}4141\sin 4\varphi + \ldots)\cos 3\lambda$$
$$+(0{,}6055\sin\varphi + 0{,}2544\sin 2\varphi + 0{,}1402\sin 3\varphi + 0{,}0423\sin 4\varphi + \ldots)\sin 3\lambda$$

$$+(-0{,}2127\cos\varphi + 0{,}0618\cos 2\varphi + 0{,}2882\cos 3\varphi + \ldots)\cos 4\lambda$$
$$+(-0{,}0225\cos\varphi - 0{,}3858\cos 2\varphi + 0{,}0395\cos 3\varphi + \ldots)\sin 4\lambda \quad \text{Tesseral}$$

The evaluation provides all three kinds of spherical harmonics, so zonal, sectoral and tesseral forms, as well as a static part.
The zonal and sectoral part of the spherical harmonics can be grasped to one grid, called the **grid ZS**. This behaves then like a tesseral spherical harmonic, so as a grid.

1.5.2.2 - Equation: Grid ZS = Zonal + Sectorial

$$B_{ZS} = B_z + B_S$$

Comment:
In the equation 4.5.2.1 exist 17 intensity values that lie between one and eleven micro-Tesla. All other values are in the range of **nano-Tesla**!!!

1.6 – Further evaluations

The individual parts of the Fourier analysis allow a graphical representation of the total situation.

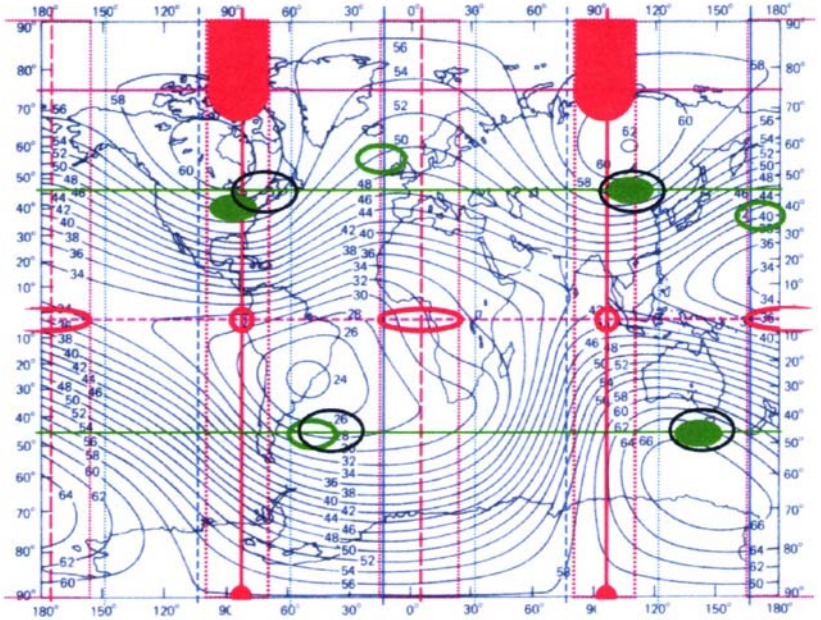


Illustration 1.6.1 – earth magnetic field

The map of the total intensity registered all extremes, magnetic structures and source points arising from the analysis.

Blue – three-axle ellipsoid
Red – Zonal, Sectorial (Grid ZS)
Green – Tesseral
Black – Hyugens source points

The illustration 1.6.1 entails relationships that are represented in detail on the following pages.

1.6.1 – Three-axle ellipsoid

With the help of satellite geodesy by C.A. Lundquist and G. Veis in 1966 the following parameters have been identified to represent the earth as a genuine three-axle ellipsoid:

a_1-a_2 = 69 Meter
λ_0=-14,75 degrees West

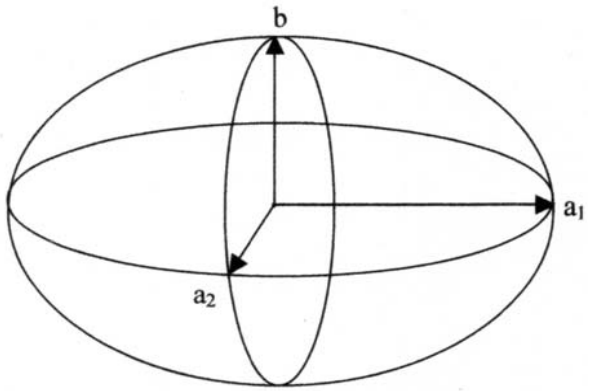


Illustration 1.6.2 – three-axle ellipsoid

The blue ellipsoid grid in illustration 1.6.1 is based on the values of Lundquist and Veis and is moved to the red magnetic system about 1.25 degrees.
So **seen globally**, a good match exists.

An analysis of the geographic locations of all occurring magnetic extremes results in a functional relationship for their longitude. The derivation of the following equation can be found in the book "Lattice structures of the earth magnetic field" Chapter 4.4 and 9.5.

1.6.1.1 - Equation: $$\lambda_E = 3{,}75^\circ \cdot m - 13{,}5^\circ$$

m is element of the integers (...-2,-1,0,1,2,...)

1.6.1.2 - Theorem: The earth magnetic field stand in relation to the figure of the earth.

1.6.2 – Grid ZS

The red magnetic system in the illustration 1.6.1 represents the **grid ZS**, so the zonal-sectoral part.

Creating a magnetic back at the north pole, while there is only a maximum point at the south pole.

The maximum zone = **magnetic main meridian** (thick red) is clearly visible, with lambda = -83.5 degrees west and lambda = 96.5 degrees east.

The minimum zones (red dashed line) are at lambda = 5.25 degrees east and lambda = -174.25 degrees west.

There are two minimal zones and two saddle points in the equatorial plane.
.

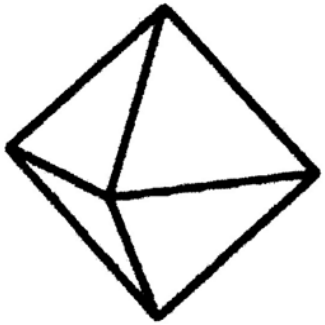


Illustration 1.6.3 – octahedron

1.6.2.1 - Theorem: All extreme value areas of the grid ZS lie on the corners of an octahedron.

1.6.3 – Tesseral field

The green system in illustration 1.6.1 provides the tesseral part. All extreme values lie approximately ±45 degrees latitude.

The green points represent the maximum and minimum points of the pure (tesseral) grid part of the earth's magnetic field.

Solid green = Maximum
Green rimmed = Minimum

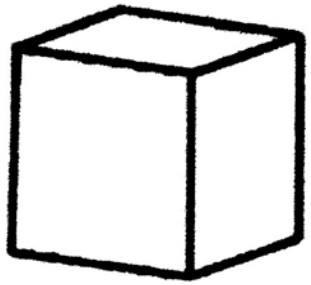


Illustration 1.6.4 – cube

In the northern hemisphere all extremes lie approximately on a **square**. Through the 45 degrees latitude a twisted **parallelepiped** (cube) is created in the earth, in terms of coordinate.
The extremal zones in the southern hemisphere are about 35-40 degrees **moved** against the northern extremal zones.

1.6.3.1 - Theorem: **The extreme values of the tesseral field are located on the corners of a twisted cube. (parallelepiped)**

1.6.4 – Huygens source points

The **black** rimmed ellipses represent the source points of the total field.

The basic field, the grid model and the Huygens principle provided that these four poles represent the **theoretical source points** from which the **whole outer magnetic field at the earth's surface** can be created

There is alignment of the source areas with the four main extrema of the tesseral field.

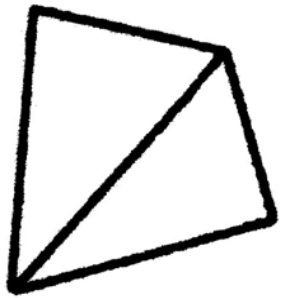


Illustration 1.6.5 – tetrahedron

The source points are located on the corners of a **tetrahedron**. The sources in the southern hemisphere are shifted by 45 degrees.

1.6.4.1 - Theorem: **The Huygens source points are located on the corners of a distorted tetrahedron.**

1.6.5 – Summary

All extreme value areas of the grid ZS are on the corners of an **octahedron**.

The extreme value of the tesseral field are located on the corners of a twisted **cube** or a **spar**.

Comment:

A parallelepiped (Synonyms: spar, Parallelotope) is a geometric body bounded by six parallelograms. The name spar comes from the calcite, whose cristals have the shape of a paralelepiped.

The Huygens source points of the field are located on the corners of a distorted **tetrahedron**.

The earth magnetic field stand in relation to the figure of the earth. An analysis of all magnetic **extremes** results in a functional relationship for their longitude:

$$\lambda_E = 3{,}75^\circ \cdot m - 13{,}5^\circ \qquad 3{,}75 \Leftrightarrow 96 \text{ Division}$$

With the 96 Division, a sufficient differentiation exists to contain **all** occurring angle for polyhedra or the Platonic solids.

1.6.5.1 - Theorem: **All Platonic solids are available as oscillation figures of the earth oscillation structure.**

1.7 – Huygens source points of the earth field

There are two ways to see a grid. The grid can be described in its own level of development.
This happens for example in the Fourier analysis as seen. Or one can describe the grid on the plane of basic oscillations. This will happen in the following.

1.7.1 - Ideal source point structure

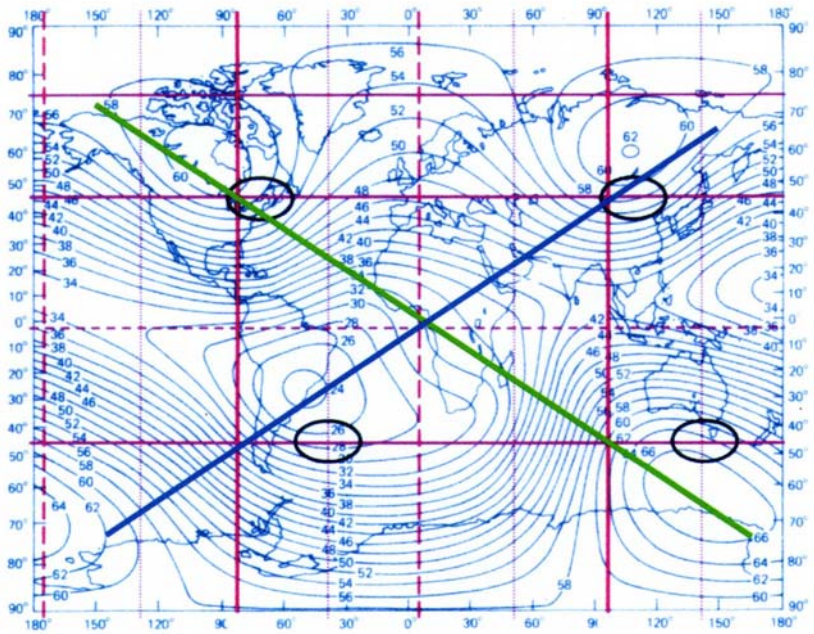


Illustration 1.7.1 – source points

The picture shows the determined Huygens source areas of the total field (black) with the magnetic main meridian (thick red vertical)

The blue and green lines represent the theoretical (mathematical) connection between ideal source points.

It is expected that the location of the extremes of the total intensity on these lines are located and the extremes lay in the vicinity of the source points - where the source points are, also the largest intensities should occur.

It can also be seen that there is a variance (disturbance) from the ideal configuration in the southern hemisphere !!!

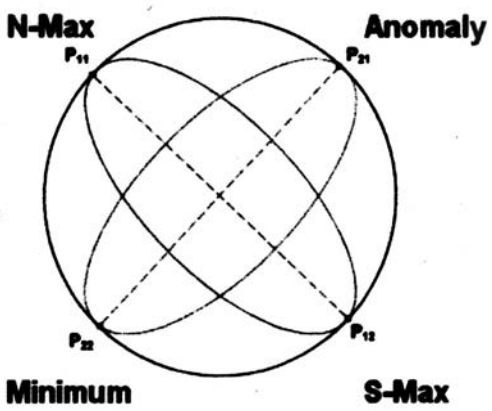


Illustration 1.7.2 – extrema -structure

On the N-Max - S-Max axis an oscillation builds up, which behaves like a **straight** oscillation - face two Maxima.
On the minimum anomaly-axis an oscillation builds up, which behaves like an **odd** oscillation - face a maximum and a minimum.
The circle that connects all source points stands vertically on two levels and is identical with the magnetic main meridian.

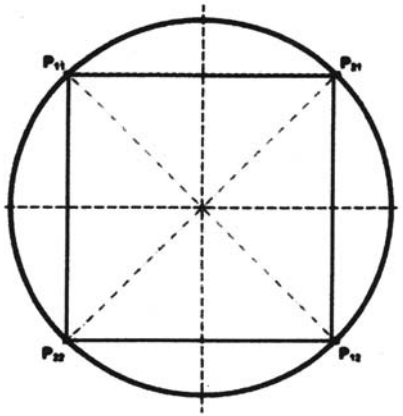


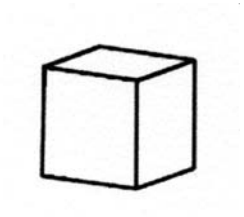
Illustration 1.7.3 – ideal arrangement

All sources in the plane of the main meridian on the corners of a **square** build an ideal (undisturbed) source point arrangement.

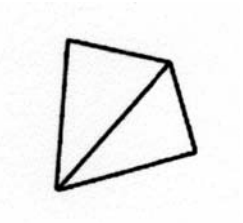
1.7.2 - Real source point structure

In the northern hemisphere, the pole or sources are located on the magnetic main meridian, in good agreement with the undisturbed source point arrangement. In the southern hemisphere, however, exists a deviation from 45 degrees to the east.

There are two possibilities of the source point arrangement:



The source points in the northern hemisphere are opposite diagonally on the cube. You can choose the source points of the southern hemisphere now:
either at the bottom of the cube vertical under the northern points or at the bottom of the cube with 90 degrees offset.
In both cases, the lower part of the cube is twisted then to ±45 Grad degrees to get the real positions.



The source points in the northern hemisphere are opposite above on the tetrahedron.
The source points of the southern hemisphere face down on the tetrahedron.
The lower part of the tetrahedron, is twisted to 45 degrees westward, to get the real positions.

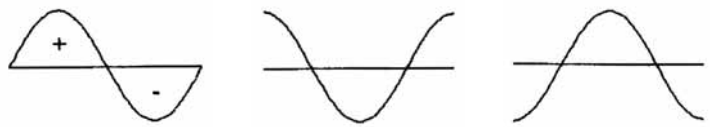
Illustration 1.7.4 – source points

1.7.2.1 - Theorem: Spatial order structures for the real (Huygens) source points are polyhedra.

2.0 – Approach for an oscillation model

The aim of this chapter is the description of basic mathematical and physical terms and conditions, that serve the development of an equation for an oscillation structure and allow a quantification of the model. The approach is based on **oscillations around a ball**.

Examples for oscillation possibilities:



sine cosine

Illustration 2.0.1 – oscillations

sine or cosine = oscillation = wave

Applies to physical oscillations:

2.01 - Equation: $f \cdot \lambda = c$

(Frequency multiplied with wavelength is equal to speed of light)

How to get vibrations around a ball ? - Analogous to the Bohr model of the atom, if it contains the surrounding Electron as a wave by de Broglie:

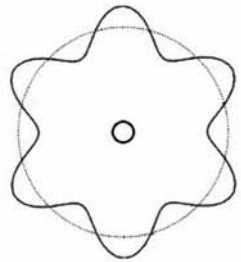


Illustration 2.0.2 – oscillations around a ball

It fits only an integer number of oscillations around the globe.

2.02 - Equation: $n \cdot \lambda \Leftrightarrow 360° = 2\pi$ $n \in N$

The wavelength is proportional to the circle angle alpha:

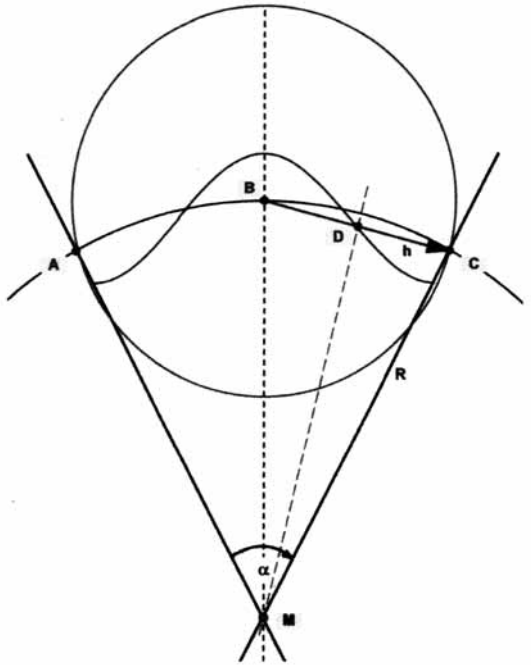


Illustration 2.0.3 – wave length and circle angle

2.03 - Equation: $\lambda \Leftrightarrow \alpha$

Condition for **n** vibrations around a globe:

2.04 - Equation: $n \cdot \alpha = 2\pi$ $n \in N$

Theoretically, the following form is possible:

2.05 - Equation: $n \cdot \alpha = 2\pi \cdot m$ $m,n \in N$

Here, the oscillation circle does not close after one revolution, but only take **m** turns.

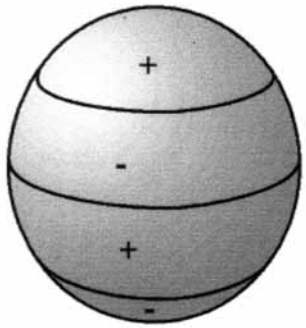
2.1 – Spherical harmonics

A standing wave around a sphere can be interpreted as a stationary state. Thus, each state of a wave is spatially fixed. The question now is: how many waves fit around a globe?
In classical mechanics, degrees of freedom is the number of freely selectable, independent movements of a system
A rigid body in space has a degree of freedom f = 6, because you can move the body in three independent directions and rotate in three independent planes.
Because a sphere is rotationally symmetric, so rotations are irrelevant. A ball has therefore 3 freedoms regarding a wave propagation. Therefore, three independent waves around the globe are possible.
Due to the spherical shape, the three freedoms can be represented as spherical coordinates.

Example earth:

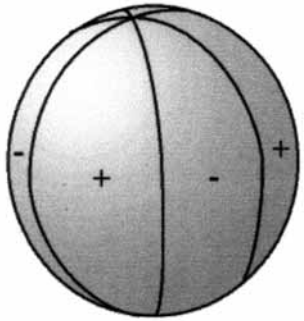
1) A wave starts from North Pole via the South Pole to the North Pole
2) The second wave runs around the equator
3) The third standing wave runs radially - based from the center

There exists a mathematical concept namely for the first two examples, that is suitable for a representation - the **spherical harmonics**.
Standing waves on the surface of a sphere can be treated as spherical harmonics. There are 3 types:



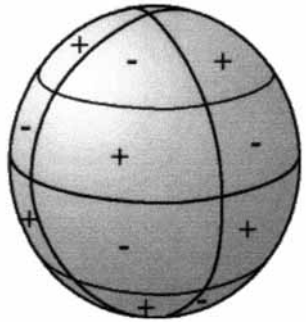
Zonal spherical harmonics only depend on the latitude. **$\sin\varphi$** **$\cos\varphi$**

Illustration 2.1.1 – zonal spherical harmonic



Sectorial spherical harmonics depend only by the degree of longitude. **$\sin\lambda$** **$\cos\lambda$**

Illustration 2.1.2 – sectorial spherical harmonic



Tesseral spherical harmonics depend of the latitude and the longitude. **$\sin\varphi\cdot\sin\lambda$** **$\sin\varphi\cdot\cos\lambda$** **$\cos\varphi\cdot\sin\lambda$** **$\cos\varphi\cdot\cos\lambda$**

Illustration 2.1.3 – tesseral spherical harmonic

2.1.1 - Definition: **tesseral spherical harmonic**
= product of two oscillations
= 2 perpendicular standing waves
= **grid**

Comment:

A complete route in terms of square grid on a sphere can not materialize. Only grid systems are developed, which are designed as the geographic grid system. There are always **two** poles. The corresponding "meridians" and "circle of latitude" then make the **grid**.

2.2 – Addition and multiplication of waves

spherical harmonics can present itself as two sine- or cosine waves, which are perpendicular to one another and additative or multiplicative overlap.

2.2.1 - Zero-grid

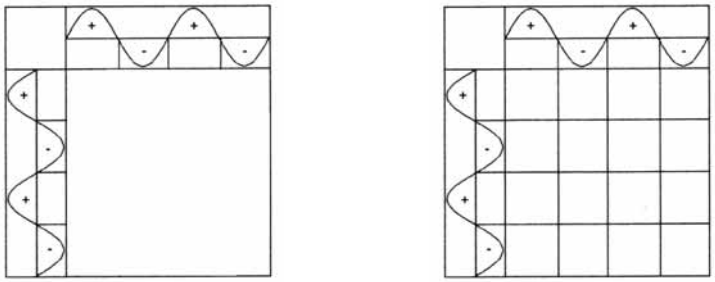


Illustration 2.2.1 – zero-grid

The zero points of both waves are transferred on the consideration level, as shown in Illustration 2.2.1 right.
This is a tesseral spherical harmonic with: $\mathbf{G_0 = \sin\alpha \cdot \sin\beta}$

Two vertical waves can be added by following **qualitative** rules:

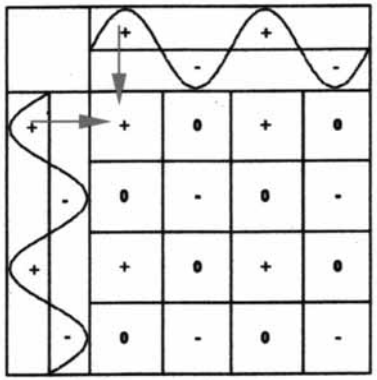


Illustration 2.2.2 – multiplication

2.2.2 – Pole forming:

1) **+ and + is +**
2) **– and – is –**
3) **+ and – is 0**

This procedure results in fields with different portents or different states. There exist three oscillations states: **positiv(+), negativ(-), neutral(0)**

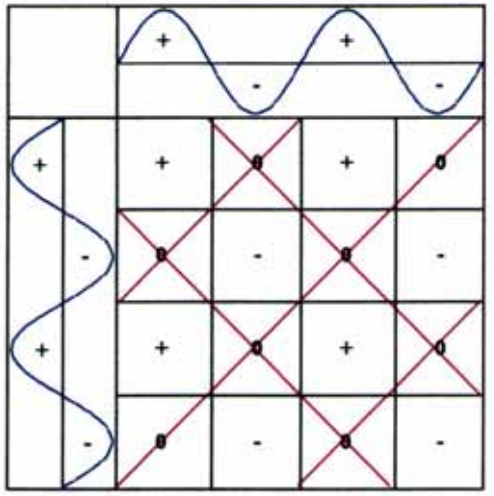


Illustration 2.2.3 – generated grid

2.2.3 – Grid forming:

It is striking that all zero fields are **diagonal** to each other.

Connecting the zero fields as shown in Illustration 2.2.3.

2.2.4 - Definition:

The (red) grid-like structure is then called **basic field** or **grid** or **generated field**.
The (blue) producing waves are called **basic oscillations**.

The basic field:
$\mathbf{G = \sin\alpha + \sin\beta}$

While the mathematical concept of spherical harmonics does not ask for the cause of the oscillation field, so the underlying waves must be included on the physical examination.

The term of the basic field does this. **The basic field is defined by the basic oscillations**.

The name **basic field** is regarded as a physical equivalent to the mathematical concept of tesseral spherical harmonics.

The multiplication of the waves works as seen first in a discreet manner and way.
A continuous point multiplication of two perpendicular to one another standing waves result in grid pattern, with alternating polarities of the grid fields, as in the illustration 2.2.4 shown.

This shows that the field maxima and minima field points occur in the middle of the squares, while the lines consist of **zero values**.
The field maxima are there as hills, while the valleys are formed by the field minima.

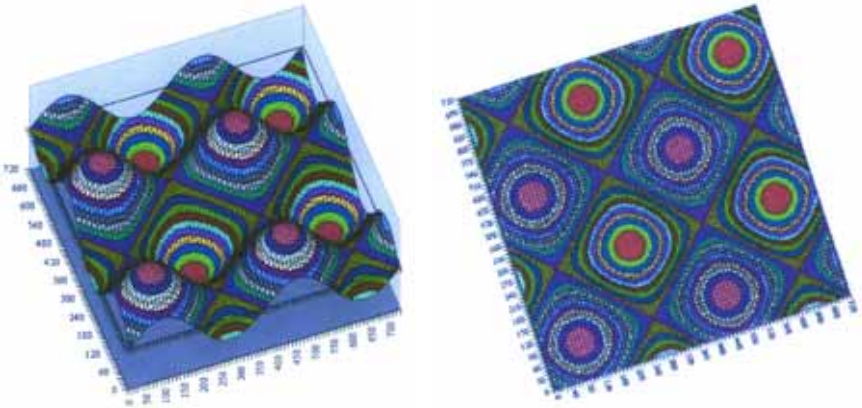


Illustration 2.2.4 – generated grid

On the bottom left and right in the left image the generating oscillations are visible. It is also visible that two generated grid fields result in a (generated) oscillation.

2.2.5 - Definition: Grid

= two-dimensional oscillation structure

It is possible here to draw a second grid. It is the **maximum grid**. It combines the field maxima and minima, so the top of the hill and the valley bottoms in the illustration 2.2.4 and represents the extreme gradient of the field.

This allows **two** perspectives of the grid:

2.2.6 - Definition:

1) the generated grid is described in the plane of **basic oscillations** with: **$G = \sin\alpha + \sin\beta$**

2) The generated gird is described in the grid plane itself.
$G = \sin\varphi \cdot \sin\lambda$

Both coordinate systems differ, they are turned against each other by 45 degrees.

For Illustration:

A physical analogue to the ground field are the

Chladni-figures

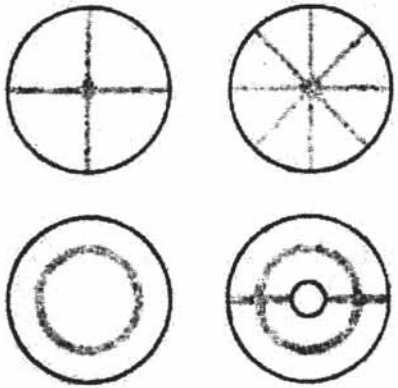


Illustration 2.2.5 – Chladni-figures

For producing the figures, a metal plate is sprinkled with sand and then moved to vibration.
When resonance occurs at certain frequencies with the natural frequencies of the plate, than the entire plate begins to oscillate.
Thus, the sand exactly in the places stays where the amplitude of the vibration is zero.

2.3 – Huygens-Fresnel principle

According to chapter 2.1 a ball has three degrees of freedom f = 3. Two degrees of freedom could be covered through the use of spherical harmonics.
The third freedom, the **radial** direction, is still missing. This requires the understanding of a physical representation with which the expansion of physical waves can be described: **the Huygens-Fresnel principle**.

The huygensche principle emanates from a source **S**, which generate wave fronts uniformly in all directions. To get the resulting wave front in the point **P**, it is not necessary to consider the entire spread of **S**.
The **Huygens-Fresnel principle** says that every point (**O**) from a wavefront can be considered as a starting point of a new wave, the so-called **elementary wave**.
The location of the resulting wavefront in **P** arises from superposition of all elementary waves.

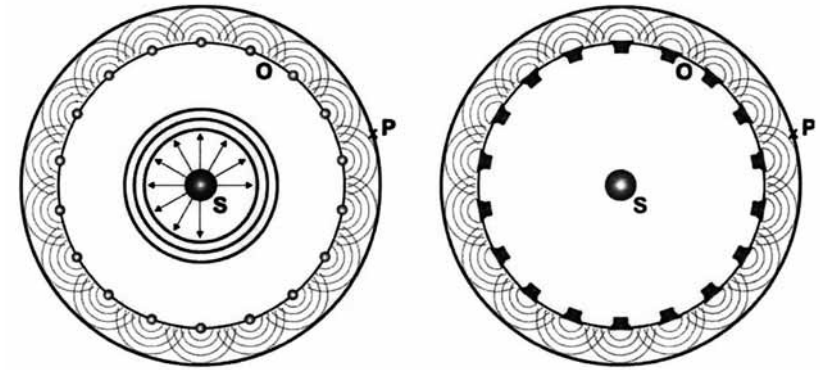
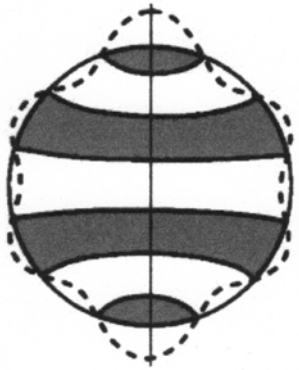


Illustration 2.3.1 – Huygens-Fresnel principle

The **origins of the waves** (O) deliver the resulting wave front (P) by superposition of **elementary waves**.

In **two** dimensions, elementary waves are **circular**.
In **three** dimensions, elementary waves are **spherical** in shape.



Application of the Huygens-Fresnel principle for a standing wave around a globe:

Extreme values of the wave
= sources
= waves origins

1 wave = 2 sources

Illustration 2.3.2 – wave origins

The following image shows the oscillation state for a wave by the Huygens-Fresnel principle with a maximum (wave peak) as a source.

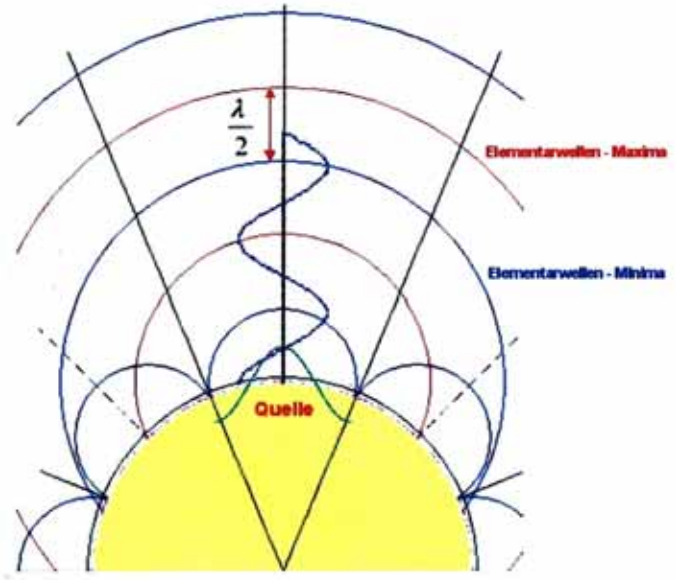


Illustration 2.3.3 – elementary waves

Since a wave consists of maxima and minima, the elementary waves also form minimal fronts (blue) and maximum fronts (red). Between the extreme fronts course zero fronts exist.

2.4 – Basic oscillations

Now the previous considerations allow a first calculation of a wave that builds up, as the earth, around a sphere. Still, it must be considered that the wave propagation takes place **linear** and **not** along the curved surface of the ball.

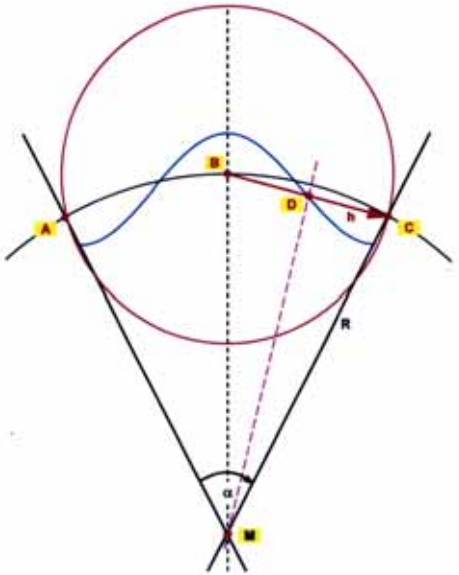


Illustration 2.4.1 – wave propagation

After the **Huygens-Fresnel principle** the points **A**, **B**, **C** serve so as **source points** of the standing wave (blue)

Electromagnetic waves propagate **spherically** from one point. (red)

If point **B** is the starting point so the distance **BDC = h** is the way of the wave.

Because there is a **stationary state**, it is sufficient to look at the way of the wave **from one source to the next source**.

This makes: $$h = \frac{\lambda'}{2}$$

The triangle of **MCD** in the picture 2.4.1 is rectangular in the point **D** and apply:

$$\sin\frac{\alpha}{4} = \frac{\frac{h}{2}}{R} = \frac{h}{2R}$$

Shift the equation to **h**:

$$h = 2R \cdot \sin\frac{\alpha}{4} = 2R \cdot \sin\frac{\pi}{2n} = \frac{\lambda'}{2}$$

Since now all sizes are known, the wavelength can be determined:

2.4.1 - Equation: $$\lambda' = 4R \cdot \sin\frac{\pi}{2n}$$

In the equation is **R** the radius of the Earth, **n** is the number of waves.

This results in the **frequency equation for basic oscillations**:

2.4.2 - Equation: $$f = \frac{c}{4R \cdot \sin\frac{\pi}{2n}}$$ n = 1,2,3,4,...

The **basic frequency** is for **n = 1**:

2.4.3 - Equation:

$$f_o = \frac{c}{4R}$$

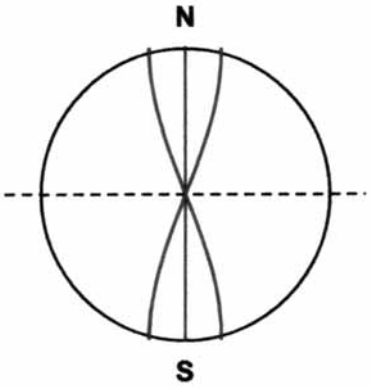


Illustration 2.4.1 – basic frequency

This is also the oscillation of a bar with free ends, which length is equal to the diameter of the ball.

2.5 – Radial structure

The picture shows the oscillation state of **n** waves, when the Huygens-Fresnel principle is applied to all sources. The maximum fronts are red, the minimal fronts are blue.

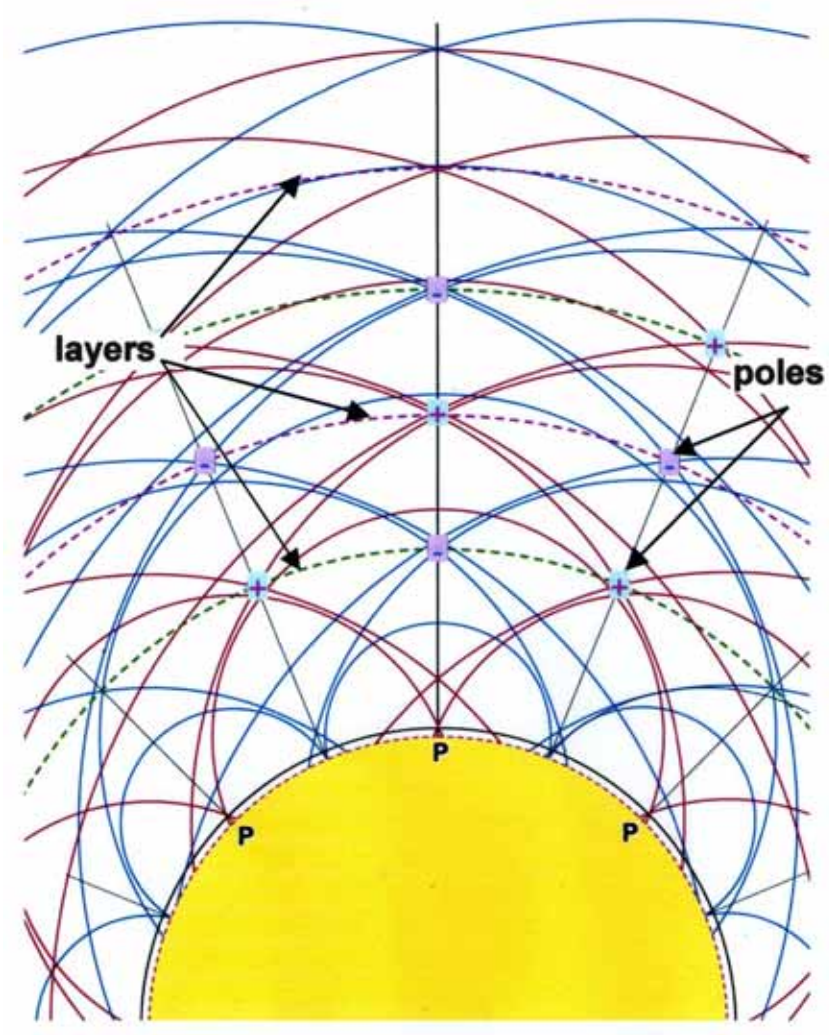


Illustration 2.5.1 – superposition of waves

2.5.1 – Stratification

The superposition of elementary waves follows the same rules as described in section 2.2.

2.5.1.1 - Definition: Pole forming

Plus poles are formed by the superposition of the positive elementary waves.

Minus poles are formed by the superposition of the negative elementary waves.

Zero poles are formed by the superposition of positive and negative elementary waves.

2.5.1.2 - Definition: Layer formation

By the superposition of elementary waves, **poles** are formed (+,-, 0) on **concentric spherical layers** in the following **Layers = L** called.

2.5.1.3 - Definition: Wall forming

Zero poles arise between these layers, which also lie on **concentric spherical layers** and are called in the following **zero walls**.

By the **interference** of different waves, raises oscillation maxima and minima or **oscillation layers** (See illustration 2.5.1) that envelope the earth **spherically**.

The layers on which the poles are can be calculated. The following derivation use a geometric approach to **calculate the distance of a layer** to the earth center.

2.5.2 – Calculating the layers

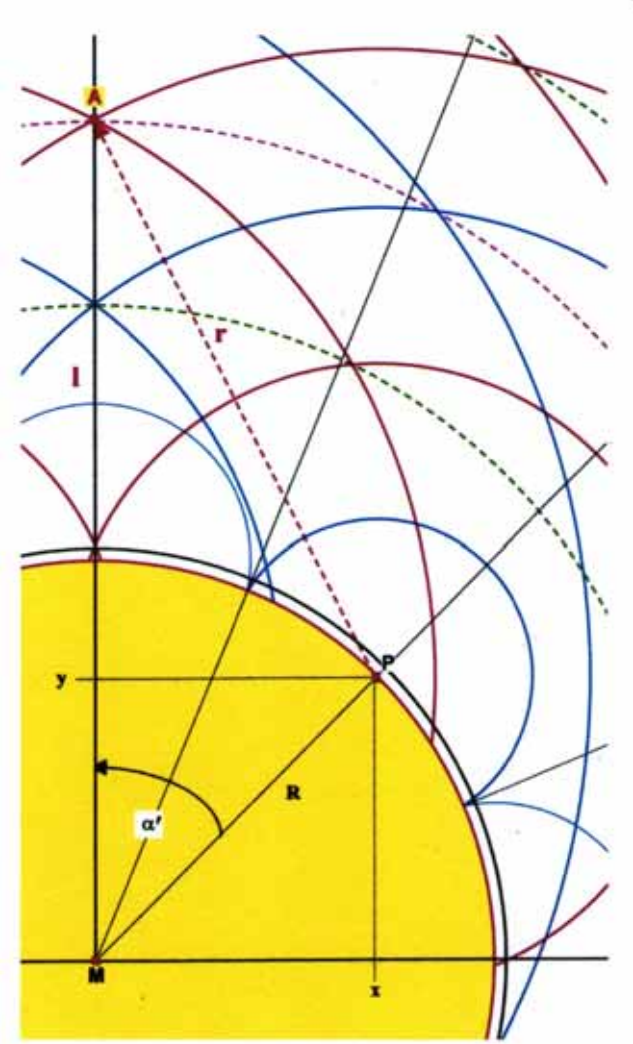


Illustration 2.5.2 – distance calculating of the magnetic layers

To determine is the center distance **MA=l'** of a magnetic layer.

One has for the line **MA**:

$$l' = y + l$$

and

$$l = \sqrt{r^2 - x^2}$$

There are the relations: $x = R \cdot \sin\alpha'$ **und** $y = R \cdot \cos\alpha'$

With the radius **R**

Based on Chapter 2 each oscillation can be allocated to a certain angle α:

The base angle is: $\alpha = \frac{2\pi}{n}$ **mit** $n \in N_0$

n is the number of oscillations around the circle. Alternatively, here also the application of equation 2.05 would be possible.

The distance from a starting point of the field to the next is half of the angle alpha. Taking into account all source points, so they occur in integer multiples of half basic angle.
It is so true:

Multiple of the angle: $\alpha' = m \cdot \frac{\alpha}{2}$ **mit** $m \in N_0$ **und** $m \le n$

In the illustration 2.5.2 one has for the source point **P**: m=2

The route of **PA = r** corresponds to the way the wave travels. From the source point **P** starting up to the oscillation layer (point A), which is to determine.
Caused by the stationary state, maximum fronts and minimum fronts arises, with regular intervals spherically around the source point.
After chapter 2 corresponds a distance to half a wavelength. Hence, the way of the wave up to the oscillation layer is always an integer multiple of half a wavelength:

The distance travelled by the wave: $r = k \cdot \frac{\lambda}{2}$ **mit** $k \in N_0$

In illustration 2.5.2 applies to the wave way **PA**: k=4

Applies to the wavelength: $$\lambda = 4R \cdot \sin\frac{\pi}{2n} = 4R \cdot \sin\frac{\alpha}{4}$$

Inserting all treated terms in the equation for **l'** leads to the following conclusions:

2.5.2.1 - Equation:

$$l' = R \cdot \left(\cos\alpha' + \sqrt{4k^2 \cdot \sin^2\frac{\alpha}{4} - \sin^2\alpha'} \right)$$

Are alpha and Alpha line replaced by the corresponding terms from the previous considerations, so is the following end equation:

2.5.2.2 - Equation:

$$L = R \cdot \left(\cos\frac{m\pi}{n} + \sqrt{4k^2 \cdot \sin^2\frac{\pi}{2n} - \sin^2\frac{m\pi}{n}} \right)$$

R = radius of the sphere, **n** = number of waves
m = number of sources – for symmetry reasons: $1 \leq m \leq n$ n,m,k = 1,2,3,4,...
k = number of half basic wavelengths to reach a layer

n, m, k are integer parameters that provide by successively application, a table of layers **L**.

2.5.2.3 - Theorem: With the radius **R** of the sphere all possible layers **L** are also given.

2.5.2.4 - Definition:

This simplified view of the **resulting field** is apparent**:**

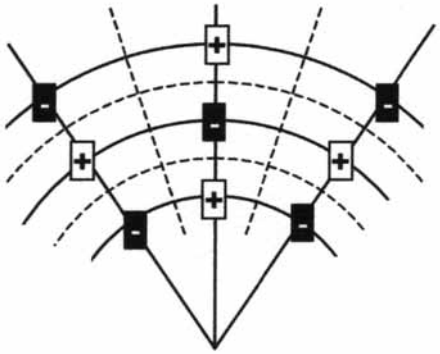


Illustration 2.5.3 – grid forming

solid lines = extremal lines = pole layers
dashed lines = zero lines = zero walls

There are **two** viewing options:

2.5.2.5 - Theorem: The **poles** form a grid-shaped radial **layer system**.

The pole layers are **stationary extremal states**.

If one looks at two pole layers lying on top of each other, these layers always own a counter phase order of their poles.

2.5.2.6 - Theorem: The **zero walls** form a grid-shaped **radial layer system**.

The **poles** are in the center of the each wrapping **zero field**.

2.5.3 – Normalisation

The layers on which the poles lie can be calculated after chapter 2.5 as follows:

$$L = R \cdot \left(\cos\frac{m\pi}{n} + \sqrt{4k^2 \cdot \sin^2\frac{\pi}{2n} - \sin^2\frac{m\pi}{n}} \right) \quad n,m,k = 1,2,3,4,...$$

n, **k** and **m** are integer parameters that provide by successive application, a table of layers **L**. With the radius R of the sphere are all possible layers **L** given.

If **R = 1** is used a normalisation of the layers table is possible.

2.5.3.1 - Normalised stratification structure

	k	1	2	3	4	5	6	7	8
n	**m**								
1	1	**1**	**3**	**5**	**7**	**9**	**11**	**13**	**15**
1	2	**3**	**5**	**7**	**9**	**11**	**13**	**15**	**17**
2	1	**1**	**√7**	**√17**	**√31**	**7**	**√71**	**√97**	**√127**
2	2	**√2-1**	**2√2-1**	**3√2-1**	**4√2-1**	**5√2-1**	**6√2-1**	**7√2-1**	**8√-1**
2	3	**1**	**√7**	**√17**	**√31**	**7**	**√71**	**√97**	**√127**
2	4	**√2+1**	**2√2+1**	**3√2+1**	**4√2+1**	**5√2+1**	**6√2+1**	**7√2+1**	**8√2+1**
3	3	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

A standardised stratification structure is depicted on the cover of this book. It is clear to see that the distribution is not uniform. Accumulation and also gaps are formed.

2.5.3.2 – General normalised stratification structure

n	m	L(k)
1	1	**2k-1**
1	2	**2k+1**
2	1	**$\sqrt{(2k^2-1)}$**
2	2	**k√2-1**
2	3	**$\sqrt{(2k^2-1)}$**
2	4	**1+k√2**
3	1	**$½+\sqrt{(k^2 - ¾)}$**
3	2	**$-½+\sqrt{(k^2 - ¾)}$**
3	3	**k-1**
4	1	**$½\sqrt{2}+\sqrt{(k^2(2-\sqrt{2}) - ½)}$**
4	2	**$\sqrt{(k^2(2-\sqrt{2}) -1)}$**
4	3	**$-½\sqrt{2}+\sqrt{(k^2(2-\sqrt{2}) -½)}$**
4	4	**$k\sqrt{(2-\sqrt{2}) -1}$**
5	5	**$½(\sqrt{5}-1)k-1$**
6	1	**$½\sqrt{3}+\sqrt{(k^2(2-\sqrt{3}) - ¼)}$**
6	2	**$½+\sqrt{(k^2(2-\sqrt{3}) -¾)}$**
6	3	**$\sqrt{(k^2(2-\sqrt{3}) -1)}$**
6	6	**$k\sqrt{(2--\sqrt{3}) -1}$**

2.6 – Radial stationary waves

The produced layers L f**orm a radial standing wave**.

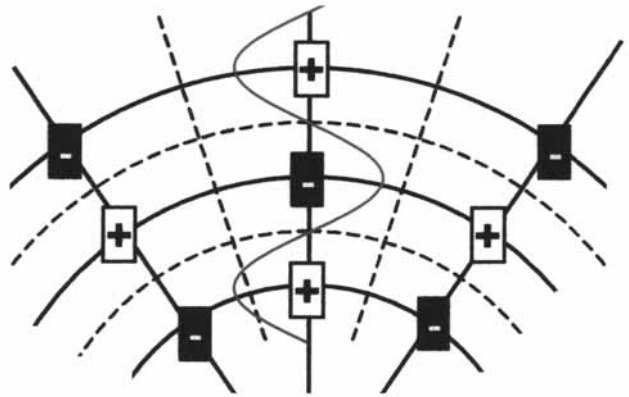


Illustration 2.6.1 – radial wave

The resulting layer frequencies and wavelengths can be calculated:

2.6.1 - Equation: $\lambda_n = L_{n+2} - L_n$

Each generated layer L can also be understood as **radial standing wave**.

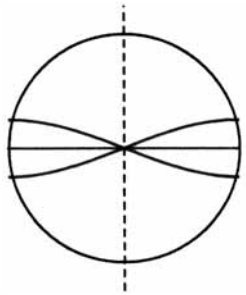


Illustration 2.6.2 – radial basic wave

The antinodes of oscillation so the oscillation maxima are always on the layer, as shown in Chapter 2.4 at the basic frequency.

To this basic oscillation suitable harmonics still come:

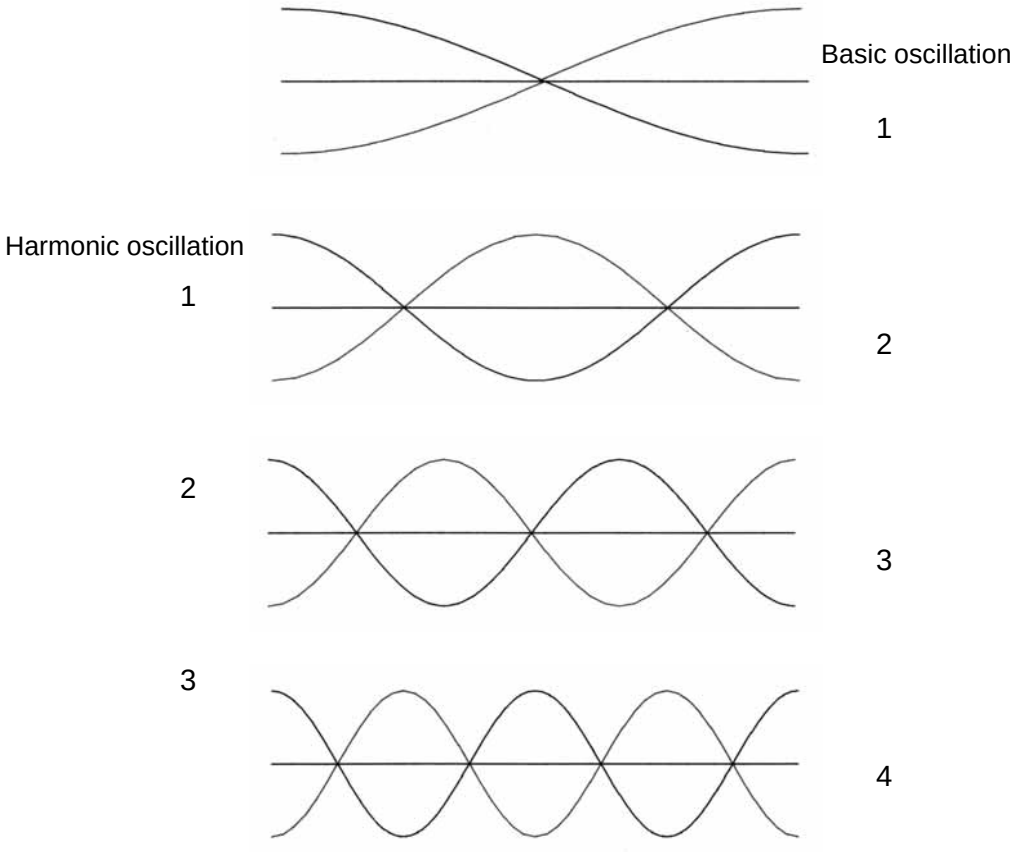


Illustration 2.6.3 – radial harmonic waves

2.6.2 - Equation: $\lambda_n = \frac{4L}{n}$ n = 1,2,3,4,...

2.6.3 - Theorem: The layers are **stationary** extremal states and form radial **standing** waves.

3.0 – Frequencies of the earth

According to Chapter 2.4 the fundamental frequency of an oscillation structure is:

$$f = \frac{c}{4R \cdot \sin\frac{\pi}{2n}} \qquad n = 1,2,3,4,...$$

The fundamental frequency (n=1) for an oscillation structure is:

$$f_o = \frac{c}{4R}$$

The following values were used for the variable R, c:

c = 299792458 m/s as speed of light

The **WGS84** is a global geodetic reference system, that determine the basis of positions on the ground, and in the near earth space. The WGS84 delivers two earth radii:

Polar radius: 6356752 m
Equator radius: 6378137 m

There are two radii, thus also two frequencies:

n	Polar radius	Equator radius
1	**11,7903 Hz**	**11,7508 Hz**
2	16,6740 Hz	16,6181 Hz
3	23,5806 Hz	23,5016 Hz

3.0.1 - Theorem: The basic frequency of the Earth is about 11.7 Hz.

$f_O \approx 11,7$ Hz

3.1 – Sferics

Between 1978 and 1979, special frequency measurements took place in Pfaffenhofen by Baumer and Sölling.
With a narrow bandwidth (2 kHz), the frequencies from 10 and 27 kHz were continuously recorded to 10 and 27 kHz by a reception facility. The range of the receiver was limited to 400-500 km.
This led to the discovery of the Sferics, which are also known as weather frequencies:

4150,84 Hz
6226,26 Hz
8301,26 Hz
10377,10 Hz
12452,52 Hz
28018,17 Hz
49810,08 Hz

See also" Das natürliche elektromagnetische Impuls-Spektrum der Atmosphäre" 1982 from Baumer and Eichmeier and in „Sferics" page 285, 1987 from Hans Baumer

The **Sferic basic frequency** is **4150,84 Hz**.

The other frequencies represent only harmonics, are therefore harmonic ratios to the sferic basic frequency.

A prime factorization with regard to the two basic frequencies of the earth is used as follows:

Equator radius 4150,84 **:** 11,75 = 353,263 ≈ 353 = prime

Polar radius 4150,84 **:** 11,79 = 352,064 ≈ 352

$352 = 11 \cdot 32 = 11 \cdot 2^5$

The back calculation for the Sferics proves:

For the Equator radius: **$11,75 \cdot 11 \cdot 2^5 = 4136,27$ Hz**

For the Polar radius: **$11,79 \cdot 11 \cdot 2^5 = 4150,19$ Hz**

The equatorial radius has a difference of 14.57 Hz to the sferic basic frequency.

The polar radius has a difference of 0.65 Hz to the sferic basic frequency.
The sferic basic frequency is used as a reference to define the earth basic frequency:

4150,84 **:** 352 = 11,79215909 = corrected basic frequency

3.1.1 - Definition: **f_0 = 11,7921591 Hz =** Earth basic frequency

3.1.2 - Theorem: **The sferic basic frequency is the 5th octave of the 10th harmonic of the earth basic frequency.**

Comment:
11th natural frequency = 10th harmonic
Taking any frequency as basic frequency, then this is also known as first natural frequency. Then, the first harmonic to the basic frequency is the second natural frequency.
General: the n-th harmonic is the (n + 1)-th natural frequency.

Comparing the measured Sferic frequency with the two derived frequencies is the consequence that the Sferic frequency stands in relation to the **polar radius** and not to the equatorial radius.

The difference between pole frequency and the frequency of equator is about 14 Hertz. In his book "The cosmic octave" (pages 38-41), Cousto establishes a link between sferic frequency and sideral day.
After a sidereal day the Sun in relation to the stars is again in the same place in the sky. This corresponds to a geometric full rotation of the earth by 360° in a star fixed system. The mean sidereal day of the earth takes 23 hours, 56 minutes, 4,099 seconds.
The comparison of the sferics with the rotation of the earth provides a difference of about 3 Hz. To maintain the link between sferics and sideral day, Cousto devide down the sferic frequencies (page 199) and could then compare it with the devided generated tone scale.

Through this division, also the error is reduced accordingly. If one make a reference to the polar radius, this "calculating trick" is not necessary. It is also sometimes read, that the difference is interpreted as measurement error. Here should be in mind the following:
The measured value for the sferic basic frequency is specified with 2 digits behind the decimal point. Thus amounts the error not more than ±0.05 Hz or with a certain generosity ± 0.1 Hz.
If one is directed to the information of Cousto and interprets the measuring value with a mistake of 14 Hz, the whole measurement would be useless, because it would be afflicted with a systematic mistake.

Nevertheless, today's measurements, just in the electro technical field (also with frequency), are very precise, so that the information of 4,150.84 hertz is to be considered as correct.
As the oscillation approach also points, the sferic basic frequency can be derived (inaccuracy <0.7 Hz) with enough exactness.

The harmonics generated by the earth basic frequency are afflicted, about the whole frequency spectrum of the Sferics, with an inaccuracy of smaller than 0.7 Hz.
With Cousto the difference becomes bigger and bigger between sferic value and calculated equatorial value with rising frequency. Because of this lacking convergence this is, mathematically seen, a sure indicator for the fact that the solution published by Cousto shows only an approximation.

3.2 – Basic hull

The corrected basic frequency allows a back calculation for the earth's radius. Rearranging the equation for the basic frequency is:

$$f_o = \frac{c}{4R} \longrightarrow R = \frac{c}{4 f_o}$$

The following values were used for the variable c, f_O:

f_O = 11,7921591 Hz = Earth basic frequency
c = 299792458 m/s as speed of light

The radius is:

3.2.1 - Definition: **R = 6355758,426 m = L_0 = Basic hull**

The comparison with the geodetic reference system WGS84 shows:

Polar radius:	6356752 m
Equator radius:	6378137 m

The basic hull, on which lie the zero lines and extremes (source points), is located at a radius of between **one and twenty kilometers below** the Earth's surface.

The oscillation structure for the earth can be defined:

3.2.2 - Definition: **Earth oscillation structure**
= Sum of **all** possible spatial grids on the basic hull.

3.3 – Table of the earth layers

By setting the basic hull L_0 in the equation for a layering structure one gets the equation for the **layers of the earth oscillation structure**.

3.3.1 - Equation:

$$L_{Erde} = L_o \cdot \left(\cos\frac{m\pi}{n} + \sqrt{4k^2 \cdot \sin^2\frac{\pi}{2n} - \sin^2\frac{m\pi}{n}} \right) \qquad n,m,k \in \mathbb{N}.$$

The table of all layers of the earth results from this equation. Here, an excerpt up to n = 4:

	k	1	2	3	4	5	6	7	8	
n	**m**									
1	1	6355,76	19067,28	31778,79	44490,31	57201,83	69913,34	82624,86	95336,38	Km
2	1	6355,76	16815,76	26205,46	35387,37	44490,31	53554,57	62596,96	71625,76	Km
2	2	2632,64	11621,04	20609,44	29597,84	38586,24	47574,64	56563,04	65551,44	Km
2	4	15344,16	24332,56	33320,96	42309,36	51297,76	60286,16	69274,56	78262,96	Km
3	1	6355,76	14635,89	21433,41	27997,91	34476,36	40913,10	47326,39	53725,14	Km
4	1	6355,76	13122,94	18378,41	23426,02	28397,82	33333,04	38247,73	43149,72	Km
4	2		7365,95	13136,72	18390,65	23477,33	28486,50	33452,99	38393,37	Km
4	3		4134,54	9390,01	14437,62	19409,42	24344,64	29259,33	34161,32	Km
4	4		3373,22	8237,70	13102,19	17966,68	22831,16	27695,65	32560,14	Km

It must be still a reordering according to size. A **direct comparison** with the depths of the geological layers and the height of the atmospheric layers is possible with the sorted table.

3.4 – Analysis procedure

The concentric layers are not evenly distributed, but accumulate in some areas.
For better optical evaluation is used, except the direct comparison, still the **mean layer method**.
The aim of this procedure is to determine the areas with oscillation accumulations and to get thus the maxima of the oscillation structure.

An example for the atmospheric layers:

From the **table of the earth layers** all values are searched out for n ≤ 20 which lie **beyond** the earth, up to a height of 700 km.

On 636 Km one receive 92 values ⇒ **6,9 Km per value = mean**

This mean value represents the mean rate of distribution of created layers by the oscillation structure.

As shown in the left figure, in some areas are concentrations in the distribution of layers and in other areas are dilutions.

Accumulation
= the distance between the layers is less than the mean value

Dilution
= the distance between of the layers is greater than the mean value

To receive an even bigger concentration of the maximum areas, the areas which form the accumulations, are summarised in each case to an **average layer**.

3.4.1 - Theorem: **The mean layers show clusters of oscillation layers.**

3.5 – Geologic layers

From the **table of the earth layers** all values for n<11 are taken that lie **within** the earth.

There are 62 values at 6355,76 km ⇒ 102,5 Km per value

Then applies to the depth of the detected maxima layers:

3.5.1 - Equation: **Depth = R_E – L**

As a physical earth radius is used the mean radius R_E = 6371 Km, as it is common in physics.
The geological layers are compared with the values from the mean layer procedure. The following image 3.5.1 shows the layers for n<11:

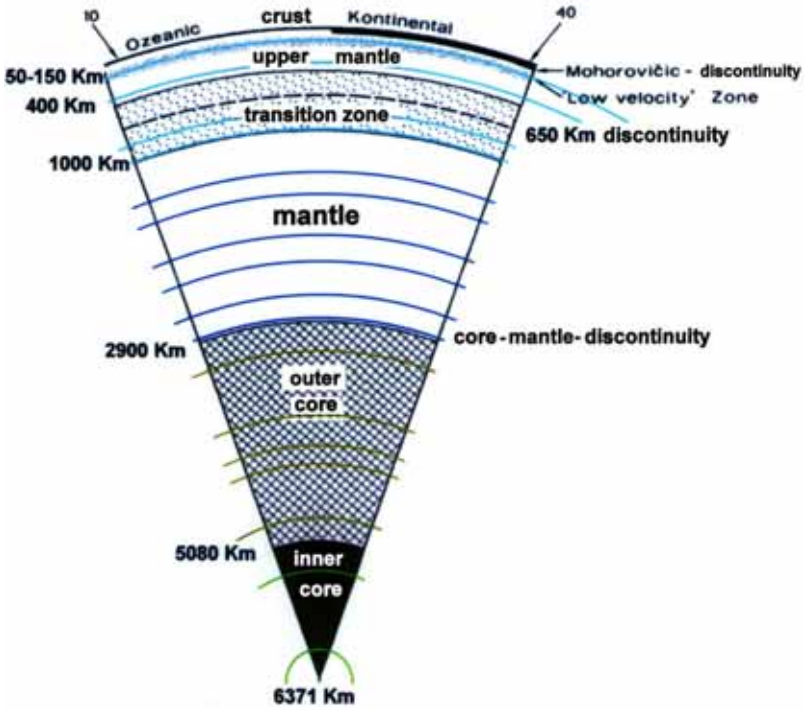


Illustration 3.5.1 – geologic layers for n<11

All values of the layer building, by the outer core to the surface, are contained in the earth layers structure. There are more calculated layers than geological layers.
A complete list of created layers can be found in „ Lattice structure of the Earth's magnetic field " chapter 13.

Greater accuracy is only achieved when increasing **n**, the number of oscillations. It is carried out evaluation for n<17.
The geological layers are compared with the values from the middle layers procedure again. The following image 3.5.2 shows the layers:

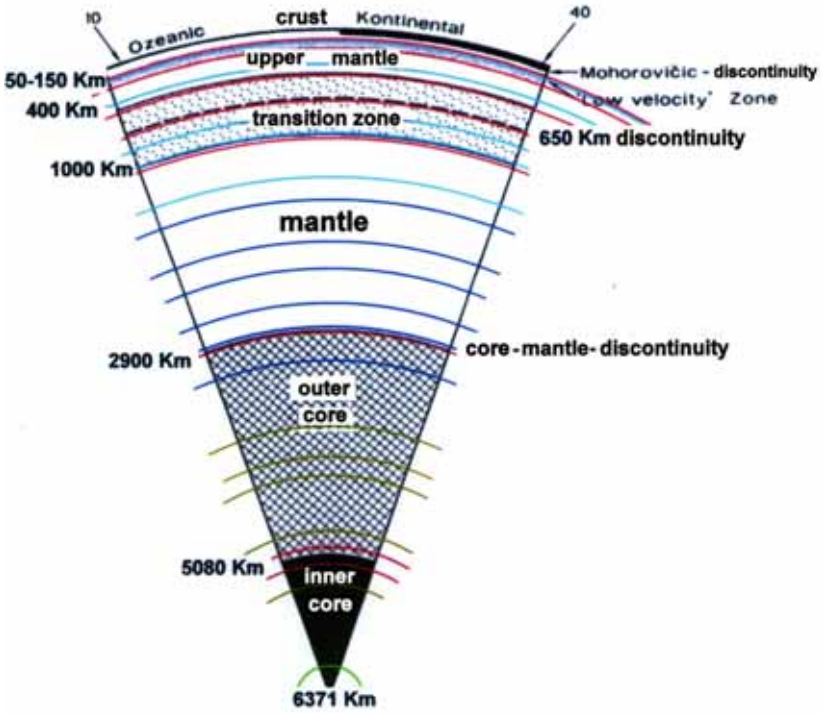


Illustration 3.5.2 – geologic layers for n<17

All values of the layer building are included in the earth layers structure. There are more calculated layers than geological layers.

3.5.2 - Theorem: The magnetic layers form the boundaries bet-ween **two** phases of matter.

With direct comparison of the calcuated layers with the geological layers arises a maximum difference of 14 kilometres for all layers, which corresponds to an inaccuracy of 0.22 per cent.
An exception is the core mantle discontinuity with 62 km difference, which corresponds to an inaccuracy by 1 percent.

Therefore applies:

3.5.3 - Theorem:

earth layer structure ⇔ earth oscillation structure

The earth layer structure is equivalent to the Earth oscillation structure.

Applies exactly:

3.5.4 - Theorem:

earth layer structure ⊂ earth oscillation structure

The earth layer structure is a subset of the earth oscillation structure.

3.5.5 - Implication: The geological layers of the earth are representable as an oscillation phenomenon.

Because the layers are at least 3 billion years old, the earth oscillation structure must have been also at that time.

The key question is therefore:

What is the **physical** connection between the model of the earth oscillation structure and the forming of the geological layers?

3.6 – Geologic layers and Laplace

Generally, you can carry together 16 relevant geological layers from the popular literature. The layers are sorted and numbered by depth.

n	Depth [Km]	Layer		ln(Depth)
	6371	center of the earth		
1	5100	border inner core / outer core		8,53699582
2	2900	border outer core / mantle		7,97246602
3	1700	1700 Km discontinuity		7,43838353
4	1200	1200 Km discontinuity		7,09007684
5	1000	border mantle / transition zone		6,90775528
6	920	920 Km discontinuity	900-1080 Km	6,82437367
7	720	720 Km discontinuity		6,57925121
8	660	660 Km discontinuity		6,49223984
9	520	520 Km discontinuity		6,25382881
10	410	border transition zone / upper mantle / 410km-disc.		6,01615716
11	300	X- discontinuity	250-350 Km	5,70378247
12	250	Lehmann discontinuity	190-250 Km	5,52146092
13	190	Lehmann discontinuity		5,24702407
14	100	low velocity zone		4,60517019
15	80	border upper mantle / Lithosphere		4,38202663
16	60	border Lithosphere / crust		4,09434456
	0	surface of the earth		

Right in the table is the logarithm naturalis (logarithm to the base e) for the respective depths.
The use of the logarithm happens because you can make an analysis easier. Function structures are more obvious.

The logarithm of the depth is represented as a function of numbering:

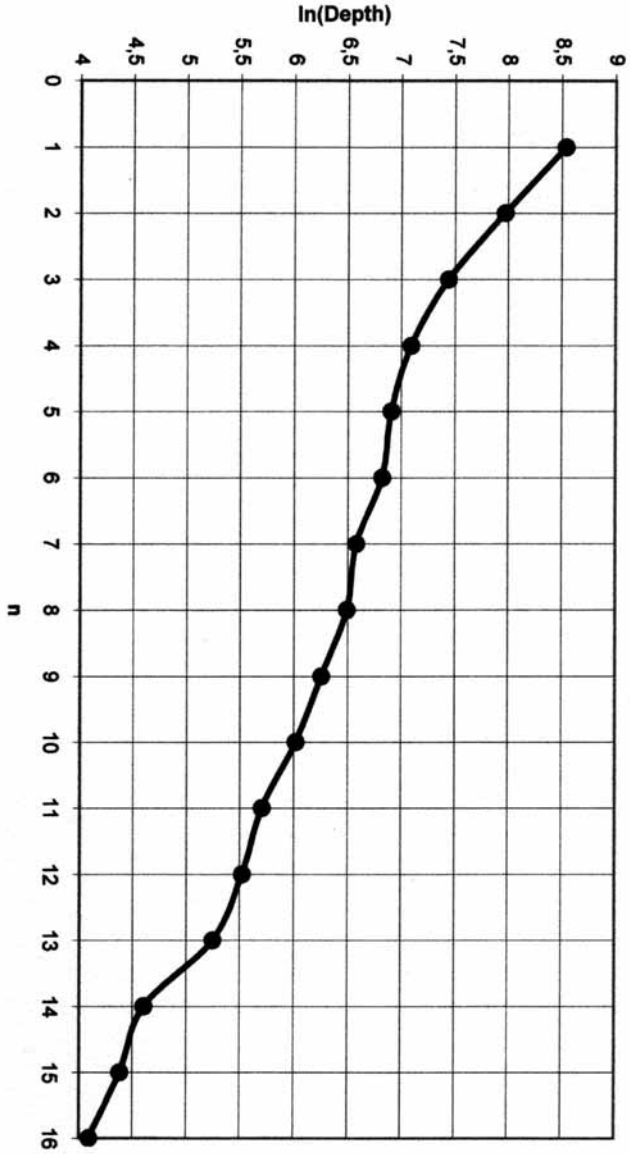


Illustration 3.6.1 – logarithm of the depth

The function in illustration 3.6.1, looks first time only some parts are approximately linear. If you look but closer to the course so you can see:

a) between point 8 and 13, the slope is nearly constant
b) between points 1 and 2 as well as between points 2 and 3 and between thee points 13 and 14, the incline is so great that there still a point can be inserted to flatten the slope.
c) between point 5 and 6 and 7 and 8, the incline is so small that there the numbering can be used on a half, increasing so the slope.

For reasons of practical mathematical handling regarding the function to be determined, it is better to start numbering with zero. The layers that are corrected in the numbering arranged by depth, then results in the following table:

n	Depth	Layer		ln(Depth)
	[Km]			
	6371	center of the earth		
0	5100	border inner core / outer core		8,53699582
1				
2	2900	border outer core / mantle		7,97246602
3				
4	1700	1700 Km discontinuity		7,43838353
5	1200	1200 Km discontinuity		7,09007684
5,5	1000	border mantle / transition zone		6,90775528
6	920	920 Km discontinuity	900-1080 Km	6,82437367
7	720	720 Km discontinuity		6,57925121
7,5	660	660 Km discontinuity		6,49223984
8	520	520 Km discontinuity		6,25382881
9	410	border transition zone / upper mantle / 410km-disc.		6,01615716
10	300	X- discontinuity	250-350 Km	5,70378247
11	250	Lehmann discontinuity	190-250 Km	5,52146092
12	190	Lehmann discontinuity		5,24702407
13				
14	100	low velocity zone		4,60517019
15	80	border upper mantle / Lithosphere		4,38202663
16	60	border Lithosphere / crust		4,09434456
	0	surface of the earth		

The newly added layers in the numbering of 1 , 3 and 13 are clear to see in the table. The corrected function looks like this:

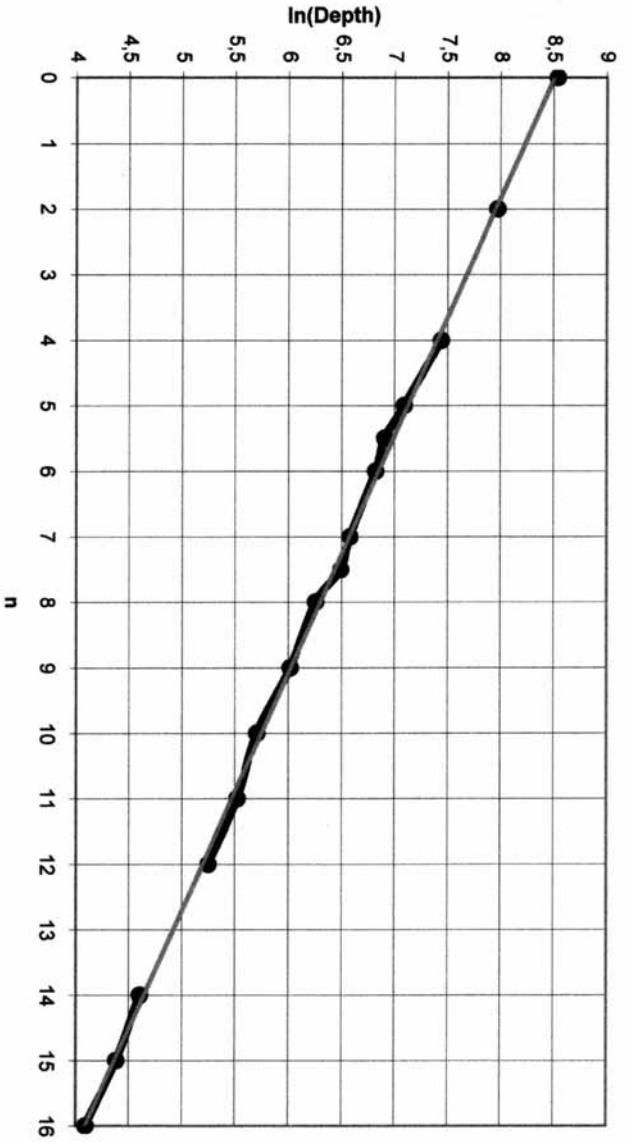


Illustration 3.6.2 – logarithm of the depth

The gray line in the illustration 3.7.2 represents a linear function that was obtained by linear regression from the corrected table. It is to see that the layer values match well with the approximation function.
So it can be used here a linear function for the geological layers as solution approach.

It arises: **ln(Depth) = - 0,2777·x + 8,537**

It is obtained by rearranging:

3.6.1 - Equation: **Depth = 5100·e$^{-0,2777 \cdot x}$**

Putting **x=n** then following function arises for equation 3.6.1:

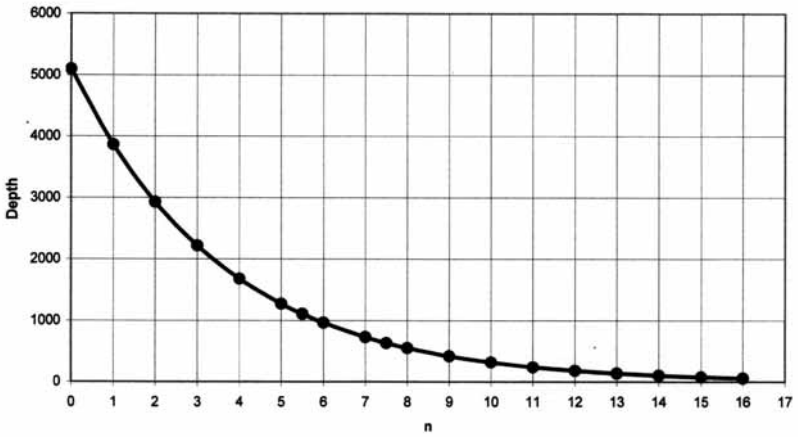


Illustration 3.6.3 – depth of the geologic layers

Equation 3.6.1 has all of the properties that are necessary to 2.11.3, to come as a function of solution of the Laplace equation into account. Thus the geological layers represent a solution of Laplace's equation, specially of the radial component.
In consequence this theorem can be set up:

3.6.2 - Theorem: **The geological layers are an expression of an oscillation phenomenon.**

On the equation 3.6.1 can be still made simplifications.

It applies: $0,2777 = 3,6^{-1} = 5/18$

When all values are used:

3.6.3 - Equation:
$$T_n = 5100 \cdot e^{\frac{-5n}{18}}$$ [Km]

It can be made the following relationship:

$r_{ik} = R_E / 5$ **r_{ik} = inner core** and R_E= 6371 Km

and it still applies:

$5100 = R_E - r_{ik} = 4/5\ R_E = 4r_{ik}$

Then, generally you can write:

3.6.4 - Equation:
$$T_n = 4 \cdot r_{ik} \cdot e^{\frac{-5n}{18}}$$ [Km]

Then, you can write for the geological layers:

3.6.5 - Equation:
$$T_n = \frac{4}{5} \cdot R_E \cdot e^{\frac{-5n}{18}}$$ [Km]

The layers arranged by depth and the calculated values result in the following table:

n	Depth [Km]	Layer	Calculated Depth [Km]
0	5100	border inner core / outer core	5100
1			**3863,505**
2	2900	border outer core / mantle	2926,798
3			**2217,196**
4	1700	1700 Km discontinuity	1679,637
5	1200	1200 Km discontinuity	1272,409
5,5	1000	border mantle / transition zone	
6	920	920 Km discontinuity 900-1080 Km	963,913
7	720	720 Km discontinuity	730,212
7,5	660	660 Km discontinuity	
8	520	520 Km discontinuity	553,172
9	410	border transition zone / upper mantle / 410km-disc.	419,055
10	300	X- discontinuity 250-350 Km	317,455
11	250	Lehmann discontinuity 190-250 Km	240,488
12	190	Lehmann discontinuity	182,182
13			**138,012**
14	100	low velocity zone	104,551
15	80	border upper mantle / Lithosphere	79,202
16	60	border Lithosphere / crust	60

The mean error of the calculated values for the geological layers are below 1 per cent.

In addition, three layers are created.

3.7 – Layers of the atmosphere

From the **table of the earth layers** all values are used for n<20, which are **outside** the earth until 640 km height.

There are 104 values at 639 km ⇒ 6,14 Km per value

Then applies to the height of the detected maxima layers:

3.7.1 - Equation: Height = L - R_E

As a physical earth radius is used the mean radius R_E = 6371 Km, as it is common in physics.
The layers of the atmosphere are compared directly with all calculated layers and then with the mean layer procedure.

All layers Mean layer analysis

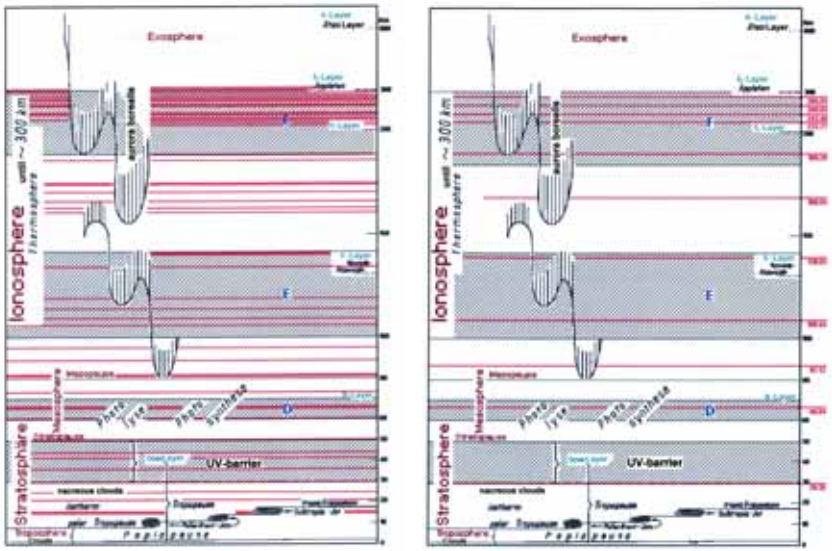


Illustration 3.7.1 – atmospheric layers

All generated layers used by the mean layer procedure lie in the areas of atmospheric layers, except for two layers. So the **earth layers structure** includes **all** layers of the atmosphere to a height of 300 km.

The ozon, D, E, F - layers are representable as an oscillation phenomenon. Oscillation clusters arise also in the gaps between the layers.

3.7.2 - Implication: The atmosphere can be interpreted as an oscillation phenomenon.

3.7.3 - Evaluation of the atmospheric layers

Layer	Height [km]	Center distance [km]	Layer [km]	n	m	k
Ozon	**30**	6401	6401,658	18	2	2
Ozon	**50**	6421	6421,979	15	2	2
D	**60**	6431	6431,846	14	2	2
D	**70**	6441	6444,102	13	2	2
E	**100**	6471	6477,747	18	3	3
E			6479,551	11	2	2
E	**140**	6511	6510,603	20	13	11
E			6510,584	16	3	3
E			6505,909	10	2	2
F	**180**	6551	6558,809	14	3	3
F			6546,103	11	7	6
F			6545,820	17	17	11
F			6541,736	9	2	2
F	**300**	6671	6674,749	13	8	7
F			6666,665	7	2	2

Direct comparison for **m=K=2** respectively a layer exists. That you can use for a simplification of the layer equation.

For **m=K=2** the atmospheric layers, relative to the center of the earth, **are directly derivable from the earth layers structure**. It is then:

3.7.4 - Equation:

$$L = L_o \cdot \left(\cos\frac{2\pi}{n} + \sqrt{16 \cdot \sin^2\frac{\pi}{2n} - \sin^2\frac{2\pi}{n}} \right)$$

Atmospheric Equation

3.7.5 - Mean layers for n≤20

n	Center distance [km]	Height [km]
1	31778,792	25407
2	11621,041	5250
3	8280,127	1909
4	7365,952	994,9
5	6982,090	611,1
6	6783,318	412,3
7	6666,665	295,6
8	6592,213	221,2
9	6541,736	170,7
10	6505,909	134,9
11	6479,551	108,5
12	6459,588	88,5
13	6444,102	73,1
14	6431,846	60,8
15	6421,979	50,9
16	6413,917	42,9
17	6407,244	36,2
18	6401,658	30,6
19	6396,936	25,9
20	6392,907	21,9

The **atmospheric equation** provides for **6<n<21** a total of 13 layers of up to 300 km height. If one put these layers in a drawing for the atmosphere, the following picture arises.

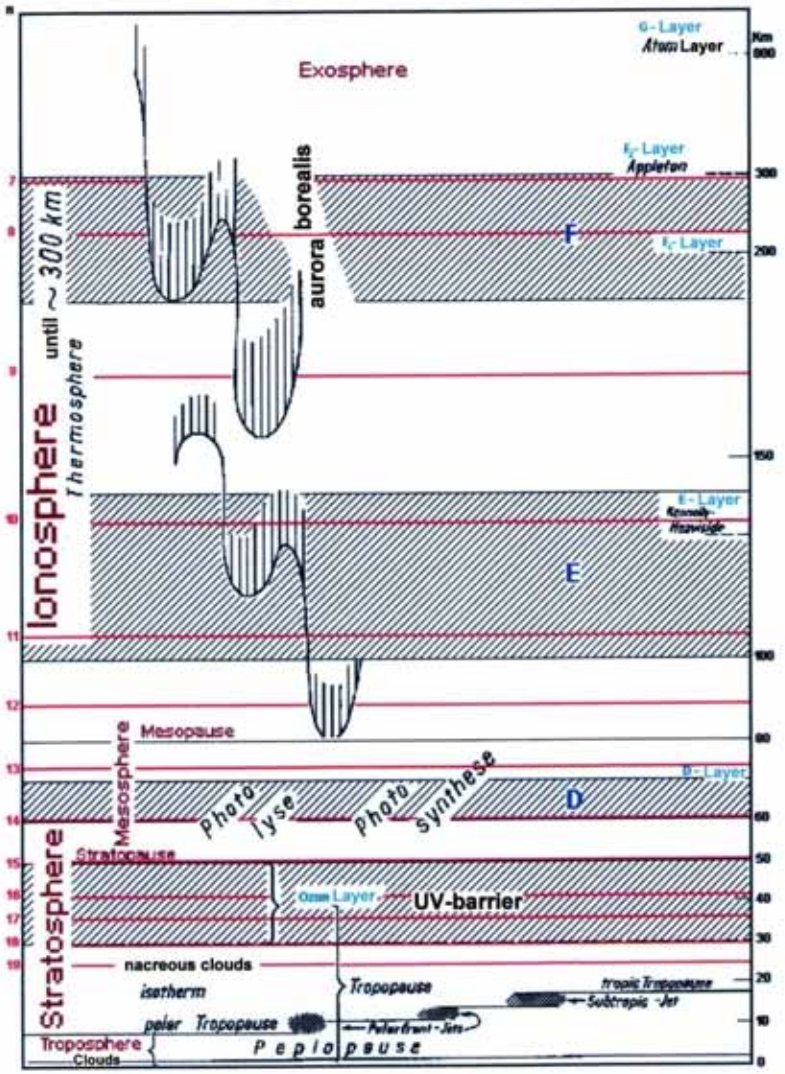


Illustration 3.7.2 – atmospheric layers

3.7.6 - Implication: The atmosphere is representable as an oscillation phenomenon.

It applies:

3.7.7 - Theorem:

atmospheric layers ⇔ earth oscillation structure

The atmospheric layers of Earth are equivalent to the earth oscillation structure.

Applies exactly:

3.7.8 - Theorem:

atmospheric layers of the earth ⊂ earth oscillation structure

The atmospheric layers of Earth are a subset of the earth oscillation structure.

The ozone, D, E and F layers also form the electrically conducting layers of the atmosphere. And, thanks to their potential structure, they are significantly involved in the electric field of the earth. Atmospheric layers and the electric field of the earth are coupled together.

So the question is:

What is the **physical** relation between the model of the oscillation structure of the earth and the forming of the atmospheric layers or of the electric field of the earth?

3.8 – Layers of the atmosphere and Laplace

Generally, you can put 11 relevant atmospheric layers together. The individual layers are sorted and numbered according to height.

n	Height		ln(Height)
0	20	Tropopause	2,99573227
1	30	Ozon	3,40119738
2	50	Ozon	3,91202301
3	60	d	4,09434456
4	70	d	4,24849524
5	100	e	4,60517019
6	140	e	4,94164242
7	180	f1	5,19295685
8	200	f1	5,29831737
9	300	f2	5,70378247
10	800	g	6,68461173

Right in the table is the logarithm naturalis for the respective heights.

The logarithm of height is represented as a function of numbering:

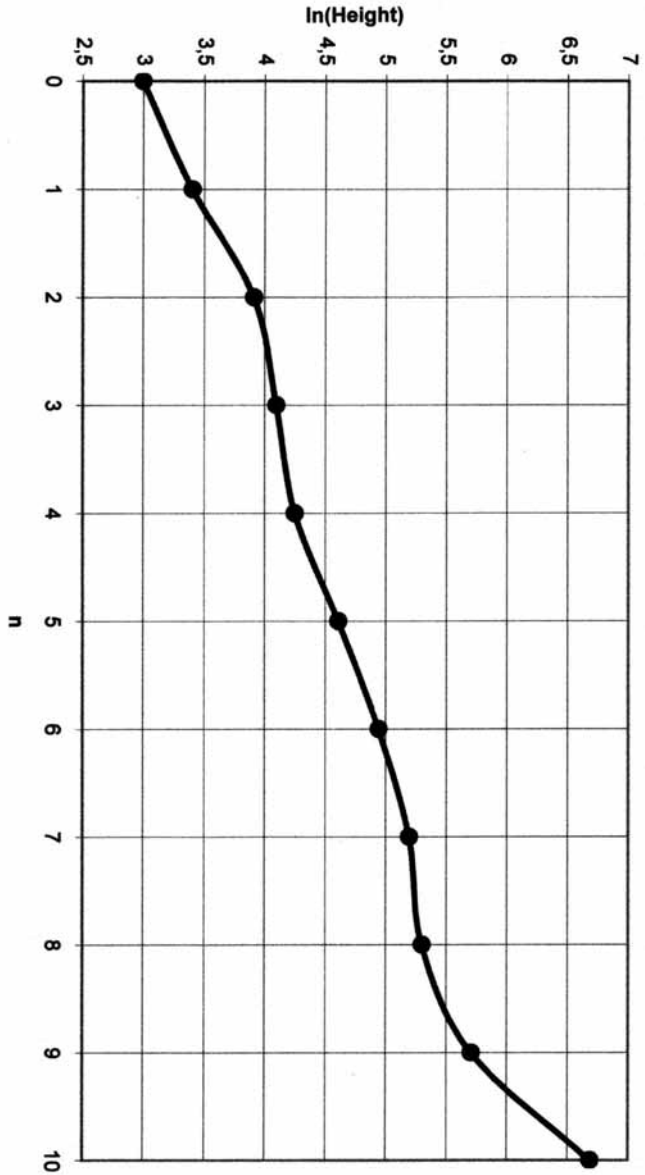


Illustration 3.8.1 – logarithm of height

The function in illustration 3.8.1, seems to be not very linear on first view except in few parts. If you look but closer to the course so you can see:

a) Between the points 2 to 7, the slope is nearly constant.
b) Between points 1 and 2, as well as between points 8 and 9 is the slope so large, there can still a point be inserted, to flatten the slope.
c) Between points 9 and 10 the slope so large that there still several points can be inserted. Therefore, point 10 is eliminated first.
d) Between point 7 and 8, the slope is so small that there the numbering can be used on a half, increasing so the slope.

The following table shows the layers that are corrected in the numbering arranged by height:

n	Height		ln(Height)
	[km]		
0	20	Tropopause	2,99573227
1	30	Ozon	3,40119738
2			
3	50	Ozon	3,91202301
4	60	d	4,09434456
5	70	d	4,24849524
6	100	e	4,60517019
7	140	e	4,94164242
8	180	f1	5,19295685
8,5	200	f1	5,29831737
9			
10	300	f2	5,70378247

The newly added layers at the numbers 2 and 9 are clear to see in the table. The corrected function looks like this:

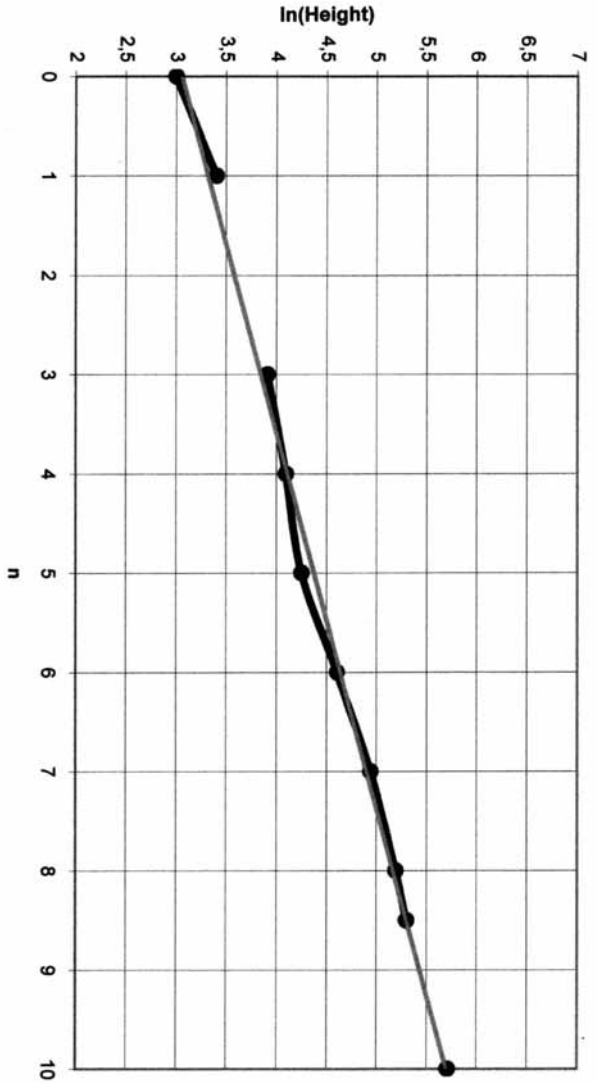


Illustration 3.8.2 – logarithm of height

The gray line in illustration 3.8.2 represents a linear function that was obtained by linear regression from the corrected table. Like is to see the layers values match well with the approximation function.
It can be used here so a linear function for the atmospheric layers as a solution.

It is as follows**:** **ln(Height) = 0,277·x + 2,9957**

It is obtained by rearranging:

3.8.1 - Equation: **Height = 20·e$^{0,277 \cdot x}$**

Putting x=n then following function arises for equation 3.8.1:

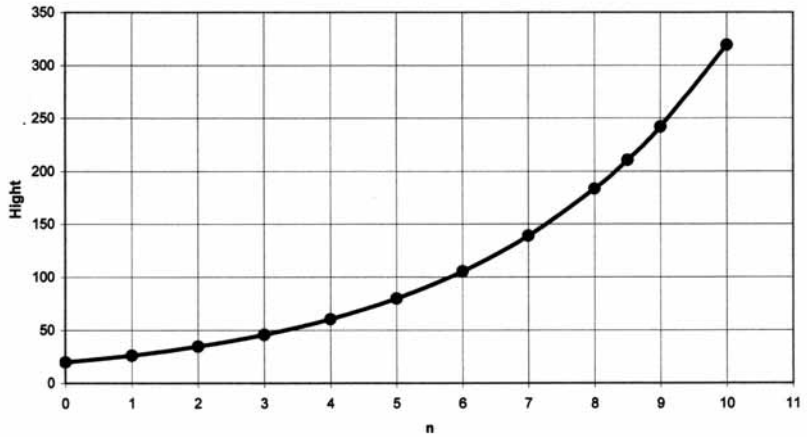


Illustration 3.8.3 – Height

Equation 3.8.1 has all the properties that are necessary to get as a solution function of Laplace's equation in consideration to 2.11.3. Thus the atmospheric layers represent a solution of Laplace's equation, specially for the radial part.
In consequence the following sentence can be set up:

3.8.2 - Theorem: **The atmospheric layers are an expression of an oscillation phenomenon.**

On the equation of 3.8.1 can be still made simplifications.

It still applies: $0,277 = 3,6^{-1} = 5/18$

When all values are used:

3.8.2 - Equation: $$H_n = 20 \cdot e^{\frac{5n}{18}}$$ [Km]

It can be made to the following relation:

$r_{ik}=R_E/5$ **r_{ik} = inner core** and R_E= 6371 Km

and it still applies:

$5100 = R_E - r_{ik} = 4/5\ R_E = 4r_{ik}$

$5100 = 255 \cdot 20$ => $20 = 4/255 \cdot r_{ik}$

Then, you can generally write:

3.8.3 - Equation: $$H_n = \frac{4}{255} \cdot r_{ik} \cdot e^{\frac{5n}{18}}$$ [Km]

3.8.4 - Equation: $$H_n = \frac{4}{1275} \cdot R_E \cdot e^{\frac{5n}{18}}$$ [Km]

The layers arranged by height and the calculated values result in the following table:

n	Height		Calculated Height
	[Km]		[Km]
0	20	Tropopause	20
1	30	Ozon	26,383
2			**34,803**
3	50	Ozon	45,912
4	60	d	60,565
5	70	d	79,896
6	100	e	105,396
7	140	e	139,035
8	180	f1	183,411
8,5	200	f1	210,657
9			**241,950**
10	300	f2	319,172

The mean error of the calculated values for the layers is below 2 per cent.

In addition, even two layers arise.

3.9 – Planetary oscillation systems

The earth with their geological layers and the atmosphere layers represent solutions of the radial component of Laplace's equation, resulting in oscillation phenomena.

It can be generally written for the geological layers:

$$T_n = 4 \cdot r_{ik} \cdot e^{\frac{-5n}{18}}$$

It can be generally written for the atmospheric layers:

$$H_n = \frac{4}{255} \cdot r_{ik} \cdot e^{\frac{5n}{18}}$$

So it be:

k=0 for atmospheric layers
k=1 for geological layers

Then applies to all layers of the earth:

3.9.1 - Equation:

$$H_{k,n} = 255^{k-1} \cdot 4r_{ik} \cdot e^{(-1)^k \cdot \frac{5n}{18}}$$ [Km]

with $\mathbf{r_{ik} = R_E / 5}$ and $\mathbf{r_{ik}}$ **= inner core** and R_E= 6371 Km

you can also write:

3.9.2 - Equation:

$$H_{k,n} = 255^{k-1} \cdot \frac{4}{5} R_E \cdot e^{(-1)^k \cdot \frac{5n}{18}}$$ [Km]

For the geologic and the atmospheric layers it was shown in two things way that it is an oscillation phenomena:

a) direct comparison with calculated layers
b) as a solution of the radial part of Laplace's equation

The geological and the atmosphere layers are therefore **planetary systems with an oscillation structure**.

3.9.3 - Definition: **Planetary oscillation system**
= Planetary system
with an oscillation structure

3.9.4 - Theorem: The structure of the two planetary oscillation systems, the geological layers and the atmospheric layers, are represented by **a single** oscillation structure.

3.9.5 - Theorem:

Earth layer ⊂ Laplace solution ⊂ Earth oscillation structure

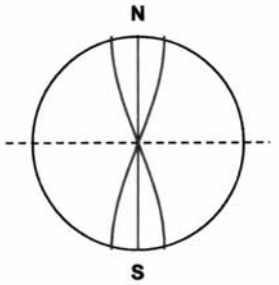
Generally the following statement can be generated:

3.9.6 - Theorem: **Stratification around or in a central solid is always the expression of an oscillation phenomenon.**

Geological layers, atmospheric layers and also electrons on their orbitals around the nuclei obey the same laws of oscillation, resulting from Laplace's equation.
Here the question originates whether this oscillation principle is, much more of a general nature and arises here as a structural principle of the universe?

3.10 – Layers and frequencies

According to chapter 2.6 a frequency can be associated with any layer. The basic oscillation behaves as if the pole diameter of the earth would swing freely at its poles.



$$f = \frac{c}{4R}$$

Illustration 3.10.1 – basic oscillation

From the table of the earth layers, you can generate such a **frequency table**. For **n = 1** results:

	k	1	2	3	4	5	6	7	8	
n	m									
1	1	11,79	**3,93**	2,358	1,68	1,31	1,07	0,907	0,786	Hz
		6355,76	19067,28	31778,79	44490,31	57201,83	69913,34	82624,86	95336,38	Km

For **n = 1, k = 2** results:
3,93 Hz = the half Schumann frequency = $\mathbf{f_S}$ /2

For **n = 1** yet another easy relation between the basic hull and the other generated layers exist:

	k	1	2	3	4	5	6	7	8
n	m								
1	1	$\mathbf{L_o}$	$\mathbf{3L_o}$	$\mathbf{5L_o}$	$\mathbf{7L_o}$	$\mathbf{9L_o}$	$\mathbf{11L_o}$	$\mathbf{13L_o}$	$\mathbf{15L_o}$

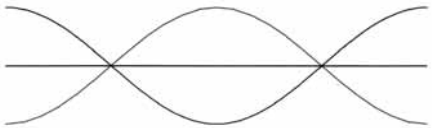
This results in the following context:

3.10.1 - Equation:

$$\frac{f_S}{2} = \frac{f_o}{3} \longrightarrow f_S = \frac{2}{3} f_o$$

The earth frequency is one fifth of the Schumann frequency

According to chapter 2.6 applies to the first harmonic:



$$f = \frac{c}{2R}$$

Illustration 3.10.2 – harmonic oscillation

	k	1	2	3	4	5	6	7	8	
n	m									
1	1	23,584	**7,861**	4,716	3,369	2,62	2,143	1,814	1,572	Hz
		6355,76	19067,28	31778,79	44490,31	57201,83	69913,34	82624,86	95336,38	Km

3.10.2 - Theorem: The Schumann frequency is part of the frequency spectrum of the earth.

3.11 – Schumann frequency

The German physicist Dr. W. O. Schumann from the Technical University of Munich in 1952 made exercises for the electricity with his students. Theme at that time was the calculation of **cavity resonators**.

While pretending that the outer ball of the resonator should be the base of the ionosphere, so the heaviside layer, the inner ball should be the surface of the earth. The question was to determine the natural frequency (resonance) of this cavity resonator. As a result, 7.8 Hz was received.

This task can be solved only by use of the differential and integral calculus. And the solution is with the discovery of so-called transversal electromagnetic waves (TM) in a cavity resonator. These are now known as **Schumann waves** or also **Schumann resonances**.

The Schumann frequency is the natural frequency of the earth surface - ionospheric cavity resonator. The consequence is:

3.11.1 - Theorem The Schumann frequency is the natural frequency of the atmosphere.

3.11.2 - Definition: Schumann frequency = f_S = 7,83 Hz

Two simple relations of earth frequency and the Schumann frequency to the basic hull $\mathbf{L_0}$ are derived from equations 2.4.3 and 3.10.1:

3.11.3 - Equations:

$$f_O = \frac{c}{4L_O} \qquad f_S = \frac{c}{6L_O}$$

Yet the following relation to the sferics exist:

Sferic basic frequency: 4150,84 Hz = $11 \cdot 2^5$ f_O and $f_O = 3/2\ f_S$

Also it is therefore:

Sferic basic frequency: 4150,84 Hz = $33 \cdot 2^4$ f_S
33. natural wave = 32. harmonic wave

3.11.3 - Theorem: **The sferic basic frequency is the 4th octave of the 32. harmonic of the Schumann frequency.**

3.12 – Summary

The Sferics are proved physically as electromagnetic waves.

The sferic basic frequency is the 5th octave of the 10 harmonic of the earth frequency. The Sferic basic frequency is the 4th octave of the 32. harmonic of the Schumann frequency at the same time.

The sferic frequencies are included in the spectrum of the earth frequencies.

The Schumann frequency is proved physically as an electromagnetic wave.

The Schumann frequency is two-thirds the rate of earth frequency – the Earth frequency is the **fifth** of the Schumann frequency.

The Schumann frequency is included in the spectrum of the earth frequencies.

There is a connection between electromagnetic oscillations and the earth oscillation structure.

Here arises the question: is there a connection of the earth's magnetic field or electric field with the earth oscillations structure? To verify this, the Earth magnetic field must be taken into consideration.

4.0 – Stratification structure

A standing wave on a sphere produces a **rotation-symmetric** spatial structure:

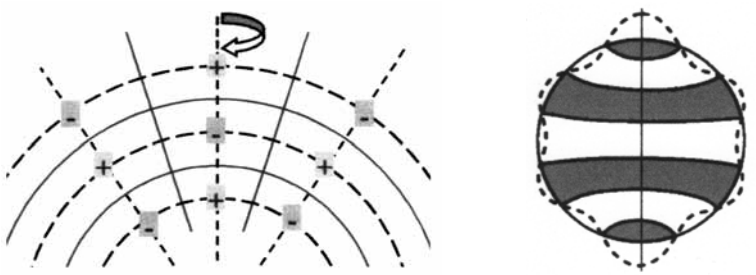


Illustration 4.0.1 – rotational symmetry

4.0.1 - Theorem: The **poles** are circular on **concentric** spheres.

4.0.2 - Theorem: The **zero areas** are concentric **cones** and **concentric spheres**.

The concentric cones from zero areas have an amazing similarity to configurations from the orbital model.

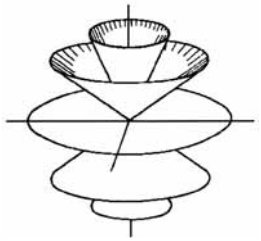


Illustration 4.0.2 – zero areas

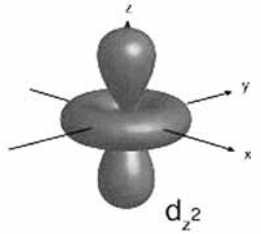


Illustration 4.0.3 – atomic orbital

Together, these oscillation figures have even the property that they are **rotationally symmetric**.

4.0.3 - Definition: **Stratification structure**
= radial stratification structure generated by **one** standing wave

4.1 – Spatial grid

Two standing waves on a sphere create a radial grid-shaped structure:

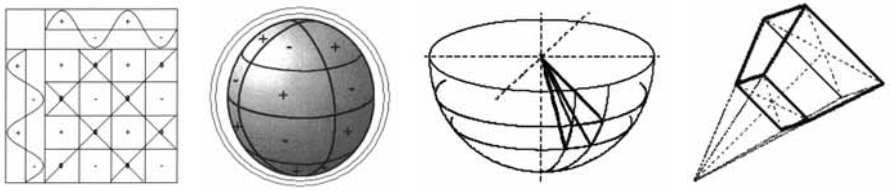


Illustration 4.1.1 – spatial grid

4.1.1 - Definition: **Spatial grid**
= **radial stratification system** generated by **two** standing waves.

Two viewing opportunities arise:

4.1.2 - Definition:

The **zero areas** form the walls of a grid-shaped radial oscillation system in the following **zero grid** called.

The **poles** are in the center of each **wrapping** zero cuboid.

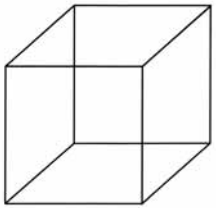


Illustration 4.1.2 – zero cuboid

4.1.3 - Definition:

The **poles** also form the walls of a grid-shaped radial oscillation system similar to a **molecular lattice** (NaCl) in the following **pole grid** called.

The **pole connections** behave like rods which swing freely on both ends.

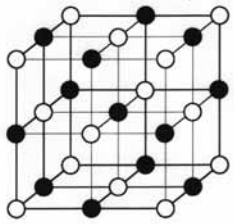


Illustration 4.1.3 – pole grid

4.2 – Spatial oscillation structure

Starting point is a standing wave around a ball

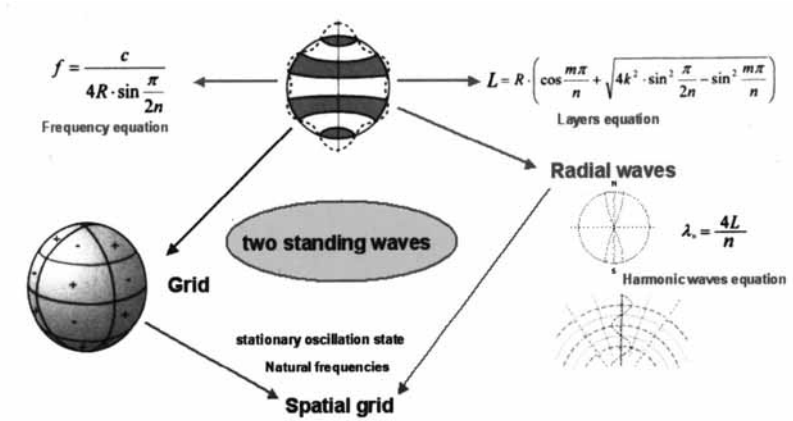


Illustration 4.2.1 – Spatial grid

4.2.1 - Definition: **Spatial oscillation structure**
= sum of all possible spatial grids on a sphere.

Consequence:

Only **1** standing wave is necessary to create a **spatial layering structure**.

2 Standing waves are necessary to create a **spatial oscillation structure**.

4.3 – Global net grids

With the definitions to the spatial grid and the oscillation structure you can introduce the notion of the global net grids. Generally, it can be defined as follows:

4.3.1 - Definition: **Global net grid**
= Sum of spatial grids

The participating spatial grids form usually **harmonical** relations. This works for all rational numbers or numbers with fractional representation. The term harmony derives from the music and thinks the harmonious consonance of tones.

Example:

If an arbitrarily fundamental tone is chosen and is applied as 1, the third with 5:4 and the fifth with 3:2 results. All three tones then compose the sound combination known as the triad. Thus represent the numbers 1 and 5/4 and 3/2 as harmonical conditions.

4.3.2 - Theorem: **Spatial oscillation structure**
= Sum of global net grids

Comment:

If grid by harmonical relationships stand with each other in relationship, there exist general reduction factors. Geometrically seen arise it from **overlapping** the grid walls or grid lines. It means that some grid walls and grid lines fall at least together.
Overlapping grids then belongs to the nature of the system.

4.4 – General attempt

With the construction of the spatial oscillation structure a mathematical and physical model is available that allows to explain the structures of the earth on a basis of waves.
The question is:
What is a general approach for an oscillation structure? The answer is found in the Laplace's equation.
Pierre-Simon (Marquis de) Laplace (28.03.1749 to 05.03.1827) was a French mathematician, physicist, and astronomer. He worked in the fields of probability theory and differential equations.
Laplace was always more physicists as a mathematician. He used the mathematics as a tool. Today, the mathematical procedures which Laplace developed and applied, become more important than his actual astronomical work.
The most important mathematical tools are the Laplace operator, Laplace's equation, Laplace's formula, as well as the Laplace transform.
The Laplace operator Δ is a mathematical operator that is a general mathematical provision (calculation way). The Laplace operator is a differential vector operator within the multidimensional analysis.
The Laplace operator occurs in Laplace's equation, for example. Twice continuously differentiable solutions of this equation are called harmonic functions.

Laplace's equation: $\Delta f = 0$

Expressed in cartesian coordinates (x, y, z):

$$\Delta f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2} = 0$$

Applies in only one dimension:

$$\frac{d^2 f}{dx^2} = 0$$

This is the equation for a harmonic oscillator, such as a pendulum or a spring without friction.

The Laplace's equation represents a mathematical formula to describe oscillation phenomena **in space**.

The common approach to a solution with a central configuration is to transform the Cartesian coordinates (x, y, z) in spherical coordinates (λ,φ,r). Then, the entire function is decomposed into two part functions. Where a function the **radial part** contains and the other function the **part of the angle**.

The general approach to a solution function of Laplace's equation in spherical coordinates looks like this:

$$f(r,\lambda,\varphi) = \sum R(r) \cdot Y(\lambda,\varphi)$$

Both part functions **R** and **Y** can be solved in each case individually.

4.4.1 – Angle part

Following general solution function is specified for the part of the angle:

$$Y(\lambda,\varphi) = \frac{1}{\sqrt{2\pi}} \cdot N_m \cdot P_m \cdot \cos\lambda \cdot e^{im\varphi}$$

These are the spherical harmonics in complex notation.

Es gilt: $e^{im\varphi} = \cos(m\varphi) + i \cdot \sin(m\varphi)$

The N_m and P_m are the so called Legendre polynomials, which can be manipulated like constants in our consideration.

So results total:

$$Y(\lambda,\varphi) = \frac{1}{\sqrt{2\pi}} \cdot N_m \cdot P_m \cdot \cos\lambda \cdot \left(\cos m\varphi + i \cdot \sin m\varphi\right)$$

Multiplying the clips it is found:

$$Y(\lambda,\varphi) = \frac{1}{\sqrt{2\pi}} \cdot N_m \cdot P_m \cdot \left[\cos\lambda \cdot \cos m\varphi + i \cdot \cos\lambda \cdot \sin m\varphi\right]$$

And here you can see again the multiplicative associated sine and cosine functions, so tesseral spherical harmonics or grids. Here equipped with a real and an imaginary part, so a complex function as a general solution for the angle part of the Laplace's equation.

4.4.2 – Radial part

The radial component is widely considered as a possible solution:

$$R(r) = A \cdot e^{-kr} + B \cdot e^{kr}$$

Whereby here only one additive component as a solution may appear. What is dependent on the limiting conditions.
As yet be seen, obeys the earth oscillation structure with its radial part of Laplace's equation.

The radial equation applied on atomic configurations leads to the Schrödinger equation.
The behavior of quantum particles is described by the so-called wave function. The Wavefunction is obtained as a mathematical solution of the Schrödinger equation.
All wave equations together transport energy with the wave in one direction.
In a particle wave of the Schrödinger equation is transported not only energy, but also a particle, E.g. an electron. Like all other waves, a particle wave has two components that are specified mathematically as real and imaginary part of a complex function.
According to the Copenhagen interpretation of probability both parts of Schrödinger's equation together indicate the probability where the particle is. Where one or both parts are large, is the particle with probability to find. Where both parts are zero, the particle is guaranteed nonexistent. Thus, the solution of Schrödinger's equation provides probabilities for the stay of the particles. It develops the so called **orbitals**, so how they are used in chemistry.

Both the model of the atom, as well as the oscillation and layering structure developed in this book, use waves around a Center (see Chapter 2.0). So it should not surprise if there are matches in the oscillation figures like the illustrations 2.7.2 and 2.7.3 represented.
The resemblance is amazing, as even a number of physical quantities such as centrifugal potential, Coulomb potential and quantum-mechanical spin are used in the model of the atom.
These variables determine the limiting conditions of the underlying differential equation and so just create the characteristic figures of the orbitals.

4.4.3 – General remarks

A function that represents a solution of Laplace's equation has two properties:

1) It is twice continuously differentiable.

2) Its second derivative is equal to the origin function, multiplied by a constant.

Generally you can formulate for the radial part:

$$\frac{d^2 f}{dr^2} = k^2 \cdot f$$

This of course also applies to the angle part.

With the consequence that solution functions for the Laplace equation only **trigonometric functions** and **e-functions** are considered.

5.0 – Generating and generated elements

Flows of liquid magma in the earth's core are viewed as the physical cause of the earth magnetic field. The outer core lies at a depth between approximately 2,900 Km and 5,100 Km, or a center distance of 1.271 Km to 3.471 Km. There rotates a liquid ball shaped mass of an iron-nickel mixture around the core. This mass can be understood as electric moved charges which generate magnetic pulsating fields as a result. The wobbling movement of the earth around the sun with the inclined axis creates a "stirring effect" around an elliptical center. This creates the pulsations of the field.

The earth magnetic field producing elements are magmatic flows of approximately 2900 km depth.

These flows are too slow and too strong to be affected by short-term geological or solar events. The earth magnetic field, the magnetic oscillation structure, and thus the magnetic grid system have therefore a certain inertia that impact contrary to all external influences.

Change of the earth magnetic field in intensity and structure can be achieved only through change of magmatic flows in their direction or their flow velocity or density. Possible factors are the Coriolis force, chemical and thermal convection and the repercussion of the generated magnetic field on the earth's core.

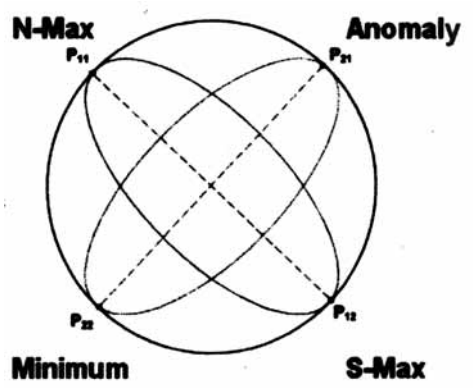
The existence of four poles with regard to the total intensity indicates two currents or flow systems. The disturbance of the earth magnetic field in the southern hemisphere shows that there (at least) two currents and flow systems exists which are not properly balanced to each other and are also not synchronized or tightly coupled.

If there exist two magnetic field generating flow systems so there are four poles. This results in three possible structures of oscillation:

a) build by two straight oscillations - four maxima

b build by two odd oscillations - two maxima and two minima

c) build by a straight and an odd oscillations - three maxima and a minimum.



The picture shows the four poles and the associated oscillation planes.
The circle through all four poles is the main meridian of the whole system.

Illustration 5.0.1 – oscillation planes

Due to the laws of physics, this basic oscillations should begin on the **core ball**, on which the magnetic field produces currents move.

5.1 – Core balls

The oscillation structure provides an approach for the core ball. Assumption is the layer equation 2.5.2.2.

For **n = 1** exist a simple relation between the radius of the (producing) ball and the center distance of the generated layers. If one sets radius = 1 (and thus standardizing it) one get:

	k	1	2	3	4	5	6	7	8
n	m								
1	1	1	3	5	7	9	11	13	15

For k = 1 always the radius of the producing ball appears. Two cases are of interest here:

5.1.1 - CASE 1

The first case is k=2. **The proportionality factor is three and one third**. An oscillation structure compatible to the basic hull is created by a core sphere which has a radius that is one third of the basic hull radius.

Basic hull = L_o = 6.355,76 Km one third = 2.118,59 Km

This corresponds to a depth of 4.252,41 Km. The **outer** core is in a depth between approximately 2,900 km and 5,100 miles. The core sphere is so located in the outer core, which is exactly in the zone in which the magnetic field generating magmatic flows are.

5.1.1.1 - Theorem: **The magnetic field generated by the magmatic flows in the outer core has an oscillation structure compatible to the earth oscillation structure.**

The basic frequency of the core ball with 35,37 Hz is three times bigger than the earth basic frequency.

5.1.2 - CASE 2

The second case is k=3. **The proportionality factor is five and a fifths**. An oscillation structure compatible to the basic hull is created by a core sphere which has a radius that is a fifths of the basic hull radius.

Basic hull = L_o = 6.355,76 Km one fifths = 1.271,15 Km

This corresponds to a depth of 5.099,85 km. The **inner** core is in a depth between 5,100 km and the centre at 6.371 km below the earth surface. This core sphere with fifths radius is identical to the inner core and can be considered as inner core ball.

5.1.2.1 - Theorem: **The oscillation structure generated by the inner core is compatible to the earth oscillation structure.**

The basic frequency of the inner core ball is five times larger than the basic earth frequency and is 58,96 Hz.

The three oscillation structures that depend on the basic hull, the outer core and the inner core are in **harmonic** proportions and are identical in parts of

their grid structure, they have the **same oscillation structure**, which is **equivalent** to the earth oscillation structure.

5.1.3 - Theorem: inner core : D''-Layer : basic hull = 1:3:5

Comment:
The D"-layer forms the lowest part of the lower mantle and thus represents the transition zone between the mantle and the core. The thickness of this layer is between 200 and 300 km.

Simplified can be written:

5.1.4 - Theorem: inner core : outer core : earth radius ≈ 1:3:5

Comment:
The ratio 3:5 or 5:3 is located close to the golden ratio. You could therefore say: **basic hull and D"-layer are roughly in the ratio of the golden section.**

Simplified can be written:

Earth radius and outer core are roughly
in the ratio of the golden section to each other.

5.2 – Creation of geological layers

The now widely accepted model for the formation of the moon says that a celestial body named Theia, with the size of Mars, nearly streaking with the proto-earth collided, about 4.5 billion years ago.
Theia itself was completely destroyed in this collision. The fragments from this impact gathered into an orbit around the earth.
Most of the impactor combined with the proto-earth to the Earth. After actual simulations the Moon was formed at a distance of approximately three to five earth radii, at an altitude between 20,000 and 30,000 Km.
The wreckage of the collision formed immediately (i.e. in less than 100 years) the proto-moon which gathered quickly all remaining debris and condensed, after nearly 10,000 years, to the moon with roughly today's mass. It circled the earth at that time at a distance of only about 60,000 km (double planet). That must have led to extreme tidal forces which deformed the egg-shaped earth and the moon.
The tidal forces were about 200 times stronger than it is today. Because the entire planet was an magmatic mass, and so was much more movable than today. Mass parts could be lifted by the tide lifting between 1 and 2 km.

Sole effects of rotation and gravity would occur in the earth to a continuous mass distribution, but not to a layer formation.

According to Chapter 3.5 is:
layer structure of the earth ⇔ earth oscillation structure

According to chapter 4.6.1 is: the earth magnetic field is in relation to the figure of the earth regarding a three-axle ellipsoid.

The three oscillation structures which caused by the basic hull, the outer core, and inner core, are identical with the earth oscillation structure according to Chapter 5.1.

The rotation period of the earth was at that time about 4 hours and was about 6 times faster than it is today. This had direct effect on the earth magnetic field, which was also about 6 times stronger than it is today.

Since the matter of the earth has **para/dia/ferro** magnetic properties and therefore magnetic fields can exert also **force effect** on the relevant matter, the formation of the geological layers can be explained if one assumes:

earth magnetic field ⇔ earth oscillation structure

The magnetic oscillation structure at the beginning of the earth building result in the forming of the geological layers served as crystallization basis for the liquid, magmatic matter.

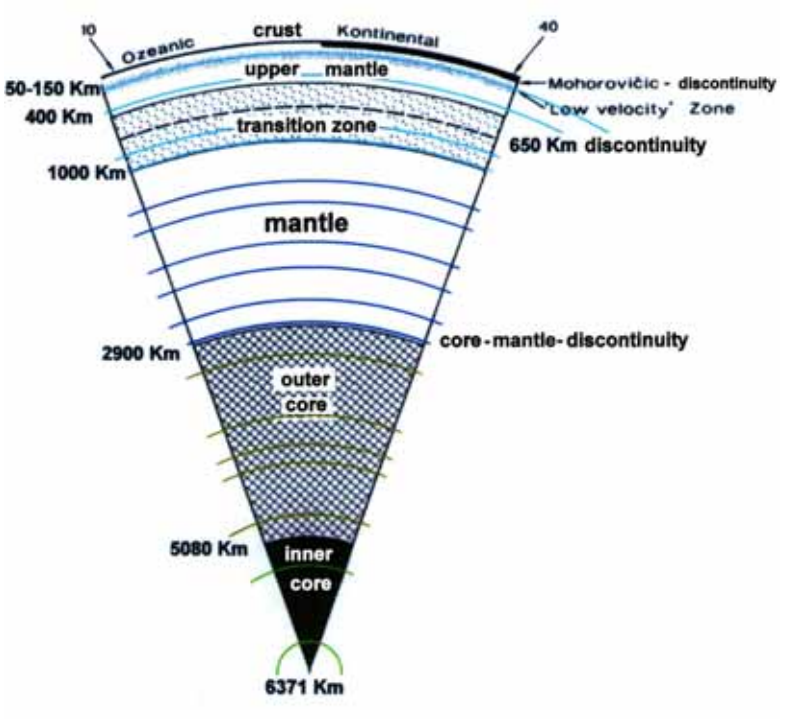


Illustration 5.2.1 – layers

5.2.1 - Theorem: **Layers**
= Clusters of maximum oscillation states
⇒ energy input

The formation of the geological layers can be explained as a resonance phenomenon.
The surrounding matter can be in response to the layers (and their frequencies) or not.

Where the surrounding matter was in response to the frequencies of the magnetic layers, there ensued energy input and force input and carried out a separation of the phases of matter.
Where the matter was not in response to the frequencies of the magnetic layers, was a crystallization in particular crystal forms.

5.2.2 - Implication: **The earth magnetic field and the magnetic oscillation structure exist since the formation of the core, and at the latest on the forming of the geological layers.**

According to chapter 4.7.2 applies: all polyhedra are possible oscillation figures.

That may have served as the basis of the crystal formation of magmatic matter by forming the geological layers.
Therefore, the polyhedron systems would be geological manifestation or crystallization of the oscillation structure at that time.

5.2.3 - Theorem: **Polyhedron systems are geological crystallization of magnetic oscillation states that prevailed by the forming of the core and the geological layers.**

5.3 – The electric field of the earth

According to chapter 3.6 applies:
layers of the atmosphere ⇔ earth oscillation structure

The ozone, d-, e- and f-region form the electrically more conductive layers of the atmosphere. This can be explained if one assumes:

earth magnetic field ⇔ earth oscillation structure

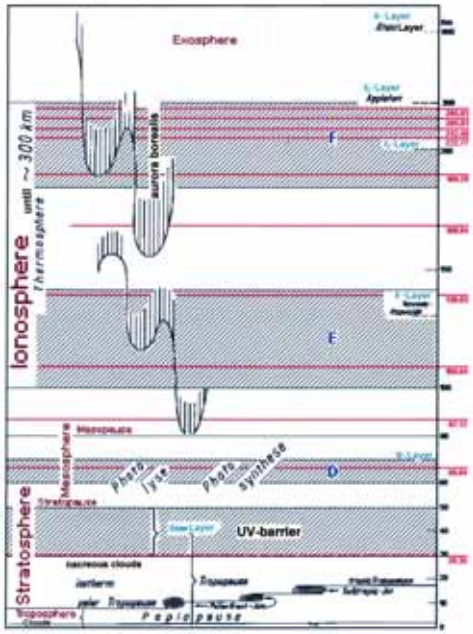


Illustration 5.3.1 – Schichten

Layers
= Clusters of maximum oscillation states
⇒ energy input

In the layers, the following phenomena can occur:

1) electric Induction
2) Lorentz force

Consequence:
Increasing ionisation is generated due to the involved matter and this leads to the forming of electrical equipotential layers.

The formation of the atmospheric layers can be interpreted as a resonance phenomenon through the increased ionisation of the involved matter with the magnetic layers.

5.3.1 - Theorem: **The magnetic layers form the basis for the conductivity of the ozone, d-, e-, and f-region.**

5.3.2 - Implication: **The magnetic oscillation structure is the motor of the electric earth field.**

Therefore, the equipotential layers of the electric earth field are constantly recharged by the earth magnetic field. And only this correlation, stabilizes the electric earth field.

Due to the relations between atmosphere, climate and weather, the earth magnetic field has two action moments, the climate regarding:

1) through the formation of electric more conductive layers and the electric field

2) through direct exposure (Lorentz force) on water and air mass transport

These very small forces may be local, but because they are effective anywhere on earth and would have some influence on the global air / clouds / water flows. The relationship of earth magnetic field and climate is not considered in any of the existing climate and weather models.

5.3.3 - Implication: **The magnetic oscillation structure is the motor of the earth climate.**

It make sense to ask what influence probably would have a **change** of the earth magnetic field on the atmosphere and their processes.
There is a certain probability that the climate change of the past years partly induced by the magnetic field also changing.

5.3.4 - Implication:

change of earth magnetic field ⇒ change of earth climate

The consequence is that the human being and its emissions have an accelerating effect at the climate change, but are not the cause of climate change.

Bibliography

Baumer, Eichmeier — Das natürliche elektromagnetische Impuls-Spektrum der Atmosphäre
Archives for metereology, geophysics and Bioclimatology
Springer Verlag, Ser A 31, 249-261, 1982

Baumer, Hans — Sferics
Die Entdeckung der Wetterstrahlung
Rowohlt Verlag, Hamburg, 1987

Berckhemer, Hans — Grundlagen der Geophysik
Wissenschaftliche Buchgesellschaft, Darmstadt, 1990

Bird, Christopher — Planetary Grid
New Age Journal, Mai 1975

Bischof, Marco — Der Kristallplanet
Ideengeschichte der globalen Gitternetze
Zeitschrift Hagia Chora, Nr.7 (2000/2001) - Nr.19 (August 2004)

Brauch Wolfgang, Dreyer Hans-Joachim, Haacke Wolfhart
Mathematik für Ingenieure
6. revised edition, Teubner Verlag,
Stuttgart, 1981

Cousto — Die kosmische Oktave
Synthesis Verlag, Essen, 1984

Dobrinski Paul, Krakau Gunter, Vogel Anselm
Physik für Ingenieure
5. revised edition, Teubner Verlag,
Stuttgart, 1980

Gauß C.F., Weber W. — Allgemeine Theorie des Erdmagnetismus
Resultate aus den Beobachtungen des magnetischen Vereins im Jahre 1838
Eds. C.F. Gauß, W. Weber, 1-57
Dieterichsche Buchhandlung, Göttingen, 1839

Gerthsen Christian, Kneser H.O., Vogel Helmut
Physik
13. revised edition, Springer Verlag, 1977

IUGG/IAGA — IGRF-1980 / IGRF-2005
International Union of Geodesy and Geophysics
IAGA, the International Association of Geomagnetism and Aeronomy
http://www.ngdc.noaa.gov/IAGA/

Kittel Charles — Einführung in die Festköperphysik
5. revised edition
R. Oldenburg Verlag München Wien 1980

Kittel C., Knight W., Ruderman M., Helmholz C., Moyer B.
Mechanik
Berkeley Physik Kurs 1
Friedr. Vieweg+Sohn Verlag, Braunschweig, 1979

Lundquist C.A., Veis G. — Geodetic parameters for a 1966 Smithsonian Institution Standard Earth
SAO Spec.Rep200, Cambridge/Mass. 1966

McLean S., Macmillan S., Maus S., Lesur V., Thomson A., Dater D.
The US/UK World Magnetic Model for 2005-2010
NOAA Technical Report NESDIS/NGDC-1,
December 2004

Nevanlinna H., Pesonen L.J., Blomster R.
Earth magnetic field charts (IGRF1980)
Geological Survey of Finnland Report,
Q19/22,0/World/1983/1

NGDC — WMM-2005
National Geophysical Data Center
http://www.ngdc.noaa.gov/

Piontzik, Klaus — Das Magnetfeld der Erde
Zeitschrift für Geobiologie - Wetter, Boden, Mensch S.35-52, 2-2002

Piontzik, Klaus — Planetare Systeme
Zeitschrift für Geobiologie - Wetter, Boden, Mensch 3-2009, 4-2009, 2-2010, 3-2010

Piontzik, Klaus — Gitterstrukturen des Erdmagnetfeldes
BOD Verlag, Juli 2007
See also: http://www.pimath.eu/

Piontzik Klaus, Eberrs Gerrit, Jähn Ulrich
Deutsches Patent 102012011759.0
Verfahren zur Messung von magnetischen Wellen

Purcel, Edward M. — Elektrizität und Magnetismus
Berkeley Physik Kurs 2
Friedr. Vieweg+Sohn Verlag, Braunschweig, 1979

Schumann, W.O. — Über die strahlungslosen Eigenschwingungen einer leitenden Kugel, die von einer Luftschicht und einer Ionosphärenhülle umgeben ist
Zeitschrift Naturforschung 7a, 149-154, 1954

Schumann, W.O. — Über elektrische Eigenschwindungen der Hohlraumes Erd-Luft-Ionosphäre, erregt durch Blitzentladungen
1957, Zeitschrift Angew. J Physik 9:373–378

Stieglitz R., Müller U. — Kann man das Magnetfeld im Labor simulieren?
Forschungszentrum Karlsruhe
Wissenschaftliche Berichte, FZKA 6223, 1999

Torge, Wolfgang — Geodäsie
1975, Walter de Gruyter, Berlin, New York
Sammlung Göschen 2163