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THE NATURAL CHARGE ON THE SURFACE OF THE EARTH.

LUKE I. MAMAH

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ABSTRACT

The natural electric charge or its artificial analogue as the fundamental unit of exploration has been fundamentally derived and compared for both the equatorial region and the polar region. The ratio of the unit charge on the surface of the earth at the equatorial region ($\omega \pm \omega_0$) = 0.59 rad where ω_0 = 1.65; to that at the polar latitude ω_0 = 1.658 is only about 50% different. The boundary effect such as skin tones or reflectivities as a second order effect is found to be the root of primary static field. The permittivity of the medium between the source and the boundary has also been investigated and found to be several orders of magnitude if the medium is the free space.

KEY WORDS: charge, amplitude and phase spectra, primary effect, secondary term.

INTRODUCTION

Notable experimentations of Hertz (1884) theory on static and current electricity have been re performed and reviewed by several authors (Chen To and Bryant 1994).

Curiosity about the electric charge dates back to 650 B.C when Thales of Miletus showed that amber rubbed with fur has electrical properties. When such two substances are rubbed together some electrons are removed from the atoms on the surface of one while the other body accepts the transferred electron. The ***Coulomb*** is usually defined as the unit quantity of electricity or the electric charge. It is that sensation of bite by the sun on the skin on a very hot day. A particle emitted from the sun with electrical energy travels through space in rays to cause the bite sensation on the skin.

Electric charges experimentally derived first by Coulomb (1836 – 1806; Lowrie 1997) therefore exist only as in positive or negative integral multiples of the magnitude of electronic charge $e = 1.60 \times 10^{-19}$ C. This implies that the electric charge is quantized Many investigations of this sensation in the past were done in high latitudes and have also shown that the algebraic sum of the positive and negative charges in any closed system never changes or in other words electric charge as an aggregate of matter is conserved (Jonk 1975). Conservation is most evident at geologic boundaries or any reflecting surfaces if light analogy is invoked. Such application has found a footing in geophysical prospecting with the fundamental concepts of the static charge (Ward 1967).

Charge density a means of describing charge distribution for simple geometries for ease of solution is then the amount of charge in a closed volume, surface or line fig. 1 and may also be related to time in which case it is described as ρ_v (x, y, z, t).

It was the volume distribution which appealed to Gauss most who then conceived the flux lines of static electric field from a spherical volume charge as the surface integral bounding the enclosed charges (Glenn Brown 2004) thus:

$$\int \varepsilon_0 \, E \, 4\pi r^2 = \int_v \rho_v dv \quad \ldots\ldots\ldots\ldots 1$$

The charge on the surface of the Earth

With reference to figure 2 ,if the source of the static lines is the spherical sun then the surface integral of the flux lines equals the totality of the charges (Q) within the volume represented in equation 1. Here ε_0 is the permittivity of free space; ρ_v is the charge density which is $Q/(4/3 \, \pi \, a^3)$, a being the radius of sphere. With little manipulation as shown in the equation box one obtains the dot product of static electric field (E.dl) or the work done on the unit charge as the Coulomb's equation 3b. Here a = dl = $1/R_0$.

Determination of ($1/R_0$) is achieved from fig 2 as follows.

Let the light transmission analogy be recounted, and then the source effects on the moment L_1 such as its shadow L_2, fig 2, can be analyzed. An experiment to determine and quantify such effects on the earth's surface at the University of Nigeria Nsukka on the 12th of May 2004 between the hours 10000 + 2 hours GMT by geophysics students showed a dependence on both time (t) and frequency (ω). Analysis from similar triangles ONM and QNP fig. 2, assumes a large earth' radius (R), creating a surface with little curvature for small frequency (ω);for a variable source distance from earths' surface (R_0).Hence $1/R_0$ can be expressed as:

$$\varepsilon_0 E = \frac{3Q(1/R_0)}{4\pi(1/R_0)^4} \; \frac{R_0}{4\pi R_0^3} \quad \ldots\ldots 2 \; (a = 1/R_0)$$

LUKE I. MAMAH, Department of Geology, University of Nigeria, Nsukka, Nigeria.

$$E.dl = \frac{3Q(1/R_0)}{\varepsilon_0 4\pi(1/R_0)^3} \; \frac{R_0}{4\pi R_0^3}$$

.........3a (dl = 1/R)

E on the source's surface is then $\frac{3Q}{\varepsilon_0 16\pi^2(1/R_0)^2}$ 3b

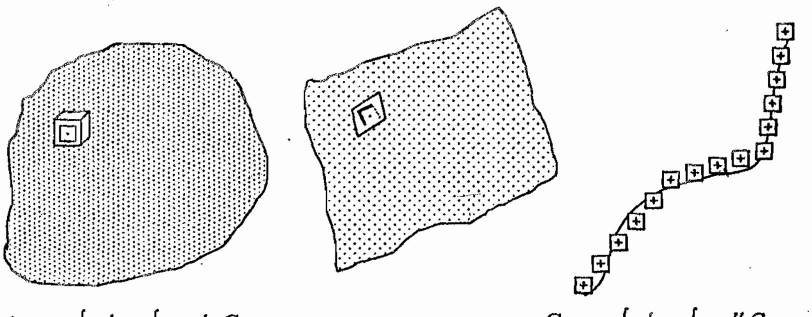
E on the earth's surface is obtained by replacing dl with R0 as

$$\frac{3Q}{\varepsilon_0 16\pi^2(1/R_0)^2}$$

..........3c

With R0 as 4.257755E+8,Q=1, and ε_0 as 8.853E-12 measured E on the surface of the earth is 1.16829422e-8C

$$1/R_0 = \frac{L_2 e^{-i\omega t}}{L_1 R}\left[1 - \frac{L_2 e^{-i\omega t}}{R} + \frac{L_2^2 e^{-2i\omega t}}{R} - \frac{L_2^3 e^{-3i\omega t}}{R}\right]$$ 4



A: $q = \int_v dq = \int_v \rho_v dv$ C

C: $q = \int_l dq = \int_l \rho_l dl$ C

B: $q = \int_s dq = \int_s \rho_s ds$ C

Fig 1. A: Volume, B: surface and C: line charge densities

$1/R_0$ is determined by **investigating** the first term of equation 4 by a logarithmic **variable transformations such as** $1/L_1 = M\,m^{-1}$; $L_2 = 1/x\,m$; and $1/R = 1/K\,m^{-1}$

hence

$$1/R_0 = \frac{Me^{-i\omega t}}{Kx}$$

Rather than take logarithm, the harmonic equation 5 has been evaluated by taking the limit as t goes to zero such that the exponential becomes $1 - i\omega t$. In that case equation 5 transforms linearly as

$$M/Kx = 1/R_0 + M/Kx\ i\omega t. \quad \text{.........6}$$

Using experimental data Table 1 obtained at UNN and displayed as fig 2; the data was plotted as in Fig 3a with the moment L_1 as 1.41 m. and source effect variable L_2 in meters. There is a shift in the axis of symmetry as the light curve is fit with a polynomial black curve whose equation is y = 0.0001x2 – 0.0166x + 2.7852. The amplitude spectrum of the polynomial curve is a trough with a minimum value at a shifted tau(0) which has been interpreted as $1/R_0$ = 2.33333E-9 m^{-1} ,whence R_0 becomes 4.28577551E08 m. The same symmetry is observed in the phase spectrum curve (fig 3b) which shows a better resolution of the symmetry about ω_0 = 1.658. With the trough's minimum at ω_0 =1.658 and $1/R_0$ is evaluated as 1.8563E-9 m^{-1}; hence R_0 becomes 5.3966E+8 m

An interpretation was also obtained for the value of $1/R_0$ as shown in the model fig 2b; for the equatorial zone when ω equals 1.065 rad. as 2.7852E-9 m^{-1}. The same result is obtainable for tau equal to zero; using the polynomial fits to the curves of amplitude spectrum or the phase spectra.

When substituted in equation 3b one obtains the charge due to the electron in volts on the surface of the sun as 2.7661E26 volts while that on the surface of the earth is obtained with equation 3c as 1.665E-8 volts. $1/R_0$ is similarly obtained for the polar zone at ω equals 1.658 rad. as 1.84E-9 m^{-1} giving the charge on the surface of the earth as 7.2652E-9 volts. It is the integral over some finite length that gives the measurable charge on the surface in volts. For example over an area of say 3.14 cm^2 the voltage is 5 millivolts at the equator.

DISCUSSION AND CONCLUSION OF RESULTS

The ratio of the unit charge on the surface of the earth at the equatorial region ($\omega \pm \omega_0$) = 0.59 rad where ω_0 = 1.65; to that at the polar latitude ω_0 = 1.658 is only about twice. This represents the difference in the static sensations on the skin on a clear sunny day. This difference is also attributable to the skin tones after prolonged exposure.

Table 1 Source effects in transformed Variables

Tau(t/x)	M/kx	ω(rad)	L_2(m)
-71.95	4.447	0.6632	0.03998
-57.58	4.2701	0.7156	0.03839
-46.9	3.953	0.7156	0.03553
-40.74	3.777	0.7330	0.03395
-37.18	3.83	0.7854	0.03442
-29.41	3.635	0.8203	0.03268
-22.38	3.459	0.9076	0.03109
-14.16	3.282	0.9250	0.02951
-8.1	3	0.9774	0.02697
-4.57	2.824	1.0123	0.02538
4.11	2.541	1.1345	0.02284
17.67	2.047	1.5010	0.01840
19.99	1.853	1.6580	0.01666
88.74	2.612	2.3213	0.02348
98.99	2.824	2.4086	0.02538
118.21	3.177	2.4435	.02855
135.23	3.177	2.5307	0.02855
138.88	3.388	2.5831	0.03460
169.61	3.88	2.6180	0.3490

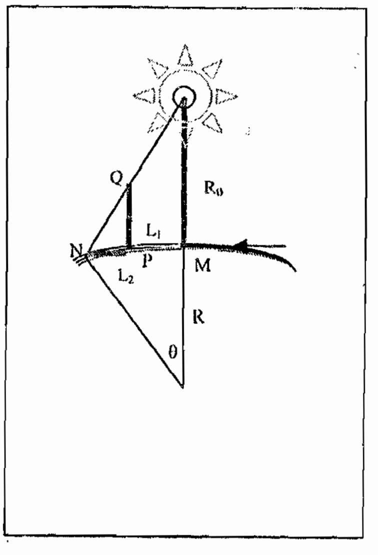


Fig 2. showing the source as the sun and the surface of the earth where the shadow of L_1 is measured.

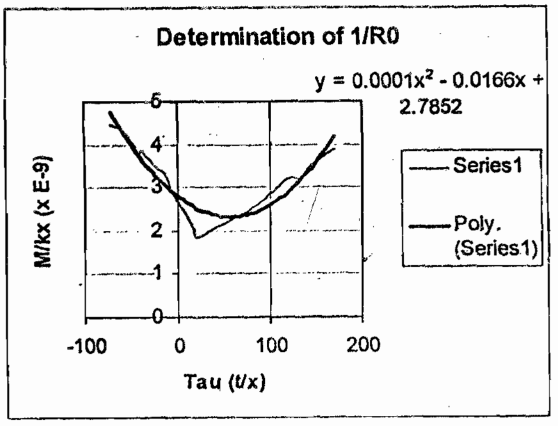


Fig 3a Shows the plot of amplitude spectrum of xperimental data of model fig 2.

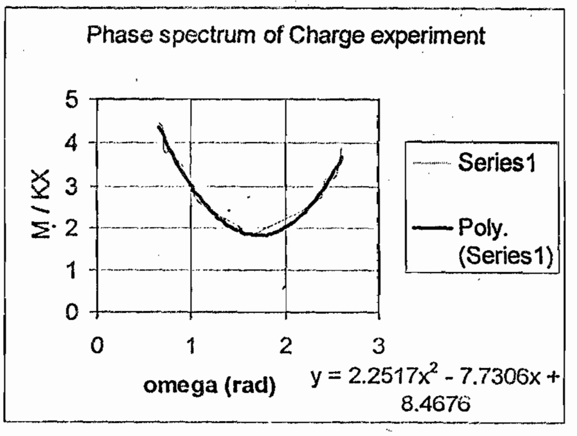


Fig 3b. shows the plot of phase spectrum of experimental data from model fig 2.

The calculated difference in the value of $1/R_0$ represents oblateness of the earth a quantity initially measured by academe royal des sciences (1736- 1743) and has been continually monitored by various space missions of NASA. On the other hand the ratio of the unit charge on the surface of the sun to that on the surface of the earth such as at University of Nigeria Nsukka at 10000 + 2 hours GMT on 12th May 2004 is very large (1.661E34) and represents relative permittivity of free space.

The second term of equation 4 indicates that some energy is reflected back to the source. Its amount is about the root of the primary energy. Boundary effects suggest subsurface imaging as is applied in the not widely used image theory of geoelectrical prospecting. The natural charge accumulation in cells ought be encouraged and harnessed in the equatorial latitudes.

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