Reversals and excursions appear to govern life evolution.

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Life evolution, human one in particular, appears to be governed by reversals and excursions in geomagnetic field, as the geomagnetic field is losing a lot in its module value[1,2] and consequently in its protective duties relative to standard with cosmic rays penetration into the Earth atmosphere and a resulting abrupt rise of the radioactivity level being possible. Apparently the increased radioactivity induced fauna gene mutations, as about 2.4 million years ago (Myr), during Gauss-Matuyama reversal, it was the gene mutation[3] in Homo lineage to remove the constraint on brain expansion, predating the origin of Homo erectus. Next pulsing radiation bombardings of homo species during excursions and reversals resulted in Modern Homo Sapiens emerge. Recent age estimates of human ancients[4], 0.23 Myr from mitochondrial DNA (mtDNA) and 0.1 Myr from Y-chromosome, both of African roots, record Homo species exposure to increasing radiation during the excursions of Yamaika, 0.25-0.23 Myr ago, and Black, 0.13-0.11 Myr ago. Here we show the preceding to be explicable in the context of the theory[5] of the Earth magnetic poles drift throughout geomagnetic field reversals and excursions.

Connections between reversals of the Earth magnetic field and life evolution have been discussed earlier[2,6,7]. The proposed ways of reversals to have effects on evolution involve an increased radiation enhancing mutation rates and climate changes producing faunal extinction.

Analysis of the latter geophysical, genetic and anthropological research data allows to develop the idea of biologic effect of reversals in the geomagnetic field.

There are no agreement both in time scheme of hominid and human evolution and in the species interrelation[8,9]. Anthropologists and genetics are solid for African continent to be the cradle of hominid and homo origin. The first ones[8] mention the hominid fossils records outside Africa to fail in breaking the 2-million-year barrier and the fossils, recently discovered in East Africa, are between 6 and 7 Myr old[10]. Genetic researches attest Africa to be the human birthplace too[11,12].

The human population evolutionary history has been traced over the several past million years. The lineages leading to humans and gorillas were estimated to diverge 7.2 Myr[13] and human-chimpanzee divergence occurred about 5 Myr ago[13,14,15]. At the geopolarity time scale these dates are assigned to the reversals, and 5.3 Myr marks the boundary between two geopolarity epochs – 5 and Gilbert.

A divergence episode close to 3.5 Myr ago separated robust and gracile hominid lineages, the former entails the appearance of Australopithecus, whereas the genus Homo corresponds to the gracile lineage[9], and the divergence time coincided with Hilbert-Gauss reversal.

The brain expansion in humankind's ancestry is predated by two gene mutations in the same age with Gauss-Matuyama reversal (~2.6 Myr) and found in all modern human sampled. The former, wherein a gene fell out of the human gene code, occurred about 2.7 Myr ago[15]. The myosin gene mutation, dated at 2.4±0.3 Myr[3], made this protein less effective producing the massive jaw muscles shrank with the following threefold brain expansion and origin of Homo erectus[8], which is assumed to be the earliest in the lineage leading to living humans[16].

The dates discussed later add to our knowledge of the history of the human gene pool. The most recent common ancestor (TMRCA) of modern human beta-globin tree is a sequence found only in Africa and estimated to have arisen approximately 0.8 Myr ago[17]. The Neanderthal and modern human mitochondrial DNA (mtDNA) lineages appear to separate about 0.5 Myr ago[18], this date is inherent to the geopolarity time scale. The time and the region of the modern humans emerge support their recent African origin. TMRCA of modern human mtDNA is about 0.23 Myr old and TMRCA of Y chromosome was estimated to be around 0.1 Myr old[4]. In both cases, it is likely that there were many more human individuals alive at the TMRCA, the same species as Homo sapiens is hard to determine, but descendants of other species are either absent or extremely rare. The dates of 0.23 Myr and 0.1 Myr ago are the geopolarity time scale marks of Jamaica and Blake excursions and 0.8 Myr corresponds to Matuyama-Brunhes reversal. The dates discussed above are given in the table.

Diversification events of African fauna correlated in time with human evolution dates, discussed above. Recent genetic research revealed African elephants to diverge into two species about 2.6 Myr ago[19]. The earlier elephants divergence into Asian and African synchronized humans and chimpanzees one about 5 Myr ago[19]. Estimates in evolutionary scenario of hartebeest complex showed their different lineages to diverge around 5, 0.5, 0.4, 0.2, 0.13 Myr ago[20].

The preceding appears explicable in the context of the fundamentally new theory[19] of the Earth magnetic poles drift throughout reversals and excursions. The essence of our conception is that the geomagnetic field loses a lot in its module value during reversals and excursions making cosmic rays penetration into the Earth atmosphere possible with the resulting abrupt rise of the radioactivity high enough to induce gene mutations. Magnetic poles motions during reversals and excursions are not chaotic but they follow fixed paths over the Earth surface. Poles drifts phenomenon was

accounted for four global magnetic anomalies influence[19]. The theory holds the geomagnetic field intensity to fall unequally over regions during reversals and excursions wherein the fall magnitudes are far less along the poles drifts tracks just as through the Americas, so through Asia and Australia, rather than in Africa and Europe. Paleomagnetic studies of Matuyama-Brunhes (B/M) reversal and of its precursor Jaramillo excursion revealed the field drops values to be unequal over regions[20]. Samples of submarine pelagic sediments, taken near Indonesia (0^0, 160^0E) and at the African west coast (0^0, 20^0W), exhibit the field module fall of no more than ten times against its initial value in the former case and of no less than thirty times in the latter one. The field module fall close to 5-7 times was observed[21] near Borneo (7º N, 122ºE). The same value of the module reduction was stated nearby California coast[22]. It was African west coast to show the greatest module fall of no less than one hundred times during B/M reversal and its precursor Jaramillo excursion[23]. The above listed facts confirm our conception about the geomagnetic field intensity falls to be not the same in various regions during reversals and excursions and we consider this phenomenon to be due to the global magnetic anomalies location, namely, all but South Atlantic Anomaly (SAA) are in the near-poles regions. The latitudinal dependence of B/M reversal duration[24] with shorter durations observed at low-latitude sites and longer durations observed at mid- to high-latitude sites bears out our conception and is in agreement with the theory of the magnetic poles drifts during reversals and excursions.

The galactic cosmic rays being a flux of high-energy protons are known to contribute much to the Earth background radiation level and it is the geomagnetic field to deflect the rays with energies less than 10 GeV. Thus the field intensity is seen to control the Earth background radiation level too. Let us illustrate our assertion with an example. The horizontal component (H) of the geomagnetic field is known to secure the scattering the charged particles bombarding the Earth. At the SAA epicenter the

horizontal component of the geomagnetic field is about one third as high as its normal value and the radiation dose rate (D) here is about seven times higher than its value beyond the SAA[25], hence it follows that $D \sim H^{-1.7}$.

Some more examples. The authors[26] refer to the stated tenfold increase of relative geomagnetic field intensity immediately after the low intensity associated with the reversal. The generally accepted dipole field intensity decrease to <20% of its normal value for a few thousand years field change in direction was mentioned[3].

All living organisms have been exposed to background radiation since their appearance on the Earth. Radiation-induced genomic instability including chromosomal rearrangements and aberrations, gene mutation in human cells is reported[27]. Research of mtDNA sampled from pedigrees receiving biologically effective dose from natural radioactivity ten times greater than the worldwide supports an acceleration of the evolutionary DNA mutation mechanism through radiation[28]. The authors[29] point to the ionizing radiation to enhance UV-induced transformations in normal mammalian cells by about 12-fold. The well-known lethal action of radiation upon living organisms appear to be consistent with the phenomenon of the population reduction in size, named “bottleneck “. Human bottlenecks are discussed to take place about 2, 0.23 and 0.1 Myr ago, the dates are noted above, and it was Africa to provide arguments[16].

The evidence suggestive of the human evolution to be dictated by geomagnetic field reversals and excursions, accompanied by cosmic rays penetration into the Earth atmosphere, is produced. The resulting abrupt rises of the radioactivity level in Africa appeared to be enough to induce gene mutations providing species emerges and diversification or to cause populations extinction.

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Table. Events in human evolution juxtaposed with geopolarity time scale.

Dates of events in human evolution, Myr	Events in human evolution	Dates of reversals and excursions, Myr	Reversals and excursions
0.015	no available data	0.015	Gothenburg
0.046	no available data	0.045	Laschamp
0.1	emerge of modern human (by Y-chromosome data)	0.11- 0.13	Blake
0.23	emerge of modern human (by mtDNA data)	0.23 - 0.25	Jamaica
0.5	Neanderthal and modern human lineages divergence	0.47 - 0.55	Emperor
0.8	age of human beta-globin gene tree	0.78	Matuyama-Brunhes boundary
2.1-2.2	Homo erectus origin	2.11- 2.27	Reunion
2.4 -2.8	mutations, predating Homo erectus emerge	2.6	Gauss-Matuyama boundary
~ 5	Humans and chimpanzees diverged	5.3	5-Gilbert boundary
7.2	Human lineage separated from gorilla one	7.3	reversal