**RESEARCH ARTICLE**

# Prebiotic Mechanisms of Life Appearance near Deep Sea Vents with Early Earth Synthetized L- Handed Amino-Acids Being Adsorbed on SWCNT

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**Abstract**

A model is described with which abiotic RNA- the admitted key for life appearance on earth- can be synthetized near some deep-sea volcano. This is considered with asymmetric chiral amino-acids and nucleobases being produced in an UREY-MILLER discharge with circular polarized light in the early earth atmosphere and which are selectively adsorbed on SWCNT formed during ultramafic volcano extrusion. All this in agreement with Precambrian carbonated rocks containing also graphenic particles and marks of early life and considering recent carbon phase transition theory and early earth conditions which can be deducted from meteorite and chondrite analysis and some revisited formation mechanisms. Those are for instance concerning the properties of diamond formed during some specific volcano extrusion and the discovered graphenic carbon residues in some carbon chondrites. Origin of last ones is proposed by condensation and accretion in the solar nebula of star dust and relics of Supernova destructed water and carbon rich red dwarf planets which have undergone some thermal differentiation. Further on, we show how earth atmosphere lightning can produce circular polarized light able to produce significant enantiomeric dissymmetry. Selective adsorption of life molecule enantiomers on CNT is suggested to cause L-type enrichment with another mechanism we newly describe basing on recently discovered selective buoyancy effect in water of CNT/life-molecule which can separate L- and D- enantiomers. RNA separation from a CNT template appears possible by its etching in pressurized sulfuric ~200°C hot water. Analysis of the sequences and effects concerning the possibility of life molecules to be assembled with exclusive L-chirality and reduced probability of destruction suggest that extraterrestrial import will be likely excluded. We discuss then how similar processes can exist elsewhere in the universe and which possibly continue to exist near some deep-sea volcanoes with femto-plankton synthesis.

**Keywords.** Prebiotic life RNA synthesis. Deep sea volcano extrusion and single wall carbon nanotube formation. Life molecule L-scalemic amplification.

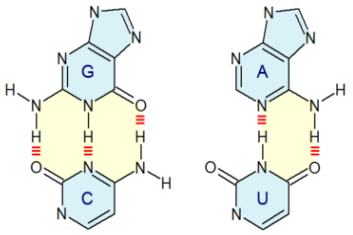
## 1. INTRODUCTION

Abiogenesis and the chemical evolution theory of life are built on first introduction of amino-acids (AMACs) in the earth ocean water and which correspond to the elementary life molecules. This generally accepted theory by scientists [1] explains that early life began with formation of lipid

and RNA/DNA coordination of proteins in cells which perform essential processes such as cell division and metabolism [2] and with which it is believed that the smallest known archaea prokaryote cells could be formed [3]. Cells use a small number of molecules, primary nucleic acids, proteins, fatty acids, and sugars, which can form many diversified larger molecules and perform a high number of different specific biologic functions [4]. Analysis of ribosomal RNA sequences from a large number of organisms has demonstrated that all existent forms of life on Earth share common structural and sequence features of the ribosomal RNA and leading to the identification of early earth's most primitive cells [1-6]. These led to a much-diversified evolution depending on early earth conditions and with which the microbial phylogenetic network could be reconstructed [7-8]. It has been demonstrated facile production with self-organization of some of these organic molecules such as lipids, peptides and proteins for several plausible prebiotic environments [9-13]. This is in contrast to unlike self-assembly of prebiotic RNA formation, considering that RNA is a hollow much complex helicoidal structure composed by 4 types of nucleobases (Figure 1) being formed with smaller

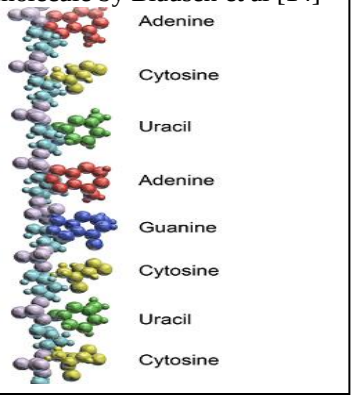
Figure 1. Pairing of nucleobases in RNA by Callahan et al [6].




Guanine (G) paired with cytosine (C)
Adenine (A) is paired with uracil (U)

amino-acids molecules (AMACs) [6-9] and for which the self-assembling probability of larger complex helicoidal RNA without the use of some appropriate template is extremely low (Figure 2) [14-15]. For this

Figure 2. Developed RNA molecule by Blausen et al [14]




purpose, it must be understood how and where AMACs have been formed and in which environment they have appeared on earth, and how they could be assembled to larger nucleobases [16] and to RNA. The corresponding mechanisms have also to give account for their exclusive L-chiral earth specificity [17] and must also be self-consistent with all surrounding conditions and is subject of many controversial discussions we propose to clear with next described analysis.

Those concern either some supposed extraterrestrial origin of the earth life AMACs via asteroids and with corresponding chondrites, meteorites and comets which have been falling on earth [6, 18-19] or the way they could have been produced on earth by water and ice UV photolysis [20-21], or within UREY MILLER discharge in the early atmosphere [16], or in deep-sea black smokers with similar effects [22-30] after the early ocean had appeared. It was also controversial the origin of the ocean water which was thought to correspond to condensing water vapor formed with chemical recombination of early earth gas content or corresponding

to delivery from cometary and chondrite earth falls [31]. However, many described scenarios appear to be not compatible with updated early earth conditions and which need all of them to be simultaneously considered:

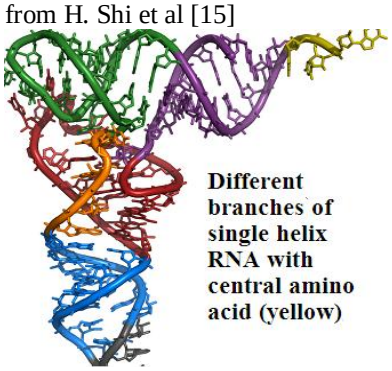
a) The chemical and thermal stability [32] and destruction mechanisms of formed life molecules (for instance with hard UV and proton and high energy radiation) [1, 19].

b) The mechanisms producing homochirality of L-type enantiomer life molecule [33]

c) The first life molecules must be able to evolve in their relevant surrounding material [34]. AMACs embedded in solid state material can hardly be assembled to larger molecules and must evolve in some liquid or gaseous environment.

This is all the more the case when considering that the first self-replicating ribozyme is believed emerging with template-directed information and only by surface reactions on chiral mineral materials [35]. Self-assembly of a high number of different nucleobases to a larger complex helicoidal structure is thought to be unlike, conversely to simpler helicoidal structure such as perovskite and CNT [1, 10, 36-38]. With above mentioned aspects, it appears difficult to synthesize a free-standing 3D hollow helicoidal RNA structure (Figure 2 and Figure 3) on a 2D chiral substrate [39-40]. Assuming that a prebiotic NRA synthesis is produced on an appropriate template, it must then also be considered with which mechanisms the helicoidal RNA can be separated from its template. Helicase molecules are known to be necessary to unwind the new formed RNA during the 3D biotic replication process [41-43]. However, this replication mechanism can hardly be considered for the

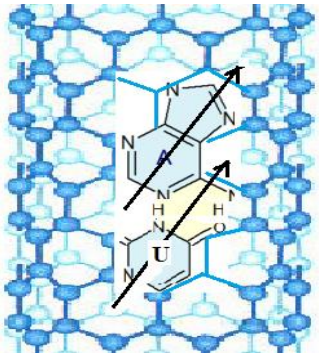
Figure.3. 3D representation of t-RNA Molecule by Yikrazuul (Wikijournal) from H. Shi et al [15]




first prebiotic RNA synthesis for which helicase have probably not yet been existing and therefore, for which must be depicted other mechanisms.

Because simple life molecules with hexagonal carbon ring could be synthetized on graphite [36] and that first early life marks have been discovered in carbonaceous material containing graphenic materials (carbon nanotube related materials) [44-45], we suggest that prebiotic RNA have been formed on specific corresponding helicoidal structure considering all recently discovered and/or newly proposed mechanisms with which this appears possible and we propose to verify with followings:

Figure.4. Scheme of adsorption of a pair Adenine/Uracil on a chiral SWCNT

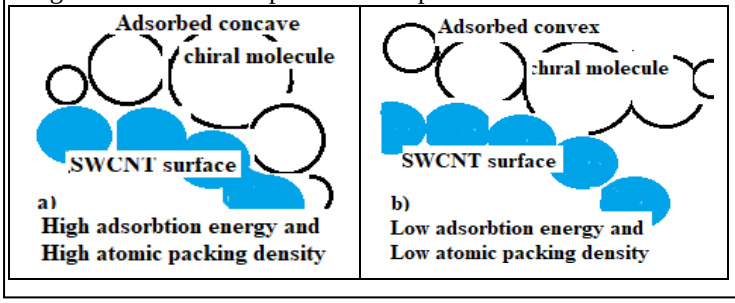


a) Nucleobases and AMACs have specific polarization owing to their asymmetric molecular geometry [1, 14-16] which can be associated to the polarization of the helicoidal structure of semiconducting SWCNT [37, 47-48] (Figure 4).

b) In addition to the polarization coupling effect, nucleobases have differentiated adsorption energy for considered template substrate depending on their size, molecular structure and plane curvature [49-50] (Figure 5).

Figure.5. Curvature dependent adsorption of molecule on SWCNT




c) RNA and SWCNT have both a hollow helicoidal structure and can have similar radius and size and [1, 5, 32, 37, 51-52].

d) The SWCNT template can be destroyed from the inside by some selective chemical sulfuric acid etching [37 & 52], meanwhile nucleobases and RNA will not [53-57].

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## 2. BRIEF REVIEW ON EARLY EARTH FORMATION HISTORY

### 2.1. Early earth formation and evolution.

#### 2.1.1. Solar nebula condensation and accretion process.

The earth formation process is believed to have started in the solar nebula with the accretion of present materials in form of different kinds of gases, dust particles and larger space bodies [5, 30-31 & 58]. Composition of the Earth's interior is essentially determined by early events corresponding in a first step to formation of stars and more specifically to the sun and with further steps which will heat up the accreted early earth and affect its gas content with some degassing and chemical reactions with some heavier elements and which will modify their oxidation state altogether corresponding to the earth differentiation process [59]. It is generally admitted that interstellar space corresponds to a turbulent hydrogen gas with pressure

varying from 10-4 ion/cm3 up to 106 molecules/cm3 and which has been formed together with first light element such as Li, Be and B with the big bang [60]. In such environment nebulae have been formed corresponding to ionized hydrogen gas enriched with some heavier elements, dust and debris coming from some space cataclysms elsewhere [61-64].

In such environment, it is admitted that solar nuclear fusion begun with helium formation within densified hydrogen gases by a heating shock wave produced by some relatively close ending life star supernova explosion [63-65]. With next steps, briefly summarized, the nuclear fusion will form light elements such as Carbon [65] and with the Bethe-Weizsäcker Carbon-Nitrogen-Oxygen (CNO) cycle [66-68] abundant oxygen and nitrogen are formed before other light elements such as Cl, Na, Mg, Al, Si, P, S, considering the relatively low nuclear collision energy necessary to the nuclear fusion CNO cycle (low Kev range) [69]. Thus, explaining why early earth chemical and physical condensing and accretion steps should have happened in an H2, CH4, NH3, CO, H2S and H2O rich environment [70-71].

However, it must also be considered the presence of heavier elements on earth (including their isotopes) which can hardly be produced in nuclear fusion reaction in nebulae and younger stars (like the sun) and which are believed corresponding to imported dust and space bodies coming from the interstellar space [72]. Up to the mass of Ni the heavier elements are produced with further nuclear fusion steps (producing most abundant Si and Fe) and which have been likely formed in elder dying stars [73]. Those ending life stars have longer existing fusion reactions with which heavier elements have been produced in contrary to younger stars [74]. Exoplanets similar to earth (whenever larger than Jupiter) have been recently evidenced with modern observation of Proxima Century, the nearest red dwarf star to the sun. Those are expected to have similar differentiation than the earth and which are also containing heavy elements, volatile gases and significant amount of water [74-75]. Elements with higher mass than Ni are known to be formed with neutron capture [76] in neutron stars which appear when ending life stars (such as red dwarfs) collapse. These heavy elements are then expulsed to the solar nebula by a supernova explosion and which explains their existence on earth. [63-65, 72-76].

### 2.1.2. Timescale.

#### 2.1.2.1. Radioactive decay and isotope distribution.

Radioactive isotopes of the heaviest elements with particularly long half time decay have been also present in the environment of the earth accretion process [72-77]. With the specific isotopic distribution of radioactive elements found in different geologic materials on earth and in accessible space bodies [78-80], a timescale for terrestrial planet formation could be established. Specific isotope distribution is also concerning AMACS and is strongly dependent from period, conditions and location where the isotopes have been formed [81-82]. It can be determined if their origin corresponds to same region of the solar nebula or farther elsewhere in the space [18, 20, 80-82]. However, it must here be taken into account that no univoque relation exist between isotope distribution and their origin, considering that it can also be modified

with some selective diffusion in consequence of particular local physical and chemical effects. This is the case for instance with the Raleigh selective diffusion of oxygen isotopes 16O/17O in water evaporation/condensing cycles on earth which is latitude dependent [83] and also for isotopes distribution linked to biotic activity concerning 13C/12C and 13C/15N isotopes [45-46, 83-85]. However, most fallen on earth chondrites coming from parent asteroids have like the earth also be formed within the solar nebula with similar earth accretion process at same period and which can provide information on the early earth formation [86-87].

2.1.2.2. Milestones of early earth evolution.

With all aspects mentioned in previous section, it is generally admitted that early earth history began 4.54 Ga ago with accretion from the solar nebula and that geological crust started to solidify on the central molten earth material some 0.04 Ga and that the earth core was complete 0.1Ga of the origin with U-Pb and Hf-W radiometric measurements of extruded materials coming from the lower mantel [77-79]. The moon formation, could be estimated nearly 4.4 Ga ago with same time scale assumptions. This has been evidenced being a secondary product of a huge earth meteorite collision at a period where the earth material had not yet been much heat differentiated with various kind of melting, selective degassing and diffusion and various chemical recombination processes [88].

2.1.2.3. First early earth life marks.

Different marks for already existing biologic activity have been found corresponding relatively short time after the earth accretion process and for which a modification of early carbon isotope distribution has been observed. Biogenic carbon has been found which has been formed in some 4.1 Ga old detrital zircon [45] and further evidence of life on earth is also preserved in about 4 Ga old sedimentary rock where graphenic CNT like structure is associated [46]. Meanwhile, oldest microfossil has been found in approximate 3.8Ga to 4.2 Ga old hydrothermal vent precipitates [89]. Other more recent signs of early life have been discovered in form of 3.45 Ga old stromatolites [90] and with fossils in a 3.5 Ga old hot spring deposit [91]. All this indicates that the biotic activity is elder than 4.2Ga and started after first amino-acids (AMACS) appeared on earth. It must be then described the anterior early earth conditions where AMACs and first NRA molecules could appear and/or could be formed. If so, it will have to be looked about the earth conditions and especially the distribution of water and carbon in the earth interior and in its atmosphere.

2.2. Earth core and mantle main characteristics.

With the accretion process, with the associated space body impacts and the energy liberated by nuclear decay, the earth material started to be molten and heavier elements (such as iron) could be selectively accumulated in the earth core by gravity [92-93]. Consequently, the upper mantle will contain more light elements as shown with the extruded material from modern volcano corresponding to basaltic materials rich in Na, Ca, Al, and carbonates [94-95] and which used to emerge on the earth crust at temperature ~1000-1500 K and which

are only weakly reduced. The lower mantel material could be gradually transformed with chemical reactions to silicates in form of Mg and/or Fe rich Enstatite, Olivine and Pyroxene corresponding to mafic and ultramafic rocks of the earth crust formed by hot spot volcano extrusion [96]. Ultramafic material rich in FeSiO4 (Fayalite) which is coming from deeper mantel can have temperature about 2500K-3000K (~1000 K higher than basaltic volcanoes) [97] and can also contain carbon in form of diamond [98-99]. Recent evaluation on earth core/mantle temperature [100-101] suggests that higher extrusion temperatures result from thermal convection and plume outburst phenomena from lower mantle/core region [102] and which can produce carbon segregation also in form of single wall nanotube (SWCNT) which are catalytically growing from FeCx materials [103] as will be discussed in next section III.

## 3. POSSIBLE SWCNT FORMATION IN ULTRAMAFIC VOLCANO CHIMNEYS.

### 3.1. Ocean formation.

Considering that biochemistry can generally only evolved in gaseous and liquid temperate environment, it has to be looked under which conditions and at which time some early ocean appeared on earth. First evidence for the existence of an early ocean has been demonstrated from dentrital zircon 4.4 Ga ago [104-105]. H2O and C concentration in mid-ocean ridge basalts indicate that the upper mantle contains ~200 ppm H2O and 80 ppm C to be compared with their higher concentration in the lower mantle which is expected to be 550-1900 ppm for H2O and 900-3700 ppm for C. These relatively low concentrations result from metamorphism which have formed oxides, hydrates and carbonates and also with the outgassing of shallow mantle materials and which were thought to be insufficient to form the ocean water [106]. Therefore, it was believed that ocean would have been formed with extraterrestrial delivery from water rich meteorites and comets [18, 59 and 71-72]. However, lower water content in earth interior was not always the case considering that the early earth ocean was already formed nearly 0.1 Ga after the earth core formation [78, 92]. In contrast to early belief, water delivery from comets could not be significant considering that the hydrogen isotope distribution measured on some accessible comet is different from the earth ocean [31].

Anticipating on section IV, we suggest that comets are not resulting from solar nebula accretion and that like larger meteorites and asteroids they correspond to fragments of differentiated planets of red dwarf stars (nearly 70% of all stars in the Milky Way) [73]. Large ice content has been identified on the crust of these planets (like on planets of the solar system) and which have been likely producing comets with various types of space collision and/or with some supernova induced destruction.

### 3.2. Carbon distribution.

#### 3.2.1. Carbon segregation in the earth mantel.

Explosive volcano eruptions at mid-ocean ridges (forming 80% of deep sea volcanoes) is the consequence of high CO2 magma degassing and suggest that the upper mantle is more enriched in carbon than originally believed [106-107]. Carbon segregation in the mantle material is observed in CO2-undersaturated basalts [108] and on defect sites in mantle mineral analogues [109].

Considering the observed grain boundary carbon mobility in deep mantel material such as periclase (MgO) and olivine ([Mg, Fe]2(SiO4), it is admitted that carbon is diffusing from the earth core [110] where the carbon content of the earth metallic core is expected to be quite high (~5%) in contrast to that of the mantle (0.1% range) where carbon depletion is the consequence of exodiffusion of terrestrial volatiles (CO, CO2 and CH4) [71]. For these achievements must be considered how condensed solid/liquid CO/CH4 will be partly transformed with heat and pressure into polymeric material before being converted into glassy carbon, diamond, iron carbides and carbonates with corresponding gas release [111].

3.2.2. Different carbon forms and quantum electronic atomic rearrangement.

Transport of carbon from the earth core to the earth mantle and crust is evidenced with the discovery of large gem diamond in different early hot spot volcano chimneys and which are containing different sorts of heavy metals [99, 111]. Carbon in the earth interior appears also in other forms such as gaseous/liquid CH4, which is associated to gem diamond [111] and with the exodiffusion of volatile gases corresponding to the solar nebula gas composition where the earth has been accreted and which used to be less oxidized [70-71, 92-98]. Also, to be considered the graphitic phase in segregated carbon [108-109] and carbonates in some volcano extruded primary rocks [45-46] and finally, also in form of dissolved material in metallic Fe [92-93]. It has been suggested that diamond is formed in the high pressure high temperature melt of the core/mantle boundary with chemical reaction between MgCO3 and SiO2 [112].

These results need to be refined considering the simultaneous existence of different carbon phase in the earth interior. It is well known that graphitic material can be transformed in diamond with heat and pressure [113-115] and recall that diamond is also produced from glassy carbon at 10 bars and ~ 3000°C [116]. Several diamond preparation processes are associating pressure and melted catalytic metal alloys [112-114], indicating that some chemical effects can contribute to the diamond formation. This is verified with glassy carbon obtained at atmospheric pressure with ~ 1000°C thermal processing of polymeric material and which can also be diamond like with significant Csp3 content (hardness about 15GPa) [117], in contrast to long believed that glassy carbon would only correspond to Csp2 (which is only obtained with longer annealing and higher process temperature).

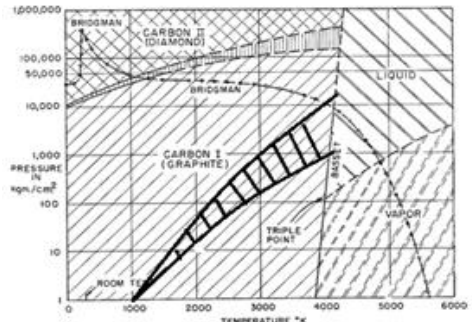
Volatile CH4, CO, H2O and NH3 gases can be recombined with heat and pressure into polymeric materials and transformed into glassy carbon with exodiffusion of gasses essentially containing H2, N2, CO2 and H2O [116] before ending in various segregated and dissolved phases and other chemical states such as carbonates and pyroxene material considering the non-uniform temperature during the earth accretion process [98].

To illustrate the role of chemistry and of the released chemical recombination energy on diamond and diamond like material, we mention the experiment showing how some kinds of composite/amorphous CNx material being annealed at atmospheric pressure at 700°C is forming densely

distributed diamond microcrystals [118]. It has been also shown how diamond film can growth with various combined chemical and physical effects other than heat and pressure (for instance within a thermal torch or in a low bias H rich plasma process) and with various other activation effects [119-120]. Glassy carbon can for instance be transformed into highly diamond like ta-C with N+ irradiation [121]. These effects illustrate the role of quantum electronic sp3 atomic rearrangement activation in favor of specific substructures which can appear with various type of chemical recombination energy release before being converted into heat (phonons) and we have described in ref. [48, 119]. Pressure and ion/atomic impact can correspond to a particular quantum electronic activation in so far valence band electrons can be excited with electrostatic repulsion and/or release of neutralization energy [119]. Figure 6 shows the instantaneous pressure temperature carbon phase diagram according to Bridgman [114] and what is achieved after some longer degradation time according to thermodynamic kinetic defined with the Arrhenius law.

Figure.6. Pressure/temperature carbon phase diagram by P.W. Bridgman [114]. Phase domain with ~104 s degradation time (thick line)




3.2.3. Possible growth of SWCNT in ultramafic Volcano vents.

In the upper mantle where the pressure can be much lower than in the core, and because of still significant temperature (in the 1500°C to 2000°C range), glassy carbon will be transformed in more graphitic/graphenic segregation (as shown with some primary rocks content [45-46]. Considering that diamond has thermal stability ~1200K at atmospheric pressure for a thermal annealing process shorter than ~104 seconds, the diamond phase formed at higher temperature and pressure in the earth core can be preserved with fast decreasing temperature.

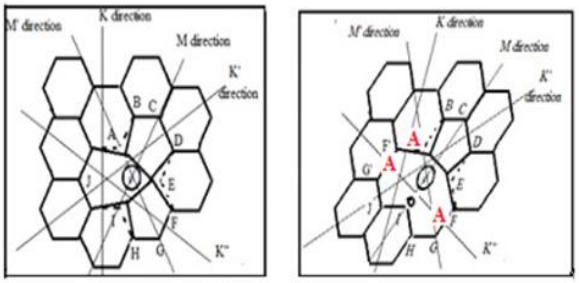
The pressure threshold of ~ 15GPa in the Bridgman diagram (Figure 6) at which the diamond becomes graphitic at 2000°K is markedly higher (x5000) than what is observed with longer annealing time and considering Arrhenius transformation kinetic [115]. Diamond is transformed into graphite at pressure of 500 MPa and temperature T~3000K, meanwhile pressure near deep-sea volcanoes is only ~ 0.1 MPa. This is a pressure at which diamond is transformed into graphitic materials at T >2000°C. Therefore, graphitic material can be extruded from the mantle via hot spot ultramafic deep-sea volcanoes, considering that SWCNT can growth on catalytic FexMyCz in a CH4 atmosphere at ~1000°C /2000°C [52 & 122] and where the SWCNT will not be destroyed by hard UV irradiation [48, 119]).

Semiconducting SWCNT can have either left or right-handed chirality [52]. Most SWCNT's show vacancies and voids which can enhance their chirality in consequence of the higher stability of internal A-edge (corresponding to the mislabeled so-called

D disorder Raman peak at normally 1350cm-1) [48]. (Figure 7) Internal void edges are presenting dangling bonds with which the SWCNT material can be etched [48, 119-124]. Above its sublimation temperature, SWCNT can be destroyed with heat (~3000°K at AP) and also with hard UV irradiation which can transform parts of the SWCNT structure in smaller/denser H6 diamond particles [48]. Chemical recombination energy release can be enhanced in presence of catalyst explaining why SWCNT growth can then be inhibited [119].

Figure.7 Stabilizing of chiral asymmetry of SWCNT by voids with A-edge formation by Neuville [48]




Void in a metallic SWCNT Void in a semicon SWCNT

## 4. EARLY EARTH EVOLUTION DEPICTED WITH METEORITES MORPHOLOGY

4.1. Meteorites and chondrites. Meteorites fallen on earth correspond to fragments from larger parent bodies which have been detached by space body collision and which are giving information the early earth formation [86-87] and on its atmosphere [31-28, 71]. They provide information on water and other elements contents [106] and on how AMACs have been formed, whenever not necessarily contributing significantly to earth AMACs. The occurrence of extraterrestrial organic compounds is a key for understanding prebiotic organic synthesis of AMACs in the universe [135]. Noteworthy is that larger asteroids Ceres, Pallas, Juno and Vesta have differentiated material which are originating from differentiated planetoids [87]. We will discuss next if chondrites which contain interstellar dust originating from differentiated materials can also have different origin from the solar nebula.

* 6% of all meteorites are originating from metamorphosed larger planets and planet fragments distributed in different belts. In the Asteroid Belt (between Mars and Jupiter), in the Saturn rings (where Titan is a differentiated asteroid with a liquid CH4 atmosphere and an ice crust with liquid water underneath) [128], in the Kuiper Belt (beyond the planet Neptune at 2000-3000 UA from the sun) composed by many icy space bodies [129-130] and the Oort Cloud (~ 50000 to 100000 UA and 1/3 the distance the sun to the nearest star Proxima Centauri) where most space bodies are comets [131] except planet Pluton a metamorphosed icy planet [131-133].
* 8% meteorites are stony achondrites which do not show any chondrules and which are believed to be chondrites which have been metamorphosed with heat [126-127]. However, considering some isotope distribution different from the solar system, they can be originating from more distant planetary and eventually other stellar systems.
* 86% of the fallen-on earth meteorites correspond to chondrites [126-127] which are relatively undifferentiated meteorites which have been formed in oxygen-rich regions of the early solar system so that most of the metal is not in free form but as silicates, oxides, or sulfides and contain water or hydrolyzed minerals. Their main characteristic is that they contain small chondrules and some refractory mats imbedded in some fine-grained matrix [134]. Chondrites are fragments of asteroids which have not been (or little) transformed since they have been formed in the Asteroid Belt and from which many of these result from an accretion processes in the solar nebula [87]. Although chondritic asteroids never completely melt some of them show significant thermal metamorphism (with H2O depletion).
* 75% of chondrites are Carbonaceous Chondrites containing larger amounts of carbon and organic compounds [126, 135]. They are fragments of some asteroids located in the Asteroid Belt corresponding to ~95% of all asteroids. The most important carbonaceous chondrite groups are CI, CM, CV, CO, CR, CK, CH and CB group, indicating various oxidation state and much different content of iron and other heavy metals (from few % up to 38%). Differences in porosity and grain size, indicate different partial fusion process and oxidation state (with hydrolysis of the original asteroid material) [134].

4.2. Asteroid and meteorite formation

4.2.1. Dating

Many asteroids have been accreted in the solar nebula at the same period of the earth accretion process some 4.55Ga ago [126-127]. An age which has been determined with radioactive isotope decay chronograph methods [61-62, 77-79 & 136-137]. 95% of the space bodies in the Asteroid belt (between Mars and Jupiter) correspond to chondritic mats from which most fallen on earth chondrites are originating. Most of the compounds in meteorites have isotopic compositions that date their formation to presolar environments and reveal some chemo-physical evolution [138-139] which have determined their hydrogen, carbon, nitrogen, and noble gases content [71, 140]. Differences in composition of space bodies and isotopic anomalies are explained by incomplete mixing of various nucleogenic contributions to the solar nebula, depending on which nuclear activity has been influencing this isotope formation and with which sort of isotopic selective diffusion process. Although having different composition and water content, the isotope signature of most fallen on earth chondrites is similar to the earth [138], in contrast to comets and other space bodies more distant from the sun [31]. However, some chondrite groups deviate from the solar composition [139] and some AMACs analysis indicate that they may be related to interstellar cloud compounds [139-140].

4.2.2. Probing, material differentiation and amino-acids content.

In order to get information on space body contents, radio reflection tomography [141] and visible [142] and IR spectroscopy have been used [143] and have confirmed the presence of ice on many planetoids [82] and abundant AMACs in the universe [6]. Both discrete soluble organic compounds and insoluble macromolecular material have been found in the bulk material of the Murchison chondrite [81, 135 & 144]. Those correspond to several types of organic materials including Polycyclic Aromatic Hydrocarbon (PAH) [145-146] and many different amino-acids from which most of them have never been found elsewhere on earth [147-148]. Measurement of isotopic distribution is pointing the fact, that their water and AMACs content have not always had the same isotope distribution than on earth and in the close solar system [31, 139] and will probably have different origin. The limited number of terrestrial AMACs is suggested being able to question their extraterrestrial origin, otherwise a much higher number of different AMACs would likely be currently found on earth, considering that with present knowledge it is not possible to consider that a selection would have been operated within extraterrestrial input. All early life material remnants discovered in some elder sediments [45-46] correspond to Atmospheric Prebiotic Chemistry [30-31]. This gives background to our hypothesis that NRA has been formed with adsorption of AMACs and nucleobases on graphenic materials [144-146] of terrestrial origin.

4.2.3. Superimposition of different effects with materials of different origin.

Star and Solar nebulae are known to have gas mixture containing H2, CH4, CO, H2O and NH3 and different materials [72] imported from ending life star [73-74, 149] in the form of star dust with the star wind and with their eventual final supernova

destruction [150-151]. These are releasing carbon material resulting from triple alpha Helium nuclear fusion and heavier elements with the Bethe-Weizsäcker fusion CNO cycle [66-68] and which will recombine first to above cited primary gas mixtures [30, 69-70]. The solar nebula is also containing further heavier materials obtained by nuclear reaction involving neutron capture in the vicinity of ending life stars being transformed into a neutron star [61, 65 & 76]. It contains also star dust which is imported from numerous more distant interstellar space and farther local nuclear events [149-151], and which can be older than the solar system [79]. (Over 3000 nebulae have been identified in the Milky Way galaxy resulting from formation processes similar to the solar [152]). Heavier elements such as Mg, Al, Si, S, Fe, Ni material have been possibly recombined to more complex molecules such as perovskite, pyroxene, olivine and refractory Calcium/Aluminum mats (corresponding to CAI in chondrites) [140, 153-154]. With the appearance of the solar and planet gravity heavier elements have been attracted on one hand closer to the sun (such as the Mercury planet) and on other hand to the center of differentiated planets [155], meanwhile lighter elements will be more concentrated at the outskirt of the solar system [131-133]. Besides specific isotopic diffusion and radioactive decay, the differences in isotopic distribution of space bodies result also on the original nuclear source type, age, size and distance to it [63-65, 137-140] and can thus indicate different extrasolar spatial origin (whenever not necessary the case if the original nuclear sources are similar).

Considering that the solar nuclear activity was likely ignited with some supernova pressure shock waves [63-65], the different molecular nebula contents will condense according to their respective melting points and which can form various material rain droplets corresponding to the chondrules particles [126-127].

It must be emphasized that liquid rain and solid flocculation are generally initiated with the adsorption of corresponding vapor molecules on dust particles [156] and which will correspond to some first accretion process steps [157]. The important number of different types of meteorites and different content is suggested to be explained with the combination of local accretion and condensation of materials from parent bodies of different origin which had achieved different stage of metamorphism and being differently degassed and remolded [157-159]. This hypothesis finds some first background with the question which has never been fully answered up to now: what have been the thermal sources with which some asteroid differentiation has been achieved? and for which several more or less contradicting theories have been proposed (radioactive decays, collision, UV irradiation, condensation heat, released chemical recombination energy and solar proton wind impact energy).

Also, still no satisfactory answer is given on the location and mechanisms with which some chondrites show remanence of some recorded magnetic field (corresponding to field intensity of 0.1 to 10 Gauss) [160]. Nebula magnetic field contrary to published claim [161] might be not sufficient to produce the measured magnetization and contrary to what can be expected in the neighborhood of AGB stars and planetoids with molten iron core able to produce larger hydro–magnetic dynamo effect [162]. Finally, another question is what may be

causing some thermally induced differentiation and water altered carbonaceous chondrites with abundant AMACs which contain significant amount of nebula primary gases but quasi absence of CH4 [6, 135 & 146]. This suggest AMACs formation from photolysis of water where nebula gases are dissolved but for which CH4 will be the main precursor and considering that the original CH4 concentration could rapidly decreases during the earth accretion process.

Water vapor can be produced in large amount in comparison to many other heavier molecular compounds because of the respective higher concentration of hydrogen and oxygen in the primary nebulae, and also because of the higher recombination affinity of H for O, considering bonding energy of O-H (~5 eV) compared to lower binding energy of N-H and C-H (~4 eV). Thus, solar planets (including Mercury) [155]) and larger lunar planetoids (such as Titan, Europe, Encelade, etc.) subject of robotic exploration such as Huygens-Cassini missions [163] and also larger exoplanets of Proxima Centauri (the nearest star to the sun recently probed with optical, radio and IR), all of them show important quantities of ice [75, 142, 164] in agreement with relevant black body thermodynamic calculation [74-75]. The ice crusts which have been subject to important space bodies bombardment and supernova shock waves are likely at the origin of the numerous comets in the Oort cloud (ice with dissolved primary gases and covered with star dust) [132-133].

Some larger meteorites and chondrites can correspond to destruction of solar system planetoids and/or exoplanets which had their own thermal sources and with which some of them have been able to produce molten iron (alloys) and a magnetic field. Corresponding fragments can have been associated to local condensation and accretion. Different moon like planetoids indicate different steps of water alteration and thermal metamorphism for which all previously described mechanisms can be associated and which can explain the wide chondrite variety.

## 5. EARLY EARTH ATMOSPHERE AND MECHANISM OF AMACs SYNTHESIS.

### 5.1. Early earth atmosphere and evolution.

The knowledge about the early earth atmosphere is of prime importance for the understanding of first earth life molecules appearance [18-22]. Several of them correspond to some Miller-Urey electric discharge in a gas mixture thought to correspond to early earth atmosphere [16, 24-31, 56-57]. Earth's atmospheric composition at the time of the origin of life is not known but is expected to be a significant source of prebiotic organic molecules, considering that early earth conditions have been probably similar to asteroids from which many types of chondrites are originating [165]. Experimental and theoretical studies have shown that atmospheric synthesis can yield molecules such as amino acids and nucleobases, however, these processes are very sensitive to gas composition, pressure and energy source [16, 26]. Abiotic synthesis of organic molecules appears more productive in reduced atmospheres [25-30], yet the primitive Earth may not have been as reducing as originally assumed considering the different oxidation mechanisms initiated with water and

considering that CH4 and NH3 molecules might have been easily destructed with UV and solar wind radiation [166-168].

Admitting the early atmosphere had appeared with outgassing of rare gases and light molecules such as H2, CH4, NH3, CO this gas mixture might have been rapidly evolved into a gas mixture [29-30] composed mainly by H2O, N2 and CO2 in agreement with modern volcano gases and of modern atmosphere composition (for which biotic O2 production must be added) [168-170].

However, different marks of possible reduction processes inside the mantle are giving credit to the hypothesis that the early earth atmosphere stayed for longer time reduced [108-109]. It has also to be considered the possibility for chondrites to deliver to the earth atmosphere some primitive gases [165 & 171] and also, several other mechanisms which can hamper the evolution of the atmosphere such as CO2 removal with carbonate formation and UV irradiation shielding [29-30, 172-173]. Main argument to consider is that escape of a primary atmosphere from a planet the size of Earth is difficult (contrary to smaller planets with less gravity) and easier for rare gases as shown with much lower Ne/N ratio (10-5) on earth, mean-while quite equivalent in the sun [167].

Primary atmospheres are by definition composed of gases captured from the solar nebula (almost H2, H2O, CH4, NH3 and rare gases) [70-71]. Such atmospheres are common in planets like Jupiter, Saturn and Uranus [173]. With preceding whole, it is generally admitted that the early earth atmosphere was not much different from the primitive nebula before major thermal metamorphism and biotic activity will deeper have affected it [166, 173]. However, as previously shown, isotope distribution indicates that the origin of earth gases is likely confined to the close solar system. Therefore, early atmosphere might be an ideal medium for the formation of amino-acid. This scenario has nevertheless to be carefully compared with other extra-terrestrial formation hypothesis and also with the deep-sea formation model. It must be verified on their compatibility with earth conditions, different evidenced effects and enantiomeric properties, considering that many approaches to prebiotic chemistry have relied on model without complete grounding [174].

### 5.2. Compatibility of different Amino-acid formation with earth conditions.

#### 5.2.1. Hypothesis of amino-acids extra-terrestrial origin.

Modern more oxidized atmospheric gas composition (with higher CO2 and N2 content) appeared as quite inappropriate for the synthesis of amino-acids with Miller-Urey electric discharge [26], contrary to what is easily achieved with supposed early earth atmosphere content [25]. Because of uncertainty on it, and with the discovery of many AMACs in several types of chondrites and other space bodies [31, 135, 144, 175-176], scientific community was agreeing that first earth AMACs should have been of extraterrestrial origin [81-82,]. Especially, when it was discovered that AMACs can be produced with UV irradiated ice where nebula gases are dissolved like in comet ice [18, 20-21, 176].

5.2.2. Questioning extraterrestrial earth life AMACs and first subsea formation hypothesis.

It has been shown that AMACs can also be formed with photochemical reaction of water where CO and NH3 are dissolved [27-28], and with spark discharge in mixture of reduced gases similar to volcano eruption where H2O vapor was added [28]. Same Urey-Miller synthesis results are obtained with the light which is emitted from the spark discharge and not with the electric discharge itself [28 & 177]. Under similar conditions, elementary organic molecule such as HCN can be formed and it could be shown that H2S addition can enhance AMACs synthesis [24, 54 & 178]. However, considering that AMACs are destroyed by intense UV irradiation and will not survive cometary impact heat [179] it was thought that AMACs could be rather formed near UV shielded submarine vents where sulfuric compounds are abundant and where they can evolve in a life compatible aqueous environment [53, 180-181].

5.2.3. Additional groundings for RNA synthesis to be considered.

Other important aspects have to be considered which will determine whether the first AMACs have been formed on earth in the atmosphere or in deep-sea or being of extraterrestrial origin. It must be considered the possibility to form nucleobases which can be assembled to RNA [182]. For this processing step has also to be taken into account how phosphor -the fifth element on earth- can be associated to the nucleobases syntheses [183]. Primitive phosphor is produced by nuclear fusion in older stars and can recombine to phosphine (PH3) in the H rich solar nebula environment [62-63] before being hydrolyzed in phosphide and phosphate explaining why they can also be found in comet material [176] although phosphide and phosphate are poorly dissolved in ocean water and more abundant in the earth crust [184].

However, modified Urey-Miller discharge with pressure and molecular content has recently shown how nucleobases are also synthetized during sparks experiments [16]. This recently discovered feature is in coherence to the point that phosphide and phosphate can be reduced with electric lightning discharge and which can therefore, be associated to the prebiotic formation of nucleobases both on earth and elsewhere in the universe on asteroids and exoplanets where appropriate conditions may exist [185]. Further on, it must be considered the possible mechanisms with which the nucleobases can be assembled to RNA and for which has been shown that the life building blocks have to be adsorbed on adequate mineral surface [186] which is acting as a template grid model [1, 35]. Recall that graphenic material surface are likely associated to formation of life molecules corresponding to plankton remnants [45-46, 187-188] (With these first associated elements it can be further on inferred that first earth life molecules are likely not corresponding to extraterrestrial import, anticipating on next section VI). Finally, must also be considered the effects causing the asymmetric L-handed enantiomeric distribution of all the 20-identified earth AMACs. Meanwhile 50 others have been identified in the Murchison chondrite which are essentially both right and left-handed enantiomers [145-148] and how enantiomer dissym-metry can be enhanced [17, 33].

## 6. ASYMMETRIC CHIRALITY OF EARTH ORGANIC MOLECULES.

### 6.1. Template-directed synthesis and asymmetric enantiomeric selection.

Prebiotic Urey-Miller synthesis achieved in usual laboratory conditions yield equal L- and D- enantiomers [20-21, 24-25 & 181]. However, looking in more detail to meteorite AMACs enantiomeric distribution, it appears that extraterrestrial AMACS are not totally racemic [189-190]. Whether organic matter has been synthetized either in meteorite parent bodies or on earth, asymmetric chiral distribution has been invoked with specific chiral environment. Enantiomeric asymmetry can be obtained with selective adsorption (with specific adsorption energy) on preferential chirality of mineral surface and by supramolecular interactions [1, 17, 39-42, 186, 191-195] (illustrated with currently used effect for purification of chiral pharmaceuticals [196]). Considering that the L- and D-handed enantiomers of a same molecular composition have generally different barycenter and different plane curvature [33, 49-52], their adsorption energy will also depend on composition and plane curvature of corresponding substrates (Figure 5) and will therefore depends on their specific chirality. Noteworthy, is that different enantiomers of a same chemical compound can produce different olfaction effect in agreement with our results showing that olfaction is caused by steric distribution and molecular size and adsorption energy dependent activation of transversal transient polarization [197-198]. These adsorption properties are thought to be at the origin of selective asymmetric autocatalysis [199] and of the amplification of slight chiral excesses as observed with chiral self-assembly of polymers [33 &200].

### 6.2. Magnetochiral chemistry

An important effect for asymmetric synthesis has been evidenced with circular polarized UV light and which is at the origin of helical-shaped enantiomeric asymmetry [201-202]. This has been verified with synchrotron radiation and corresponding UV laser beam [203-205]. Because circular polarized (CP) light is emitted from neutron stars (resulting from ending life star collapse) [206-207] (numerous neutron stars in the Milky Way have luminosity in the 10exp26 to 10exp31 Watt range), it was admitted that some enantiomeric asymmetry of extraterrestrial AMACS would have been produced with such neutron star CP radiation [208]. However, considering the distance of neutron stars to the sun (10exp6 UA range), the CP UV flux in the Ort cloud can be roughly estimated in the 10exp-3 W/m2 range, meanwhile the necessary synchrotron CP UV flux is 104 higher (~10W/m2). Therefore, interstellar magnetochiral effect will likely be negligible to produce chiral asymmetry of extraterrestrial organic material and another natural CP light source must be found.

## 7. EARTH LIGHTNING AND PREBIOTIC RNA SUBSEA SYNTHESIS.

### 7. 1. Earth lightning and circular polarized UV light magnetochiral AMACs modification

Critical review of CP UV light and theoretic modelling [209] has shown how circular polarization can be formed in presence of magnetic field which is non-

perpendicular to the light beam. A result which suggests the possibility to produce asymmetric chiral distribution of organic materials in a terrestrial atmosphere. An effect which may also exist on some planetoids and exoplanets for other type of early life elsewhere in the universe (with other isotopic distributions and other types of AMAC's).

From recent observation on optical power and energy radiated by lightning [210-211], it can be verified that the lightning radiations is of same 10W/m2 range than produced by volcano lightning with which AMAC's are also produced [57] and by synchrotron CP polarized light radiation with which enantiomeric asymmetry is achieved [205]. Earth lightning investigations have shown abundance of strong high frequency and high energy radiation being measured with different earth and satellite observation systems (FORTE satellite) and some correlation could be established between optical emission and VHF radiances [211-213] and with which can be presumed that polarization characteristics will be also correlated. Two main lightning types can be distinguished (besides other less important ones such as CC lightning between clouds). The vertical lightning corresponds to an electric discharge between cloud and the earth (CG) and the horizontal intracloud lightning (IC) [214-215].

**Clarification of some current elusive aspects of lightning**

- Glow discharges are ignited with relatively low intensity rising current at a voltage depending on the pressure, the gas ionization potential and the geometry of counter facing electrodes which define the plasma potential and its auto-polarization [223]. An arc can be generated according to the Paschen law when the current continues to rise and a voltage threshold is reached for which the equilibrium of charges is broken and which is ionization potential (humidity, pollution, dust, etc.) and pressure x distance dependent [223-224]. This happens generally about 10 ms after the glow discharge light appears. Both light and electromagnetic wave emission are originating from the same discharge and will have similar polarization.

-Investigations on lightning TIPP's (Trans-Ionospheric Pair Pulse) conclude that the strike on the earth floor generates additional radio waves [225-227] and which can be differently screened out in the clouds [211]. Therefore, lightning radiance registered with a satellite, can be different from earth registered [217].

-With a CG lightning, the negative electric charge in the cloud is locally annealed and therefore, will initiate a delayed coupled IC lightning perpendicular to the GC. Circular polarized electromagnetic waves can be considered as the addition of coherent phase shifted perpendicular planar polarization between CG and IC lightning. The question will be if some of them and/or parts of them can have orthogonal polarization and if they can interfere and form CP waves in a zone where they have still significant intensity However, the generated light will hardly interfere considering the high distance which is covered by the light emitted by the CG lightning until the IC lightning appears (~10 to 100 ms) and have no more significant intensity

The lightning physics is complex and not fully understood up to now. The initial breakdown discharges generally are lasting some µs [216], meanwhile optical emission can start ~10ms before and is lasting afterwards with after-glow effect up to several 100ms [217-219].

A resolution time higher than the discharge steps duration (0.1µs to 1ms) will not be

able to register any polarization and only the mean result of randomly distributed discharge directions [211-213]. The question is then if these CP electromagnetic waves have been formed with some lightning branches which are non-collinear with the magnetic field, in agreement with previous mentioned theoretic prediction [209] or the result from addition of specific GC and IC lightning segments for which orientation and time would produce a CP interference. Last aspects appear unlike considering the weak intensity of an eventual CP light which can be achieved with a reduced fraction (~ 1/1000) of each lightning branches. Planar polarized waves are registered when using defined electronic oscillator continuous earth sources [211-213]. With the recent investigations on lightning electromagnetic wave polarization [212-213] both planar and circular polarized electromagnetic waves have been evidenced with IC lightning's, meanwhile tortuous GC lightning do not show any polarization. This is suggested to be explained with the point that IC can be collimated by the earth magnetic field [222], contrary to GC lightning. However, CP light is achieved with IC lightning being collimated by the earth magnetic field in agreement with the Jorissen theory [209] and in agreement with the observed correlated CP electromagnetic wave [212-213] and which likely can produce asymmetric chiral AMACs in an early earth atmosphere with Urey-Miller sparking. (Figure 9).

### 7.2. Prebiotic RNA synthesis with L- chiral AMACs

AMACS asymmetry will hardly be produced in deep-sea darkness and considering the local lower magnetic field. With the rainfall which is accompanying thunderstorms where IC lightning appear, the formed asymmetric chiral AMACs and nucleobases will be flushed to the earth surface and to the ocean, where vertical water down streams (compensating vertical up-streams) can transport them near deep-see hot spot vents where they are UV shielded.

However, with the high interest recently focused on the way to select the different types of SWCNT [228-229], recent investigations have shown how SWCNT enantiomers can be separated in water in making use of a selective buoyancy effect. This is achieved with the adsorption of chiral AMACs like molecules on SWCNT of same chirality and similar size which show higher atomic packing density in contrast to the complexes formed with chiral AMACS on SWCNT of opposite chirality [230] (Figure 5). The reverse effect can be used to amplify the majority AMACs enantiomers.

In the first case, the formed SWCNT/ nucleobase complex will have a denser structure considering the better steric fit between curved AMACs plane and SWCNT curvature: the complex will then sink towards the deep-sea. Meanwhile, AMAC's of opposite chirality adsorbed on SWCNT will form less dense complex material in consequence of plane curvature misfit (Figure 5) and can move upward to shallow water where UV can destroy them. Additional AMAC's and Nucleobases can be adsorbed on first formed dense complexes staying near the deep-sea vents, taking into account on one hand, the polarity of formed macromolecules bricks and the polarity of the SWCNT along their own chiral distortion (Figure 4) and the complementary molecular shape and

affinity of each nucleobase/AMAC's brick to each other's (Figure 1). Significant amount of sulfuric acids exists in the vicinity of deep sea vents which can etch from the inside the hollow AMAC/SWCNT complex [24, 124], meanwhile the more stable RNA will not [22, 32,181 & 231].

Starting with a mixture of AMACs enantiomers slightly L asymmetric in presence of a racemic mixture of SWCNT, it can be shown how the enantiomeric selection will gradually achieve 100% L-handed chirality, similar to other types of identified chiral asymmetric enhancement mechanisms [17, 33 & 201]. The complexes formed with the minority D-handed AMAC's has a lower formation probability (because of their lower quantity) than the complex formed with the majority L-handed. Thus:

- $C_D.A_L > C_LA_D$ ($C_D$ concentration of D-handed CNT, $A_L$ concentration of L-handed AMAC's and $A_D$ the concentration of D-handed AMAC's with $A_D < A_L$ and $C_L° = C_D°$) the D-handed SWCNT is eliminated at the sea surface (with UV) faster than the L-handed SWCNT.

- $C_D.A_D < C_L.A_L$ L-handed AMAC's concentration will be enriched in the deep-sea.

The SWCNT skeleton of the sinking denser complexes can be etched away with sulfuric acid [24, 47 & 124] meanwhile AMACs and nucleobases are not affected by the considered sulfuric acid [231]. The liberated AMAC's and nucleobases can start the selective adsorption process again and leading thus to a gradual enrichment of the L-handed enantiomers. At this stage the RNA and dissolved AMACs and other hydrocarbon molecules can evolve to larger more complex primary life structures [4-6, 22 & 34].

To be observed that earliest life cells correspond to prokaryotes structures corresponding to sea water virus and femto-plankton [232-234] which are formed with proteins sticking on an RNA molecule without any lipid membrane, in accordance to the point that prebiotic synthesis of lipids could probably not be formed in salty sea water, but only in earth crust fresh water [235] and which can arrive in the sea with the earth water cycle for further biochemical steps.

## 8. CONCLUSIONS

With the present work we have shown how prebiotic earth RNA can be synthesized in different steps. Non-racemic preferential L-distribution of amino-acids and nucleobases can be formed in the early earth atmosphere with lightning's and associated earth magnetic field producing polarized light. Helicoidal single wall (hollow) carbon nanotubes can grow catalytically from iron carbide alloy in CH4 environment in the vicinity of deep-sea ultramafic carbonatite volcano extrusion. A selective adsorption of nucleobase enantiomers on corresponding helicoidal CNT enantiomer can be achieved in considering their relevant bending radius along their deformed hexagonal cyclic ring helicoidal direction and corresponding electric polarization. A deep-sea buoyancy effect can enhance the L-enantiomer selection of amino acids/ nucleobase coated CNT in consequence of enantiomer CNT/nucleobase complex density differences. The selective destruction of the (hollow) CNT substrate (skeleton) by sulfuric acid environment can leave the RNA free in the deep-sea where it can evolve to more complex life molecules.

This scheme appears to be coherent with the appearance of the smallest known primitive prokaryotic cells corresponding to femto-plankton (sea virus) composed by proteins adsorbed on a RNA core without association of any lipid cell membrane and which are still living today in the sea. Considering that AMACs are also formed in CO2/H2O/H2S rich atmosphere above some deep-sea volcanoes [53, 178 & 181] where abundant lightning can appear, we set the hypothesis that RNA and femto-plankton might be continuing to be formed near deep sea vents. This hypothesis is in agreement with the fact that larger plankton species resulting from the biochemical evolution of femto-plankton appear to be in excess in such region, meanwhile the plankton population decreases everywhere else in shallower sea water [188]. More detailed investigation near deep-sea vents has to be achieved in order to confirm these assumptions.

This study is leading to the conclusion that organic molecules contributing to primitive life appearance on earth have likely not been imported from extraterrestrial sources in so far only a limited number of AMACs have been identified on earth in comparison to much larger content number in meteorites and accessible asteroids. Additional reasons will be their specific different isotope distribution and the point that they can be easily destroyed by combination of more intense solar proton and hard UV irradiation and that AMACs buried in the bulk of solid state fallen on earth meteorites, can hardly evolved to larger more complex organic molecules.

Appearance of primitive life on other space bodies has to be considered independent from earth scenario with other similar mechanisms and another enantiomer distribution. This is what is suggested to have been recently discovered on the Saturn moon Titan [28 & 236], although it is not known if RNA exists there and how it might have been formed. SWCNT formation conditions or other helicoidal self-assembly material to be used as RNA template could not be evidenced there up to now. However, similar schemes which need to be verified appear to be eventually possible on some differentiated exoplanets where such conditions might be gathered [237-238] and which will be possible to check with future longer distance and longer lasting space missions.

## Biography of the author

Stephane NEUVILLE obtained a degree in physics at the Grenoble Polytechnic Institute with Louis Neel in 1970 before joining R&D at Siemens in Karlsruhe (Germany) for new generation of field emission, surface science electron spectroscopy and microscopy. With different companies involved in vacuum, thin films, surface science, plasma technology, scientific spectroscopy and analytical instruments, he always close associates R&D to related industrial and marketing export management for number of different advanced surface science, scientific analytical spectroscopic and plasma thin film equipment's for most advanced applications including opto-electronical, electrochemical, diamond and hard carbon coatings. Deepening those acquired he obtained a PhD in plasma-technology and material sciences in 1996, before continuing theoretical and applied R&D as an independent consultant. With additional input from the whole he developed also an expertise on advanced carbon material and associated

fundamentals concerning hard coating adhesion, catalytic carbon material growth, biologic olfaction mechanisms and on different other nanomaterials. In 2011, he developed a quantum electronic activated atomic rearrangement theory and in 2014 some decisive updated carbon Raman spectroscopy fundamentals, both appearing to be keys for a comprehensive extended ta-C coating engineering able to provide superior surface functions for new more demanding applications including optoelectronic applications and renewable energies. In revisiting associated quantum mechanical aspects, he opens new perspectives for superconductivity critical temperature increase and also for new kind of nuclear fusion development.

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