DEFINITION OF ASTROBIOLOGY WITH LIQUID PHASE CHANGE AND DYNAMIC CYCLIC CHANGE. Yas. Miura, Yamaguchi University, 1677-1 Yoshida, Yamaguchi University, 753-8512, Japan (dfb30@yamaguchi-u.ac.jp)

Introduction: Definition of astrobiology with life activity is required for the following factors:
1) Combined inorganic and organic (INOOG) materials of life,
2) Changes of gas-liquid (VLS) phases, and
3) Space and time (ST) factors [1-5],
which is main purpose of the present paper.

Life materials with combined IOOG: Almost all life materials are combined with two materials as follows:
1) Inorganic (IN) materials of mineral crystals with carbonates, phosphates and oxides in composition with cyclic materials (called as “fossil” as some state IN with relatively long cyclic system), where carbon (C), hydrogen (H) and phosphorous (P) together with minor elements (Fe, Ni, Mg, S, Cl, Mn, Cr, Co, Cu, and Zn [2]) found in bone and shell etc. are richer in carbonaceous meteorite than crystal rocks as cosmic abundances based on silicon [5,6,7].

2) Organic (OG) materials with carbon-bearing organic materials in composition with cyclic materials (some state OG with relatively short cyclic system), where carbon-based organic compositions of RNA and DNA found in the life cell and blood are characteristic for active reactions with short periods in life (as shown in Fig.1).

In this sense, life materials are considered to be “combined materials of inorganics and organics (IOOG)”, which are difference in composition and activity with short (IO) and long (OG) periods found as “inorganic fossil” [6,7] in present time as lost life activity.

Changes of gas-liquid-solid states VLS: There are two affairs on material changes of life activity as follows:
1) State change VLS: Life activity (in human, animal and plants etc.) is cyclic system of the following three states VLS:
   a) Vapor state V (like gases of oxygen and carbon dioxide).
   b) Liquid state L (like liquids of cell and blood etc.).
   c) Solid state S (like solids or minerals of bone and shell etc.; Fig. 1).

2) State changes for cyclic system: Life activity (in human, animal and plants etc.) is required dynamic changes of materials by the VLS state change for overall cyclic system of the following phenomena:
   a) Birth and death BD (in life activity)
   b) Formation and destroy FD (in inorganic fossil and any minerals and rocks; Fig. 1).

In this sense, life materials are “dynamic VLS activity with carbon, hydrogen, oxygen and nitrogen (CHON), which are considered to be “dynamic mini-cycle materials” or “water-air-planet Earth”.

Space and time factors ST: Astro-life materials are largely required to be considered to be dimensions of space and time (ST) as follows (cf. Fig.1):
1) In near space and short time (in the Earth of the Solar system):
   a) Time: short period (from second to year).
   b) Space: localized space (from nm to km)

2) In deep space and long time (in Universe space):
   a) Time: long period (from year to light year).
   b) Space: localized space (from km, a.u. to light year distance)

In this sense, life materials can be “discovered” not only in the Earth of the Solar system, but also in deep space (called as overall astro-life).