

Towards a new paradigm of Bio-Planetology

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[Problem]

Our science community should discuss now the next potential target of research program, combining all different branches of Earth and Planetary sciences, because of rapidly growing knowledge of science and technology that make "huge science" leading a global edge or frontier of science beyond national borders in this Century. I try to propose a subject called Bio-Planetology to be established within 10 years which will become an interface between natural and social sciences, to consider the fate of human being which way to go.

[How many independent variables to keep the Earth habitable]

The Earth has been a boring planet, even though called as habitable over 4.0 b.y., because large multi-cellular animals including vertebrates emerged only after 640Ma. We propose a new concept termed as evolutionarable to bear large multi-cellular animals beyond "habitable".

[Role of the study of the Earth]

Parameters making the Earth habitable over 4.0 b.y. can be determined through the extensive and systematic works on our planet, Earth, and brother planets in our solar system. Through the multi-disciplinary works on the history of the Earth and Life, seven major events were elucidated to make the Earth evolutionarable. The independent variables to make it possible were summarized as (1) solar mass, (2) its composition, (3) distance from the central star, (4) size of planet, and (5) time. Even though all were prepared, yet the habitable planets can be classified into the following five types.

(1) Hadean Earth, (2) Archean Earth, (3) Proterozoic Earth, (4) Phanerozoic Earth, and (5) Quaternary Earth with cultural development by human being.

[For the search of habitable planets in our Galaxy]

To find out the habitable planet outside our solar system, we utilize the chemistry of atmosphere covering the planets. First, we target the stars with appropriate mass and composition to neglect the carbon planets, and the selected targets should be older than 4.0Ga after the formation. The presence of ocean may be detected by atmospheric spectrum through telescope. Thereafter, the chemical composition of atmosphere can be used to differentiate the evolutionary stage of life, the Hadean-type, through Archean enriched in methane and CO₂, and Phanerozoic-type enriched in oxygen or ozone.