Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-01 Room:104 Time:May 22 10:45-11:00

Systems of life in closed-ecology

Kaori Tomita-Yokotani[1*]

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Living creatures on the earth have been evolved since its origin a long time ago. They equip several important functions affecting each other. Knowledge on those functions and interaction of the ecology is essential for secure design of a closed-ecosystem with limited number of living species under the harsh environments, such as space and deep sea or desert. Organic substances can produce the ground on the surface of our earth. The mechanisms of soil production are very important matter in all the cases of bio-ecosystems. After the production of many species of creatures, the interactive functions among their organisms have important mechanisms during the evolution. It thinks that the establishment of the ecosystem to have been equipped with the higher feature in providing the place of the advanced specialized field research information about each biological system and its functions detailed feature when the human being tried artificial ecosystem becomes possible. In this time, as the first step, I will discuss about several research field, soils, microorganisms, plants, mammal, human and several creatures interactions.

Keywords: biological systemes, closed-ecology, biological function

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-02 Room:104 Time:May 22 11:00-11:15

Initial soil formation derived from volcaniclastic materials

Kenji Tamura[1*], Maki Asano[1]

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We report on the initial soil formation derived from volcanic ash and scoria in volcanic Islands, such as Miyake Island and Izu-Oshima, connecting with an artificial closed ecosystem.

Keywords: pedogenesis, initial soil formation, volcaniclastic materials

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-03 Room:104 Time:May 22 11:15-11:35

Use of cyanobacteria in terraforming of Mars

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Cyanobacteria, the photosynthetic, oxygen-evolving proarchconservate, grow in diverse habitats ranging from tropical to polar regions and from sea to desert.They are considered to be useful in terraforming of Mars, keeping clean atmosphere in a space station, and serving as a food for astronauts. Since cyanobacteria are desiccation tolerant, they are easily transported under severe flight conditions. They can revive soon after rewetting. Molecular bases of these properties will be discussed.

Keywords: cyanobacteria, Mars, terraforming

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-04 Room:104 Time:May 22 11:35-11:55

Assessment of allelopathic activity in closed ecosystems

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We have developed a new bioassay for allelopathy in closed ecosystems. We named this new method as Life cycle assesent (LCA). This method is also valuable to evaluate the allelopathic activity in the closed ecosystems in space and also contribute for the future agricultural interaction in grass house or agriculture on earth. LCA Method was established using agar medium, and Arabidopsis or Rapid Plants (Brassica sp.). DNA microarray analysis using plant material with LCA method could analyze the gene expression to specific allelochemicals. Fagopyrum esculenthum is one of the several crop species possessing strong allelopathic properties. In our previous study we had identified eight allelochemicals in buckwheat and analyzed by microarray analysis two important compounds such as rutin and gallic acid. The gene expressions of 20 days old A. thaliana plants were analyzed using Affymetrix GeneChips ATH1. The results showed 168 and 55 genes with higher expression after 6 hours of exposure to gallic acid and rutin, respectively. However, only 14 genes were found common for both compounds. The study revealed some genes which are important in regulating plant responses to stress. Induced genes fell into different functional categories mainly, metabolism; cell rescue, defense and virulence; cellular communication/signal transduction mechanism and transcription. This study may lead to a better understanding of the allelochemicals mode of action which in the future could be used in biological control of weeds..

Keywords: allelopathy, allelochemical, closed eco-system, life cycle assessment

Japan Geoscience Union Meeting 2011
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HCG035-05 Room:104 Time:May 22 11:55-12:10

Insect tolerance to severe environments

Shigeru Matsuyama[1*]

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Insecta is the most diverse group of animals on the planet, which represents more than 75% of all known living organisms, and includes 850,000 to 1,000,000 described species. Likewise, you can find numerous insects in most terrestrial environments. Insects can be found in grasslands, forests, freshwater streams, lakes, the Arctic and deserts.

In this presentation, I'd like to introduce the examples of insect tolerance to severe environments such as harsh temperature (heat, cold), dryness (desiccation), less oxygen and so on.

Keywords: insects, severe environments, tolerance

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-06 Room:104 Time:May 22 12:10-12:25

Neuronal response in evolution of biological organism on Earth

Yasuhiro Kumei[1*]

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Neuronal response has been conserved from lower to higher animals in the long years evolution process of biological organism on Earth. Adaptation to gravity change can be observed in wide range of animals as a kind of stress response. Well-organized animal model would provide good estimation of stress response in humans.

Keywords: neuron, gravity, stress response

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-07 Room:104 Time:May 22 12:25-12:45

Human dualism: human biology as a solution for unite ”I as a thinking being” and ”body as closed-ecology”

Yoriko Atomi[1*], Miho Shimizu[2], Eri Fujita[2], Tomoaki Atomi[3], Noboru Hirose[4]

[1]Univ of Tokyo, Radioisotope Center, [2]Grad Sch of Info Sci, Univ of Tokyo, [3]Tokyo Metropolitan University, [4]Teikyo University of Science

Closed-ecology system is useful to understand rules of not only own system of individual biological organism but also a possibility and problems of the mutual interaction. Through consideration of closed-ecology system, common rules of biological organism from a unit to multi-system or different species will be elucidated. We human beings belong to animals, a heterotroph, which is an organism that cannot fix carbon and uses organic carbon for growth. In order to get foods to survive, animals have special system, brain-neuro-muscular system to move in the living environment. Human beings have discovered special method to move on land in the evolution with bipedal waling and running keeping standing posture. However, we have been lived longer with small activities due to utilization of man-made transportation system, and almost forgotten how to walk and run, resulting in happening of fall, osteoarthritis, dementia, especially in aged perple. Recent progress of brain and life sciences has shown our biological system is intrinsically organized to survive as in ”activity-dependent rule”, which governs at various levels of gene expressions, translation, living cell organization, and tissue-communication in our body of multi-cellular biological system. In this presentation, I would like to understand human system from biology ? human biology, considering into both closed-ecology system and self-control. Usually normal and healthy human being as one of animals is excluded in scientific research field, especially aspect of life science of individual human being. Activities are basically essential for our existence individually and also socially and cannot be forced by others. Therefore, dual autonomous ideas of autonomous system obtained in evolution and human spontaneity/emergence including free will are essential for our human living. We should think about how does hierarchical soft structure create spontaneous activity by working with smart dynamics from single macromolecule to human body. Human body is a typical closed-ecology system, only works in a small range of environmental conditions, such as temperature, pH, blood glucose level, mechanical strength like stretch, compression, etc. In addition, human body is controlled by human brain, which not only control our body system but also had created completely different world of nature, virtual world. We should start to study a principle of our life system, the spontaneity/emergence of human body including human brain/mind system. As Professor Fumio Oosawa was inspired by the tracking motions produced by Protista several decades ago, spontaneity is a characteristic aspect of life. A protisis can behave with spontaneity resulting in selecting and deciding the comfortable environment for the survival after rushing back and forth. Such characteristics of Protista suggests that a cell exhibits spontaneity as well as individual organisms. Since human beings belong to a multicellular organism, we have at least two levels of spontaneity, both at cells and an individual. In this presentation, we would like to focus on ”a real living body” itself and its biological material system, which generates soft and loose structures and changeable shapes, and produces a directional activity, and to extend to both limits of a body, from micro to macro systems. We will start the discussion from the cytoskeleton, which is considered intrinsically to produce cell’s spontaneity in our body against the environment, water, and connect to the brain, which has been evolved to control actions in spontaneity in the society where the brain communicates. We have the intention to create a new concept of philosophy of spontaneity and initiative from the basis of principle of biological material science.

Japan Geoscience Union Meeting 2011
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HCG035-P01 Room:Convention Hall Time:May 22 14:00-16:30

Study of effective utilization of the Nirogen-fixing terrestrial cyanobacterium based on the desiccation-related genes.

Hiroshi Katoh[1*], Yuji Yamaguchi[2], Hiroyuki Takenaka[2]

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Using DNA microarray from a terrestrial cyanobacterium *Anabaena* sp. PCC7120, the typical desiccation-responsible genes were selected and the gene-disruptant were characterized. All of typical gene-disruptants showed low viability under desiccation using cells grown in N_2-free medium. These results may suggest that desiccation-tolerant genes contain nitrogen fixation relating genes, are expressed irrespective of nitrogen content to protect desiccation sensitive N_2-fixing heterocyst and express to stabilize intra-and outer-cellular condition under desiccation in N_2-rich condition. We were also shown that the no-inducible photosynthesis gene, *psb28*, was related to desiccation tolerant. Psb28 protein associates with photosystem II but function of Psb28 is not enough to understand.

Desiccation tolerant N_2-fixing cyanobacterium, *Nostoc commune* is related to the *Anabaena*. The *Nostoc* has ability to use scientific research for desiccation tolerance system, food and soil for plantation. These abilities expect to improve devastating soil to nutrient-rich soil including space agriculture. So it was tried to isolate the *Nostoc* and succeeded to cultivate the *Nostoc* axenically. To confirm ability of the *Nostoc* soil, the *Nostoc* was used plantation as nutrient containing plate. The result of difference plant growth between N_2-deficient plate and cyanobacterial mat is now in progress.

Keywords: desiccation, tolerance, cyamobacteria, gene analysis, bioremediation, agriculture

Japan Geoscience Union Meeting 2011
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HCG035-P02 Room:Convention Hall Time:May 22 14:00-16:30

The small ecosystems using cyanobacteria and a Martian regolith simulant

Haruka Fujishiro[1*], Yukari Tida[1], Yuichi Igarashi[1], Kyohei Motohashi[1], Seigo Sato[1], Masayuki Ohmori[2], Kaori Tomita-Yokotani[1]

[1]University of Tsukuba, [2]Chuo University

The detailed verification of the space-environment tolerance of the creature on the earth has the merit of a lot of new results and the possibility about the development related to them. Specifically, the appearance of the cyanobacteria, one of photosynthetic creatures, on the earth had a great influence on the material recycling and the oxidation of the atmosphere in the earth in the past period. Arai et al.(2008, 2010) have reported that Nostoc sp. of the cyanobacteria showed the high tolerance to vacuum. It has been also proved that cyanobacteria could grow in the Martian regolith simulant. Their results lead the possibility that the dried cyanobacteria can be carried in the outer planet from earth, in future, too. Here, we design small scale of bio-ecosystem using the Martian regolith simulant and the cyanobacteria. The designed small ecosystems are variously changed in the environmental conditions. We will review the utilization for teaching materials in the designed system which examines the process of the change and also discuss the possibility that the small ecosystems are able to use in the several research fields after our investigation.

Keywords: cyanobacteria, Martian regolith simulant, small ecosystems, teaching materials

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-P03 Room:Convention Hall Time:May 22 14:00-16:30

Symbiosis among two plants and their related fungus (Rhizoctonia).

Shohei Fujimori[1*], Junichi P. Abe[1], Kaori Tomita-Yokotani[1]

[1]University

Spiranthes sinensis var. amoena is a orchid with a typical orchid mycorrhizal association. A tripartite symbiotic association is reported among Abies firma, Chamaegastrodia sikokiana and mycorrhizal fungus which forms mycorrhiza in both plants. Recently, we reported that isolates which were isolated from the roots of Zoysia tenuifolia,were able to promote the germination of seeds of Spiranthes sinensis var. amoena. In this study, we demonstrated a tripartite symbiotic association among Spiranthes sinensis var. amoena, Zoysia tenuifolia and a symbiotic fungus which forms mycorrhiza in Spiranthes sinensis and promotes the germination and growth of Zoysia tenuifolia.We have already found some property in the isolated fungus and functions. We have also investigated the functional substances extracted from the isolated fungus which affect the plant seed germination or growth. The results from our study, symbiosis among several species of creatures, will lead the important information at the selection of creatures into the artificial bio-ecosystems.

Keywords: Symbiosis, Spiranthes sinensis var. amoena, Rhizoctonia

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

HCG035-P04 Room:Convention Hall Time:May 22 14:00-16:30

Microbial response to the applied magnetic field

Kenta Tsubakihara[1], Tomoko Abe[1*]

[1]Tokyo Denki University

Biological reactions under magnetic fields should be considered in closed-ecology on planets because the Earth's magnetic field (geomagnetic field). For example, magnetotactic bacteria are oriented along the magnetic field lines of geomagnetic field.

Magnetic fields may induce multiple effects in biological systems, including change in DNA replication or RNA transcription and modification of ion and protein flow across membranes. In recent years, influences of various electromagnetic fields on cell and organisms have been investigated by many researchers. However, the detailed mechanisms in the effects of magnetic field on organisms are still controversial.

In this study, we had focused on influences of the magnetic field (the hundreds of mT range of magnetic flux density) on environmental microbes. Some microbes susceptible to the applied magnetic field have been isolated from the soil. To reveal the species or strain of these microbes and these mechanisms, we investigated changes of these microbial metabolisms by the applied magnetic field individually.

Keywords: environmental microbe, magnetic field

Japan Geoscience Union Meeting 2011
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HCG035-P05 Room:Convention Hall Time:May 22 14:00-16:30

Method for the measurement of bacterial cell growth using Quarts Crystal Microbalance

Hitomi Torii[1], Hiroaki Takahashi[1], Masao Yamana[1], Tomoko Abe[1*]

[1]Tokyo Denki University

Rapid methods for bacterial detection are significant for food, industrial, clinical diagnostics, and environmental monitoring.

Recently, a quartz crystal has been used as a mass detector and has been applied to determine gases, ions, and some biomolecule (e.g., immuno-compounds). These studies are based on the fact that the resonant frequency change of the quartz crystal corresponds to mass change on the crystal surface.

In this study, we used a quartz crystal microbalance (QCM) as a transducer for the measurement of bacterial cell growth. As a result of the current experiment, both the dry cell weight and the living cell weight were linearly proportional to the frequency change in the range of 10^{-8} to 10^{-5} when our QCM sensor was used for the measurement. Namely, the measurement of bacterial cell weight is possible within this range using the sensor.

The aim of this study is to develop the device and method to monitor in real time cell growth of in situ environmental cultivation. This method will also be variable to analyze the behavior of microbes in the closed-ecosystem.

Keywords: Quartz Crystal Microbalance, Biosensor

Japan Geoscience Union Meeting 2011
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HCG035-P06 Room:Convention Hall Time:May 22 14:00-16:30

Several applied utilizations of tree allelopathic function in artificial closed bio-ecosystems.

Yukari Tida[1*], Kyohei Motohashi[1], Haruka Fujishiro[1], Yoshiharu Fujii[3], Kei'ichi Baba[3], Seigo Sato[1], Kaori Tomita-Yokotani[1]

[1]University of Tsukuba, [2]National Institute for Agro-Environmenta, [3]Kyoto University

It has been well known that allelopathy is a phenomenon that an action of natural bioactive chemicals produced by plants to other life. Many allelopathy researches have reported and accumulated the results, identification of the candidate substances which cause the phenomenon and its functions, using many species of plants as materials. When designing the closed-ecosystem in outer planet or severe environmental place, the tree has a lot of utility values. Tree produce excess oxygen, woody materials for living cabin, and provide biomass by cultivating crops and other species of creatures, in addition to the material recycling in the atmosphere. The study of allelopathy evaluation becomes necessary sufficiently when trees cultivate in the artificial ecosystems. We have found a tree, one of Prunus tree line, which had a high medicinal utility value in the study of an allelopathy. When we establish an artificial ecosystem design, there will be several utility matters in the one field of study developed from the allelopathy research. We will show the result as one of the example study and discuss them.

Keywords: tree, functional substaces

Japan Geoscience Union Meeting 2011
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HCG035-P07 Room:Convention Hall Time:May 22 14:00-16:30

Rice BRITTLE CULM 6 gene is required for cellulose synthesis in secondary cell walls

Toshihisa Kotake[1*]

[1]Toshihisa Kotake, [2]Ami Sato, [3]Tsutomu Aohara, [4]Ko Hirano, [5]Yasuko Kaneko, [6]Yoichi Tsumuraya, [7]Hiroshi Takatsuji, [8]Shinji Kawasaki

Cell wall polysaccharide are synthesized by actions of glycosyltransferases including cellulose synthases in plants. Brittle culm 6 (Bc6) is a semi-dominant rice mutant with easily breakable plant bodies, and expected to have defects in the formation of secondary cell walls. In this study, Bc6 gene was isolated, and appeared to encode a cellulose synthase catalytic subunit, OsCesA9. Bc6 mutation reduced the cellulose content by 31%, while it increases the hemicellulose content by 48%. Introduction of the mutant Bc6 gene into wild-type rice significantly reduced cellulose content, causing brittle phenotypes. Expression of BC6 gene was observed in the culms, nodes, and flowers, and related to that of BC1, which encodes a COBRA-like protein involved in cellulose synthesis in secondary cell walls in rice. We might regulate the cellulose synthesis using BC1 and BC6 genes.

Keywords: cell wall, rice, cellulose, polysaccharide

Japan Geoscience Union Meeting 2011
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HCG035-P08 Room:Convention Hall Time:May 22 14:00-16:30

The response to gravity and light in tilapia *Oreochromis niloticus* in closed recirculating fish rearing system

Masato Endo[1*]

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Living organism adapts to their habitat environment and lives depend on it. Fish is especially dependent on environmental water and thrives in it. In artificial closed ecosystem, fish adaptation to gravity and light based on water environment is grasped and the environmental factors are needed to control for sustainable operation of the artificial ecosystem. This presentation introduces the response to gravity and light in tilapia *Oreochromis niloticus* and explains environment control in closed recirculating fish culture system that can be used in artificial closed ecosystem.

Keywords: artificial closed ecosystem, closed recirculating fish culture system, tilapia, gravity, light, rearing water

Japan Geoscience Union Meeting 2011
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HCG035-P09 Room:Convention Hall Time:May 22 14:00-16:30

Human reproduction in bioecology systems in the space environment

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Since 2004, when we first presented a paper entitled Prospects for reproductive medicine in space at the 20th Space Utilization Symposium, we have continuously studied and discussed together with our colleagues the topics of the human reproduction in the space environment. For example, we have investigated the effect of gravity on the fetus development in the uterus on the earth, or discussed face to face feeding behavior for mother milk in the space environment. During the past half a century development of space exploitation and utilization greatly progressed. It is not a surprise that astronauts or cosmonauts stay for several months and even one year on a space station, and now space tourism is commercially planned and promoted extensively. There will be more opportunities that much more people will visit or contact with the space environment, and it will become realistic and definite that housing structures for human being will be constructed on the moon, Mars or orbits of the earth. In the present meeting we summarize a series of our previous studies and discuss the necessity of a systematic approach to the study of space reproductive medicine for the coming human society that will be built in complex bioecology systems in the space environment. We also presented most of this discussion at the 27th Space Utilization Symposium, January, 2011, Sagamihara.

Keywords: reproduction, sexuality, space, fetus, gravity, microgravity