ASTROBIOLOGY ABSTRACTS:

1. Gatta RS (in press). *The case for life existing outside of our biosphere: techniques for identifying molecular structures*. Proceedings of The Seventh Conference on Chemical Evolution. In: Origins: Genesis, Evolution and the Biodiversity of Life, ed. J. Seckbach, COLE Book Series, Vol. 6, Kluwer Academic Publishers, Dordrecht.
2. Gatta RS and Chela-Flores J (in press). *Application of molecular biology techniques in astrobiology*. Proceedings of The Seventh Conference on Chemical Evolution. In: Origins: Genesis, Evolution and the Biodiversity of Life, ed. J. Seckbach, COLE Book Series, Vol. 6, Kluwer Academic Publishers, Dordrecht.

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1. THE CASE FOR LIFE EXISTING OUTSIDE OF OUR BIOSPHERE: TECHNIQUES FOR IDENTIFYING MOLECULAR STRUCTURES

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Abstract. In order to identify life outside of a terrestrial paradigm we examine the Jovian moon, Europa as a potential source for biological material. The selection of biological targets is based on an investigation of convergent evolution as a universal precept in eukaryote development (1). Analytical techniques have benefited from multi-disciplinary efforts that have led to the creation of the first functional microscopic-scale laboratories that can perform a concerted series of "hyphenated" functions. Devices contained within a specialised Europan lander (2) will have the ability to gather samples, screen for promising biosignatures, and present sufficient data to accurately determine the characteristics of the samples. Application of these "labs-on-a-chip" (3) holds great promise in the search for life out of our own biosphere.

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2. APPLICATION OF MOLECULAR BIOLOGY TECHNIQUES TO ASTROBIOLOGY

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Abstract. The opportunity for direct examination of the Europan surface and sub-surface calls for a systematic and deductive approach to experimental design. To avoid the limitations of our inherent Earth-centric definition of life (1), we would be forced to examine a wide range of potential bio-signatures to guide more specific biological experiments (2). It is also important to look for recurring features that are important from the evolutionary history of our own biosphere (3). Of the many candidate molecules, the structurally heterologous superfamily of voltage-gated cation channels is an evolutionary sensitive group of molecular structures, the single varieties of which can

be easily distinguished. Implementation of the analytical aspects of this experiment would require remote control of miniaturized robotic systems. These mechanisms are under constant evolution since their uses are strongly tied to commercial, scientific and military interests. One paradigm for feasibility studies could come from data inferring the reprocessing of ice covering a Europan ocean. Reprocessing could be inducing life forms extant in the liquid water subsurface towards the ice covering, as it has already been demonstrated at the frozen surfaces of Antarctic lakes (4), and as it has been suggested by geophysical analysis of the Galileo images of the icy surface of Europa (5). The proposed series of experiments can be carried out in situ either within a submersible in the ocean beneath the ice layer (carried and launched from a cryobot), or even on the surface ice itself. Results from a preliminary examination of the environment would be used to determine the conditions necessary for sampling and pre-processing of any material of possible biological origin. Many techniques are currently available for identifying targets according to their molecular structure and their chemical-physical characteristics:

- novel sampling and isolation methods involving capillary, electro-magnetic and laser based manipulation,
- specific antibodies or diabodies engineered as molecular probes,
- micro-arrays based on site-specific immobilization of complementary molecules,
- microscopy and micro-sensors for visualization/digital sampling of positive results.

New challenges will arise from the novel settings and will have to be addressed, singly, well in advance of any preliminary exercises. Moreover, a myriad of practical applications could be developed by addressing pertinent, emerging questions relating to:

- stability of sensitive organic material over a large (approx. 5 years) interval of time, and under extreme conditions,
- maintenance of biological activity within silica-, or hydro- micropatterned biogels,
- multiplexing in a microfluidic (lab-on-a-chip) environment,
- miniaturization of analytical devices such as microscopes and their power sources.

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