ABSTRACT FOR ISSOL2005 IN BEIJING

Microbial origin of life on Europa

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Europa is a world where life may have existed or still exists. It becomes an important philosophical and practical concern to prevent contamination of this unknown world with microorganisms of terrestrial origin. However, we also need to explore hypothesis that life that originated on Earth was transferred to other planets, namely Europa.. Similar hypothesis is more than century old (Arrhenius, 1908) and mostly concerned transfer of life to the Earth rather then from the Earth. The possibility of similar transfer was considered in detail (Mileikowsky et al., 2000) focusing mainly on Mars-Earth transfer but partially also on Earth-Mars transfer. Life proliferation on Earth is primarily based on water in liquid state. Potential planets containing water in liquid state are Mars (deep within the crystalline rocks) and Europa (under the thick layer of ice). It may be more difficult to detect life on Mars due to deep rocky environment than on Europa, where water is expected under the thick water ice. It can be shown that such dormant life forms can be preserved inside meteorite ejecta traveling from one planet to another. Meteorite mass surrounding the life forms provides an extra protection against lethal ionizing radiation. Both the launch and the landing of ejecta meteorites occur during highly energetical processes. Significant fraction of ejecta avoid heating above 100C and shock as they come from layer close to the surface (spall zone) where the shock pressure is reduced by interference of the pressure waves with the surface (Kletetschka et al., 2004; Melosh, 1984). Typical maximum thickness of the spall zone is less than half of the impactor diameter. The absence of shock in ejecta will not reduce ejecta velocity, as the acceleration is proportional to the gradient of the pressure reaching the maximum at the planetary surface containing the spall zone. The size of the ejecta controls the temperature reached due to friction with the atmosphere. Large initial velocity will cause rapid surface heating and this hot surface layer will be eventually stripped down during the altitude increase. The material stripping will reduce the heat sources by the time the ejecta reach the space the thin surface layer will cause size dependent internal heating due to poor heat conductivity of most of the rock compositions. In general the heat-modified layer (fusion crust) is less than 1 cm (depending on porosity and composition) and will not heat significantly rocks that are more than 10 cm in diameter. The transfer of life between planetary bodies hypothetically occurs mostly during the first 1 Gy of solar system existence due to large frequency of impacts. The thicker atmospheres due to impacts likely allowed safe delivery of the biological material inside ejecta material. After ejecta landing, the contact with liquid water would mobilize the biochemical mechanisms and start proliferation of the primary DNA/RNA from the host rock. The first microorganisms created this way would become a subject of evolutionary pathway dictated by Iovian moon environment. This would include adaptation for absence of light under the ice, high radiation doses from

Jupiter (radiation belts), and abundance of water ice interface. Existence of such mechanism of life transfer calls for need of verification and appropriate system development capable of microbial life detection. Recent sampling of terrestrial aquifers (Shields, 2004) uses a DNA extraction method (Grunwald, 2001) that does not require designed to avoid cellular collection. The method takes advantage of existence of free-floating cellular-DNA dissolved in the aquifer water (dDNA) upon release upon cell death.. This is possible due to relatively largelong life-spanhalf-life of free floating dDNA in the aquifer before being leased anddegraded and utilized incorporated into a structureby surrounding microorganisms. G. Kletetschka, J. E. P. Connerney, N. F. Ness, and M. H. Acuna, Pressure effects on Martian crustal magnetization near large impact basins, Meteoritics & Planetary Science, Volume 39, Number 11, pp. 1839-1848, 2004. Shields M. S. (2004) Aquifer Microbial Diversity Represented by Whole Cell and Dissolved DNA. EoS, transactions, American Geophysical Union, (fall supplement (abstract)) 85(47), B21A-0858 Melosh H. J. (1984) Impact ejection, spallation and the origin of meteorites. Icarus 59, 234-360.

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