Interplanetary Transport of Microorganisms: Biogeological Considerations

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Interplanetary transport of microbes can be envisioned to occur either naturally as a consequence of impacts (lithopanspermia) or as a result of human spaceflight. In either case, the considerations for modeling successful transfer of microbial life are the same. The probability of interplanetary transfer of life by either natural or human means is a function of: (i) the initial population size (i.e., the bioload); survival of (ii) launch, (iii) transit through space, (iv) entry and deposition; and (v) survival and proliferation on the recipient planet. Modeling this process for testing lithopanspermia and for mitigation of forward and back contamination by human spaceflight calls for accurate simulation of all aspects of transfer, driven by realistic experimentally-derived survival and growth data. Data will be presented supporting the notion that bacteria can satisfy criteria (i) - (iv) listed above. Regarding criterion (v), results from our experiments under simulated Mars conditions indicate that growth of terrestrial bacteria is constrained by extreme low pressure, atmospheric composition, and limited availability of liquid water and organic nutrients. Current experiments are aimed at understanding the underlying cellular responses to these stresses, and determining if terrestrial bacteria can adapt to Mars environmental conditions through evolution.