STRATEGIES FOR DETECTING RADIOLYSIS-POWERED ECOSYSTEMS BEYOND EARTH.

D. Atri[1], [1]Blue Marble Space Institute of Science, 1001 4th Ave, Suite 3201, Seattle, WA 98154, datri@protonmail.ch.

Introduction: The discovery of *Desulforudis audaxviator* in a South African gold mine was a major milestone in our understanding of life [1]. The sulfate reducing bacterium was powered exclusively by radiolysis, induced by radiation from U, Th and K present in radioactive rocks. Ionizing radiation dissociate molecules in its surroundings which is used by the bacterium for its metabolism. This was the first discovery of a single-species ecosystem completely cut off from rest of the biosphere existing independently on radiolysis [1].

Beyond Earth, another source of ionizing radiation is Galactic Cosmic Rays (GCRs) which upon interacting with the planetary objects can induce radiolysis in its subsurface environment. Monte Carlo simulations suggest that for planets such as Mars and Europa which negligible atmospheres, the subsurface energy deposition by GCRs [2] is comparable to the energy utilized by *D. audaxviator* for its metabolism [2, 3].

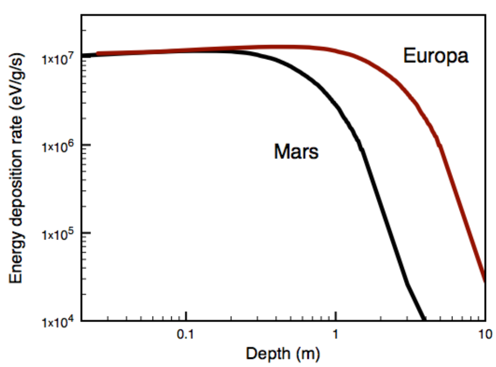

Figure 1: Energy deposition profile for Mars and Europa produced by interaction with Galactic Cosmic Rays.

Simulation Results: Figure 1 shows the energy availability in the subsurface environment of Mars and Europa. *D. audaxviator* powers is metabolism from a radiation dose rate of ~ 10^6 eV/g/s [1, 3] whereas simulations on Mars and Europa show a dose rate from ~10^7 eV/g/s going down to 0 with depth [2]. In presence of suitable nutrients along with this constant source of energy, pockets of “habitability” could exist on such planets where ecosystems are powered exclusively by radiolysis.

Discussion: Extremophiles have always surprised us with their ability to survive in the most extreme situations imaginable. The existence of an ionizing radiation-powered organism, *D. audaxviator*, has opened up new possibilities for life to exist beyond Earth. I will discuss the possibility of such ecosystems within our Solar system, their potential signatures and propose detection strategies for future planetary science missions.

References:

[1] Chivian D. et al. (2008) *Science*, *322* (5899) 275-278. [2] Atri D. (2016) *Journal of The Royal Society Interface*, *13*, 123, 20160459. [3] Lin, Li-Hung, et al. (2005) *Geochemistry, Geophysics, Geosystems* 6.7.