ORIGIN OF RADIATION RESISTANCE IN TERRESTRIAL MICROORGANISMS. H. J. Sun[1], C. P. McKay[2], C. D. Georgiou[3], and M. Daly[4]. [1]Desert Research Institute, Las Vegas, NV 89119, henry.sun@dri.edu, [2]Ames Research Center, Moffet Field, CA 94035, [3]University of Patras, Patras - 26500, Greece, [4]Uniformed Services University of the Health Sciences, Bethesda, MD 20814.

On Earth many microorganisms, notably *Deinococcus radiodurans*, can survive acute exposure to extreme high doses of ionizing radiation, on the order of 6,000 Gy, a level that is never encountered in their natural habitats. This evolutionary oddity is conventionally interpreted as an accidental benefit from desiccation tolerance, that mechanisms that help survive desiccation also help survive radiation. Here we suggest a variation on this hypothesis: radiation resistance originated in deserts where there is a need for protection from photochemical oxidation while the cell is in a desiccated state. It is known that UV irradiation of the dry desert topsoil produces photochemical oxidants such as superoxide radical that diffuses to some depth in the soil and accumulates as metal superoxides and peroxides. At the same time, the bacteria in the soil are in a desiccated state and cannot be protected by their antioxidant enzymes such as superoxide dismutase. Survival thus requires a non-enzymatic defense that entails bathing their enzymes and DNA in small molecules such as trehalose, carotenoids, and Mn-peptide complexes that are biologically compatible, yet can scavenge superoxide and other radicals. Ionizing radiation kills by generating superoxide radical at a rate that overwhelms the enzymatic antioxidant defense. Therefore, the antioxidants in desert bacteria allow them to survive high doses of radiation. This hypothesis has important implications for astrobiology as the environments of interest on other worlds have high levels of ionizing radiation