Cardiopulmonary Inflammatory Response to Meteorite Dust Exposures – Implications for Human Health on Earth and Beyond

CARDIOPULMONARY INFLAMMATORY RESPONSE TO METEORITE DUST EXPOSURES – IMPLICATIONS FOR HUMAN HEALTH ON EARTH AND BEYOND A.D. Harrington[1,2,3], F.M. McCubbin[1], J. Kaur[3], K.E. Vander Kaaden[4], A. Smirnov[3,5], K. Galdanes[2], M.A.A. Schoonen[3,6], L.C. Chen[2], and T. Gordon[2] [1]NASA Johnson Space Center. [2]Dept. of Environmental Medicine, New York University School of Medicine. [3]Dept. of Geosciences, Stony Brook University, [4]Jacobs Technology, NASA JSC [5]Geology Dept., Lone Star College. [6]Environmental Sciences Dept., Brookhaven National Laboratory. Andrea.D.Harrington@nasa.gov

This year marks the 50th anniversary of Apollo 11, the first time humans set foot on the Moon. The Apollo missions not only help answer questions related to our solar system, they also highlight many hazards associated with human space travel. One major concern is the effect of extraterrestrial dust on astronaut health. In an effort to expand upon previous work indicating lunar dust is respirable and reactive, the authors initiated an extensive study evaluating the role of a particulate's innate geochemical features (e.g., bulk chemistry, internal composition, morphology, size, and reactivity) in generating adverse toxicological responses *in vitro* and *in vivo*. To allow for a broader planetary and geochemical assessment, seven samples were evaluated: six meteorites from either the Moon, Mars, or Asteroid 4 Vesta and a terrestrial basalt analogue.

Even with the relatively small geochemical differences (all samples basaltic in nature), significant difference in cardiopulmonary inflammatory markers developed in both single exposure and multiple exposure studies. More specifically: 1) the single exposure studies reveal relationships between toxicity and a meteorite sample's origin, its pre-ejected state (weathered versus un-weathered), and geochemical features (e.g. bulk iron content) and 2) multiple exposure studies reveal a correlation with particle derived reactive oxygen species (ROS) formation and neutrophil infiltration.

Extended human exploration will further increase the probability of inadvertent and repeated exposures to extraterrestrial dusts. This comprehensive dataset allows for not only the toxicological evaluation of extraterrestrial materials but also clarifies important correlations between geochemistry and health. The utilization of an array of extraterrestrial samples from Moon, Mars, and asteroid 4Vesta will enable the development of a geochemical based toxicological hazard model that can be used for: 1) mission planning, 2) rapid risk assessment in cases of unexpected exposures, and 3) evaluation of the efficacy of various in situ techniques in gauging surface dust toxicity. Furthermore, by better understanding the importance of geochemical features on exposure related health outcomes in space, it is possible to better understand of the deleterious nature of dust exposure on Earth.