Hydroxyl radical generation of lunar dust analogs in biologically relevant human respiratory system fluids

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Abstract. The Artemis III mission is currently set to launch in October 2024 and will be the first crewed lunar landing since Apollo 17. With renewed human presence on the Moon, comes the renewed need to understand the potential hazards to humans posed by the lunar surface. A ubiquitous material on the lunar surface is dust. Chemical and toxicological studies involving Apollo samples have led to the established permissible exposure limit (PEL) of 0.3 mg/m^3 for lunar dust exposure for missions up to six months in duration.[1] Previous reactivity studies have also used terrestrial materials as proxies for lunar dust.[2] However, until we understand the relative toxicity of the components of lunar dust, it remains unclear whether we have fully assessed the health hazards of lunar dust. One recognized process that can modify lunar fines is space weathering, which results in the formation of metallic iron (Fe°) trapped within glassy rims. Here, we describe the results of experiments in which lunar regolith simulants are subjected to thermochemical reduction to produce Fe° (analogous to that found in lunar dust) using the methods described in Allen et al. (1994).[3] We then perform quantitative assessments of the reactivity of these experimentally space-weathered regolith simulants using methods described in Hendrix et al. (2019)[2] in an effort to further build upon our knowledge base of how space weathering modifies the reactive properties of lunar regolith. This work allows for an assessment of lunar dust reactivity without relying on pristine lunar dust samples or Apollo samples. Figure 1 compares the reactivity of the three lunar simulants both in their reduced (red) and non-reduced (gray) forms.

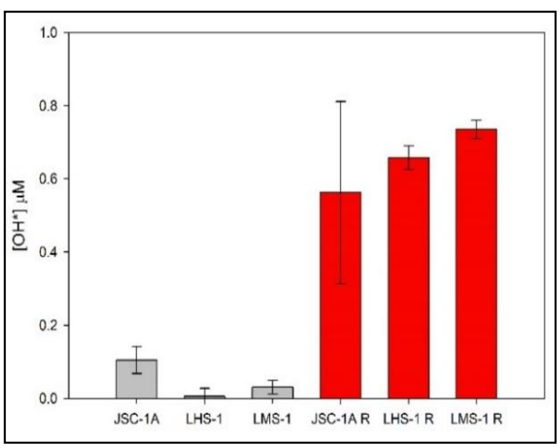

Figure 1. OH* (μM) generated by lunar simulants.

Our results are consistent with those of Wallace et al. (2010)[5], who showed the large OH* generating potential of lunar dust relative to the non-reduced simulant, JSC-1A. They attributed increased OH* generation to the presence of Fe° and described a correlation between lunar dust maturity and reactivity. Our results also suggest that Fe° is likely responsible for reactivity trends observed in Figure 1. Future work will assess reactivity of experimentally space weathered lunar dust simulants in artificial lung and lysosomal fluids.

[1]Scully, R.R. et al., HRP SHFH Element (2015). [2]Hendrix, D.A. & Hurowitz, J.A., *GeoHealth* 3, 28-42 (2019). [3]Allen, C.C. et al., *J. Geophys. Res* 23, 173-185 (1994). [4]Wallace, W.T., *Meteorit. Planet. Sci* 44, 961-970 (2009). [5]Wallace, W.T. et al., *Earth Planet. Sci. Lett* 295, 571-577 (2010).

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