Lunar crater mini-wakes: Structure, variability, and volatiles

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Abstract. Within a permanently shadowed lunar crater the horizontal flow of solar wind is obstructed by upstream topography, forming a regional plasma mini-wake. In the present work kinetic simulations are utilized to investigate how the most prominent structural aspects of a crater mini-wake are modulated during passage of a solar storm. In addition, the simulated particle fluxes are coupled into an equivalent-circuit model of a roving astronaut, including triboelectric charging due to frictional contact with the lunar regolith, to characterize charging of the astronaut suit during the various stages of the storm. In some cases, triboelectric charging of the astronaut suit becomes effectively perpetual, representing a critical engineering concern for roving within shadowed lunar regions. Finally, the present results suggest that wake structure plays a critical role in modulating the spatial distribution of volatiles at the lunar poles.

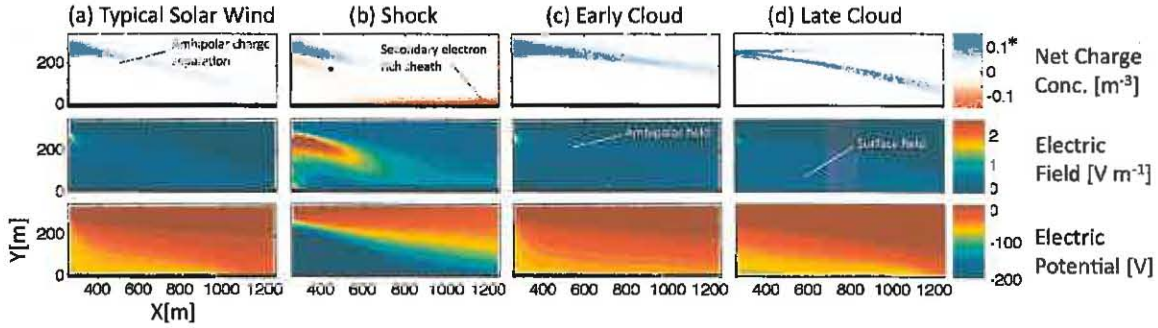

Figure 1: Simulated plasma environment within a shadowed lunar crater during passage of the May 1998 CME. *Net charge concentration levels in column (d) have been amplified by a factor of 10.

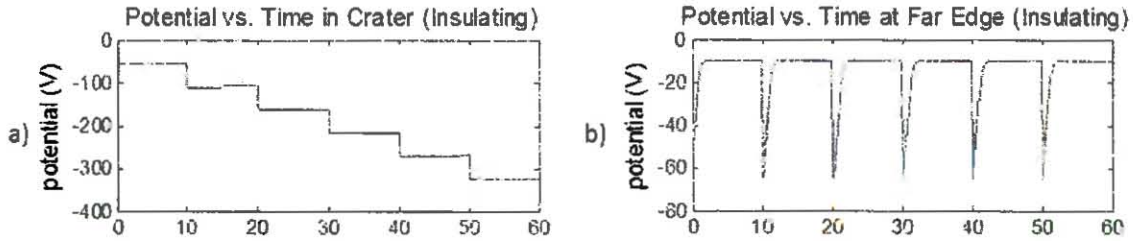

Figure 2: Charging history of an insulating astronaut suit at x_1=250 m (a,c,e,g) and x_2=1500 m (b,d,f,h) at a stepping rate of 1 step per 10 s, under the conditions of Figure 1a. At location x_1 (deep within the electron cloud) charging is effectively perpetual.