Can Solar Wind Volatiles Survive the Day inside a Lunar Pit?

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We use a new three-dimensional illumination and heat diffusion code to characterize the daily insolation and heating cycle inside a lunar pit, as shown in Figs. 1 and 2. This allows a detailed assessment of volatile stability in adjacent shadowed regions such as prospective lava tubes. While sometimes relatively cold with respect to the exposed lunar surface, shadowed regions inside a pit can still receive significant amounts of reflected sunlight and heat re-radiated by directly illuminated surfaces nearby. Finally, the daily delivery of solar wind volatiles is characterized via a plasma particle code. Combining the heat and plasma codes enables an analysis of volatile stability as well as patterns of migration from hot, illuminated areas into colder, shadowed regions.

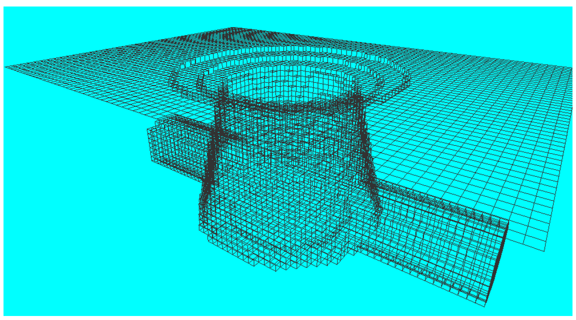

Figure 1: Mesh representation of a lunar pit, similar in geometry to the Mare Tranquilitatis pit. Prospective lava tubes with circular cross-sections have been added to either side of the pit below the surface. This geometry was used to create the voxel representation seen in Fig. 2.

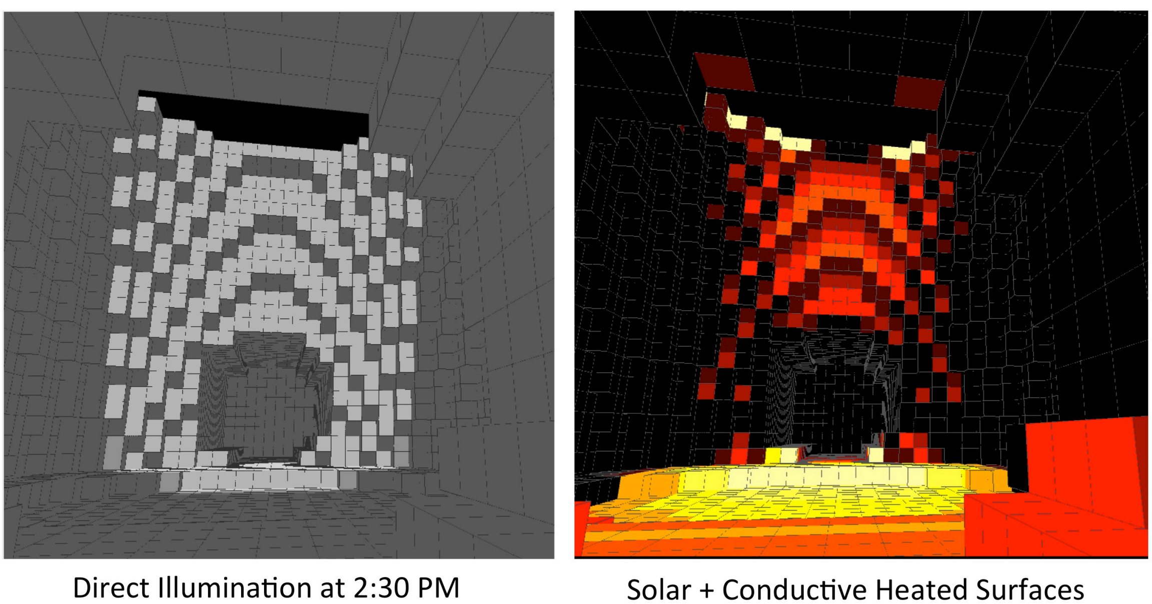

Figure 2: (Left) View of the illuminated voxelized pit of Fig. 1 from within one of the subsurface lava tubes. (Right) Temperature profile as observed from the same vantage point. The hottest regions are in direct sunlight, and the brightest shades of yellow correspond to a temperature >400 K.