H_2O TRANSPORT CHARACTERIZATION THROUGH PACKED BEDS OF LUNAR HIGHLAND AND LUNAR MARE SIMULANT UNDER RELEVANT *IN-SITU* RESOURCE UTILIZATION CONDITIONS

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Introduction: In the support of further space exploration, the development of *in-situ* resource utilization technologies for H_2O extraction is integral. Utilizing lunar resources (*e.g.*, volatile H_2O extraction from permanently shadowed regions) affords the opportunity for the deployment of permanent settlements. This also allows for the on-site synthesis of propellants further space exploration using the moon as a base. Recent work has focused on identifying and predicting favorable volatile extraction locations with H_2O(s) content approaching >5 wt.% [1]. To better develop extraction technologies, the gas transport properties of the volatiles in the transition and Knudsen flow regimes relevant to *in-situ* applications was previously examined. This work expands upon previous efforts with JSC-1A [2] to characterize H_2O(v) lunar mare simulants.

Results: Experimentation was performed in a flow apparatus (figure 1) described by [2] with beds of lunar highland and lunar mare simulates with the pressure drop measured as a function of mass flow rate of H_2O(v).

The normalized diffusivity measurements approach the predicted Knudsen diffusivity for both simulants as shown in figure 2, with a steeper transition for LMS. These results are consistent with previous work studying the transport characteristics though JSC-1A and highlight the relevance of Knudsen flows for in-situ lunar resource utilization. Further work is being conducted to study the variation of sublimation rates and coupling that to heat transfer models.

Acknowledgments: This work was carried out as part of REVEALS which was directly supported by the NASA Solar System Exploration Research Virtual Institute cooperative, agreement number NNA17BF68A.

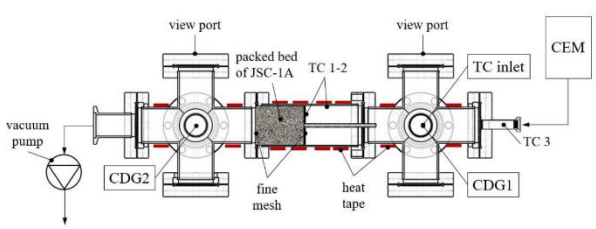

Figure 1: Schematic of the vacuum flow apparatus

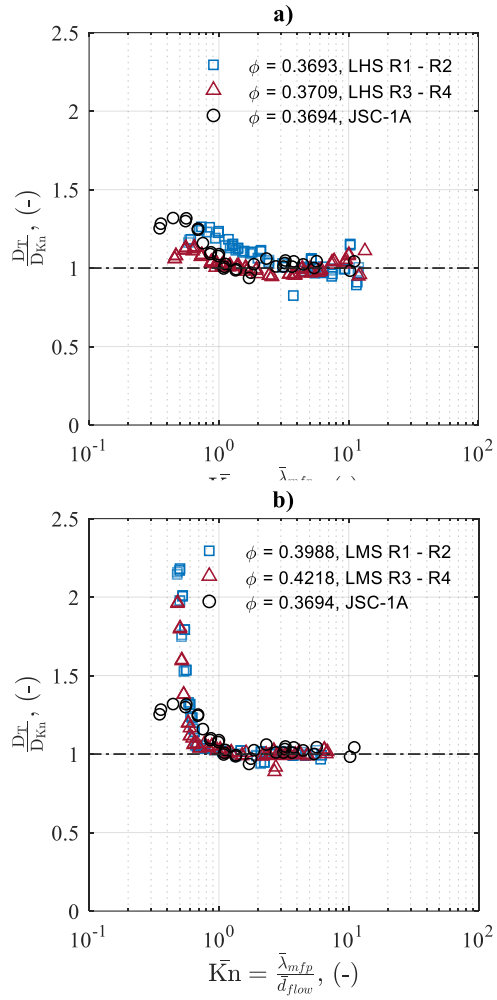

Figure 2: Measured total diffusivity normalized to the resultant Knudsen diffusivity as a function of average Knudsen number for (a) lunar highland and (b) lunar mare simulant. The black circles are previously published results for JSC-1A [2].

References: [1] K.M. Cannon, D.T. Britt, A geologic model for lunar ice deposits at mining scales, Icarus, (2020) 113778.

[2] G.L. Schieber, B.M. Jones, T.M. Orlando, P.G. Loutzenhiser, Characterization of H_2O transport through Johnson Space Center number 1A lunar regolith simulant at low pressure for in-situ resource utilization, Physics of Fluids, 2021.