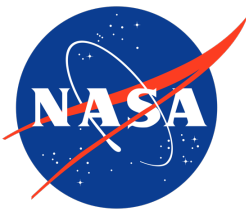


# Sublimation Loss from Open-Gap Lunar Water Extraction

Timothy S. Krause<sup>1</sup> & Leslie Gertsch<sup>2</sup>

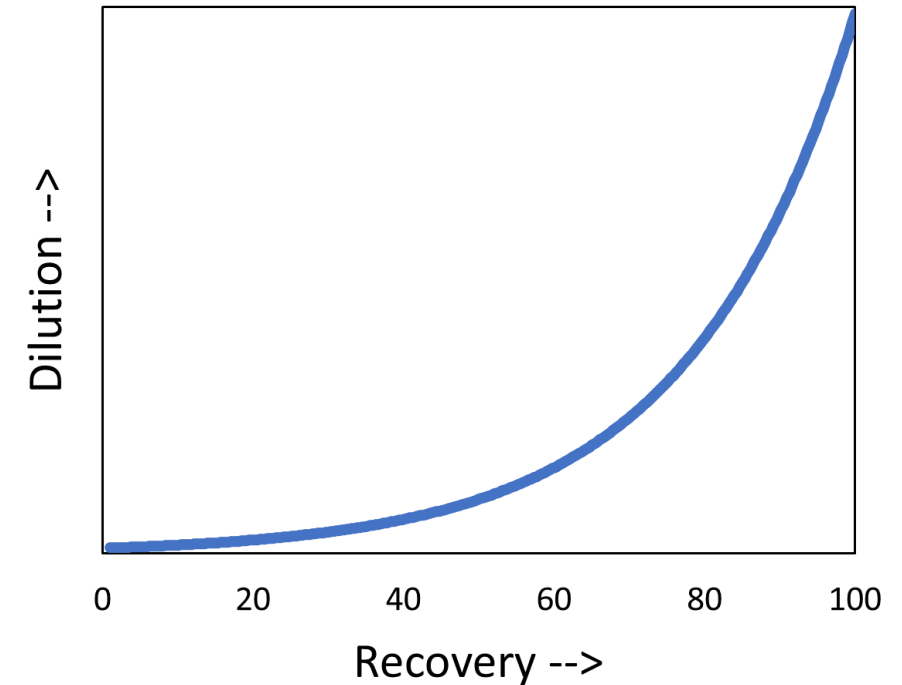
<sup>1</sup>Universities Space Research Association, NASA GRC, Cleveland, OH

<sup>2</sup>Missouri University of Science and Technology, NASA GRC, Cleveland, OH



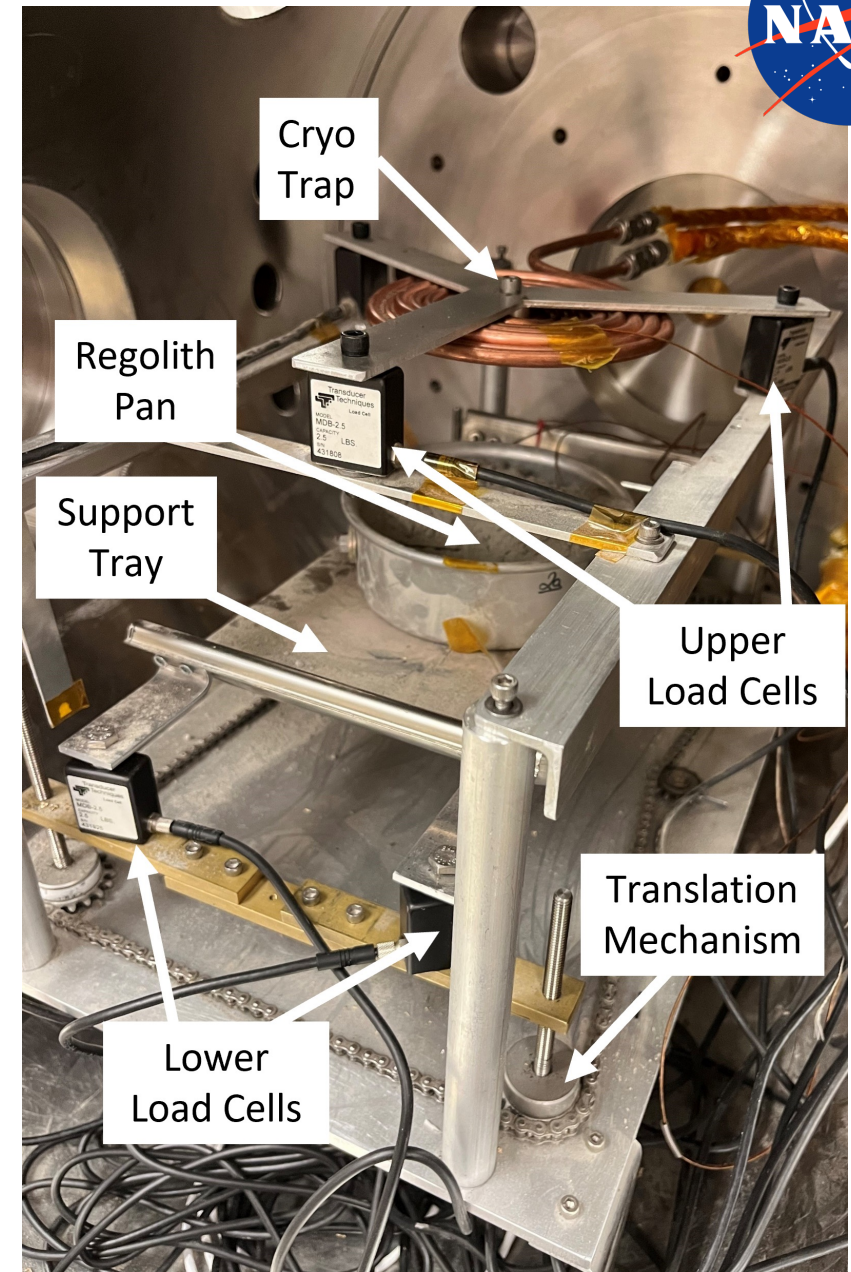
# Introduction

- ISRU for water capture on the moon is important for sustained lunar presence
- Pressurized systems to capture water from icy regolith introduce complex infrastructure
- This research campaign poses an alternative approach: In a **seal-less** design, how much water would be lost through a gap between a bin of icy regolith and a nearby cryotrap?

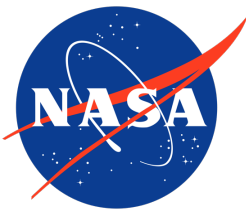


# Experiment

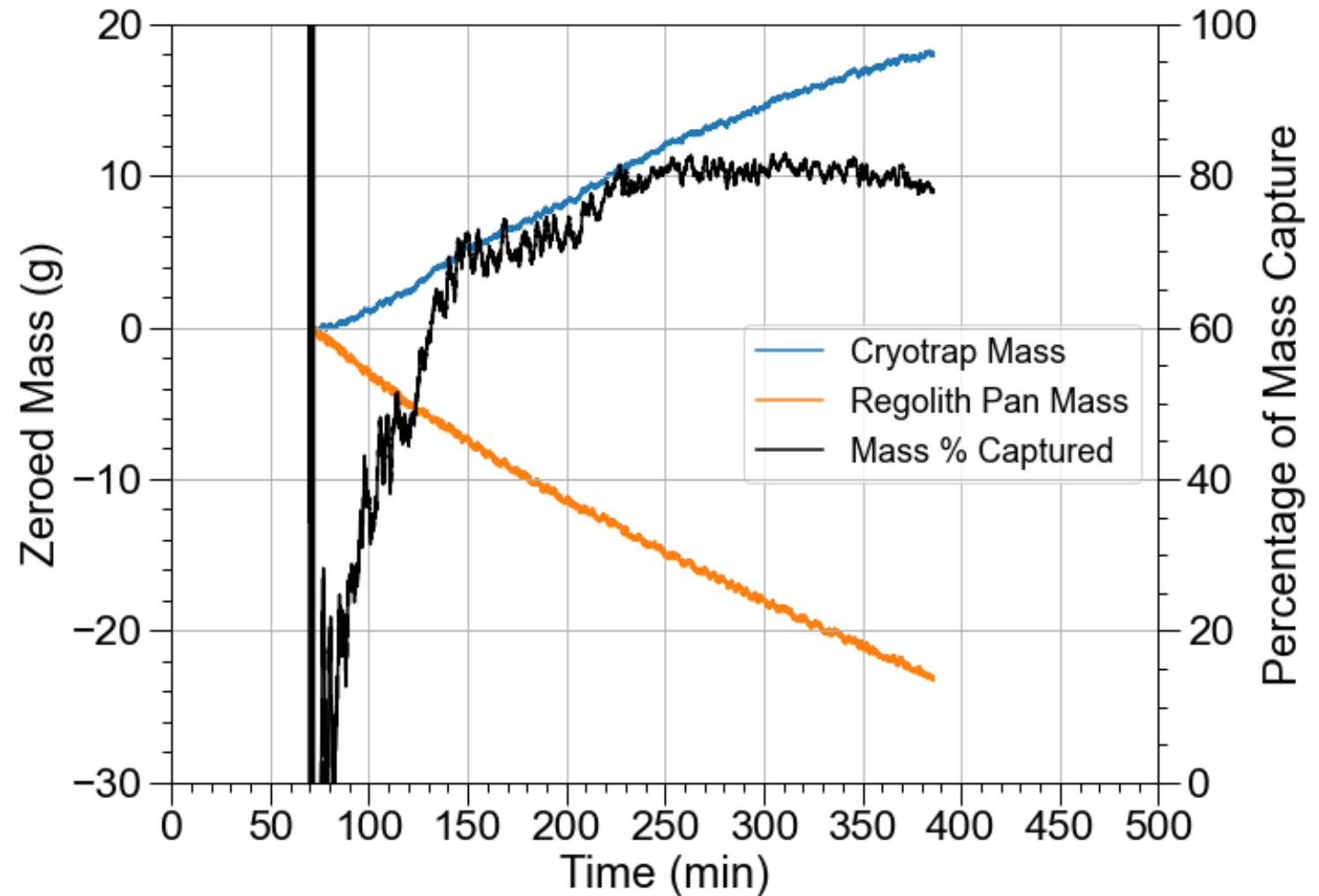
- Housed in the NASA GRC 2-ft dirty vacuum chamber
- Circular tray with 92 wt% NU-LHT-3M and 8 wt% water heated from below
- Water captured above in cryo trap
- Heat flux, pan diameter, and vertical distance are varied
- Pressure levels –  $10^{-4}$  torr



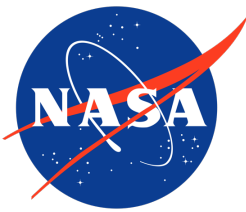
# Results



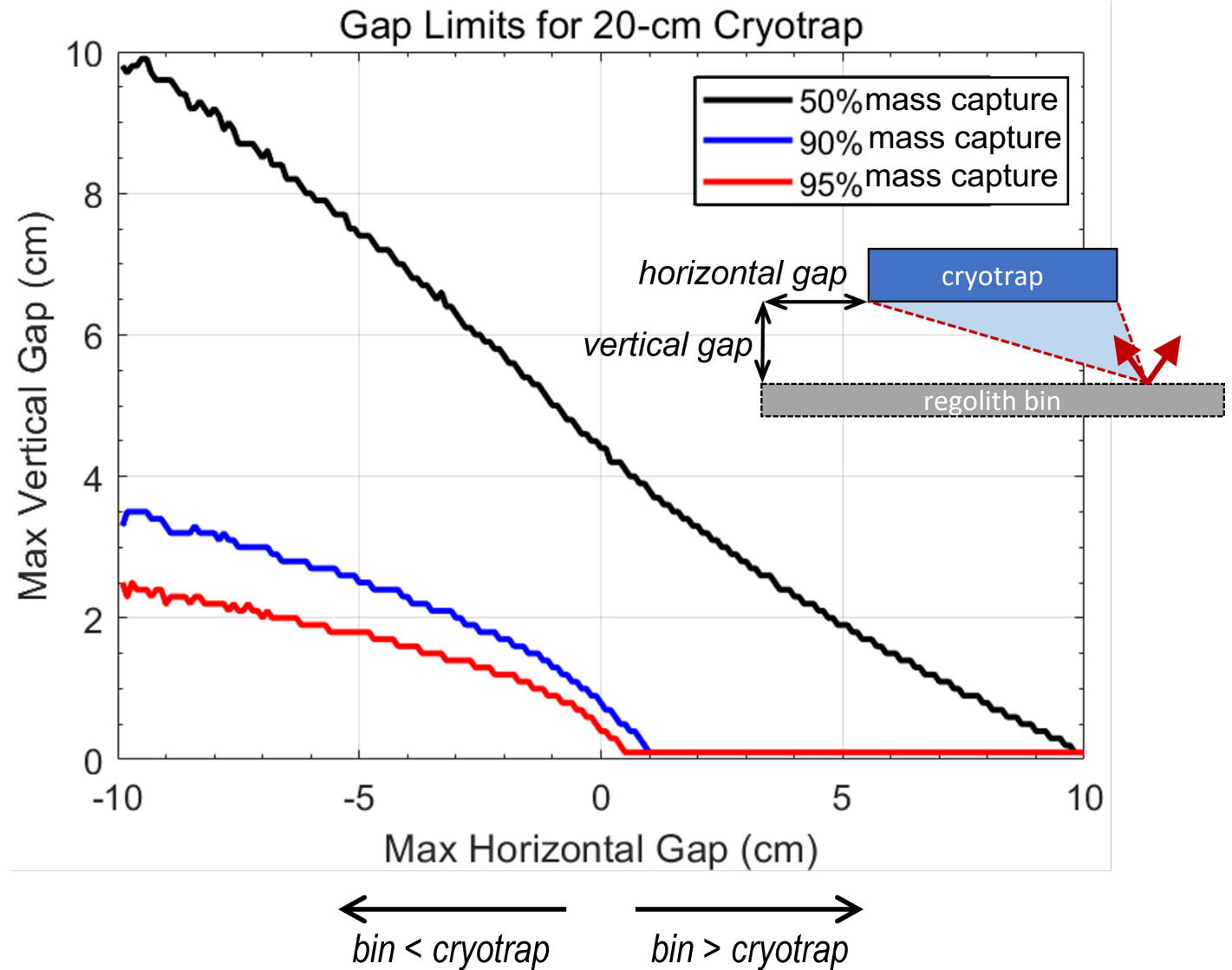
- Typical results show a transient period followed by a leveling off
- The mass capture of cryotrap: 70-100%



# Model

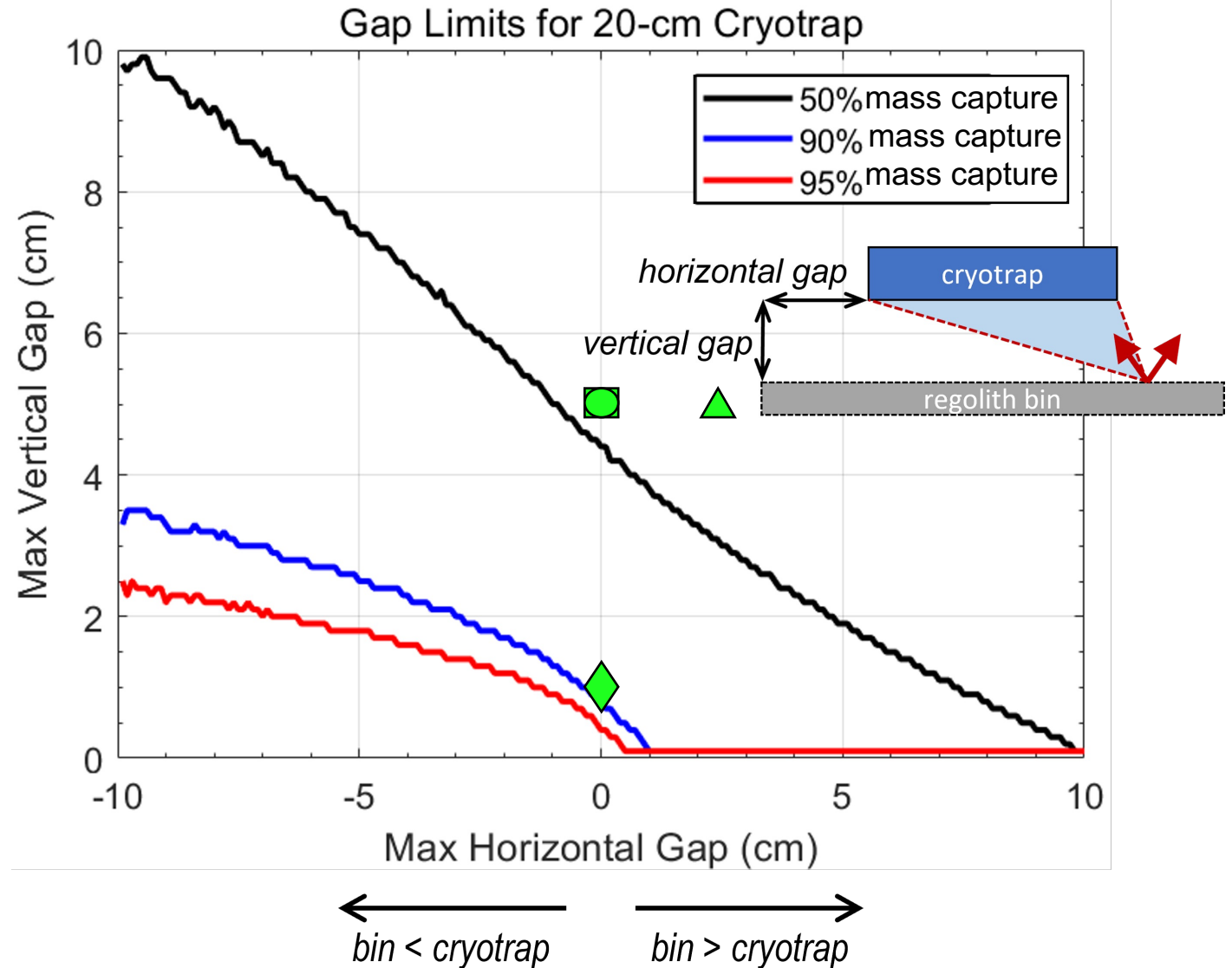


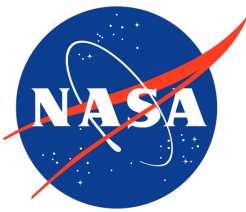
- Capture rate in the cryotrap can be determined geometrically
- The vertical and horizontal gaps are compared against experiments



# Comparisons with Experiment

- $\diamond$  : 98% actual mass capture, ~90% predicted
  - 1 cm vertical gap
  - 0 cm horizontal gap
  - 0.4 W/in<sup>2</sup> heat flux
- $\square$  : 95% actual mass capture, ~45% predicted
  - 5 cm vertical gap
  - 0 cm horizontal gap
  - 0.4 W/in<sup>2</sup> heat flux
- $\circ$  : 80% actual mass capture, ~45% predicted
  - 5 cm vertical gap
  - 0 cm horizontal gap
  - 0.1 W/in<sup>2</sup> heat flux
- $\Delta$  : 75% actual mass capture, ~40% predicted
  - 5 cm vertical gap
  - 2.5 cm horizontal gap
  - 0.1 W/in<sup>2</sup> heat flux

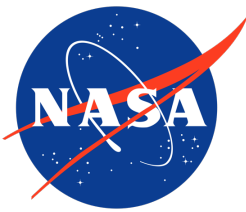




# Conclusions and Future Work

- Experiments show possibility of an open-gap concept for lunar water capture
- While the current experimental setup is not quite an analog for expected lunar conditions, the results will inform the decisions of future testing campaigns
- Improvements are underway for the model
- Experiments are underway to further investigate the influence of heat flux differences
- Another experiment campaign is investigating the influence of the regolith pan depth

# Acknowledgements



- This work is funded by NASA under the Game Changing Development Program of the Space Technology Mission Directorate
- This work is part of the Fundamental Regolith Properties, Handling, and Water Capture Technology (FLEET) portfolio

# Backup

# Temperature Profiles

- Three thermocouples in regolith
- One thermocouple on heater and one on the cold trap for monitoring

