

A New Icy Lunar Regolith Simulant: Pressure Fused Granular (PFG)

Daniel K. M. Johnson and Chris B. Dreyer
Center for Space Resources, Colorado School of Mines,
1310 Maple St GRL140, Golden, CO, 80401, Contact: dkjohnson@mines.edu

INTRODUCTION

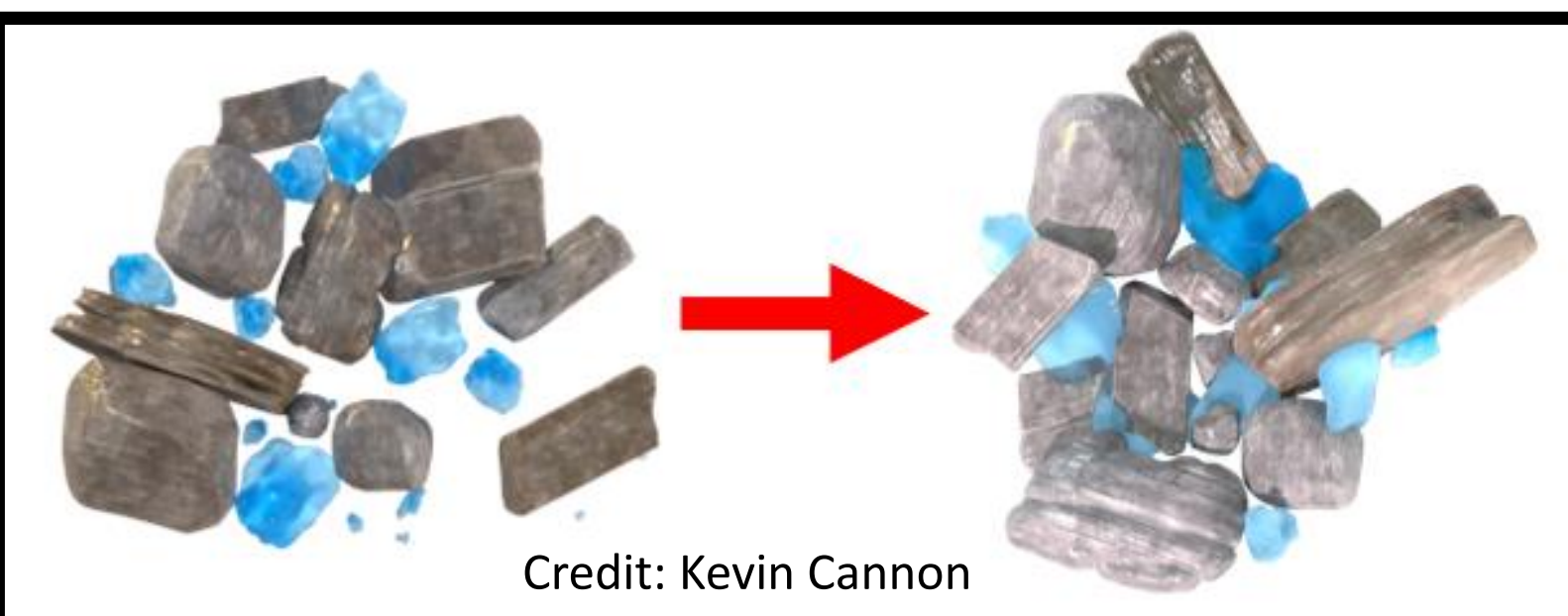
- Current icy lunar regolith simulants mix liquid water with regolith, then freeze
 - Results in strength similar to limestone or concrete
 - No indication that wet simulants are applicable for the lunar environment
- Pressure Fused Granular icy lunar regolith simulant, PFG, uses solid phase water ice that never melts in its production
- PFG is highly versatile, the material properties can be modified by changing the applied isostatic pressure
 - Can be tailored to whatever we find on the Moon

PFG PRODUCTION METHOD

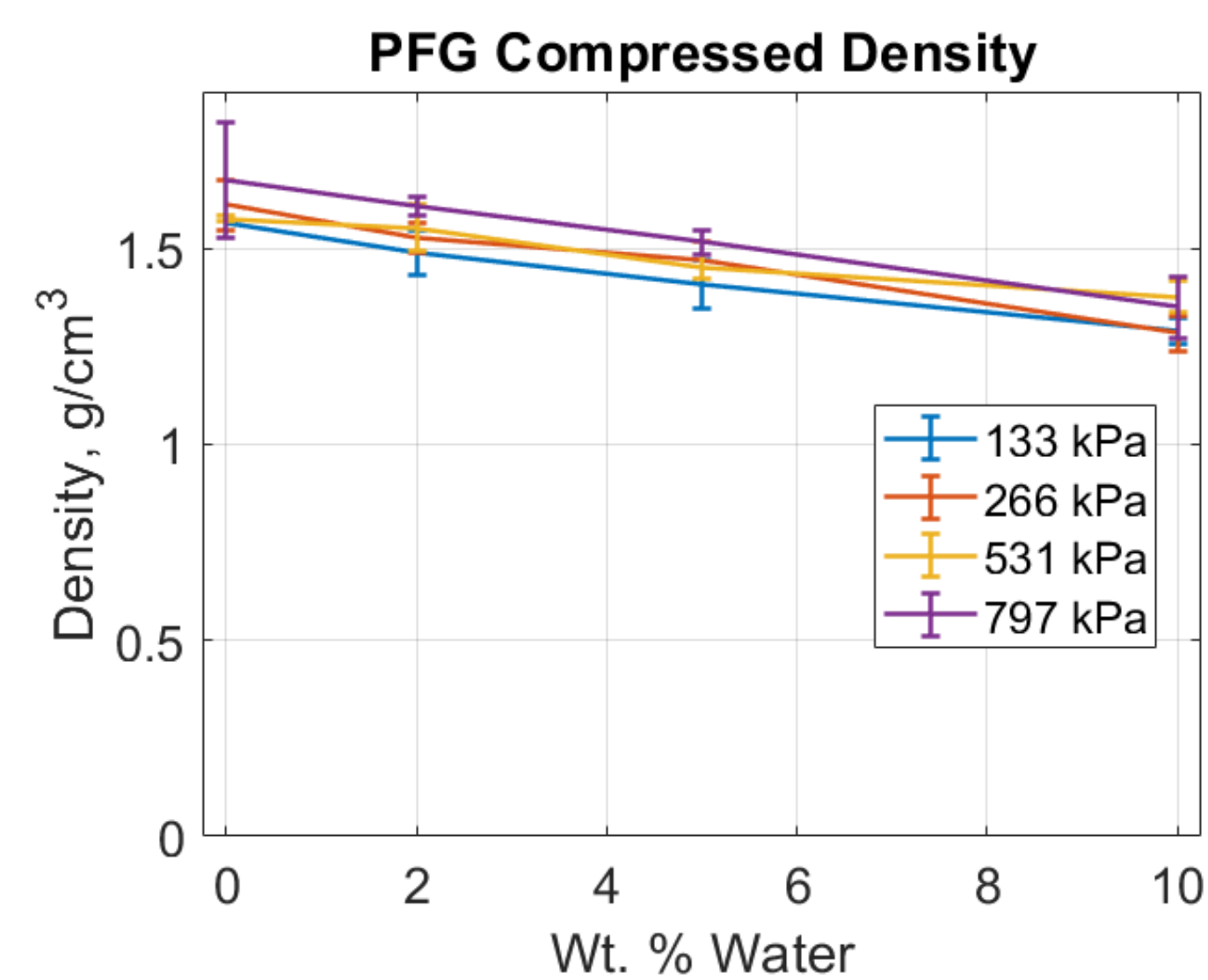
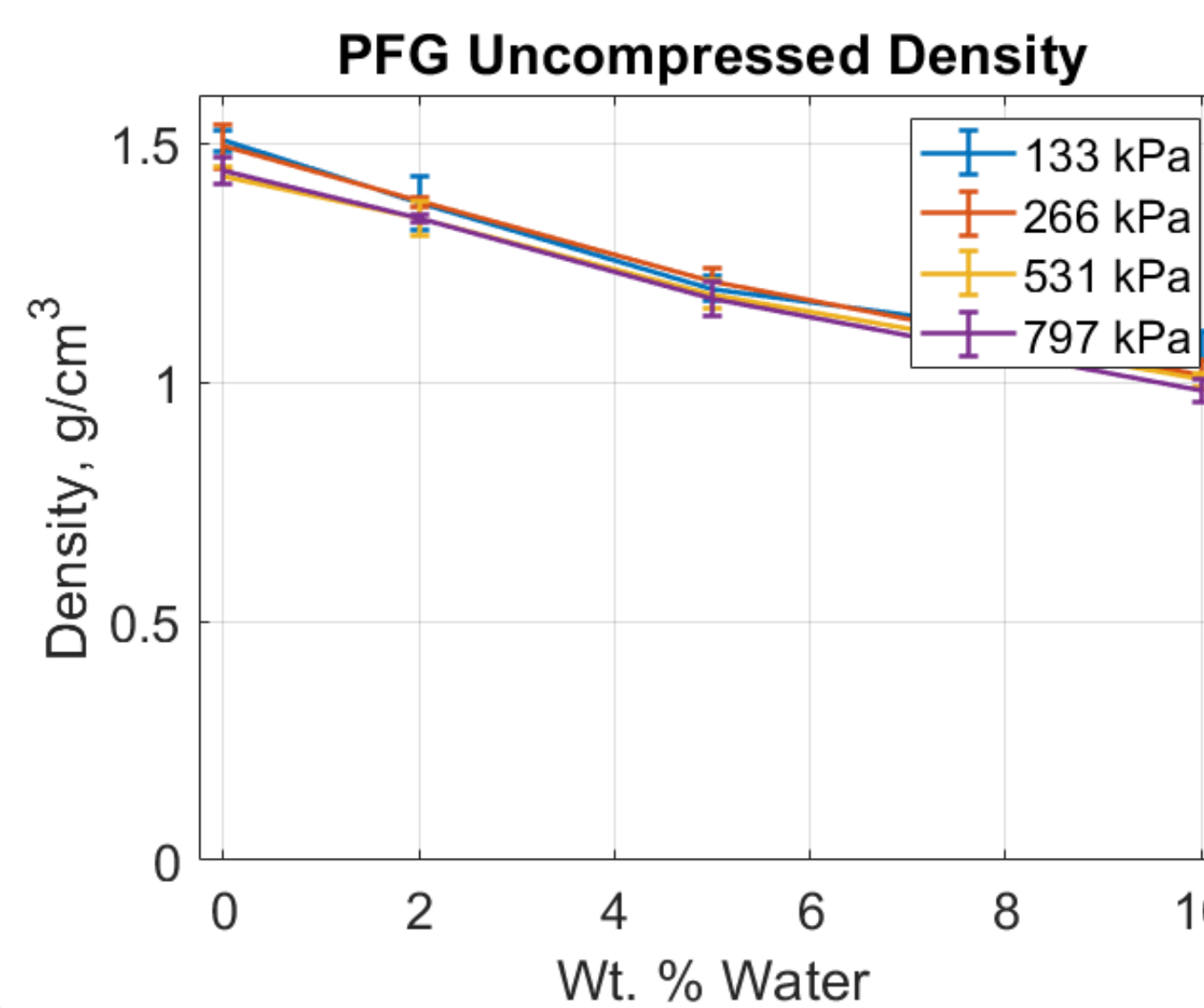
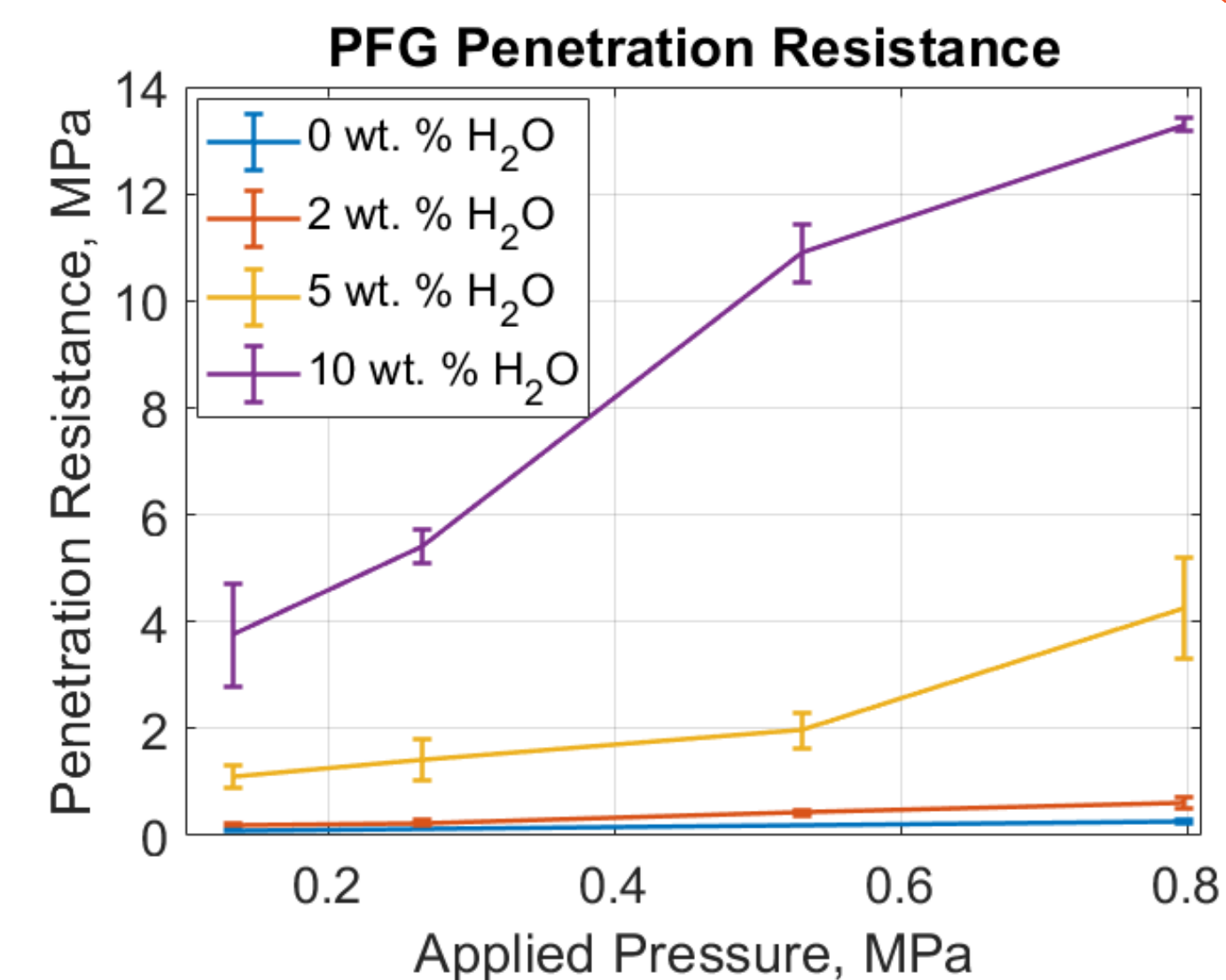
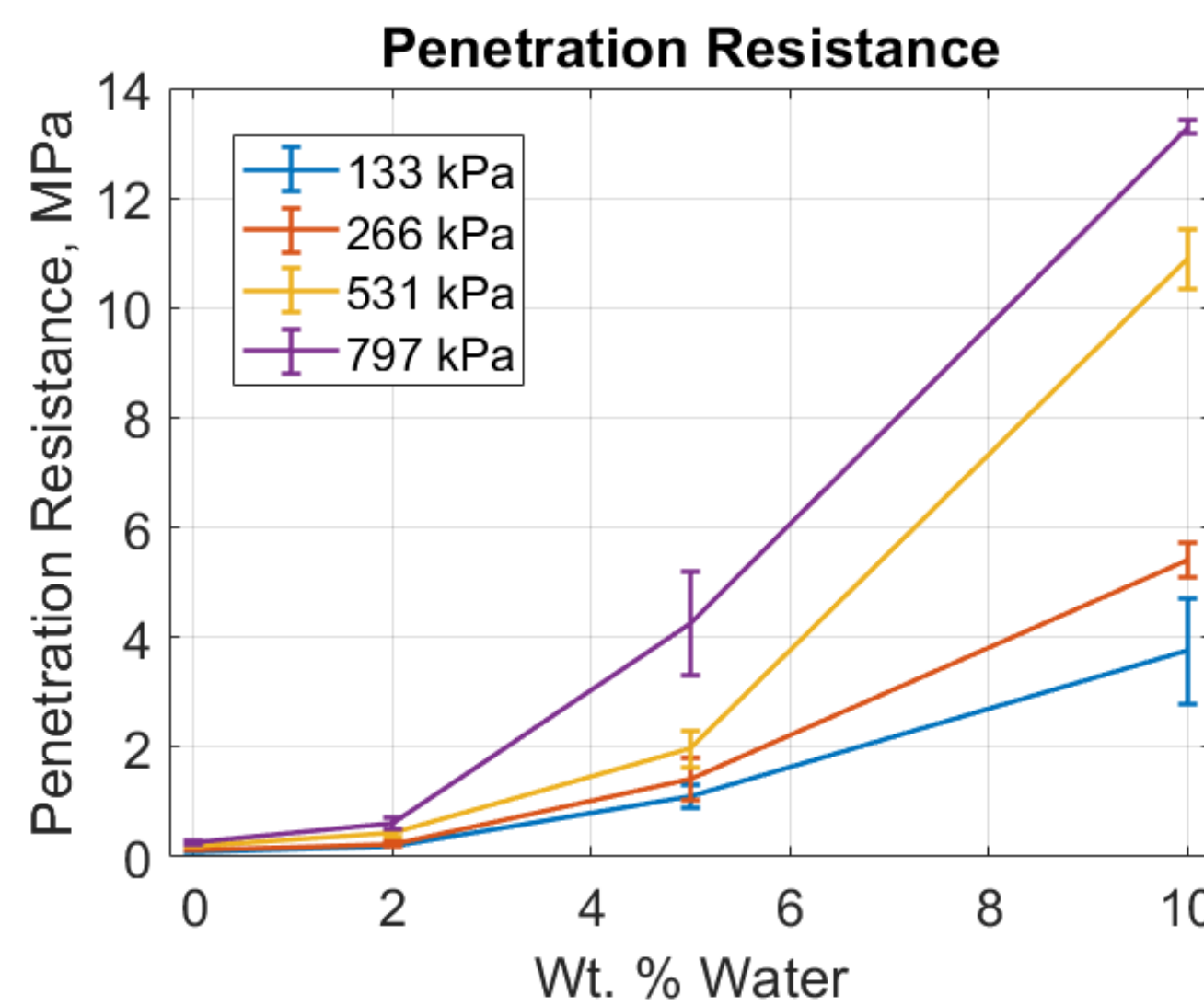
- Shave ice and sieve to below 500 μm .
 - Mix with regolith simulant of choice in desired mixture ratio
 - Pour mixture into cup
 - Press mixture at desired isostatic pressure for 10 minutes
 - Remove piston
 - Test penetration resistance with 10mm diameter flathead penetrometer
 - Highest resistance in 5 mm penetration recorded
- 0%, 2%, 5%, and 10% water tested by weight
CSM Lunar Highlands Terrain (LHT) simulant used

DATA ANALYSIS

Morphology



- Unconsolidated ice grains fuse with regolith grains under pressure
- Higher pressures result in higher strengths, greater fusion



CONCLUSIONS

A sample of PFG with lower water content can have a higher penetration resistance than one with higher water content if greater pressure is applied. In this way, PFG is tunable to a wide range of strengths for a given water content simply by varying the applied pressure. Since the precise morphology of ice in lunar PSRs is unknown, PFG may be more likely than other simulants to be able to replicate lunar conditions.