



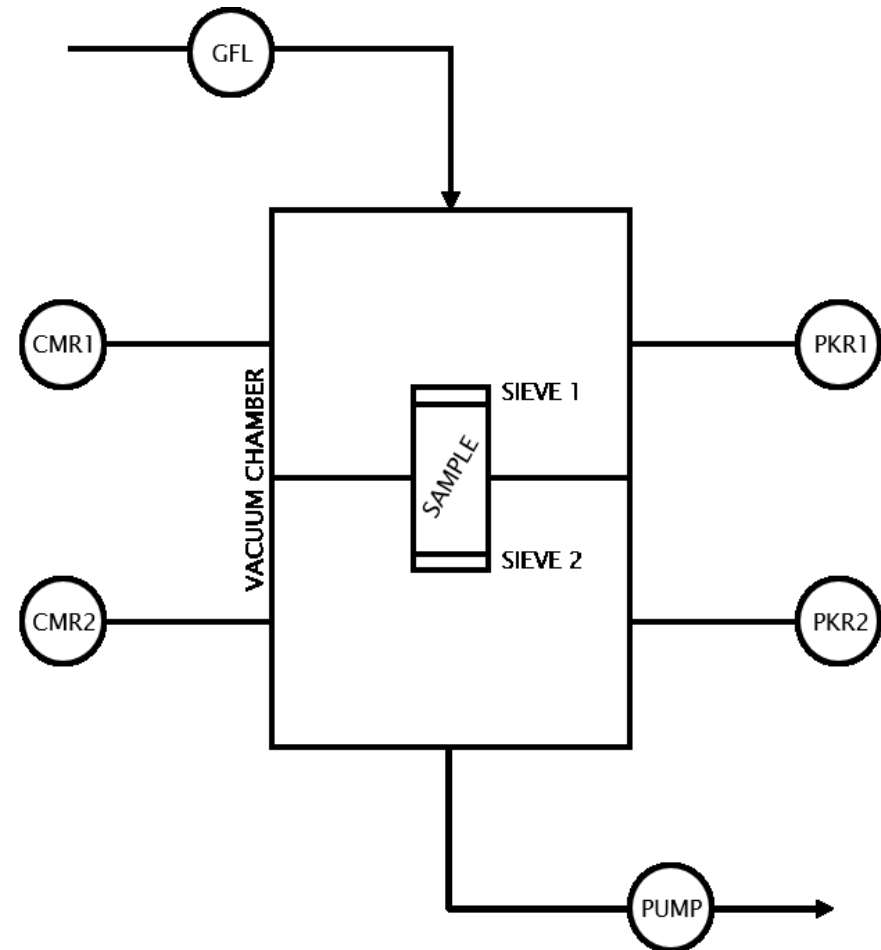
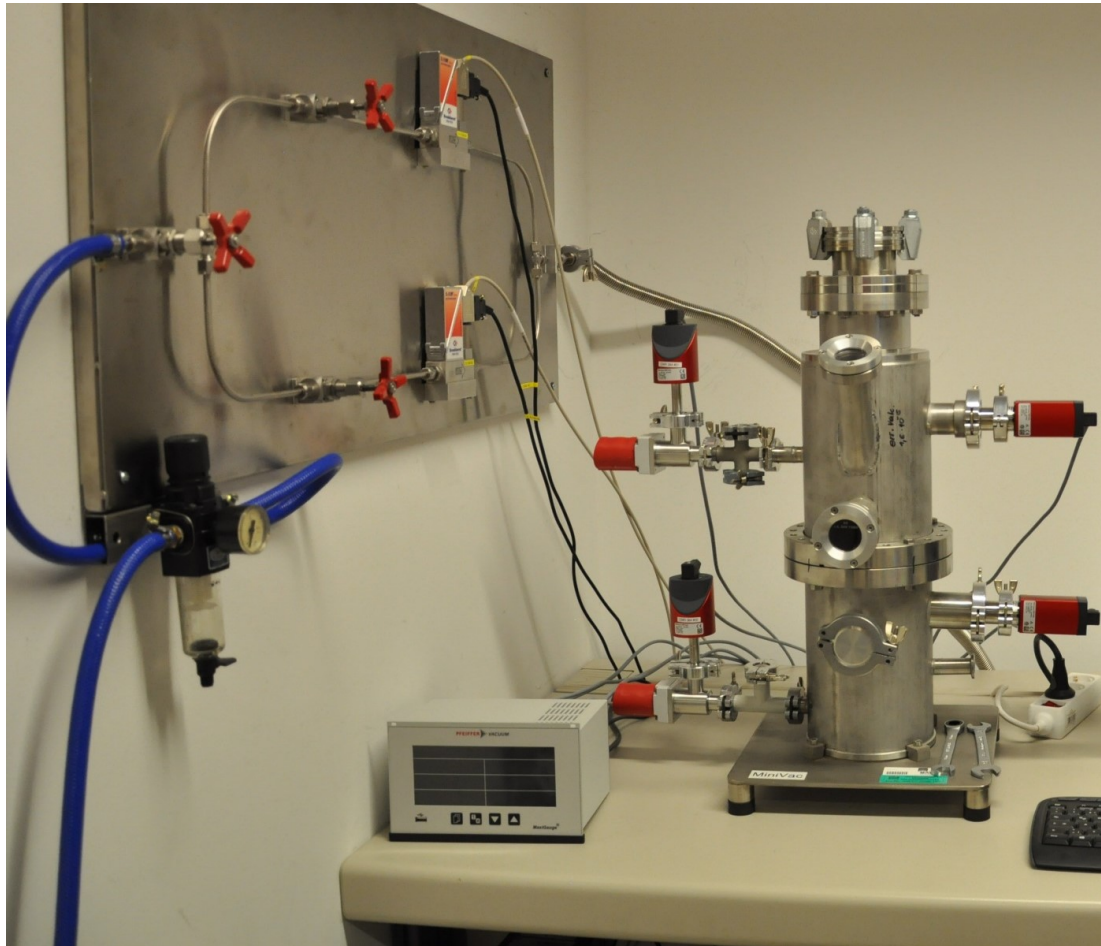
Gas flow through porous media with regard to comets and asteroids

Maria Schweighart

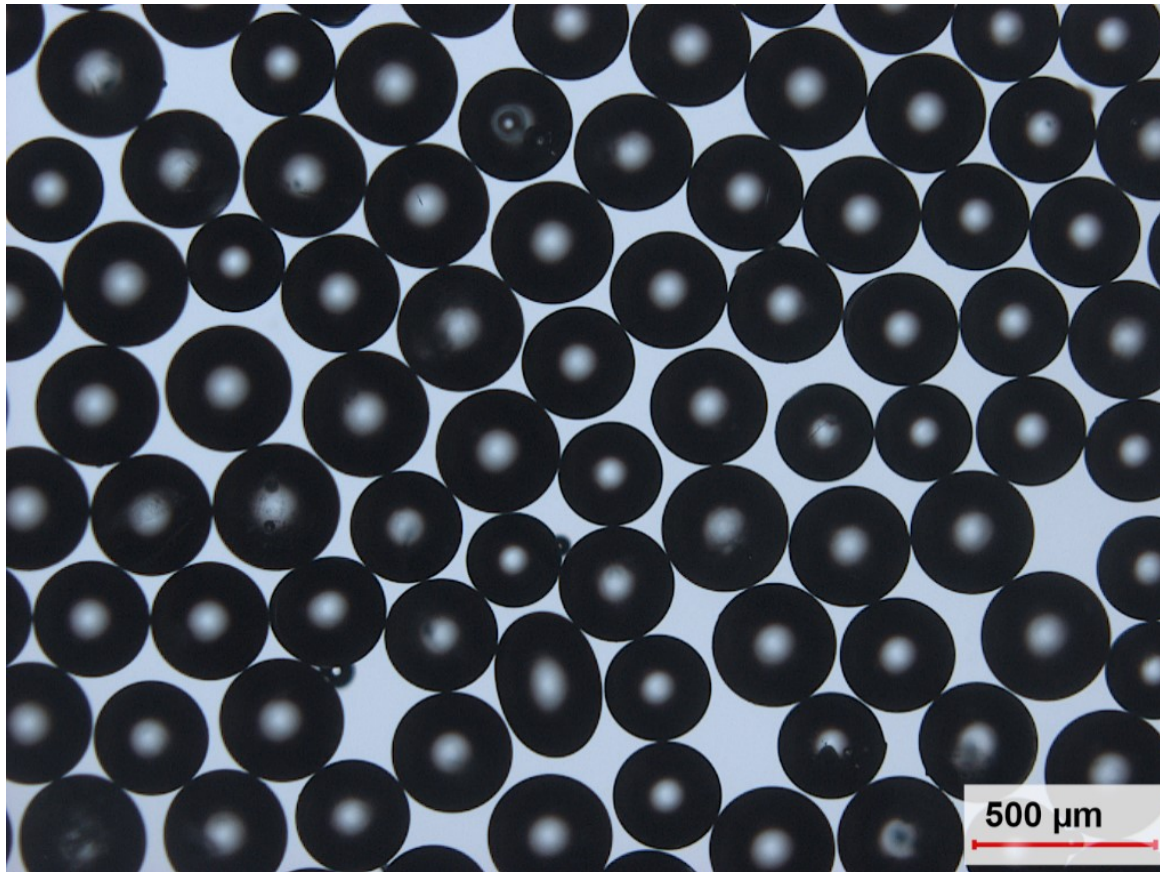
Space Research Institute Graz, Austrian Academy of Science



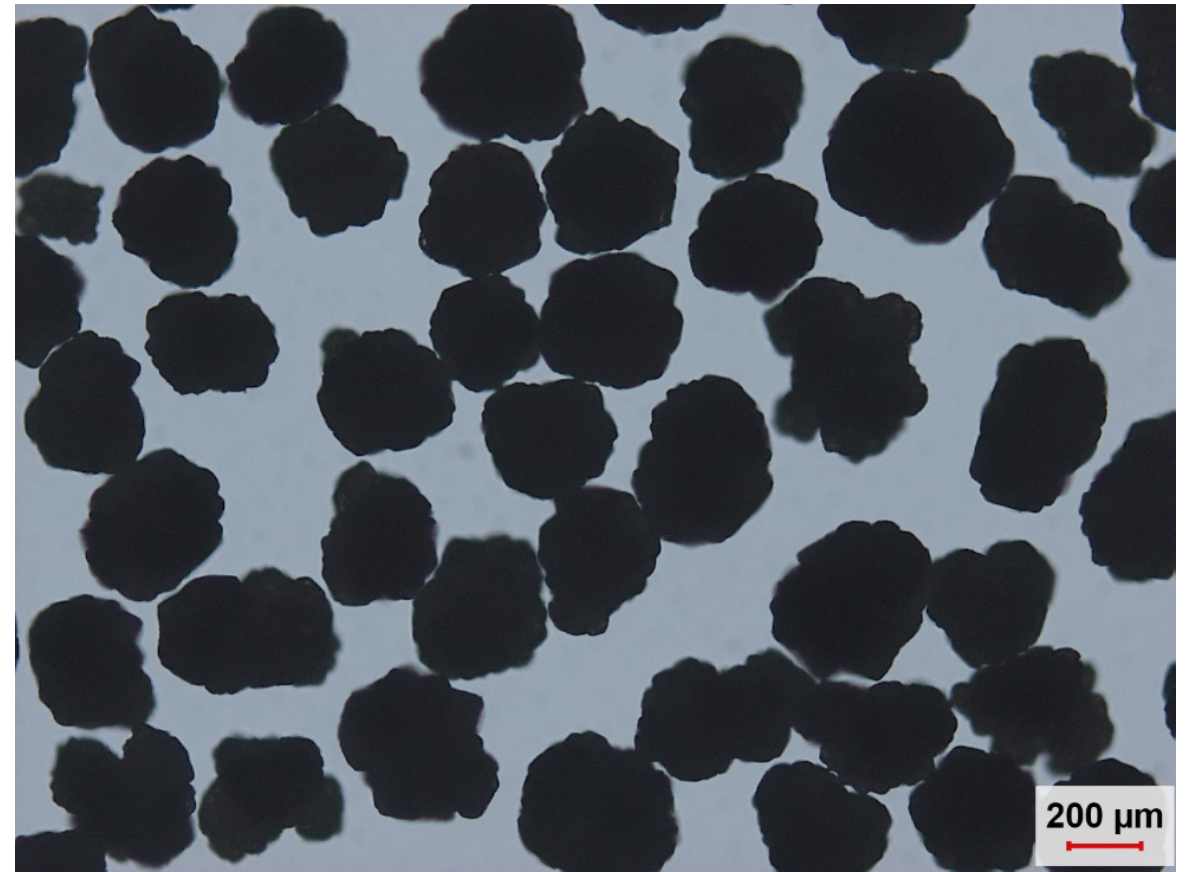
Experimental scheme



Glass beads



$d = 0.250 - 0.355 \text{ mm}$



$d = 0.125 - 0.200 \text{ mm}$



Analogue Materials



JSC-Mars 1



UK 4 sand



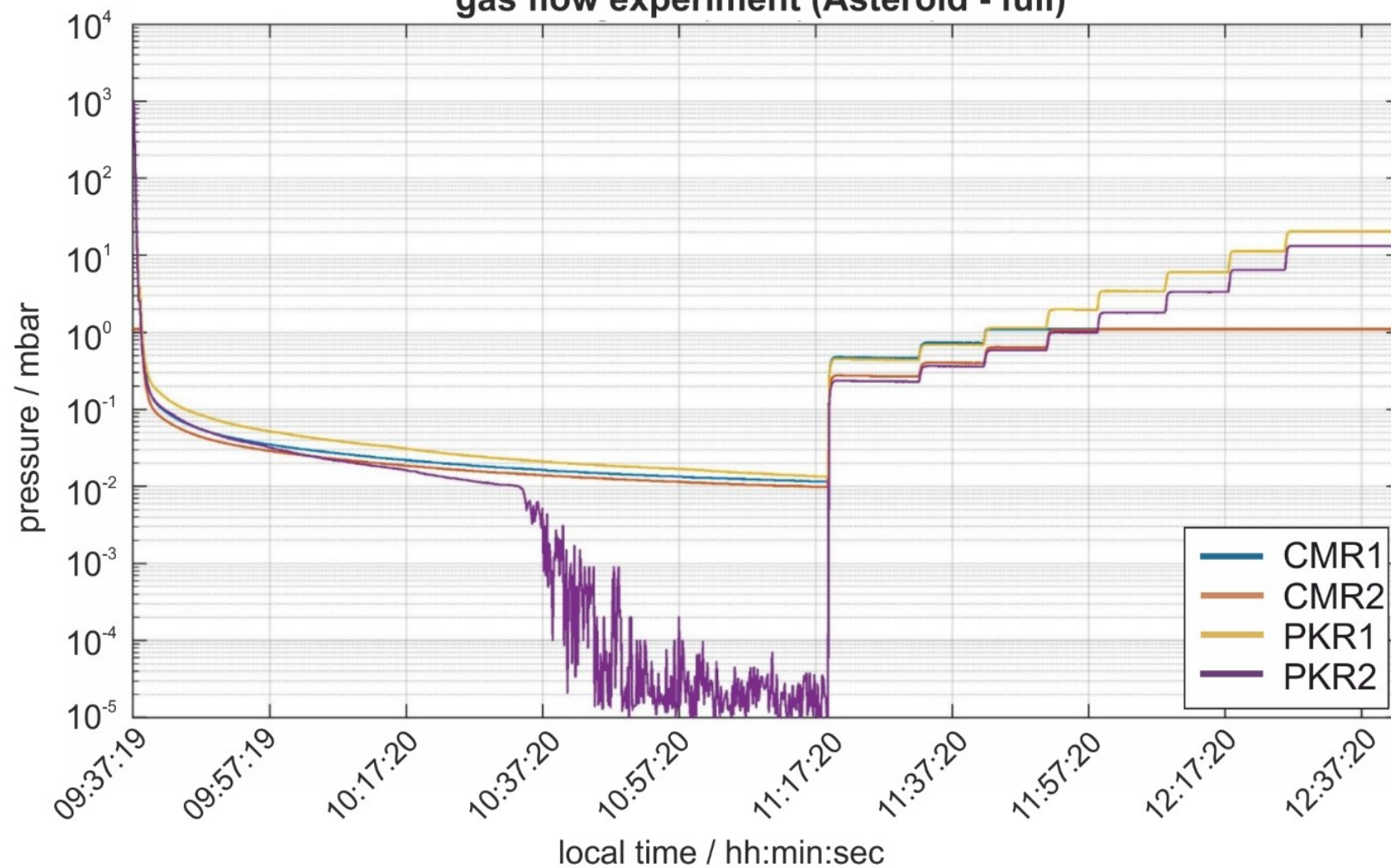
JSC-1 Lunar



UCF/DSI-CI-2
Asteroid Simulant
(Exolith Lab)

Measurement

gas flow experiment (Asteroid - full)



Pumping and then stepwise increase of gas flow from 0.15 mg/s till 19.2 mg/s



Analysis

Sum of viscous flow and Knudsen flow (Mason and Marrero 1970*)

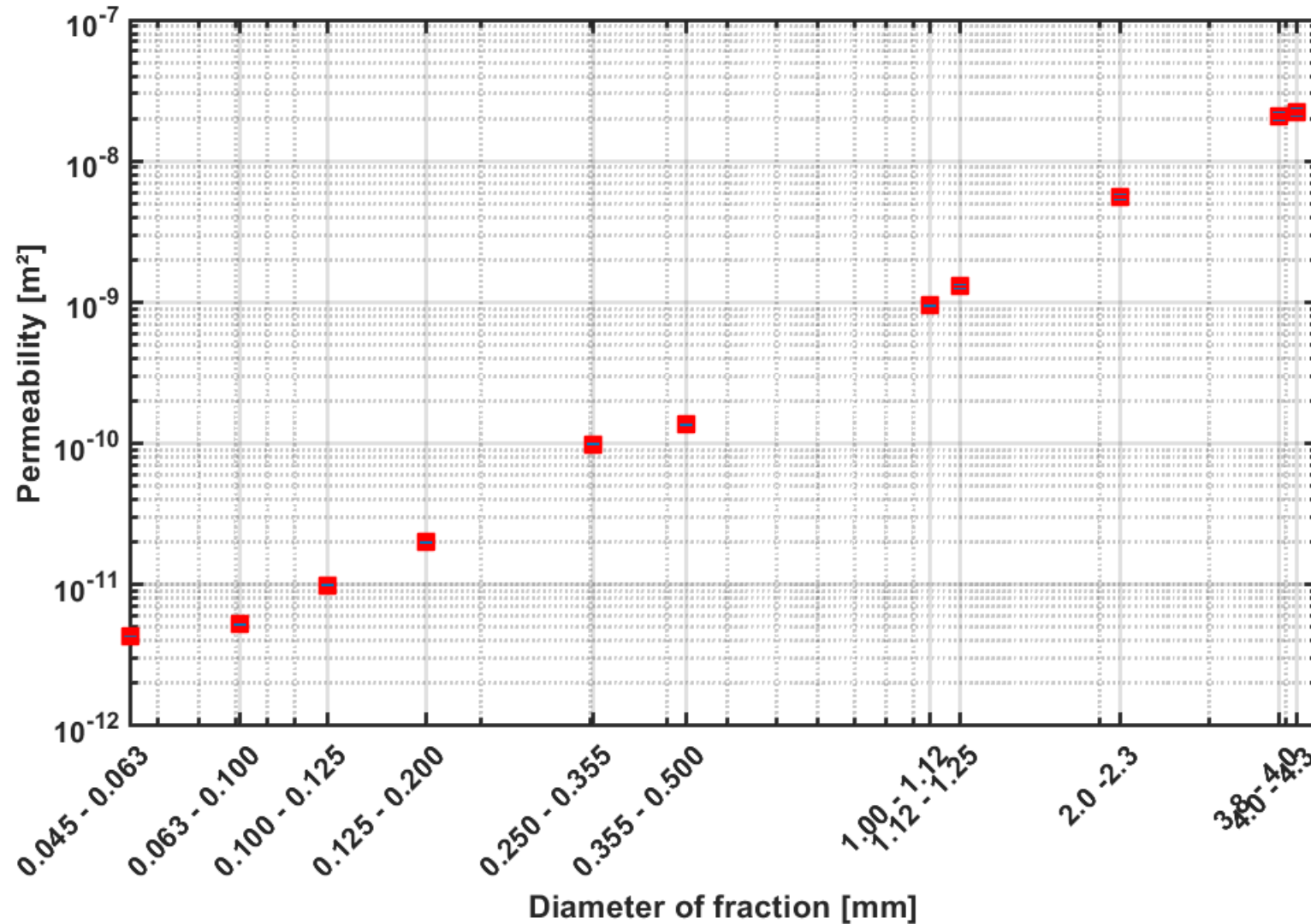
* Mason, E. A.; Marrero, T. R. (1970): The Diffusion of Atoms and Molecules.

In : Advances in Atomic and Molecular Physics Volume 6: Elsevier, pp. 155–232.

$$\bar{p} \frac{B_0}{\mu} + D_K = - \frac{RTFx}{MA(p - p_0)}$$

- A ... sample cross section [m^2]
- B_0 ... gas permeability [m^2]
- D_K ... Knudsen diffusion coefficient [$\text{m}^2 \text{s}^{-1}$]
- F ... mass flow [kg s^{-1}]
- M ... molar mass of gas (air) [kg mol^{-1}]
- p ... downstream pressure [Pa]
- p_0 ... upstream pressure [Pa]
- \bar{p} ... mean pressure [Pa]
- R ... gas constant [$\text{J mol}^{-1} \text{K}^{-1}$]
- T ... temperature [K]
- x ... sample height [m]
- μ ... viscosity coefficient [$\text{kg m}^{-1} \text{s}^{-1}$]

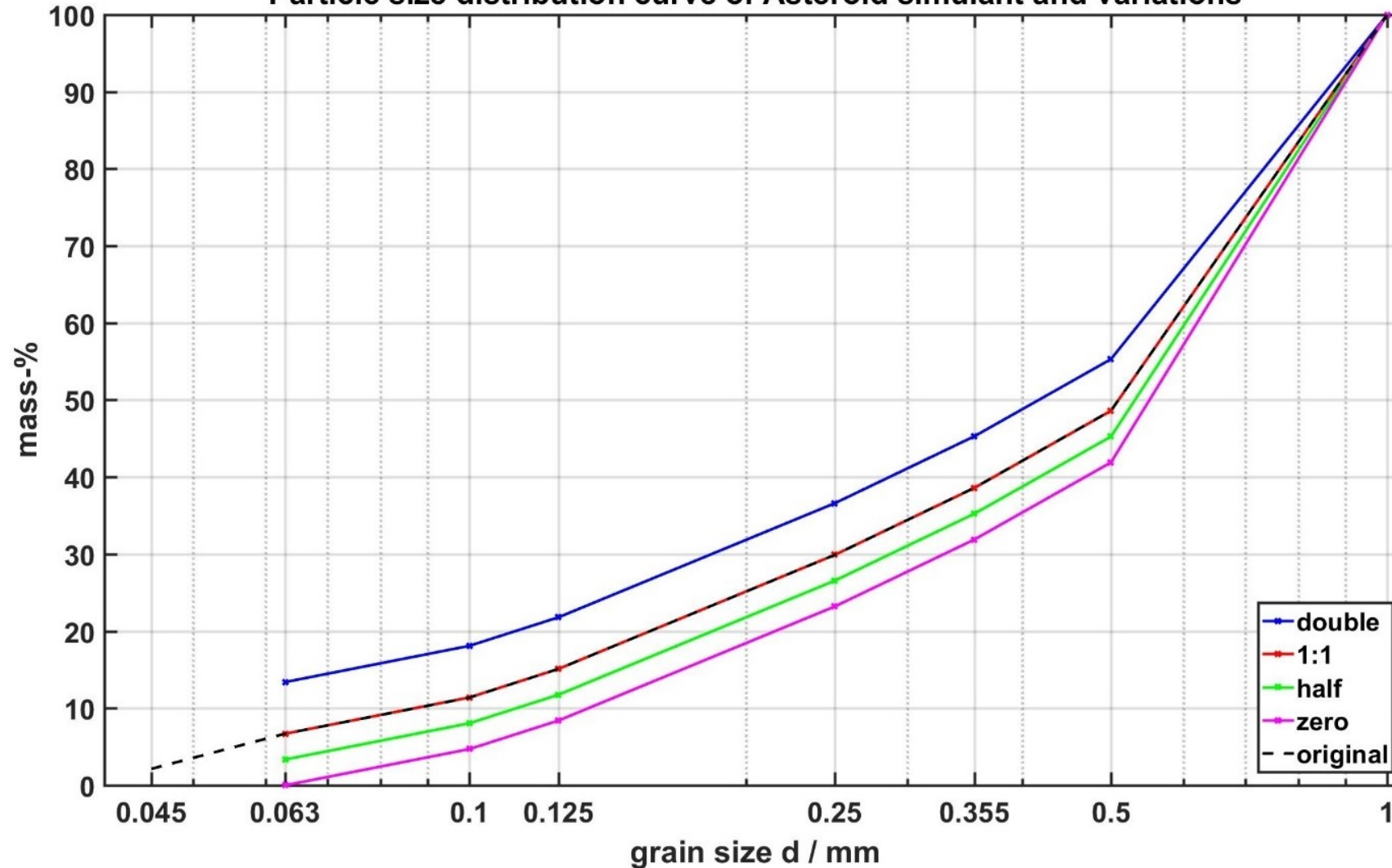
Permeability of glass bead fractions



Permeability decreases with decreasing bead size

Asteroid replicas

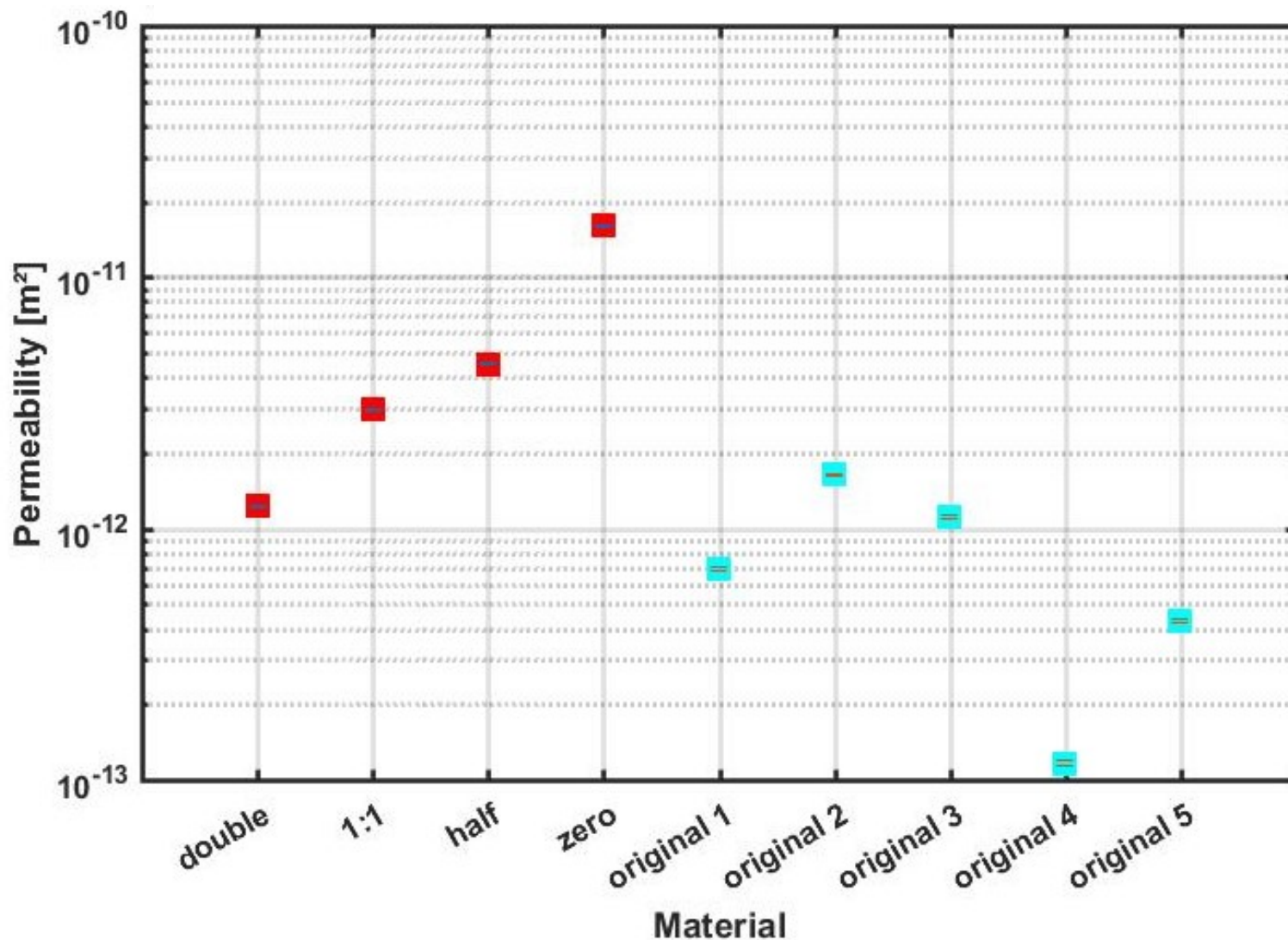
Particle size distribution curve of Asteroid simulant and variations



Glass replicas of the original Asteroid simulant according to its particle size distribution with various amounts of the smallest glass beads



Permeability of Asteroid simulants and variations

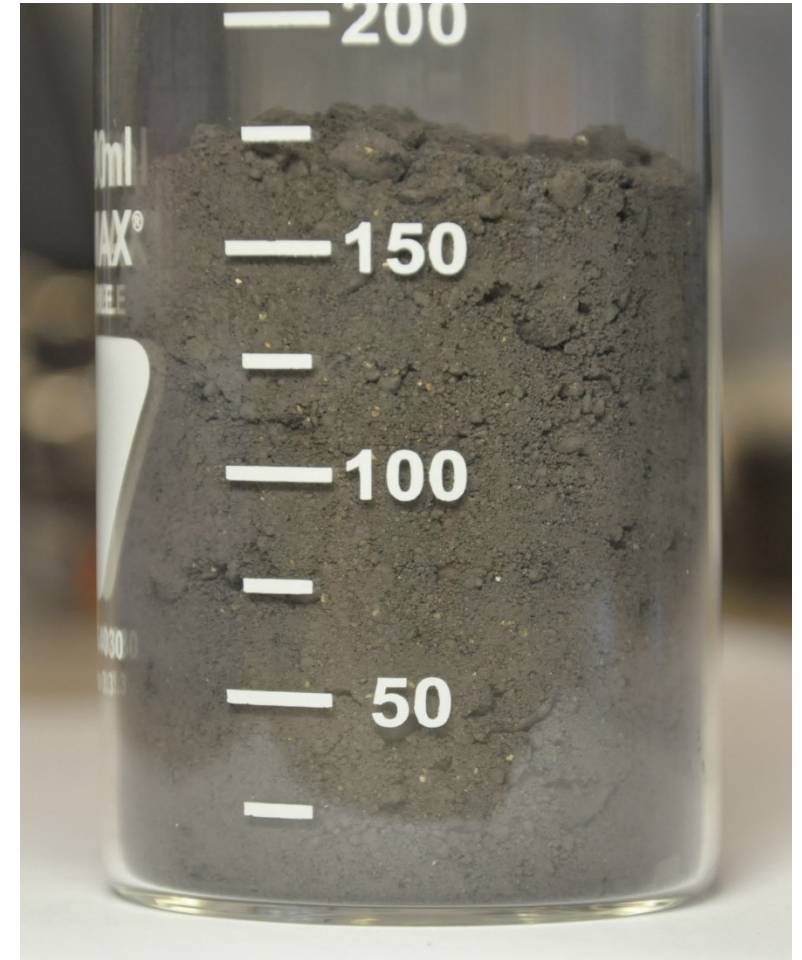
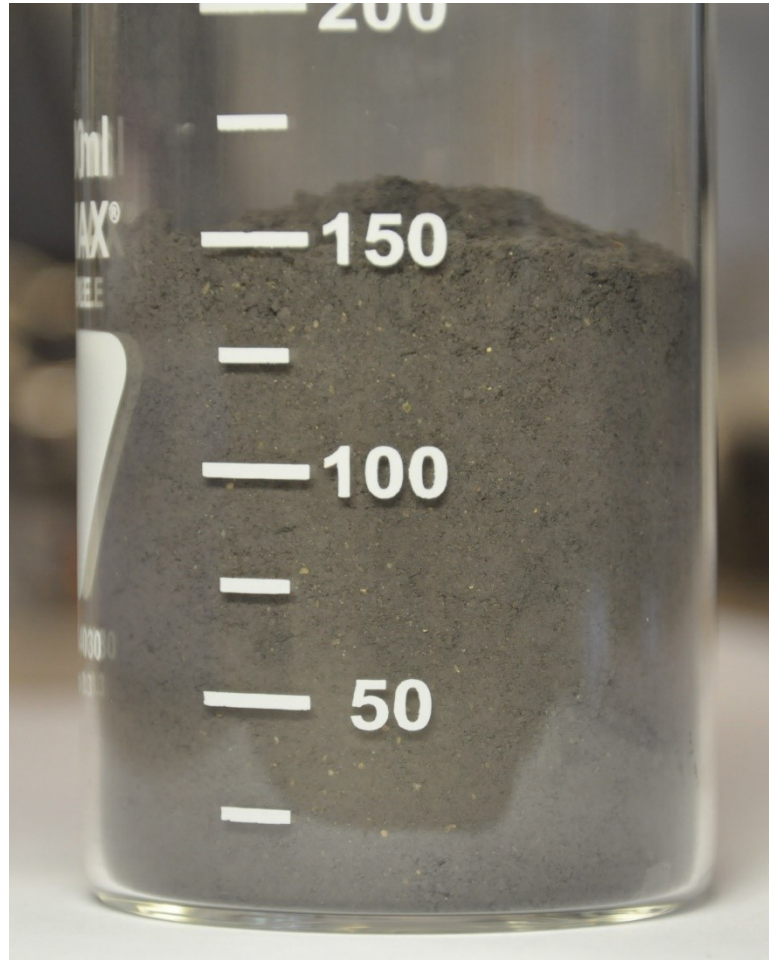
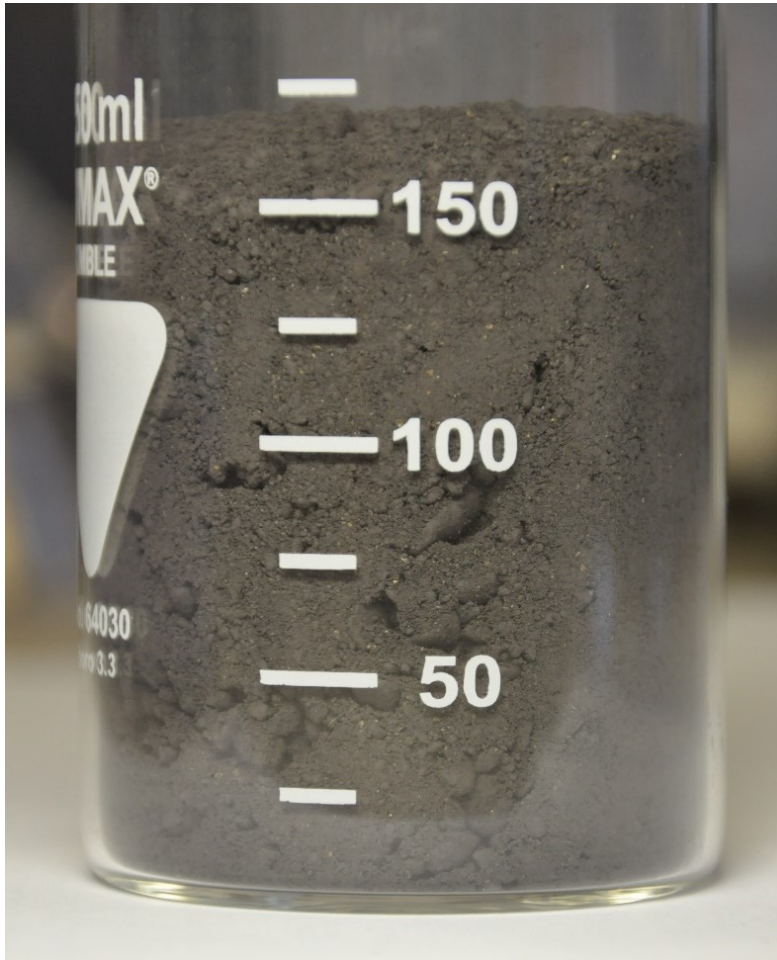


Permeability values of replicas behave according to the amount of smallest beads within the sample (as expected)

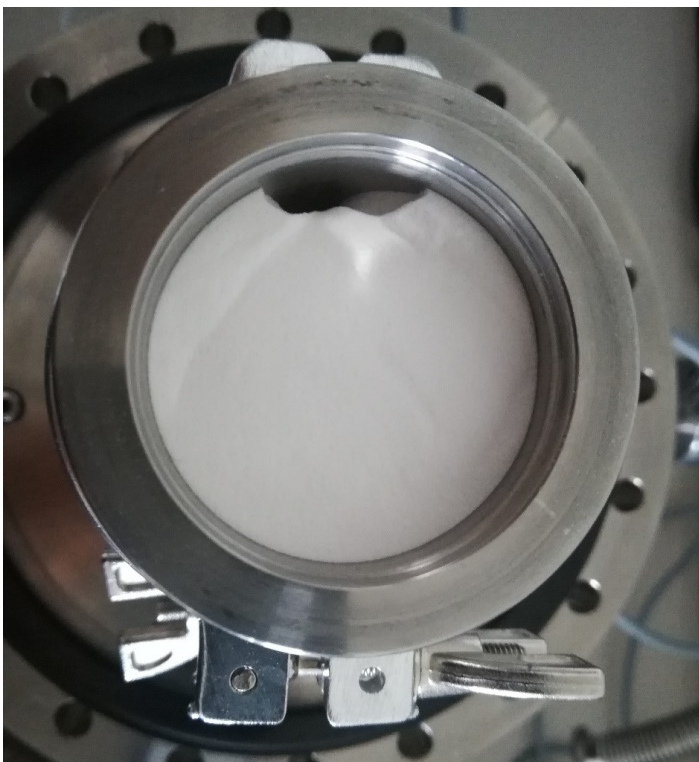
No uniform picture regarding the original Asteroid material due to irregular packing of sample (see next slide)



Random packing of Asteroid Simulant



Findings after measurement



Glass: 0.045 – 0.063 mm



Asteroid simulant





Conclusion

- Investigation of 11 glass bead fractions and 4 analogue materials
- Gas permeability B_0 values ranging between $(10^{-13} - 10^{-8}) \text{ m}^2$
- Glass beads: permeability decreases with decreasing bead size
- Analogue materials: the greater the amount of small fractions, the lower the permeability
- More densely packed sample shows a lower permeability
- Shape of the grains significantly influences the packing of the sample



<https://twitter.com/cophylab>



https://www.youtube.com/channel/UC8nf_yakXVYn9JyFYLSZYww

DFG

SNF

FWF

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