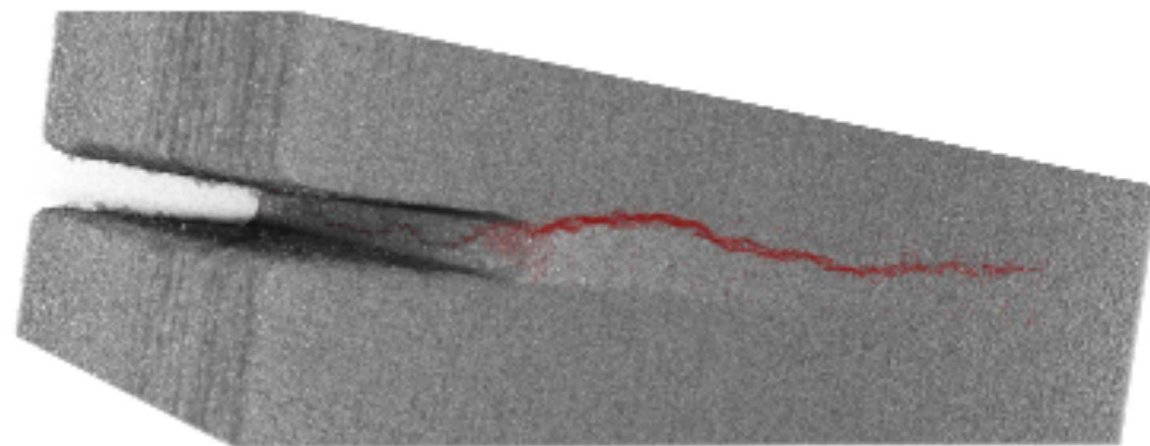
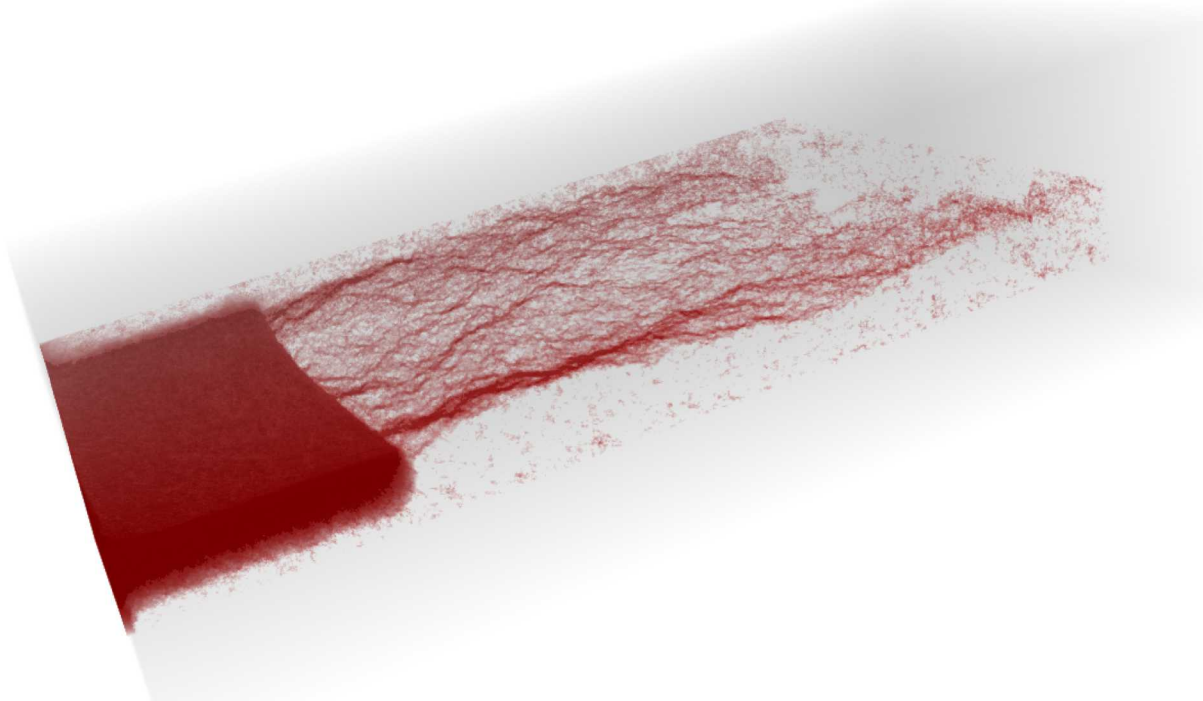


Crack Propagation in Layered Analog Rocks with Oriented Texture

Liyang Jiang, Hongkyu Yoon, Antonio Bobet, Laura J. Pyrak-Nolte



Background

- Analogue material to study tensile failure behaviors
- 3D printed samples do not have isotropic rock behaviors
- Sample layering creates anisotropy
- In-layer mineral orientation makes them orthorhombic



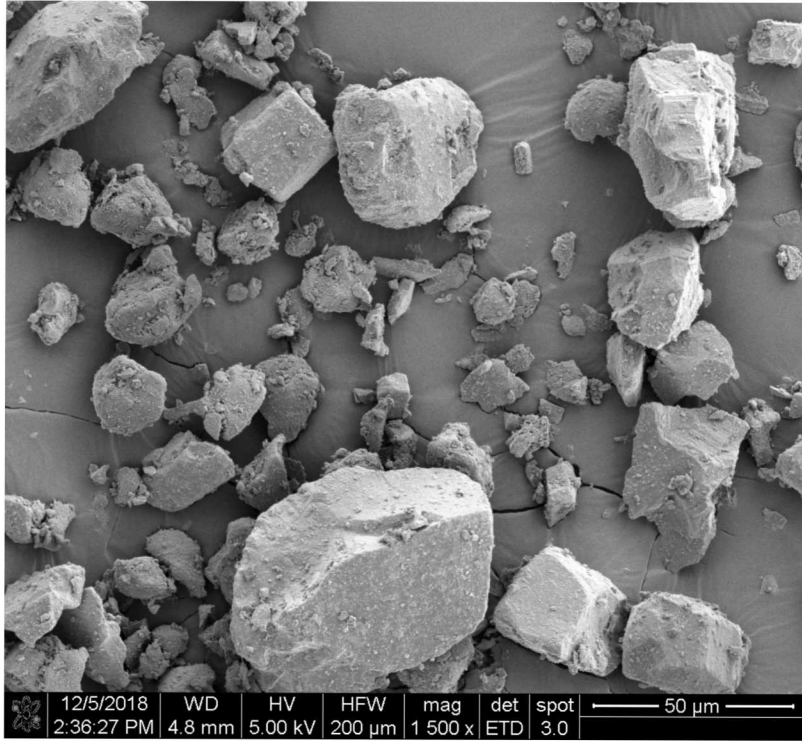
Chemical Reaction

Introduction

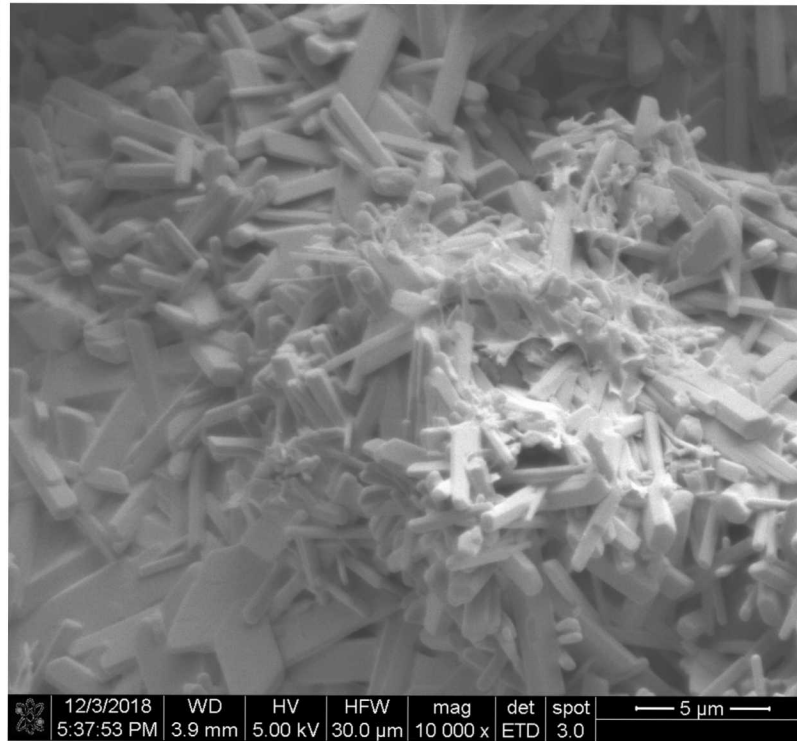
Orthorhombic

Surface roughness

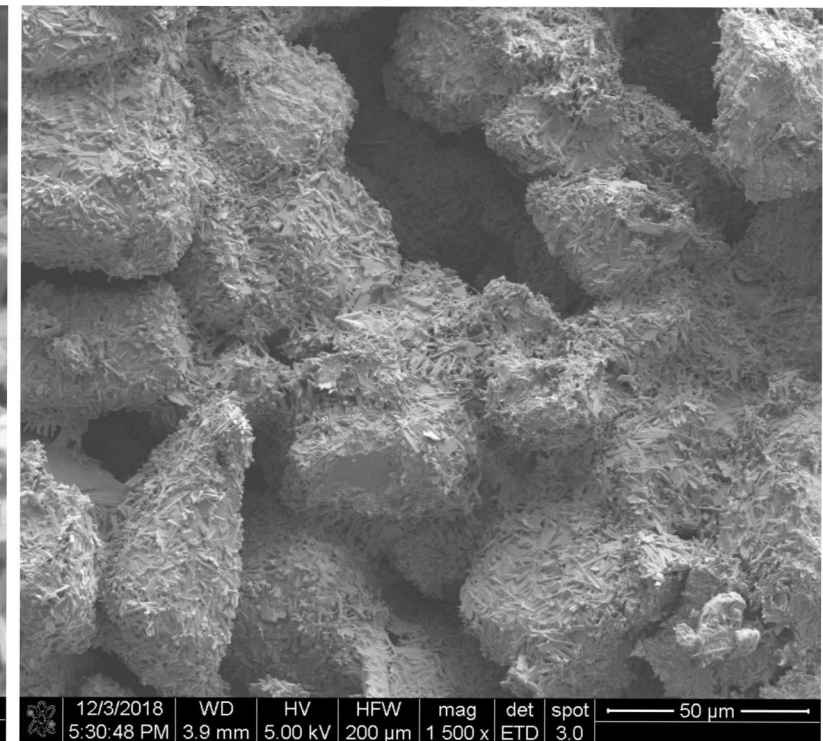
Conclusion



Bassanite powders

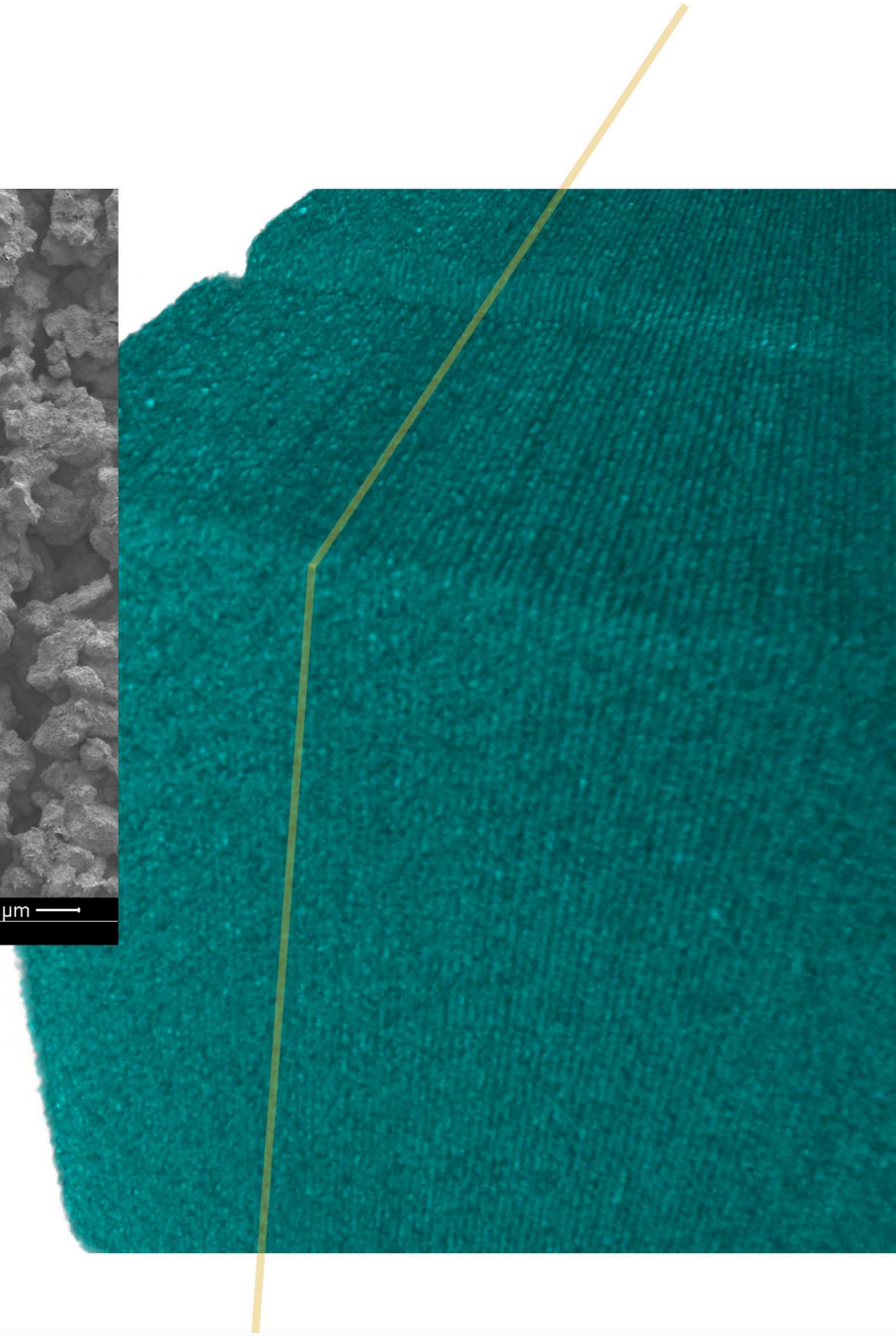
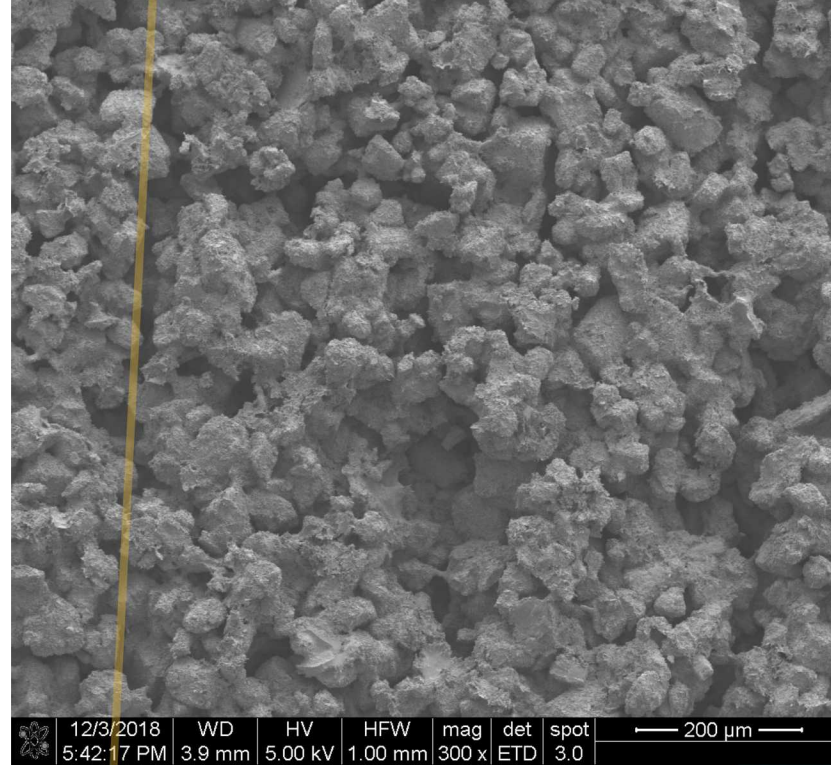
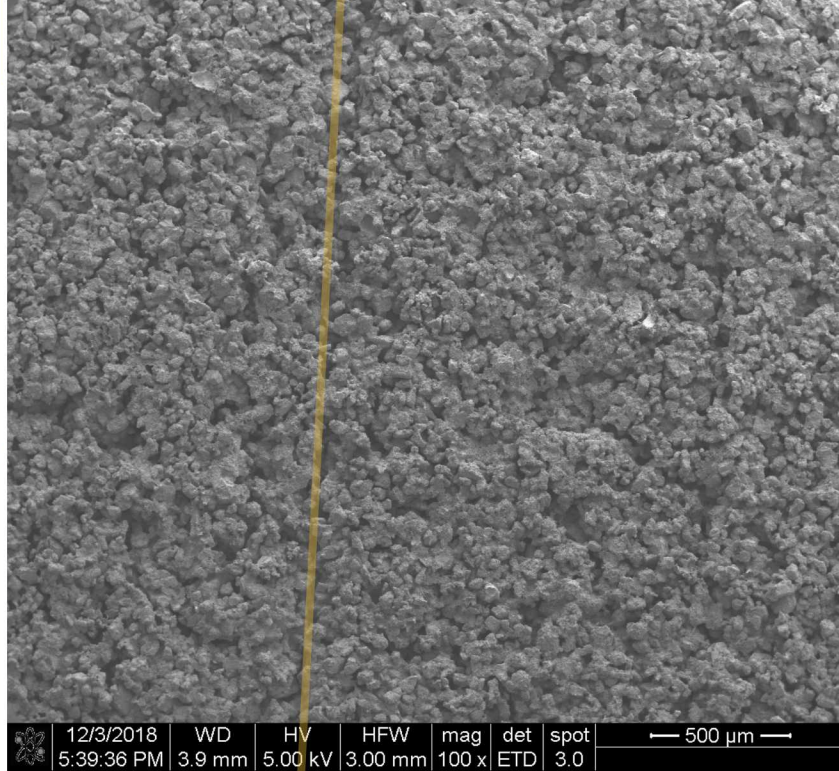


Gypsum crystals
formed when binder
applied



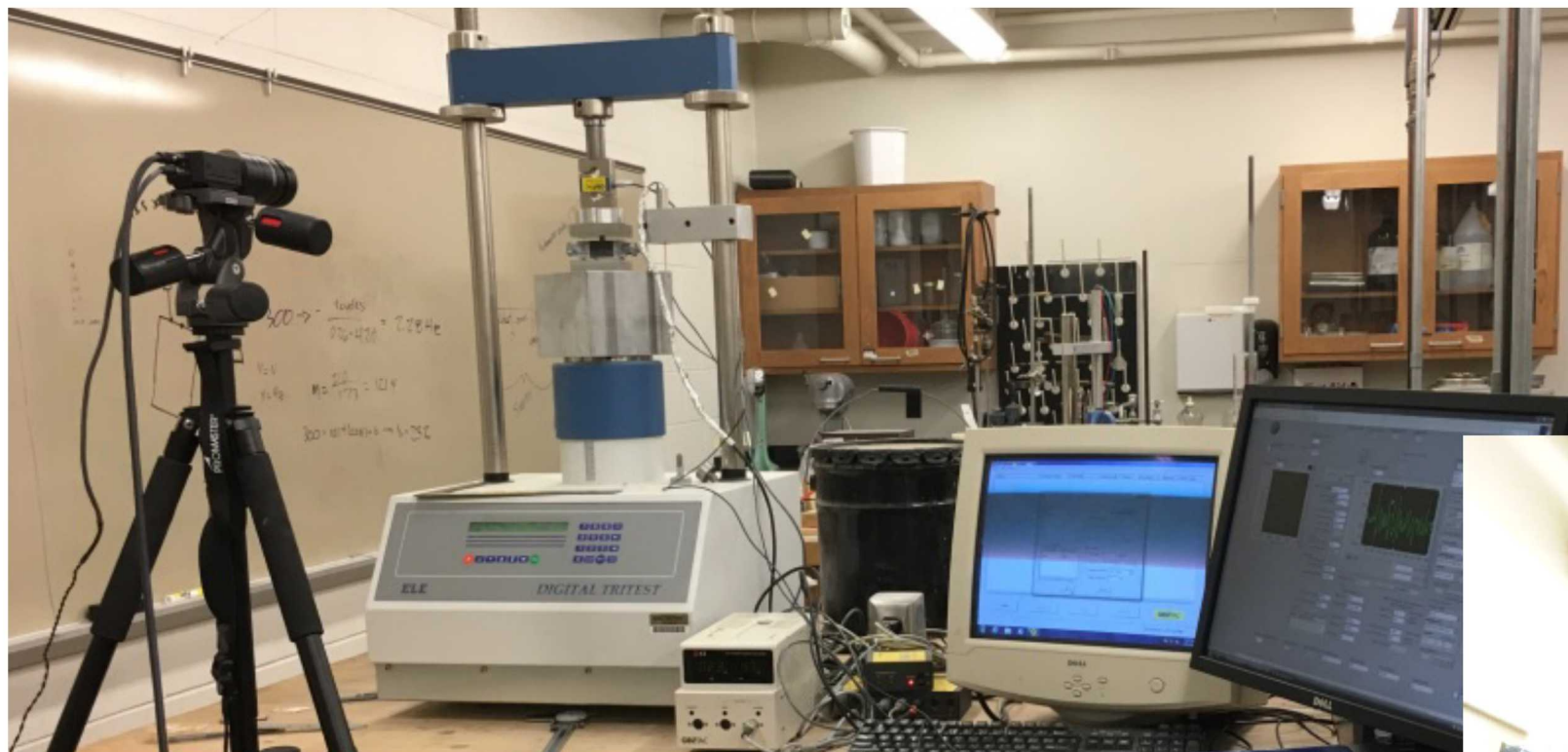
Gypsum crystal bonds clusters

Layering and Texture Formation



More voids between layers

Experimental Setup



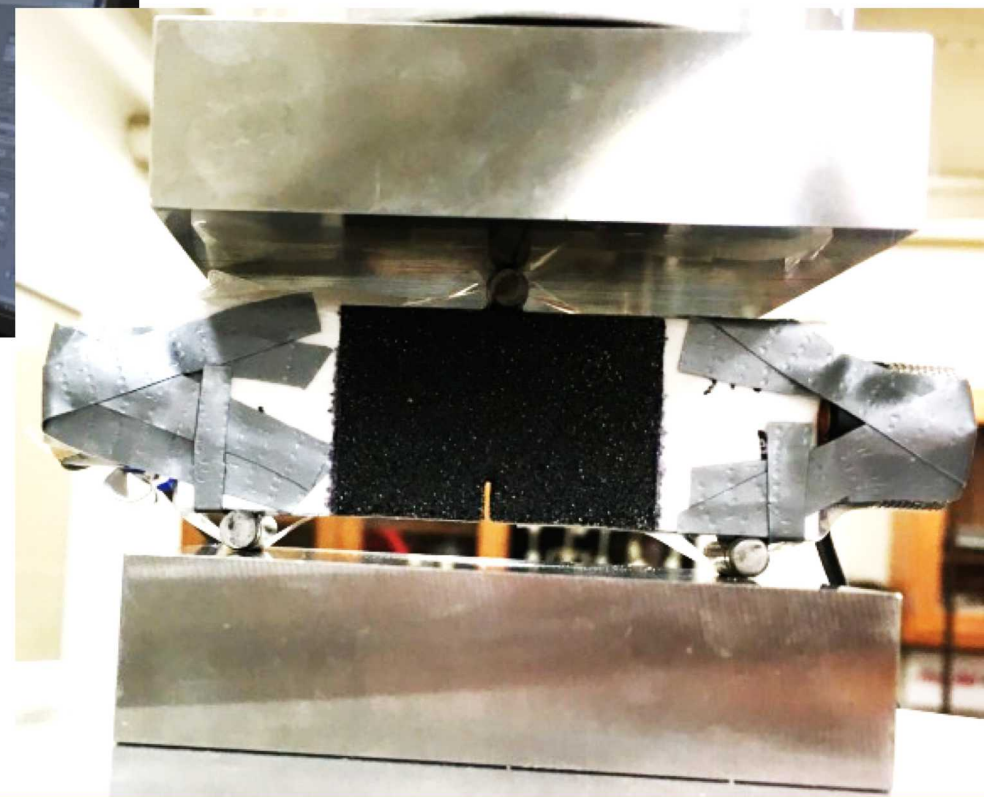
Digital Image Correlation
(resolution 3.54 μm)

Ultrasonic compressional
or shear seismic waves
(1MHz peak frequency,
5Hz recording rate)

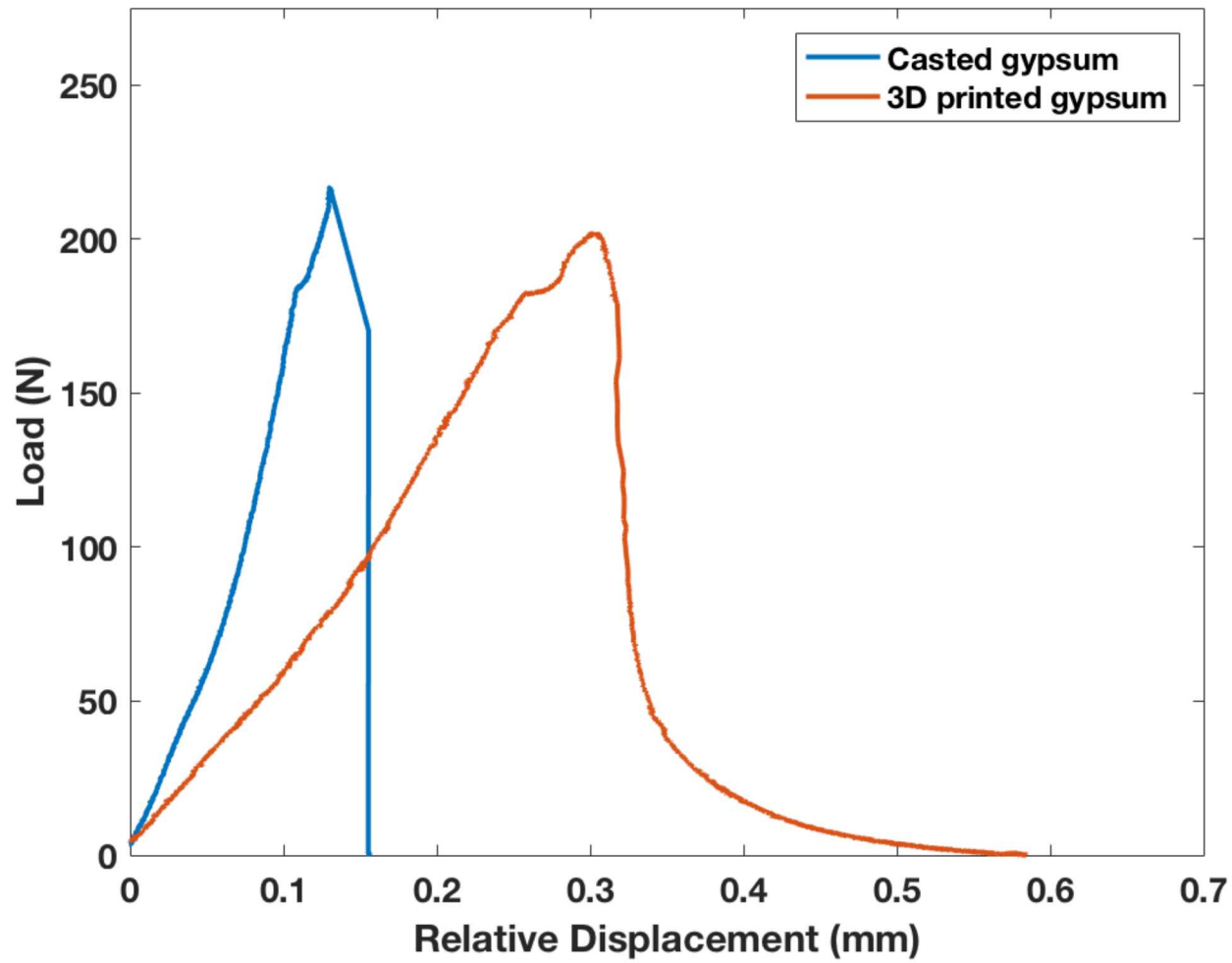
Height 25.4 mm
Length 76.2 mm
Thickness 12.7 mm

Middle Notch Height 5.08 mm

Rod diameter 4.76 mm
Rod length 19.05mm



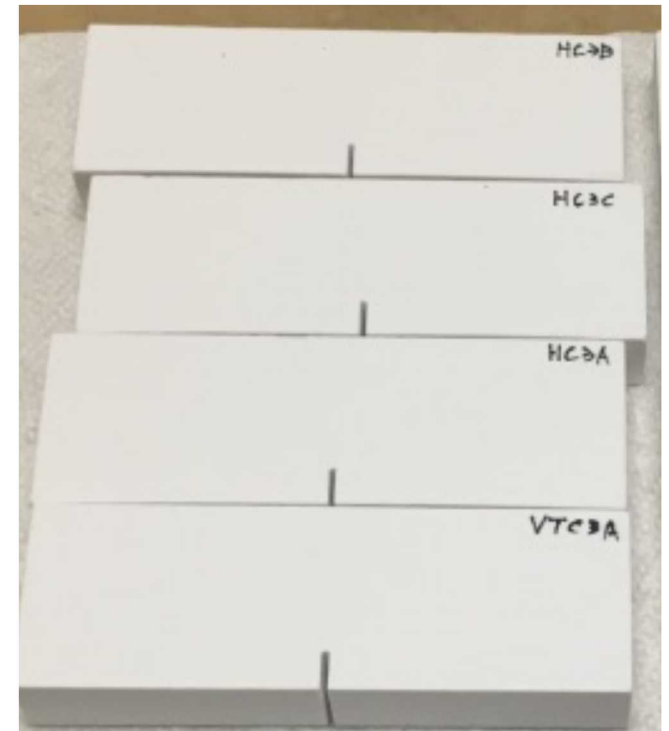
Casted Gypsum VS 3D Printed Gypsum



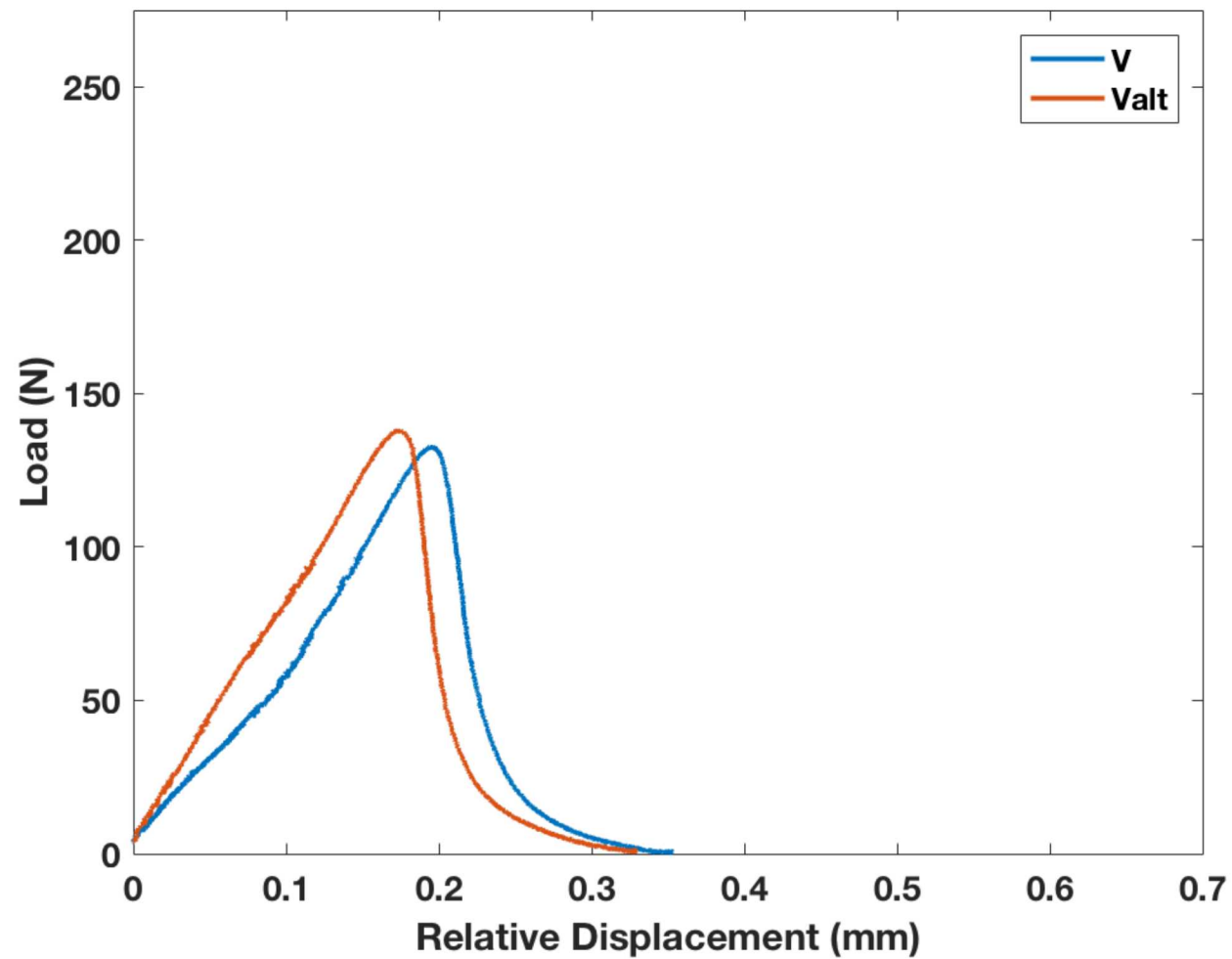
Casted gypsum



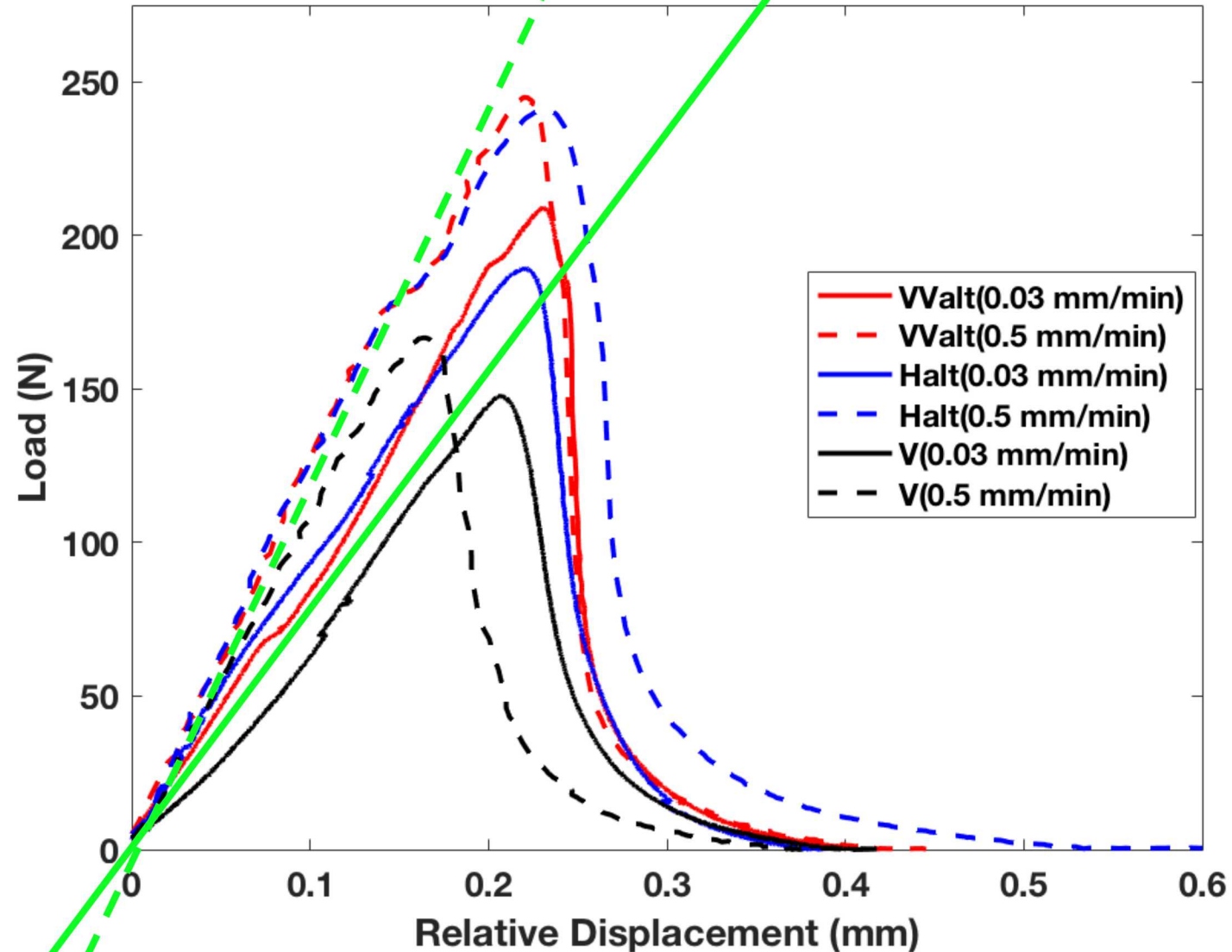
3D printed gypsum



Weakest Samples

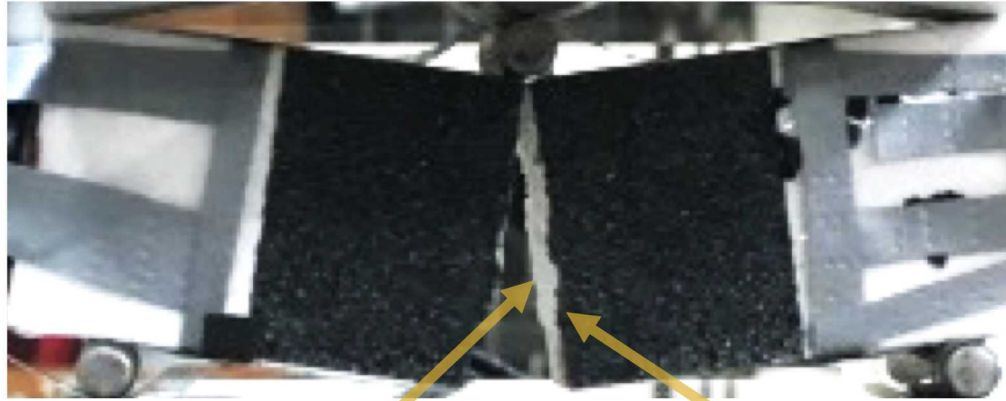


Loading Rate Influence

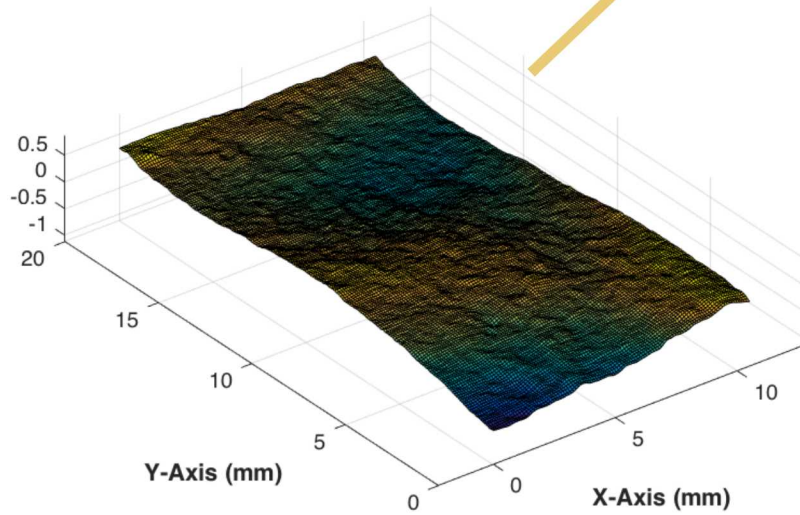


- When the loading rate is higher, samples were stiffer.
- Different geometry strength ratios were similar when loading rate changes.

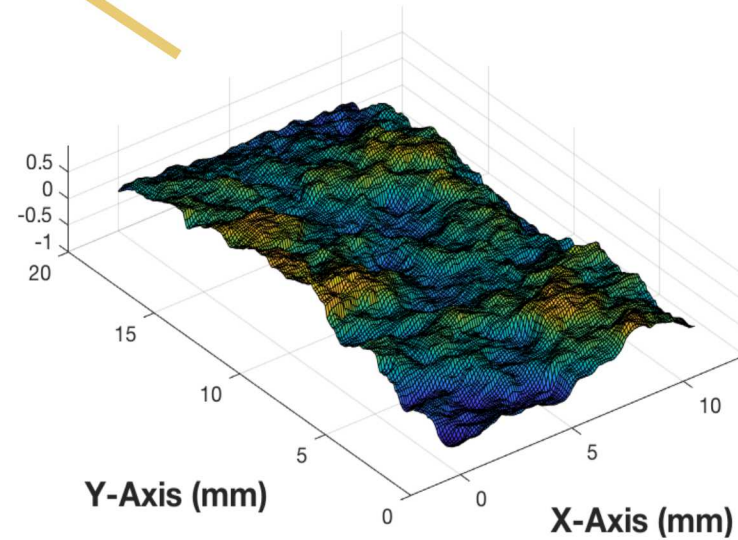
Surface Roughness



Asperity height (mm)



Casted gypsum



3D printed sample (rougher)

Conclusions

- Anisotropy in 3D printed rock can rise from two sources: layering and direction of mineral growth
- Peak loading during tensile failure is geometry-dependent

Questions?

~Thank you~

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