Fault in Guatamala, Photo by USGS

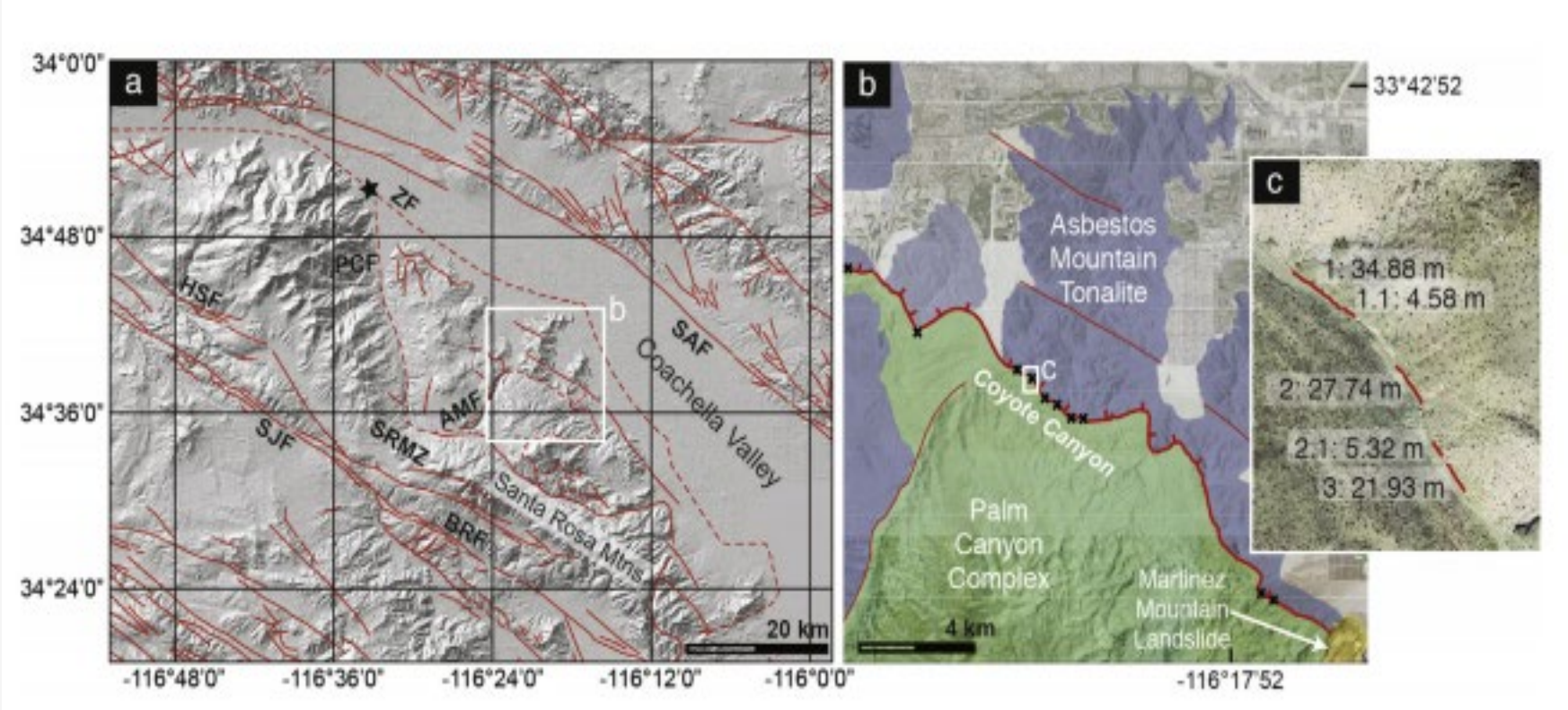
# *SMOOTHING AND ROUGHENING IN FAULTS*

*By Alexander Bissell*

# *STUDY OVERVIEW*

- *The geometric properties of a fault zone have major effects on earthquake rupture processes*
- *Characterizes a single, exposed fault zone via photogrammetry*
- *Smoothing and re-roughening processes are approx. balanced*

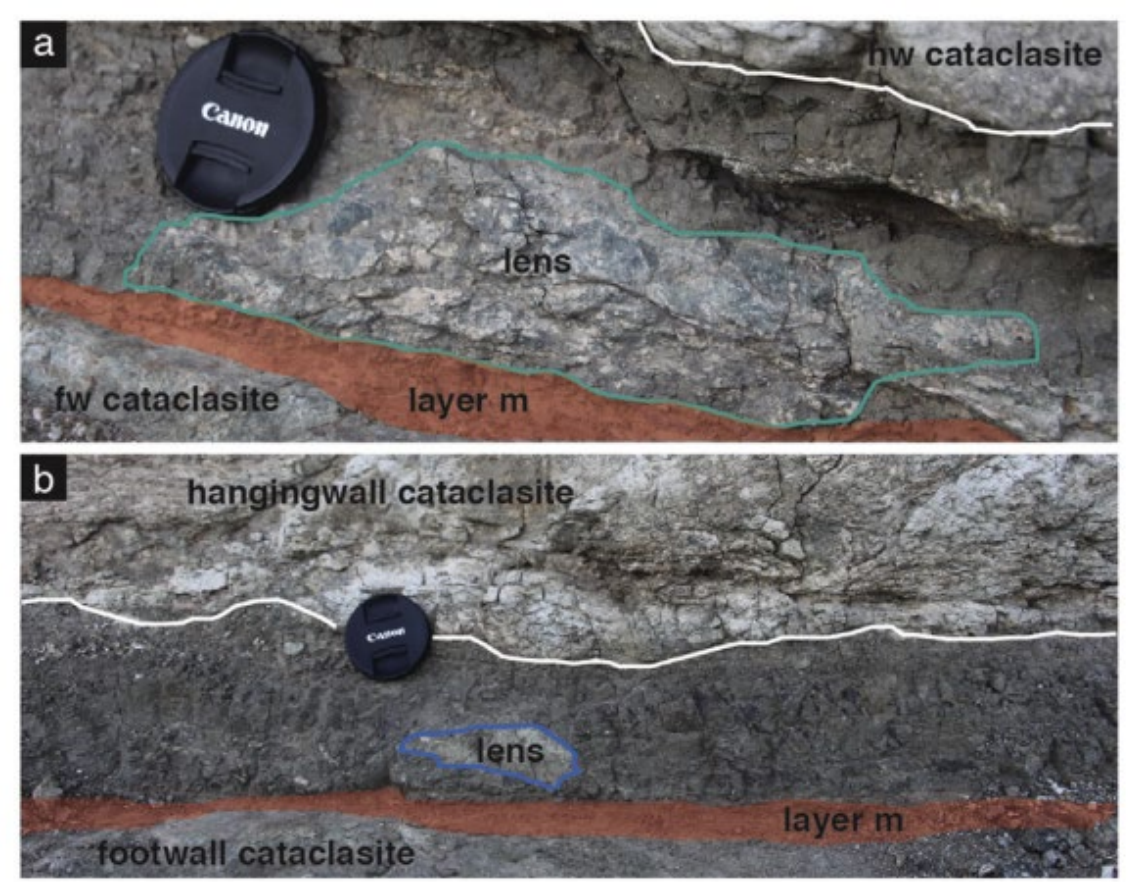
# Geologic Setting



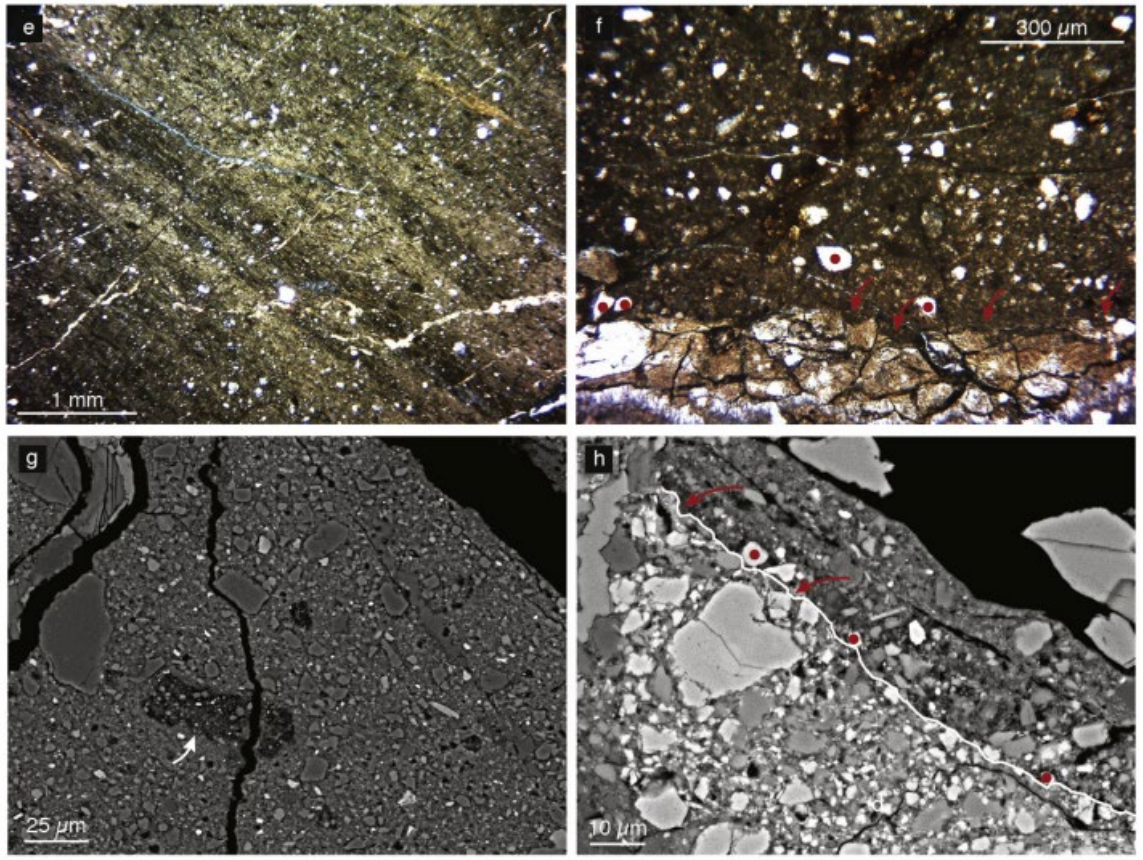

- La Quinta Fault in Coyote Canyon, So. Cal.
- biotite-hornblende rich tonalite containing a weak regional foliation

*A: Hydraulic Pump B: Computer to collect data C: Loading frame D: Loading frame control*

# *Outcrop Info*



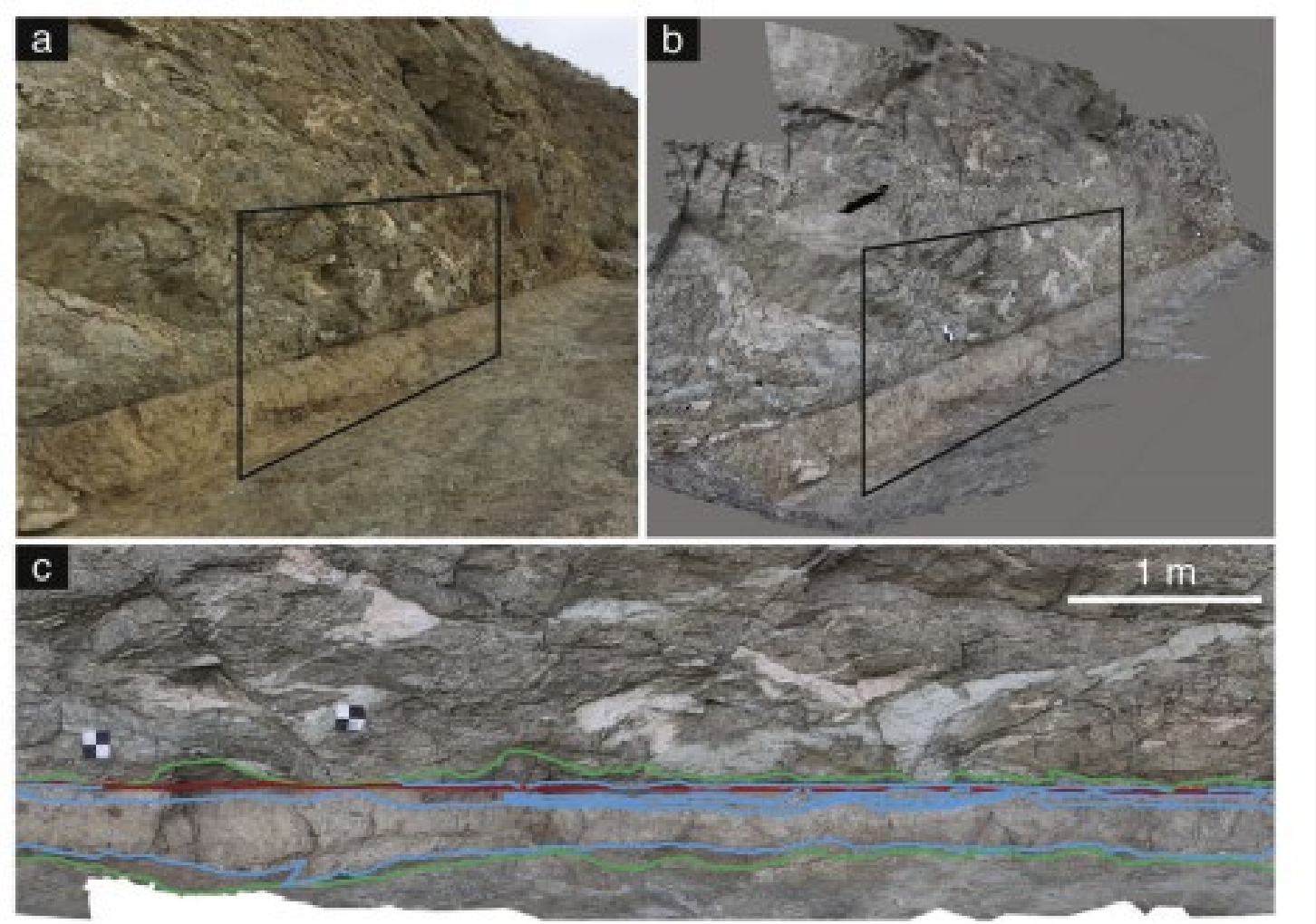

- Surfaces of older faults are smoother than younger, and in the slip-parallel direction
- Fault contains multiple generations of slip events
- Measured roughness of slip surface on the centimeter to 10 meter scale
- Apparent equilibrium between the various roughening and smoothing regimes




# Processes

- At the micro scale, grain plucking between layers acted to re-roughen by creating embayments
- Repeated grain plucking smooths at scales larger than grain size
- Clasts formed within inner fault core originate from sheared asperites, a smoothing event.
- Fracture surfaces around these clasts are rougher than surrounding rock

# *Methods*



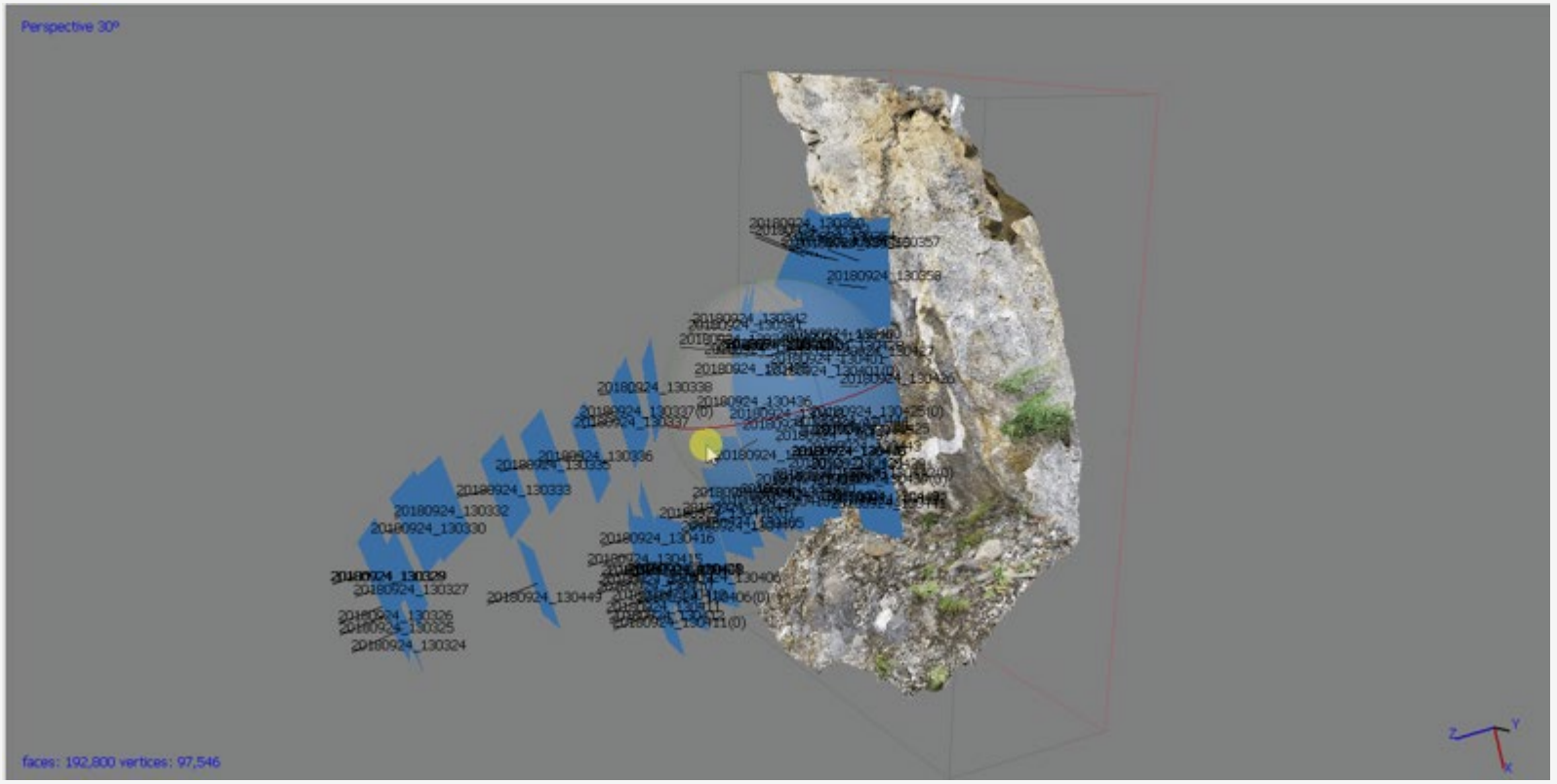

a) Photograph of the fault. b)Computer generated 3D model
c)Rectified texture of the fault after 3D generation.
Blue = inner fault, green = outer fault

- Fault outcrop mapped using photogrammetry
- 150 photos taken of a highly exposed (56.5%) fault
- External structure mapped using Structure from Motion technique
- Internal structure measured in the field using standard stereo-net methods

# *Photogrammetry Overview*

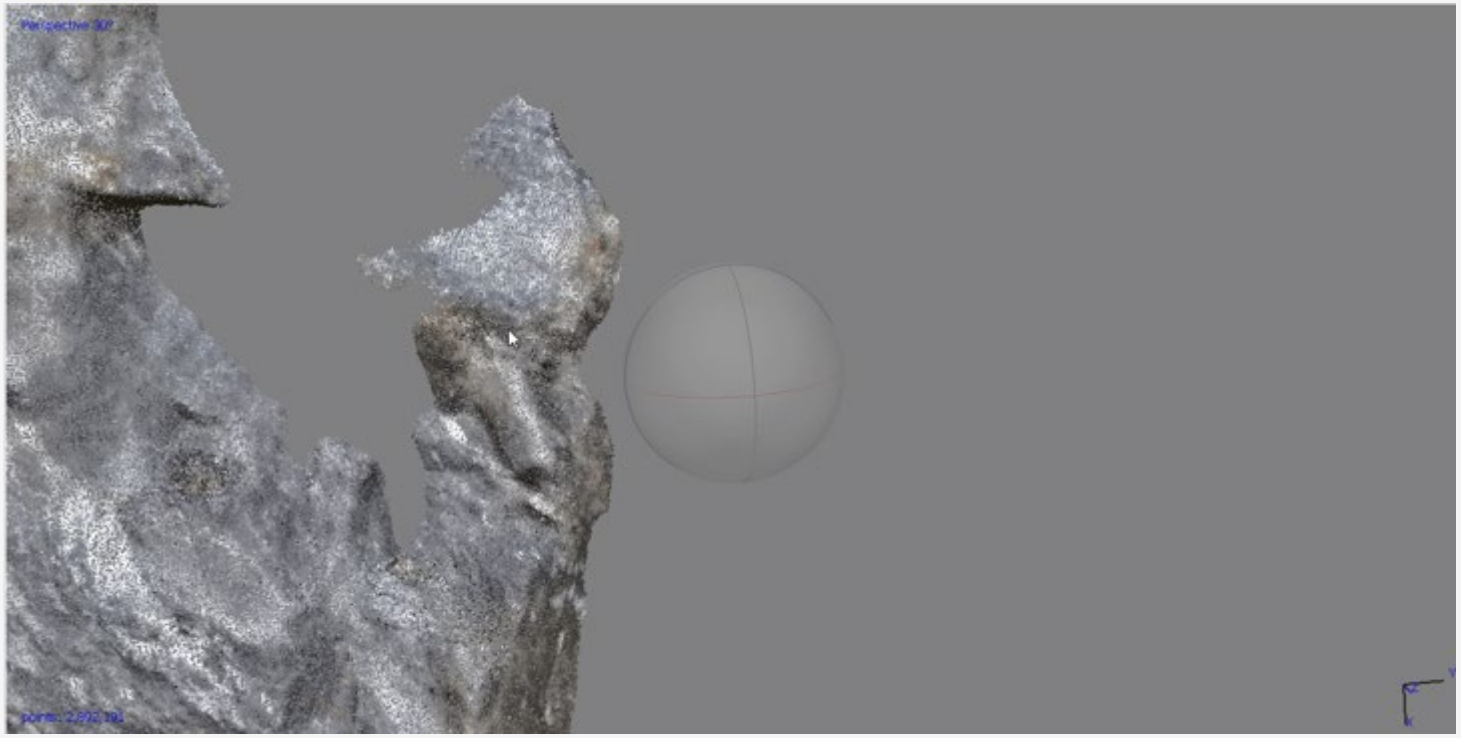
- Dozens to hundreds of photos are taken from varying angles in a consistent light (i.e. an overcast day, around noon)
- The program maps out a point cloud using the subtle shifts in shadows and edges from the movement of the camera
- This point cloud is used to generate polygons, and a texture from the photos is applied

Model by Alexander Bissell using Agisoft PhotoScan



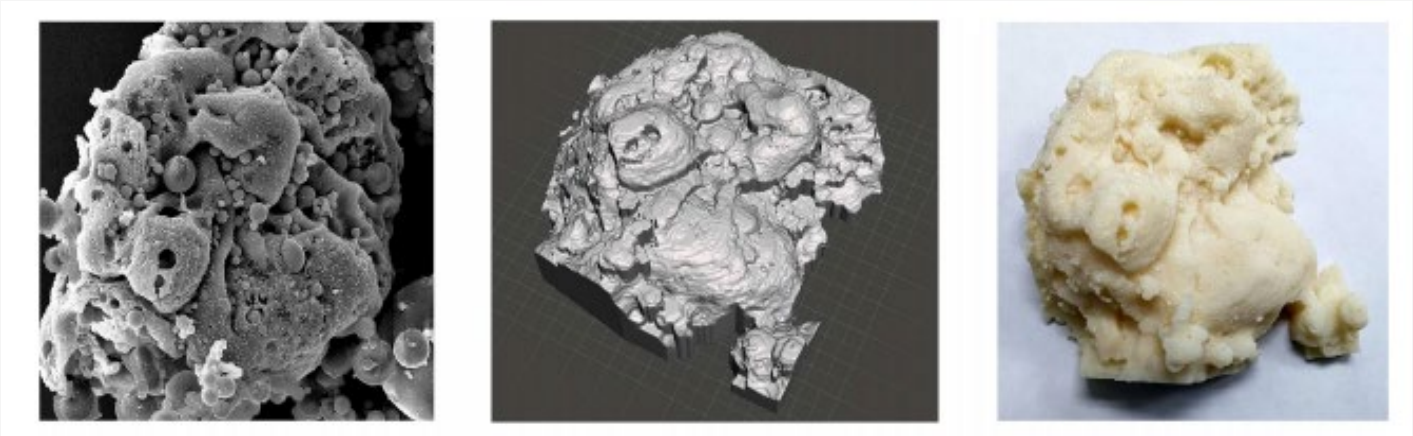

# *Rectifying Pictures*

- Photos are rectified against one another, as well as against GPS data
- Manual Tie-In points can be added to increase accuracy
- Using the GPS and compass in the phone, EXIF data from each photo is used to geo-rectify the outcrop
- In the original study, ground control points and reference markers were used.



# *Model Accuracy*

- Resolution of 1.2 mm/pixel
- Generated model will vary slightly each time it is generated
- Sub-cm accuracy is easily obtained
- Sub-mm accuracy requires more precise techniques ($$$)



# *Future studies*

- Use a Scanning Electron Microscope (SEM) to image on the grain scale
- Do topological analysis to find out neat things (i.e. moment of inertia)
- 3D print subsequent model for educational purposes
- Impress your friends and colleagues with hand specimens of fly ash

# *Questions?*

*(also seriously lets scan some microscopic stuff)*