

# ASTRA 2023

## Dynamic 3D Context Provision for Planetary environments: PRO3D Sequence Bookmarking

Author / Presenter: Gerhard Paar<sup>1</sup>

Co-Authors: Christoph Traxler<sup>2</sup>, Emily Cardarelli<sup>3</sup>, Andreas Bechtold<sup>4</sup>, Robert Barnes<sup>5</sup>, Sanjeev Gupta<sup>5</sup>

<sup>1</sup>JOANNEUM RESEARCH Forschungsgesellschaft mbH, DIGITAL - IVA, Graz, Austria

<sup>2</sup>VRVis Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH, Vienna, Austria

<sup>3</sup>Dept. of Earth, Planetary, and Space Sciences, University of California, Los Angeles, Los Angeles, CA, USA

<sup>4</sup>University of Vienna, Dpt. of Lithospheric Research, Vienna, Austria

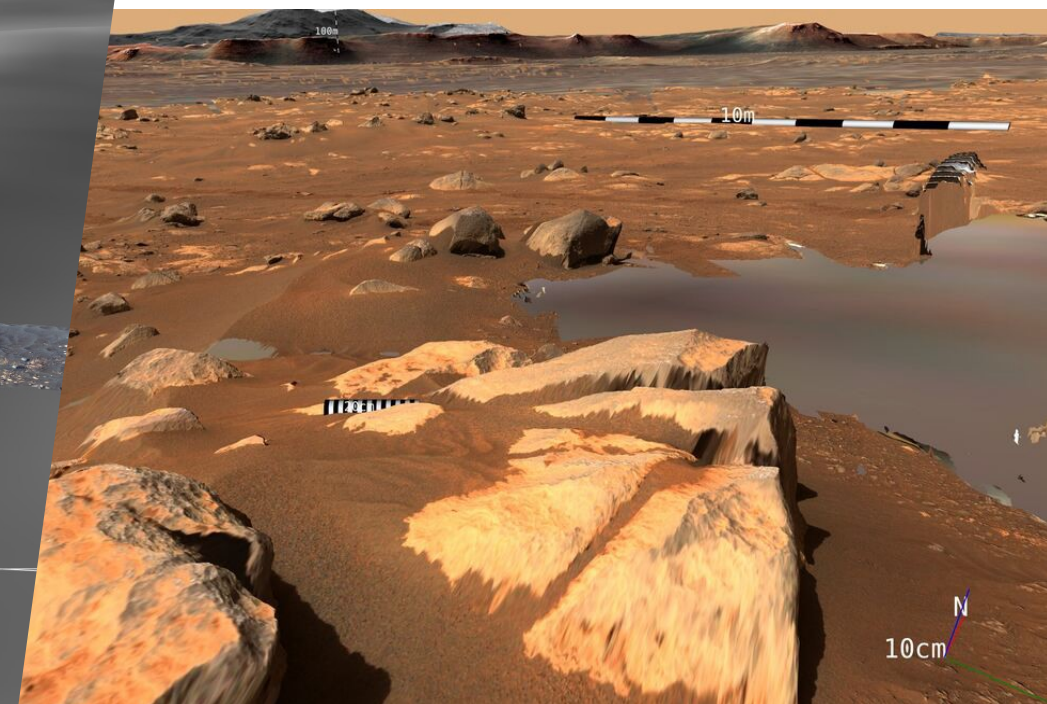
<sup>5</sup>Imperial College London, London, United Kingdom



Imperial College  
London

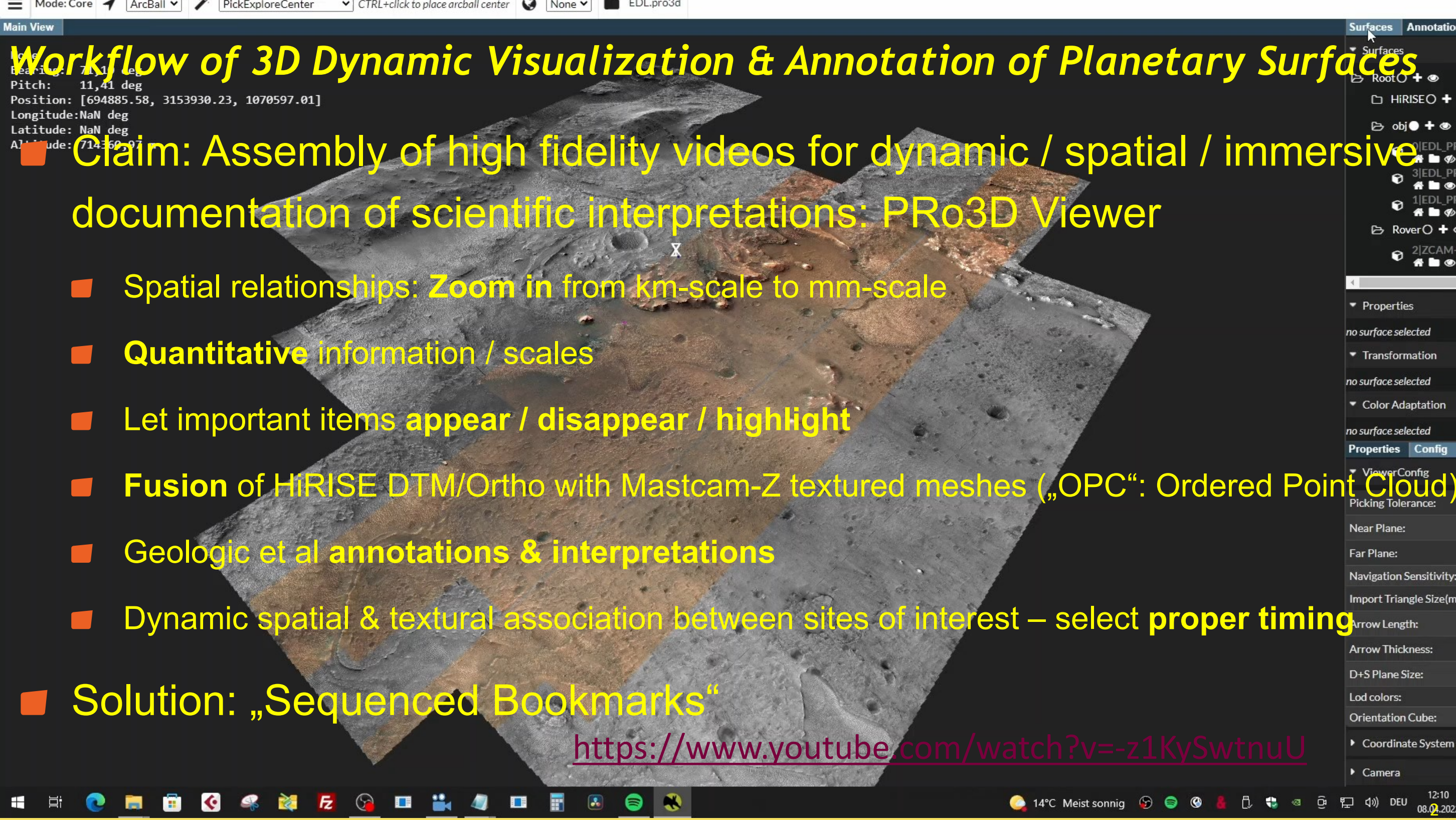


[Gerhard.Paar@joanneum.at](mailto:Gerhard.Paar@joanneum.at)



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All Graphics shown are crediting NASA/JPL/CalTech/ASU/MSSS/JR/VRVis/ÖAW/ICL



# Workflow of 3D Dynamic Visualization & Annotation of Planetary Surfaces

Claim: Assembly of high fidelity videos for dynamic / spatial / immersive documentation of scientific interpretations: PRo3D Viewer

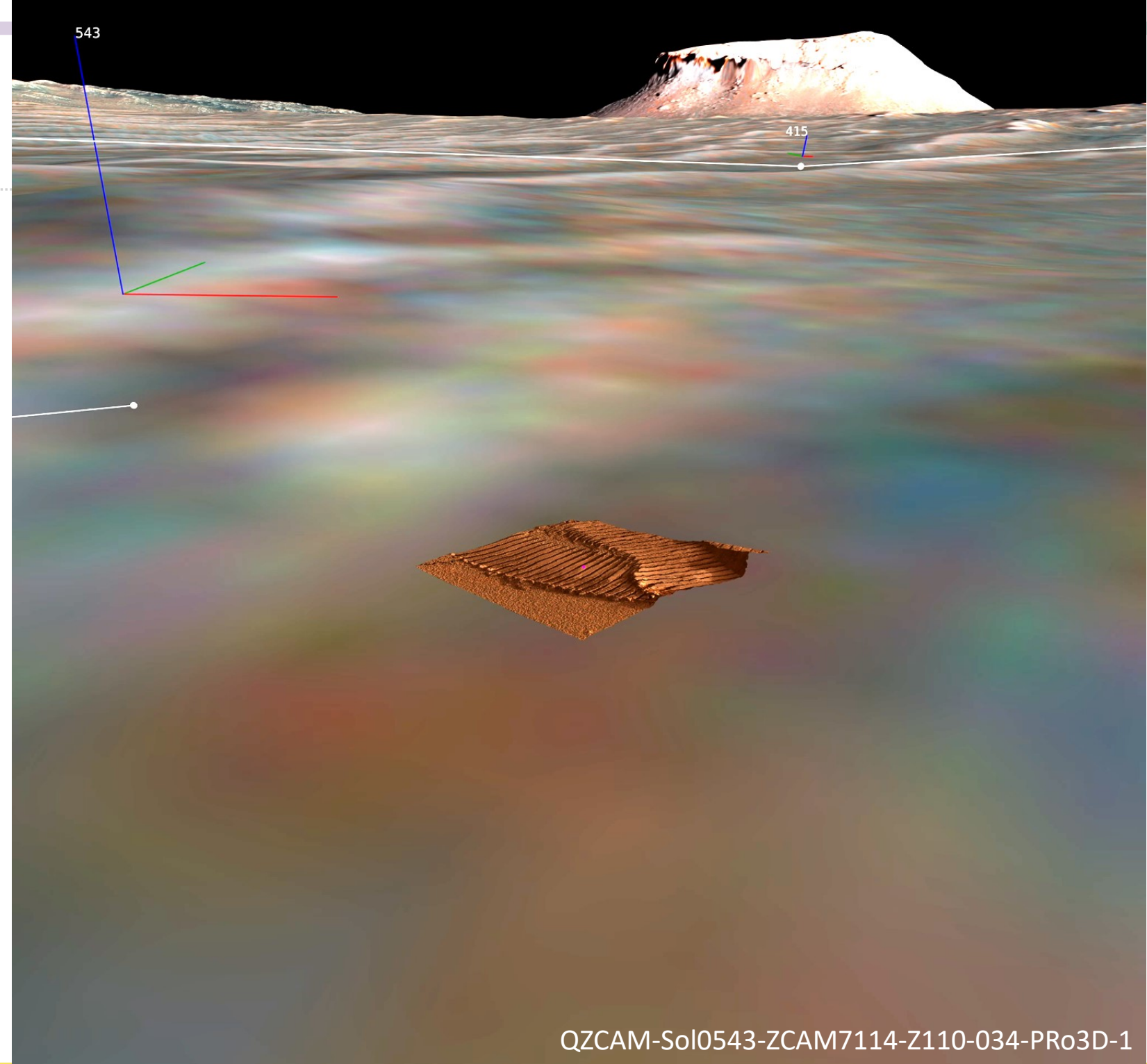
- Spatial relationships: Zoom in from km-scale to mm-scale
- Quantitative information / scales
- Let important items appear / disappear / highlight
- Fusion of HiRISE DTM/Ortho with Mastcam-Z textured meshes („OPC“: Ordered Point Cloud)
- Geologic et al annotations & interpretations
- Dynamic spatial & textural association between sites of interest – select proper timing
- Solution: „Sequenced Bookmarks“

<https://www.youtube.com/watch?v=-z1KySwtuU>



# ***A Simple Sequenced Boomarks Example***

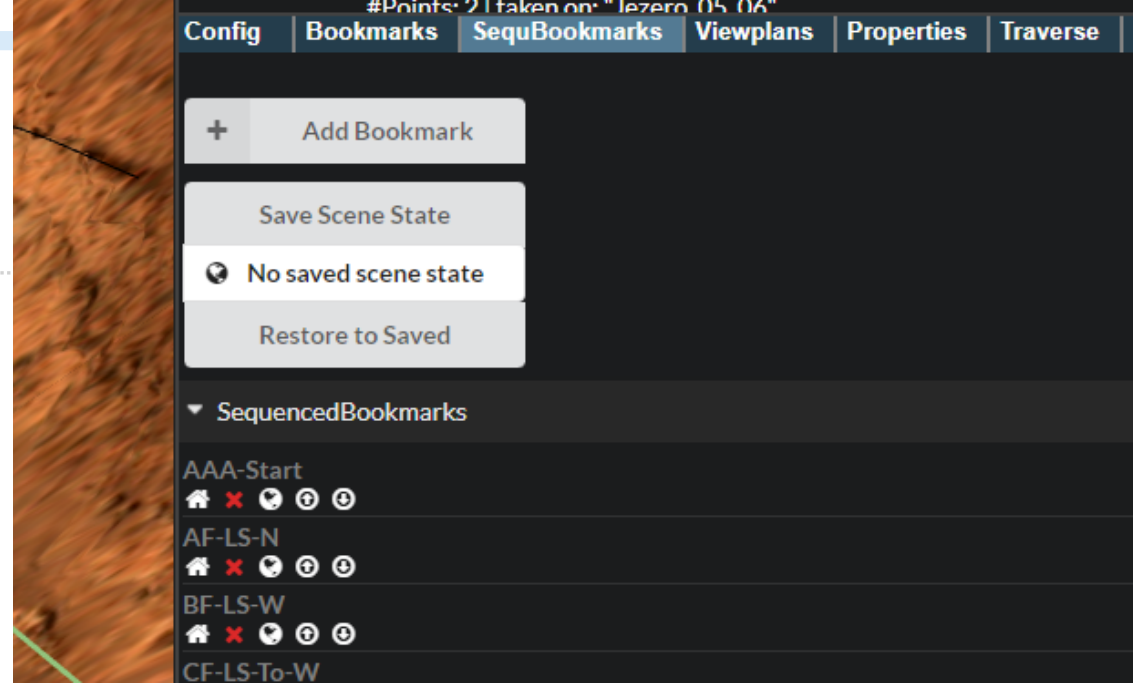
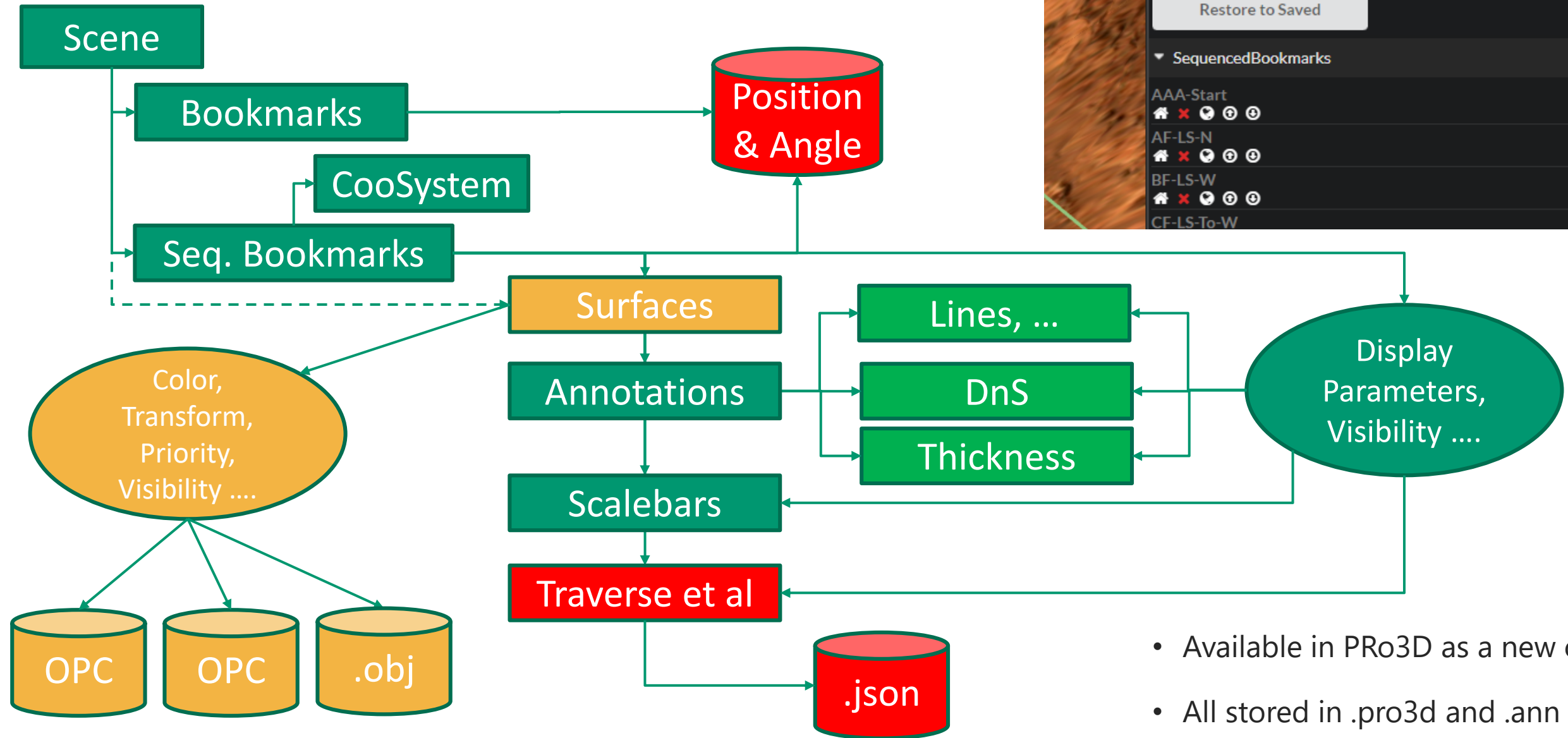
- Fusion of HiRISE DTM & Mastcam-Z OPCs
- Bookmarks Position for 3D virtual navigation
  - Viewing position & orientation
- Scale Bars appearing & disappearing
- 110mm higher resolution sequence reconstruction appearing midway
- Annotation shown & disappearing
- Timing as designed



QZCAM-Sol0543-ZCAM7114-Z110-034-PRo3D-1

<https://www.youtube.com/watch?v=Izef3FGXJGw>

# PRo3D Sequenced Bookmarks

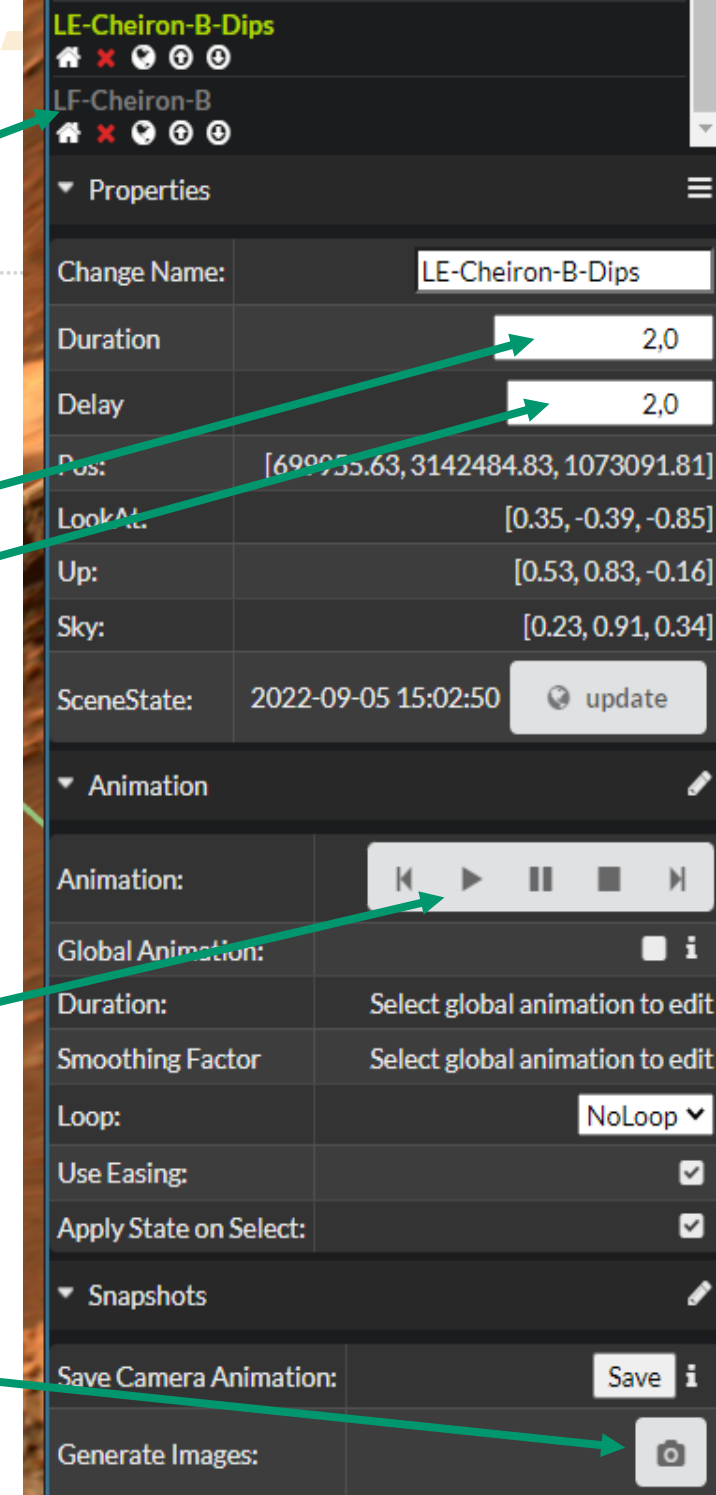


- Available in PRo3D as a new category
- All stored in .pro3d and .ann pair of files

Gerhard.paar@joanneum.at

# Sequenced Bookmarks: Video assembly within minutes

- Bookmarks' view defined incl. Naming
  - Should be compatible with your Video assembly SW
- Sequence of bookmarks defined
- Parameters per bookmark
  - Transition Duration
  - Static Duration
  - Scene features (**visibility**,...)
- *Real-Time Playback for testing*
- Saving capturing .json & launching off-line capture
  - Typical duration: 1sec per HD frame



Cheiron

# Visibility et al

Show Text:	<input checked="" type="checkbox"/>
Visible:	<input type="checkbox"/>
Show DnS:	<input type="checkbox"/>
Show Text:	<input type="checkbox"/>
Visible:	<input type="checkbox"/>
Show DnS:	<input type="checkbox"/>
Dip Angle:	

- Scalebars
- Measurements
- Dip-and-Strike
- Thickness
- Coordinate frame
- Lines / Polygons
- Rover Traverse
- Loaded Surfaces
- Imported Surfaces
- Zoom Factor
- ....

Gerhard.paar@joanneum.at

# After Export: Clips in Video Editor

Master

Timeline 1

[003204-00...]

[002962-00...]

[002636-00...]

[002406-00...]

[002158-00...]

[002042-00...]

[001818-00...]

[001546-00...]

[001304-00...]

[001134-00...]

[000910-00...]

[000801-00...]

[000571-00...]

[000377-00...]

[000159-00...]

[000067-00...]

Smart Bins

Keywords



Timeline playback controls: stop, play, previous, next, first, last, refresh, zoom in, zoom out, zoom reset, volume, mute, solo, dim.

Timeline ruler and zoom controls: 01:00:00:00, 01:00:00:00, 01:00:12:00, 01:00:24:00, 01:00:36:00, 01:00:48:00, 01:01:00:00.

Video 1 track: [000067-00...]

2 Clips

[000067-00...]

[000159-00...]

[000067-00...]

Toolbox

Cross Fade

Video Transiti...

Audio Transiti...

Favorites

Cross... 0 dB

Cross Fade +3 dB

Cross Fade -3 dB

Cross Fade 0 dB

Dissolve

Mixer

A1 Bus1

EQ

Audio 1 Bus 1

S M M

0.0 0.0

-5 -5

-10 -10

-15 -15

-20 -20

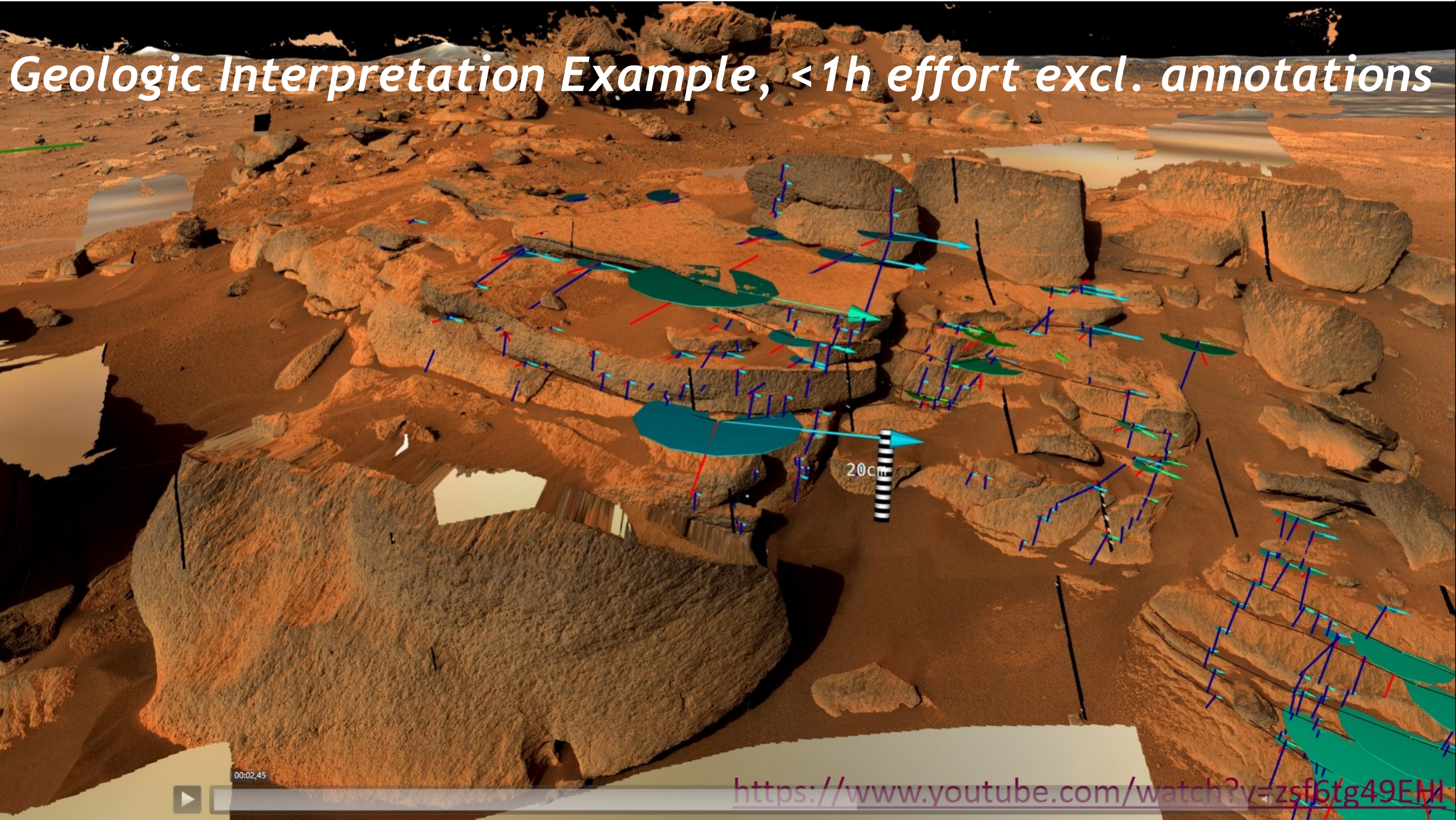
-30 -30

-40 -40

-50 -50



# Geologic Interpretation Example, <1h effort excl. annotations



00:02,45



<https://www.youtube.com/watch?v=zs6tg49EM>

Mars (IAU ellipsoid)

Bearing: 55,82 deg

Pitch: -44,27 deg

Position: [702181.60, 3141692.73, 1074090.53]

Latitude: 18,451311735850435 deg

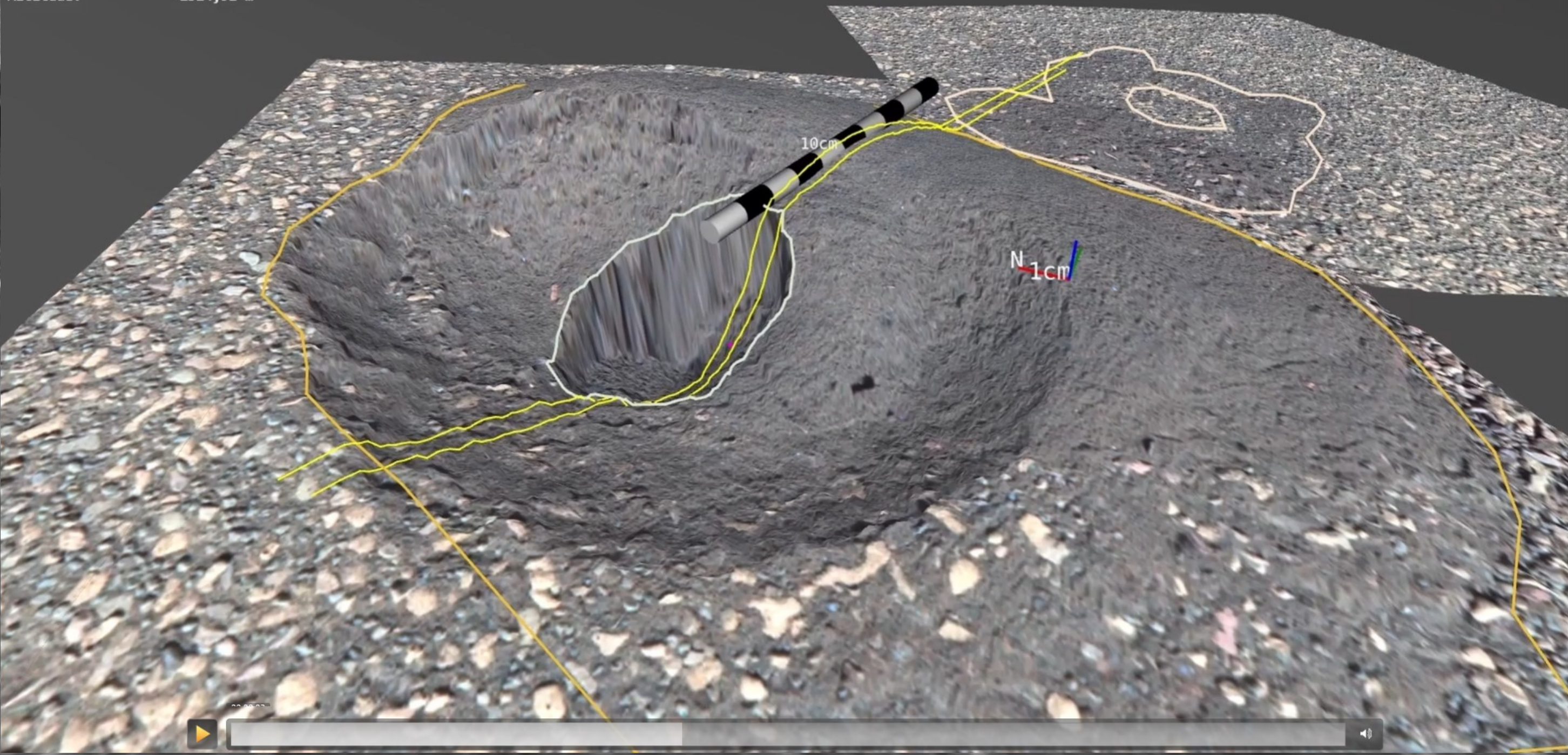
Longitude: 77,40121462918984 deg

Altitude: -2524,92 m

# Regolith Sample Documentation: Sample Hole Depths

Credits: Elisabeth Hausrath

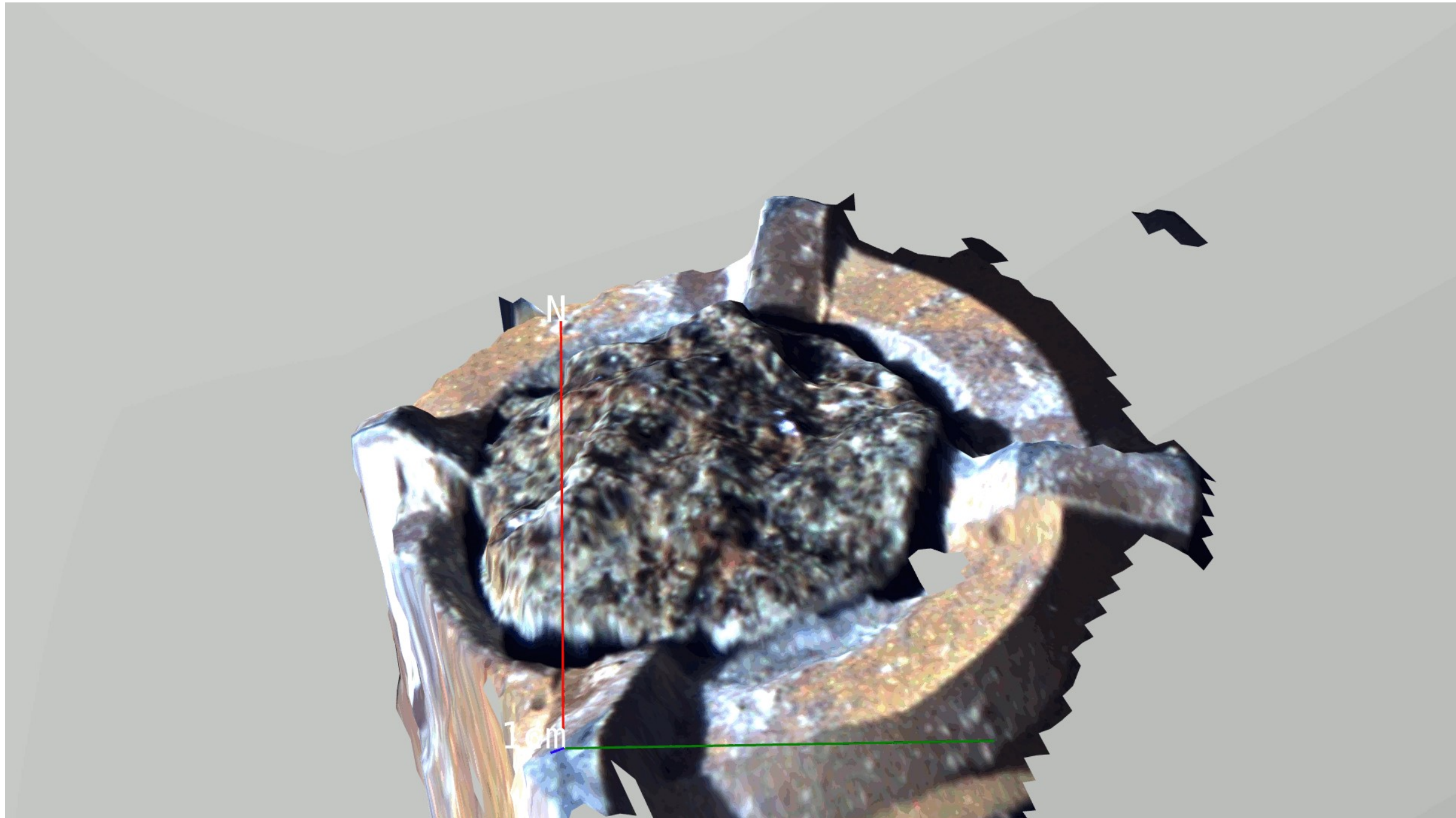
10



# Regolith Analysis: Angle of Repose



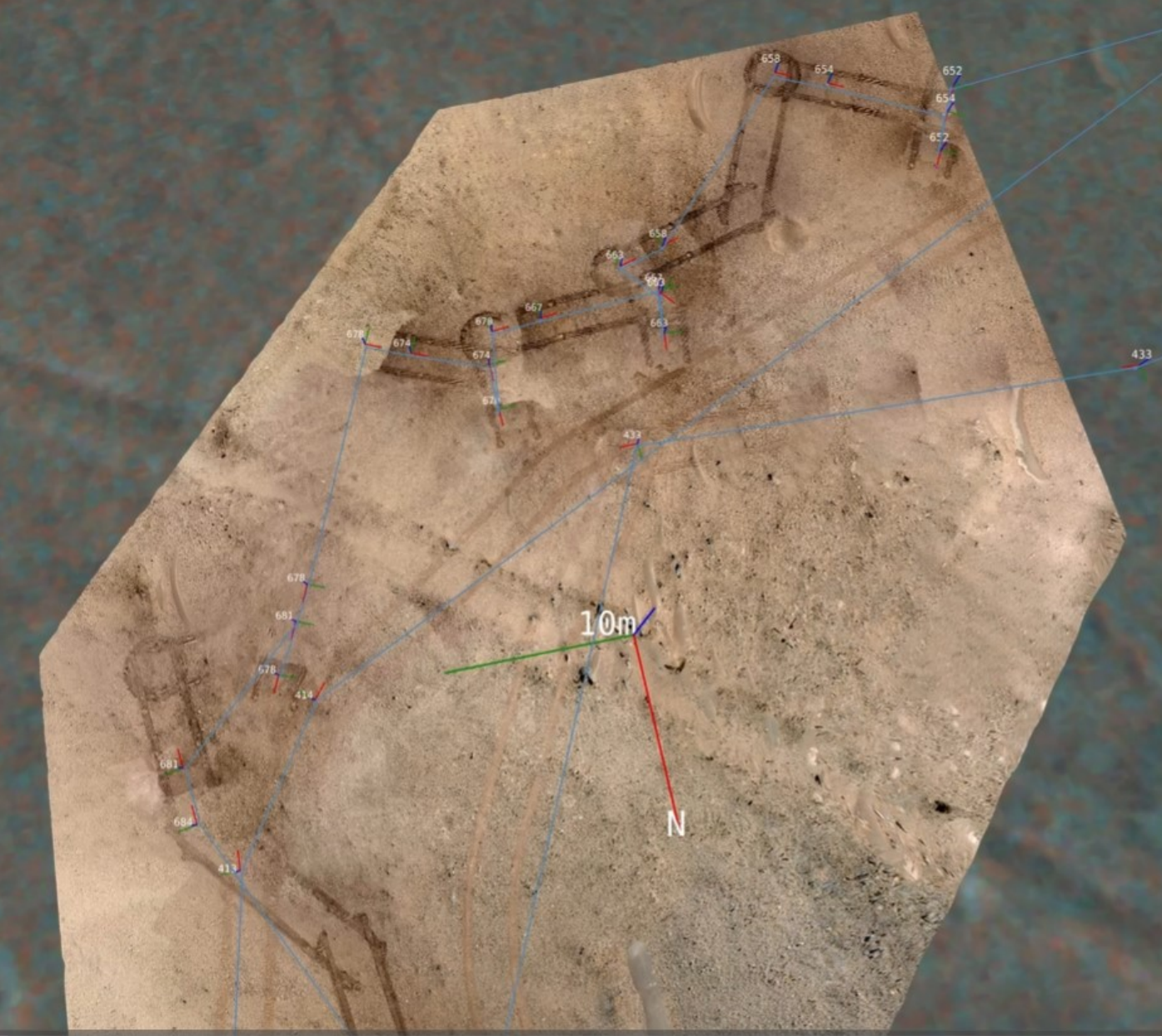
# Lefroy\_Bay Core Characterization



[Gerhard.paar@joanneum.at](mailto:Gerhard.paar@joanneum.at)

Mars (IAU ellipsoid)  
Bearing: 181,46 deg  
Pitch: -70,62 deg  
Position: [701793.13, 3141780.24, 1074204.39]  
Longitude: 18,45313137564317 deg  
Latitude: 77,40830193817908 deg  
Altitude: -2488,23 m

# Three Forks Sample Depot. Credits: Cornell Univ / Christian Tate



Surfaces Annotations ScaleBars

Annotations

root

Dip&Strike ColorLegend

Actions

no annotation group selected

Config Bookmarks SequencedBookmarks

Add Bookmark

Save Scene State

No saved scene state

Restore to Saved

SequencedBookmarks

- Bookmark 15
- Bookmark 13
- Bookmark 14
- Bookmark 16
- Bookmark 0
- Bookmark 1
- Bookmark 2
- Bookmark 3
- Bookmark 4
- Bookmark 5
- Bookmark 6
- Bookmark 7
- Bookmark 8
- Bookmark 9
- Bookmark 10
- Bookmark 11
- Bookmark 12

Properties

Change Name: Bookmark 4

Duration: 4.6

Delay: 0.9

Pos: [701773.07, 3141725.85, 1074203.09]

LookAt: [-0.25, 0.08, -0.97]

Up: [0.14, 0.99, 0.04]

Sky: [0.21, 0.93, 0.32]

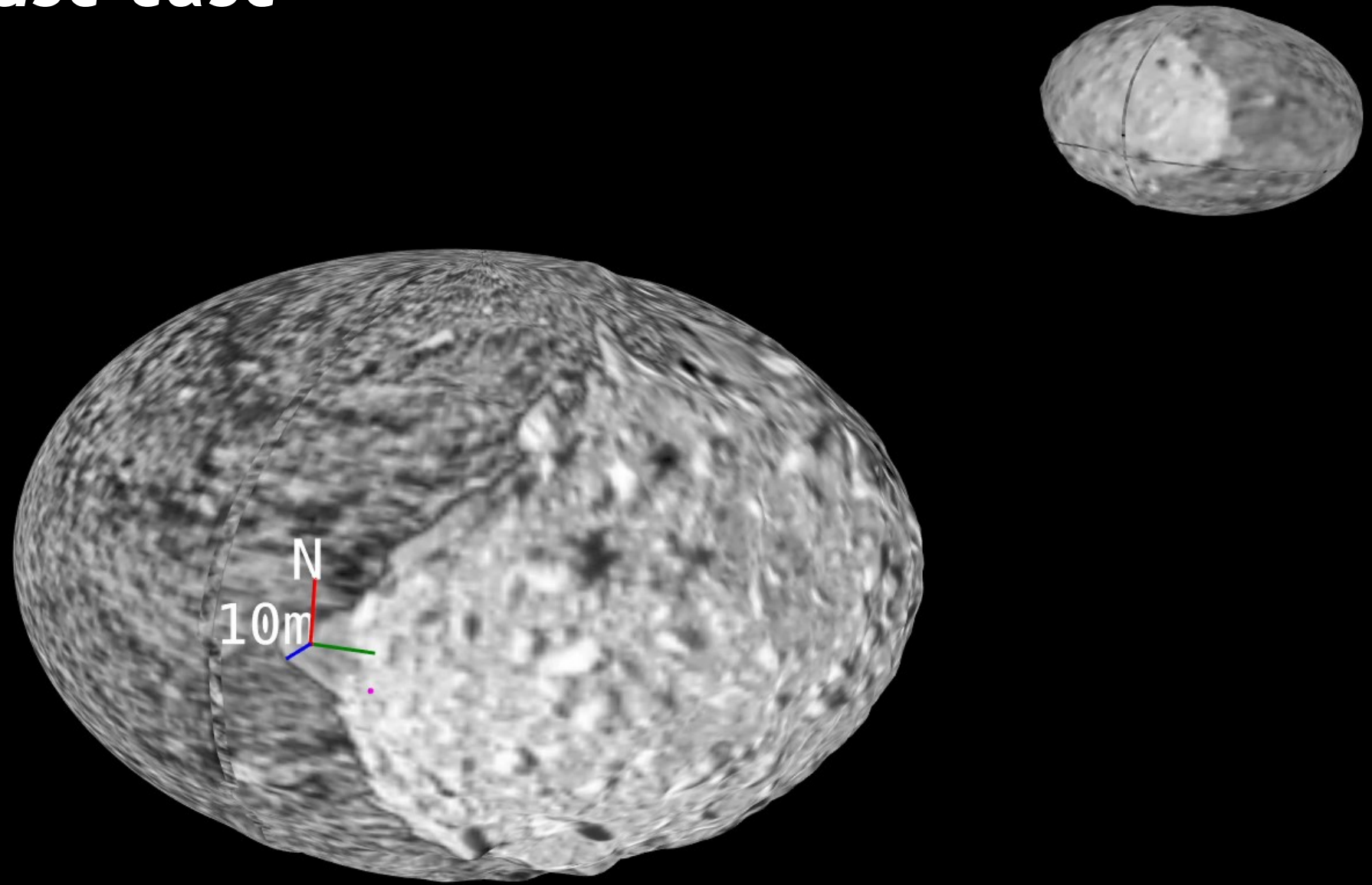
SceneState: 2023.06.19 22:00:07

Animation

Animation: [play button]

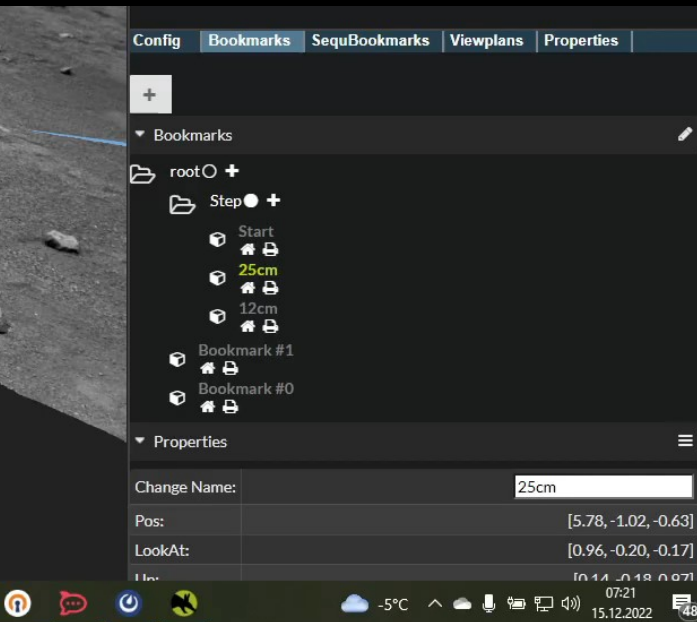
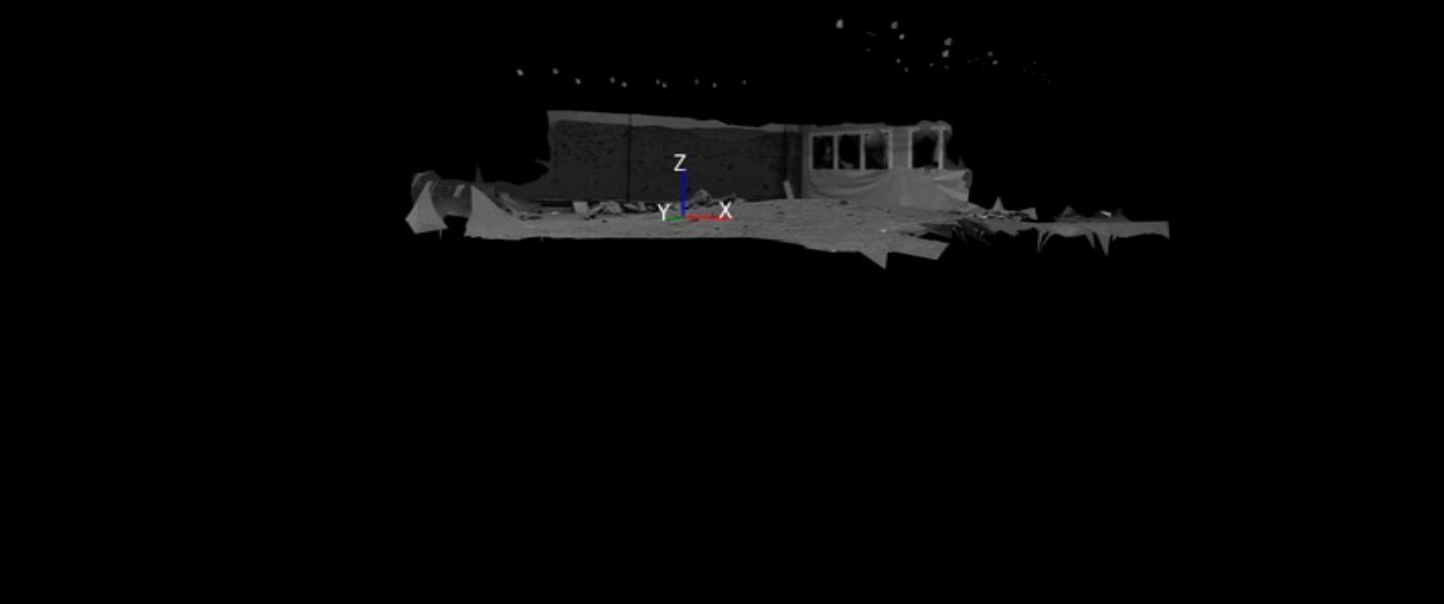
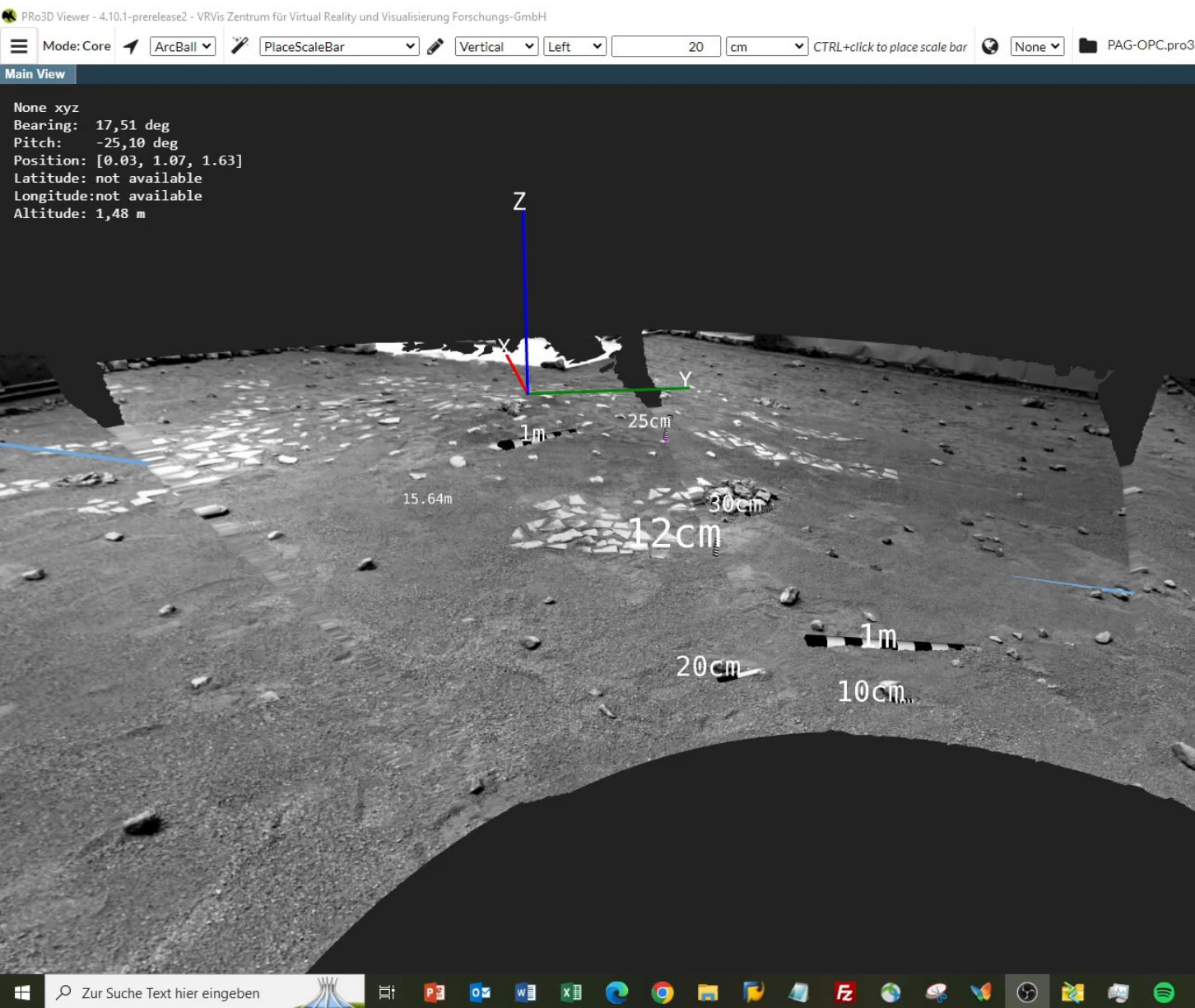
Global Animation: [play button]

# *Hera as further use case*



*Credits: DART Team, Hera Team, ESA  
60/40 simulated / real data*

# ExoMars GTM Data

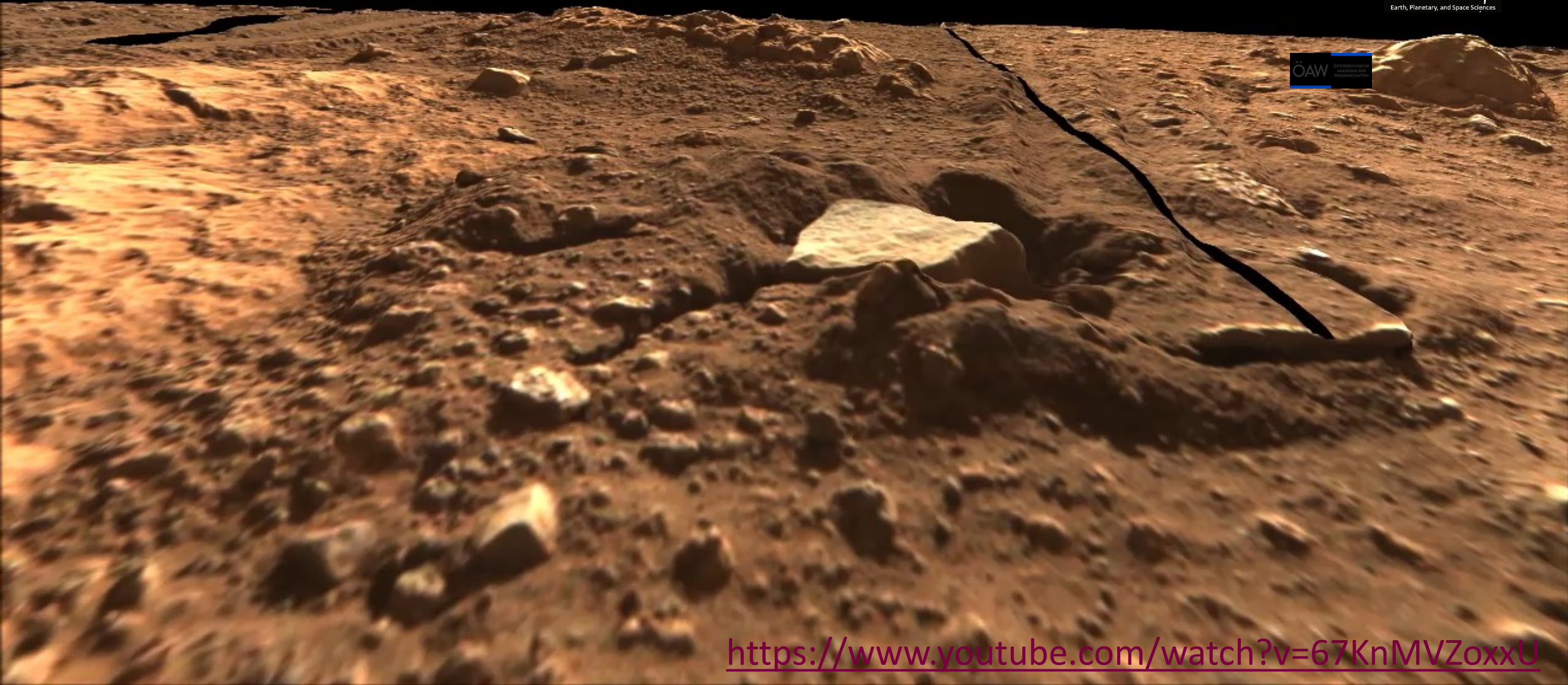


Structure-from-Motion 3D Model

Gerhard.paar@joanneum.at

Assessment of calibration glitches

<https://github.com/pro3d-space/PRo3D>



<https://www.youtube.com/watch?v=67KnMVZoxxU>