Image-based Reconstruction of Virtual Lava Tube

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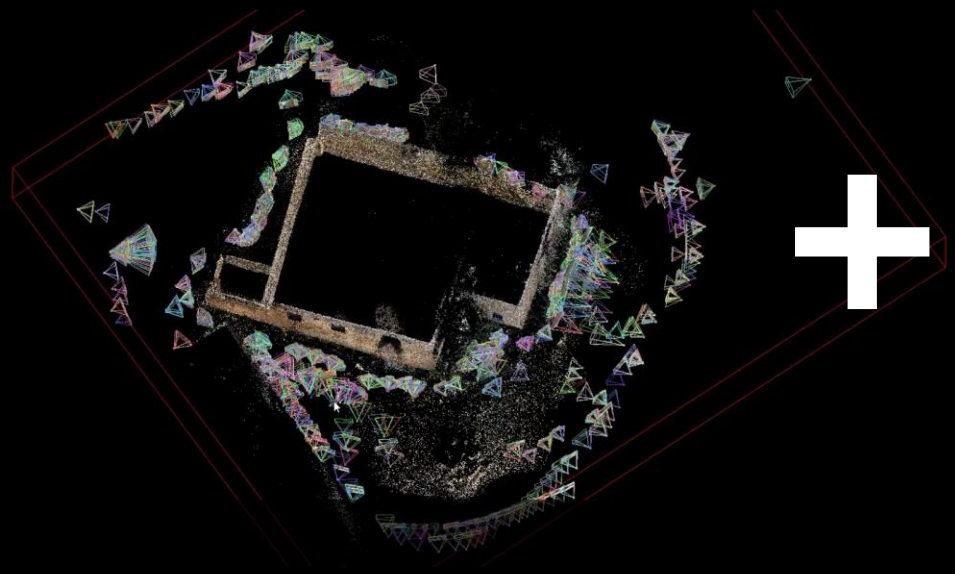
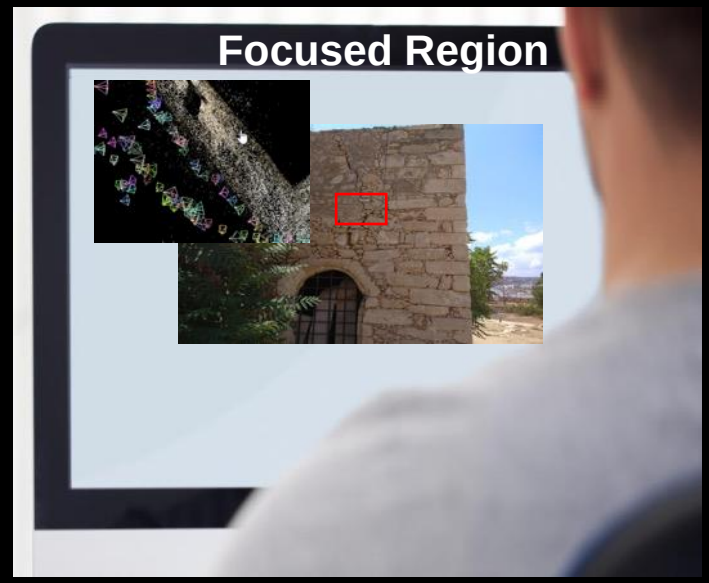
Objective

Reconstruct an **image-based virtual Lava Tube** using images collected on the site to learn the **formation** and **structural characteristics** of Lava Tube remotely so as to process and analyze highly focused areas at a time which may decipher useful information of extraterrestrial habitats.



Reconstructed Model

Original Images

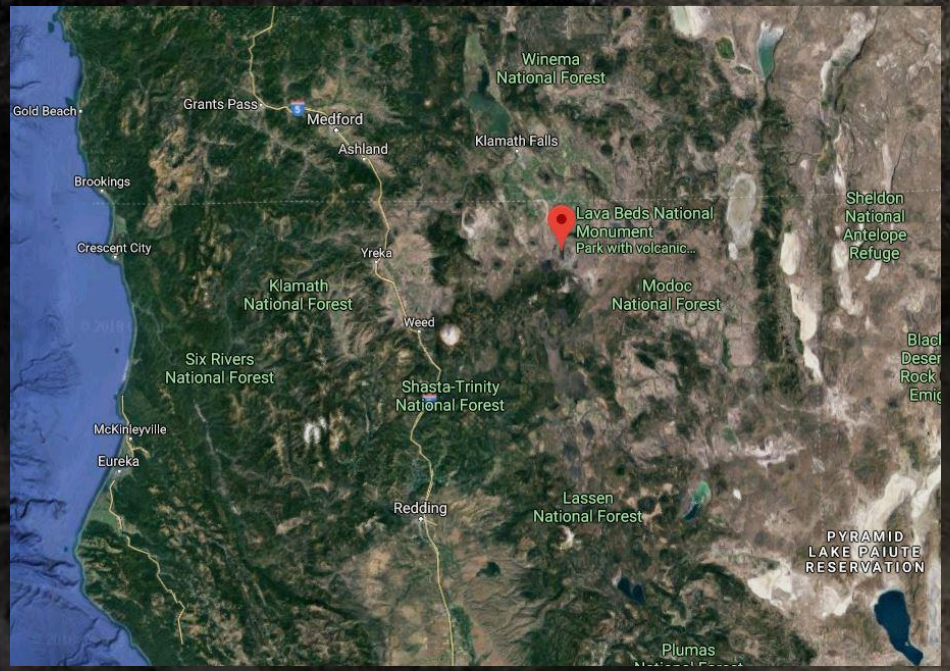


Virtual Tour & Observation

U.S National Park

Lava Beds National Monument

- There are over 2,000 caves in the park
- We explored 9 caves at first day
- We chose two caves that meets for both geological and reconstruction purposes



Valentine Cave Section 2, direction ‘left’

Data Output from the Lava Tube

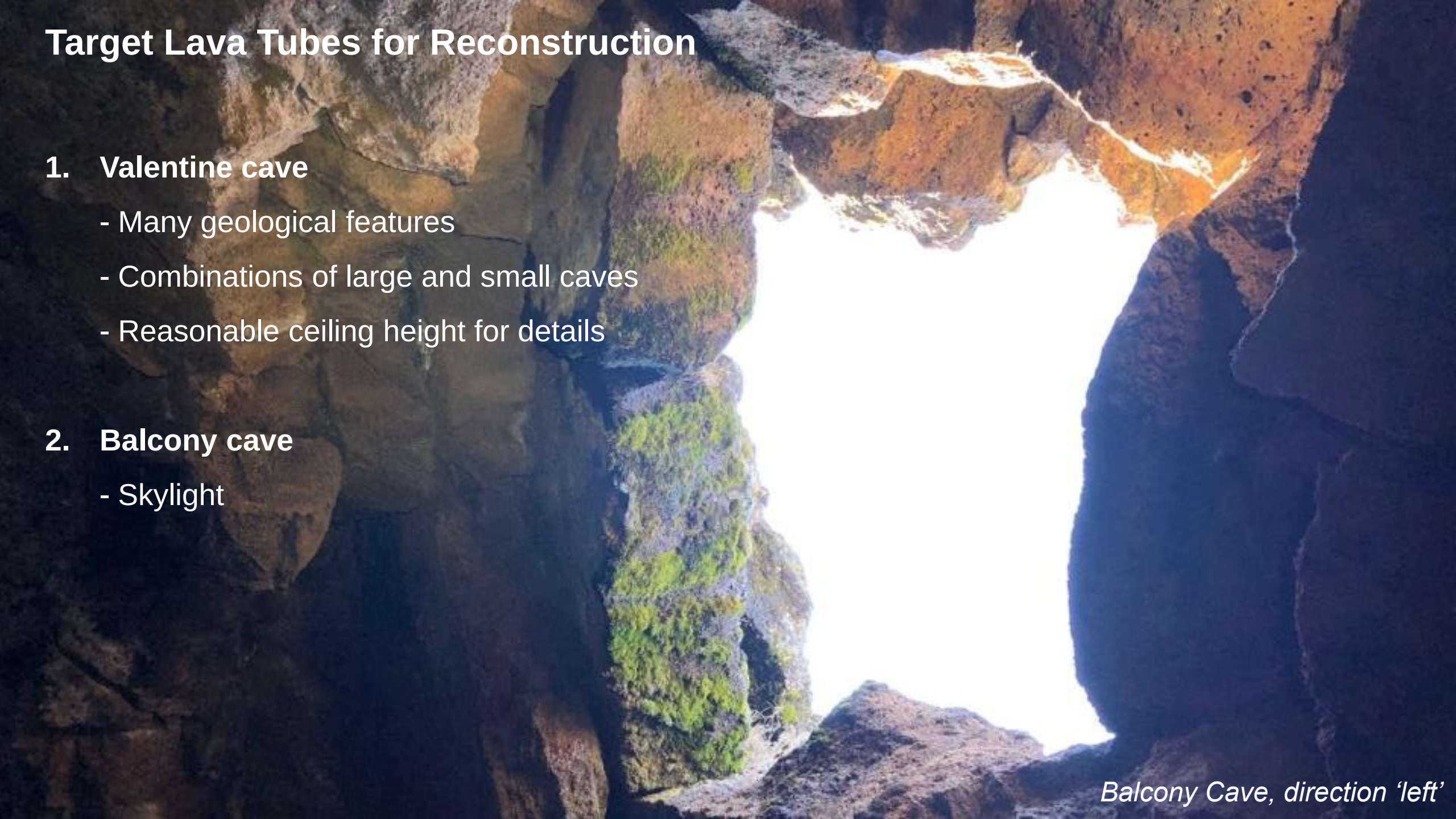
- Provide a **large volume of high-quality images**
- Provide **reconstructed lava tube** for virtual tour.
- Provide a **video form** of the virtual tour
- Provide a **measurement capability** using the reconstructed lava tube

Valentine Cave Section 2, direction ‘right’

Target Lava Tubes for Reconstruction

1. **Valentine cave**
   - Many geological features
   - Combinations of large and small caves
   - Reasonable ceiling height for details

2. **Balcony cave**
   - Skylight



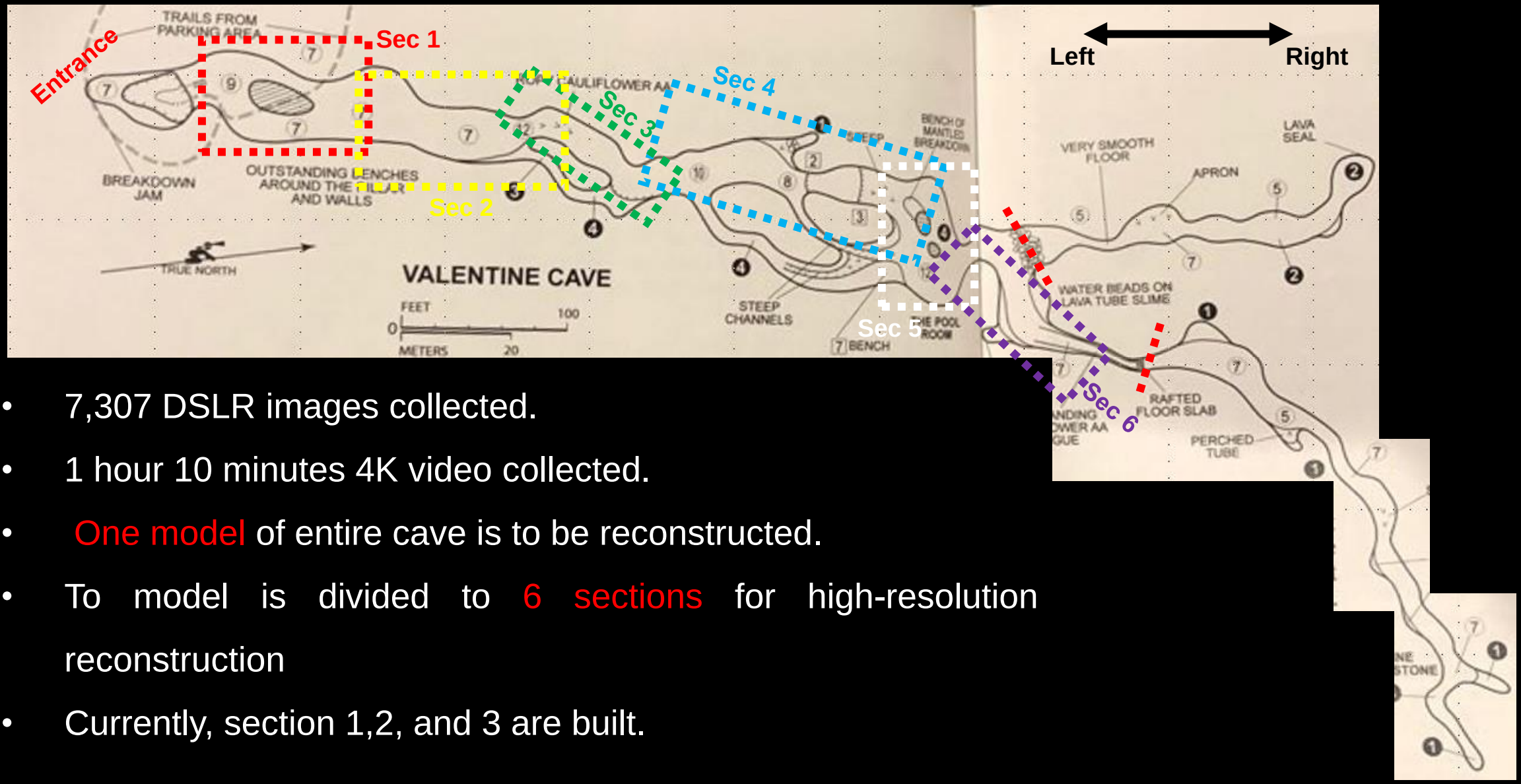
Balcony Cave, direction ‘left’

Limitation

- Reconstructed model has some blurry regions or spherical shape objects.
- Reconstructing ‘One Model’ is inefficient in terms of virtual investigation and computation cost.
  - ‘One Model’ in medium-quality
  - Six separated models in high-quality

Balcony Cave, direction ‘left’

Valentine Cave Reconstruction

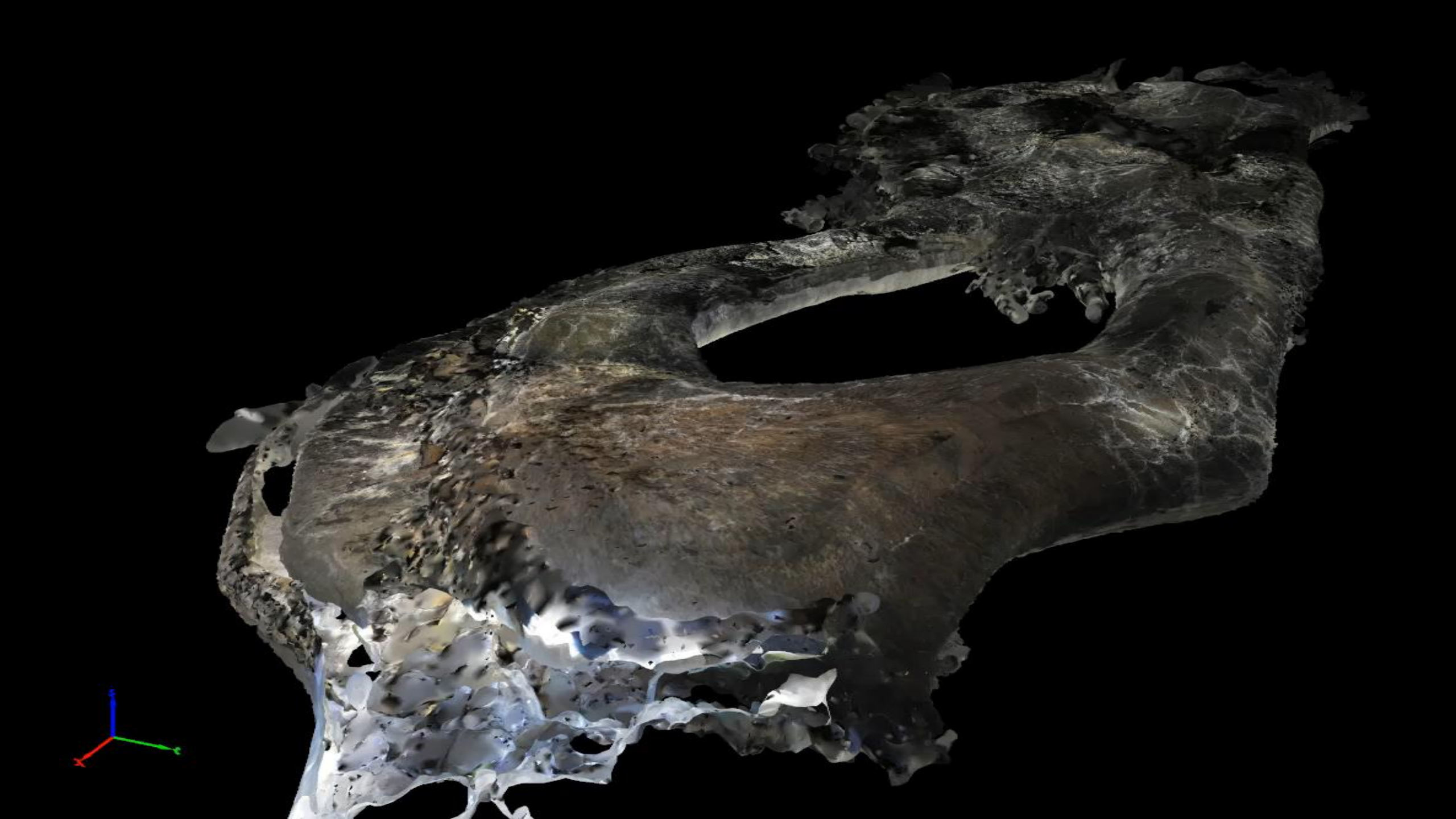


- 7,307 DSLR images collected.
- 1 hour 10 minutes 4K video collected.
- One model of entire cave is to be reconstructed.
- To model is divided to 6 sections for high-resolution reconstruction
- Currently, section 1,2, and 3 are built.

Section 1 Reconstruction – Valentine Cave

- Video version
- Measurement
- 3D model

Valentine Cave Section 1, direction ‘left’



Pix4Ddiscovery - Non Commercial - home_valentine_full_01234567

Project Process View rayCloud Help

Project Process View Navigation Clipping Point Cloud Editing

Unclassified Assign

Click for Trial

Home
Map View
rayCloud
Volumes
Mosaic Editor
Index Calculator
Processing
Log Output
Processing Options

Create

Layers

- Cameras
- Rays
- Tie Points
- Point Clouds
- Point Groups
  - Display Properties
    - Unclassified
    - Disabled
    - Ground
    - Road Surface
    - High Vegetation
    - Building
    - Human Made Object
- Triangle Meshes
- Objects
  - Polylines
    - Display Properties
  - Surfaces
  - Animation Trajectories
  - Orthoplanes
  - Scale Constraints
    - Display Properties
      - Vertex Color
      - Vertex Radius
      - Line Color
      - Line Width
    - Scale 1
  - Orientation Constraints

Properties

Selection

Scale 1 (Scale Constraint)

GCP/MTP Labels: mtp3, mtp4

Computed Length [m]: 0.000 ±0.000

Initial Length [m]: 9.46 ± 0.001

Apply Cancel Help

Instructions

Images

Image Size Zoom Level

Processing

1. Initial Processing 2. Point Cloud and Mesh 3. DSM, Orthomosaic and Index

Current: 0%

Total: 2. 0/8

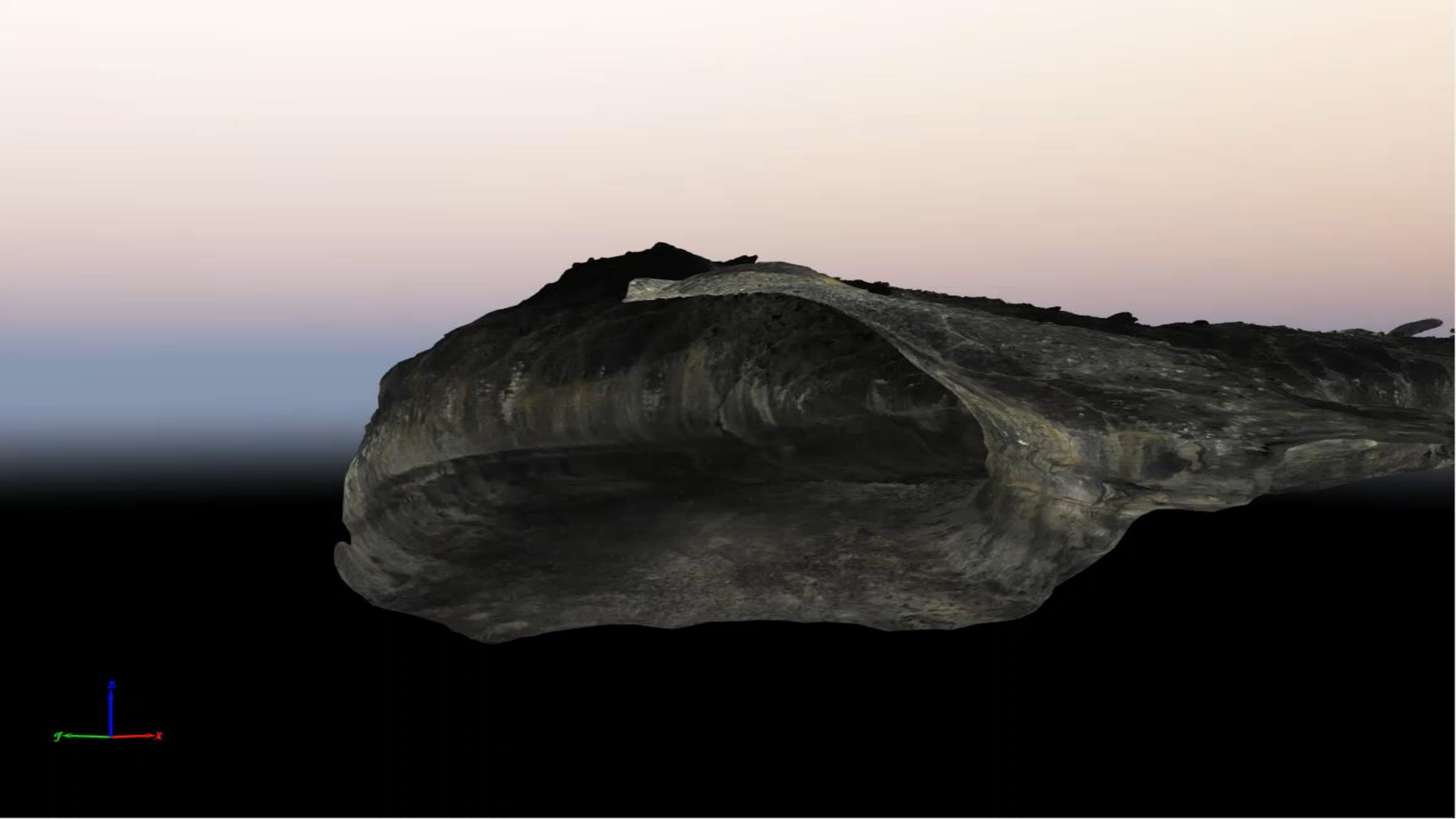
Output Status... Start Cancel Help

Arbitrary (m) - (3.50, 9.10, -0.

Section 3 Reconstruction – Valentine Cave

- 3D model
- Video version

Valentine Cave Section 3, direction ‘left’

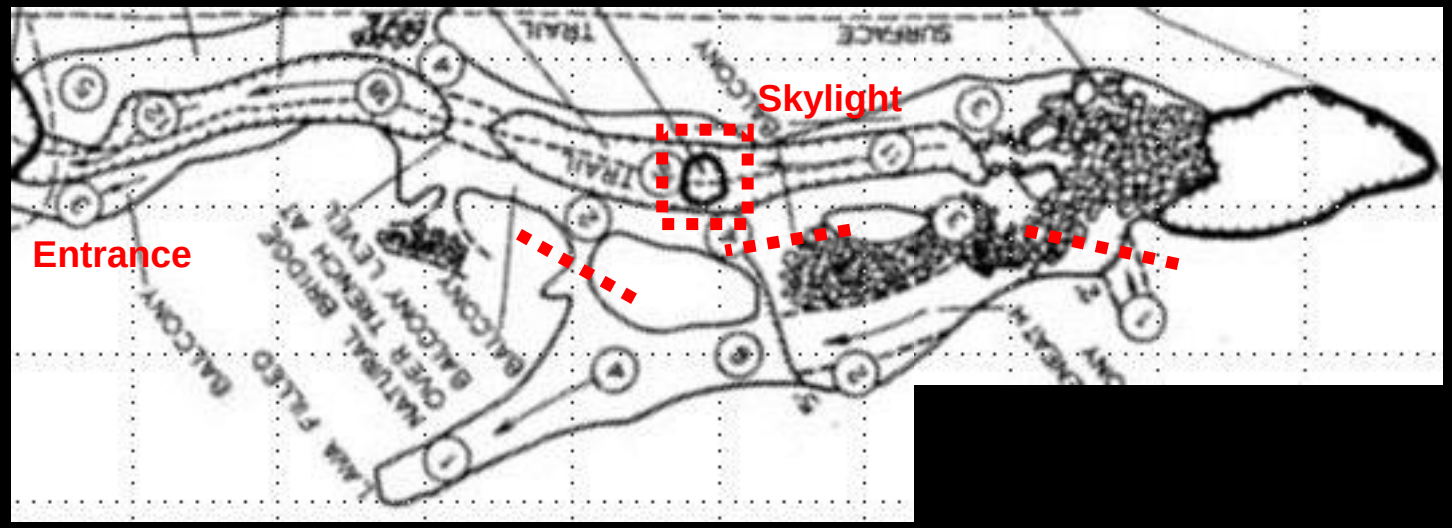

z
y
x

I will provide..

- One model of entire Valentine cave: mid-quality
- Six models from Valentine cave: high-quality
- One model of entire Balcony cave: high-quality
- All images and video footages

Balcony Cave, direction ‘right’

Balcony Cave Reconstruction



- 1,780 DSLR images collected.
- 20 minutes 4K video collected.
- One model of entire cave is to be reconstructed.
- No section division

Section 2 Reconstruction – Balcony Cave

- 3D model
- Video version
- Measurement

Valentine Cave Section 2, direction ‘right’