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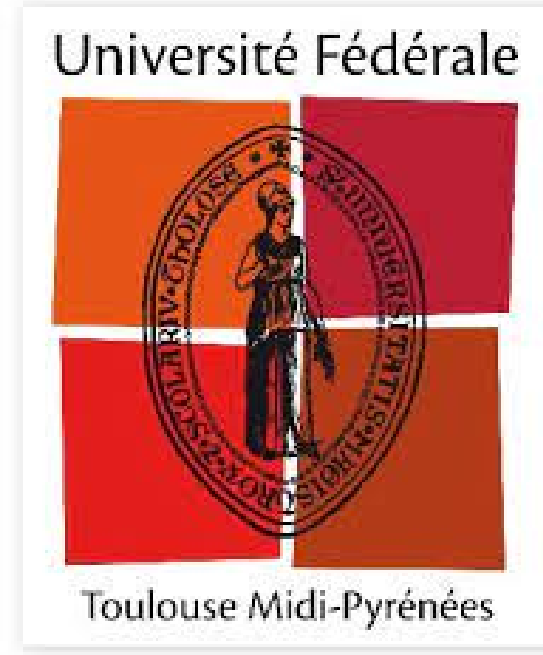


# CONTRIBUTIONS OF PHOTOMETRY TO THE 3D-DIGITIZATION OF HERITAGE

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## NEED FOR 3D-DIGITIZATION

Three main objectives in 3D-digitization of cultural heritage:

- Conservation of the remains
- Analysis of the artifacts
- Transmission of heritage

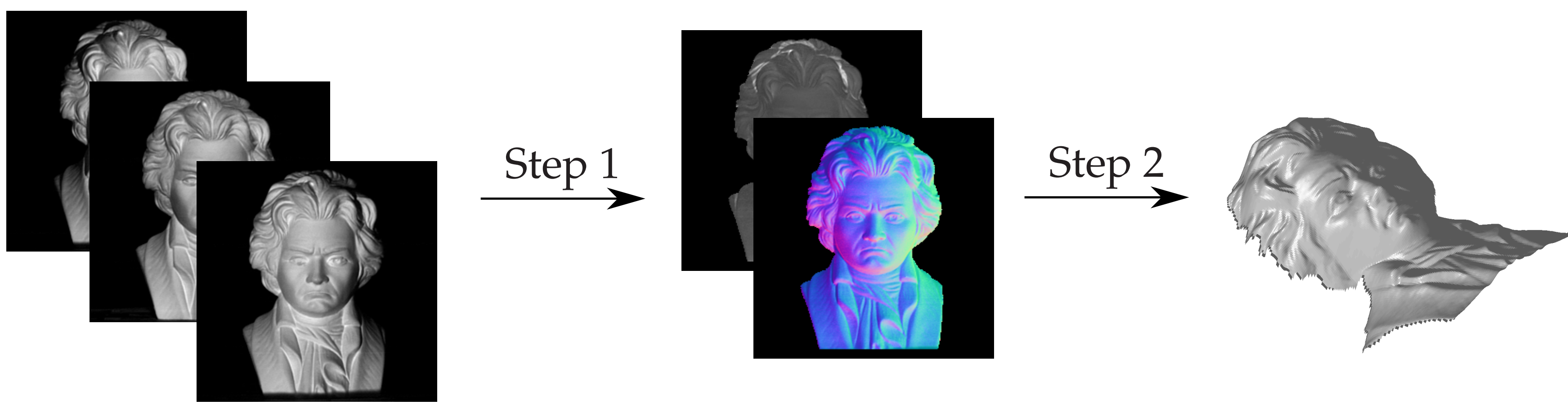
## 3D-SCANNING TECHNIQUES USED IN ARCHAEOLOGY

- Lasergrammetry and photogrammetry: reconstruct the scene in 3D, but not precise enough for micro-reliefs.
- Reflectance Transformation Imaging (RTI): highlights the micro-reliefs by simulating a grazing light, but without reconstructing them.
- Contribution: adapting photometric stereo to archaeology reconstruct micro-reliefs.

## PHOTOMETRIC STEREO (PS) [1]

- Goal: from  $m$  images  $I^i$  and  $m$  light vectors  $s^i$ , estimate a depth map  $z$ .
- Lambertian model: 
$$I^i = \underbrace{\rho}_{\text{Albedo}} \times \underbrace{s^i \cdot n(z)}_{\text{Shading}}$$

Greylevel                      Albedo                      Shading
- Two-step pipeline: normal and albedo maps estimation, then normal integration.

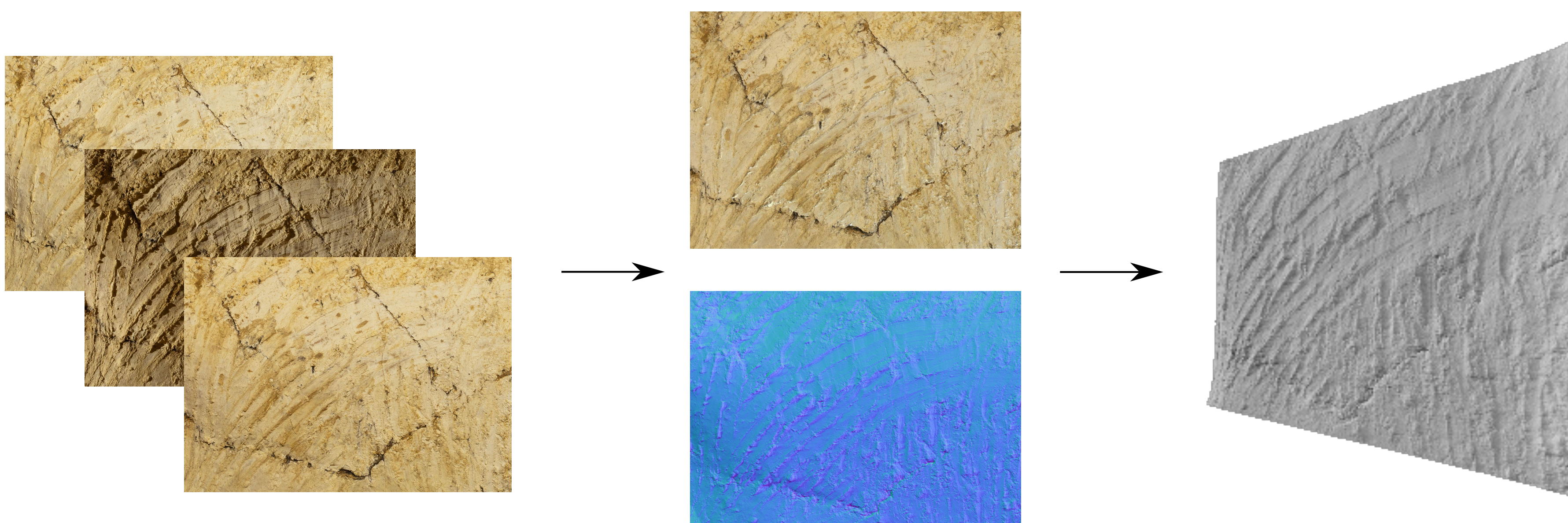


## LIGHT CALIBRATION



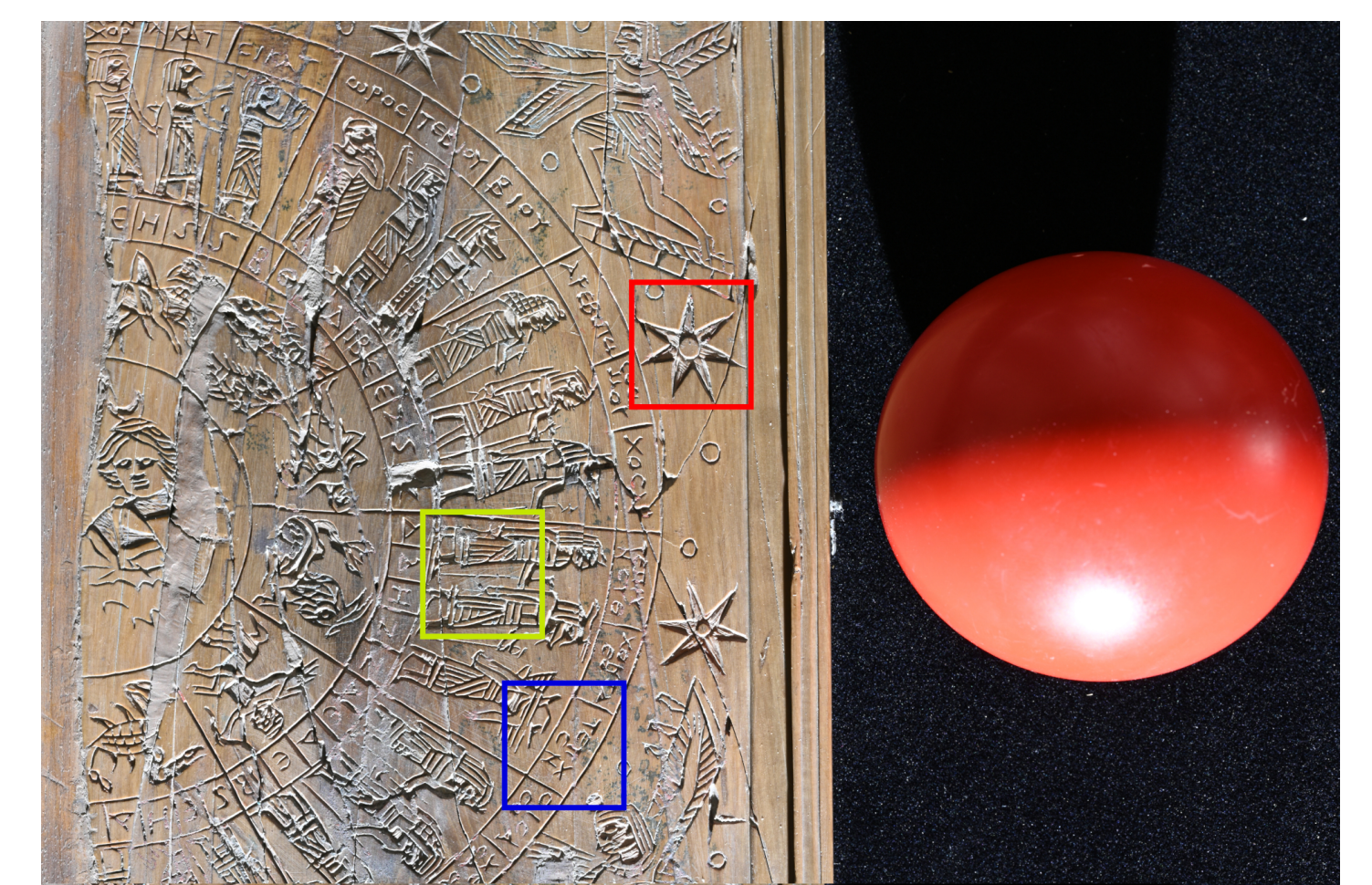
“Panneau des Mammouths raclés”: A white sphere is used for light calibration.

## CHAUVET-PONT-D'ARC CAVE

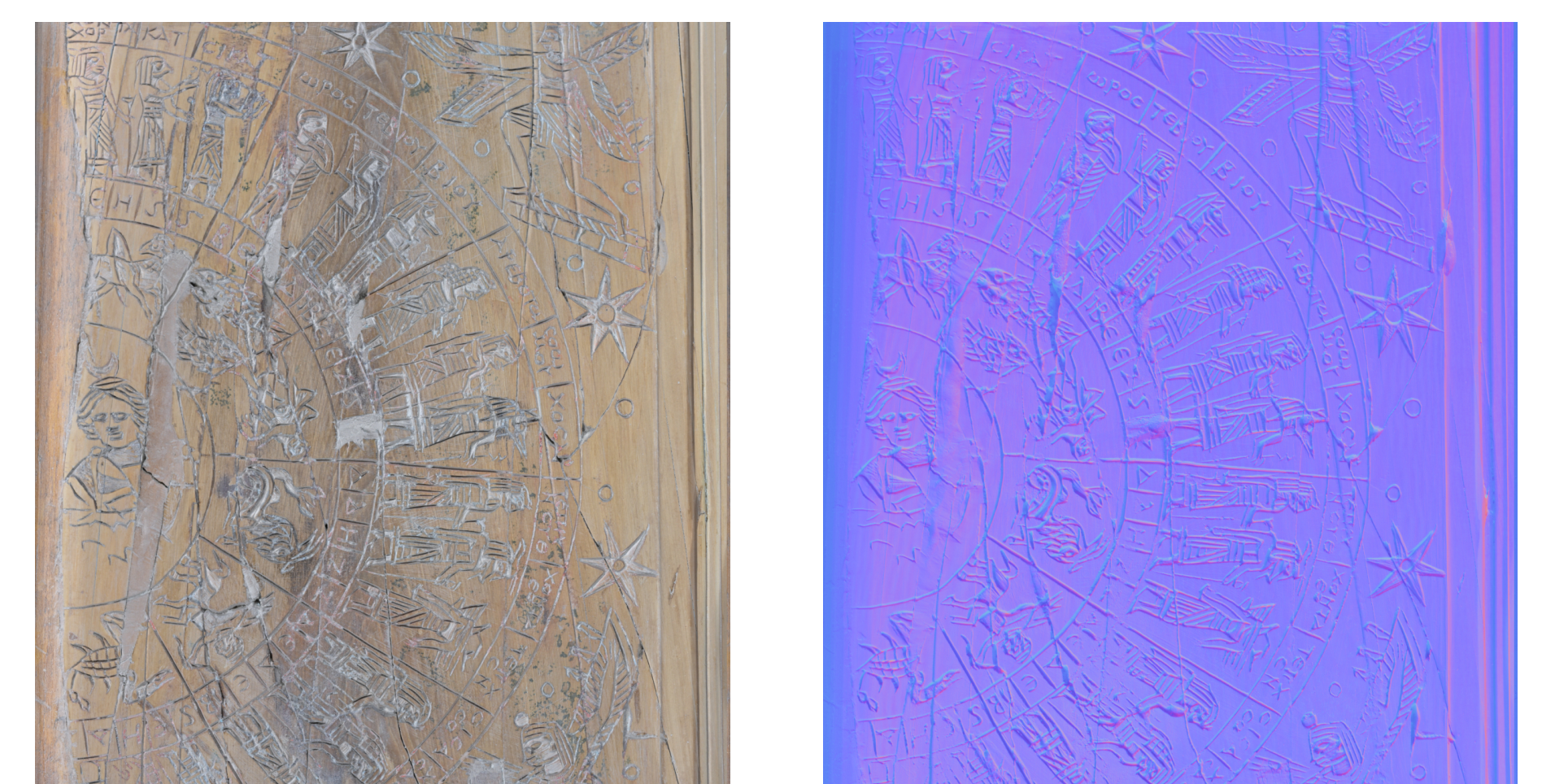


From left to right: Zoom on three pictures of the “Panneau des Mammouths raclés”; estimated albedo and normal map; reconstructed depth in perspective view.

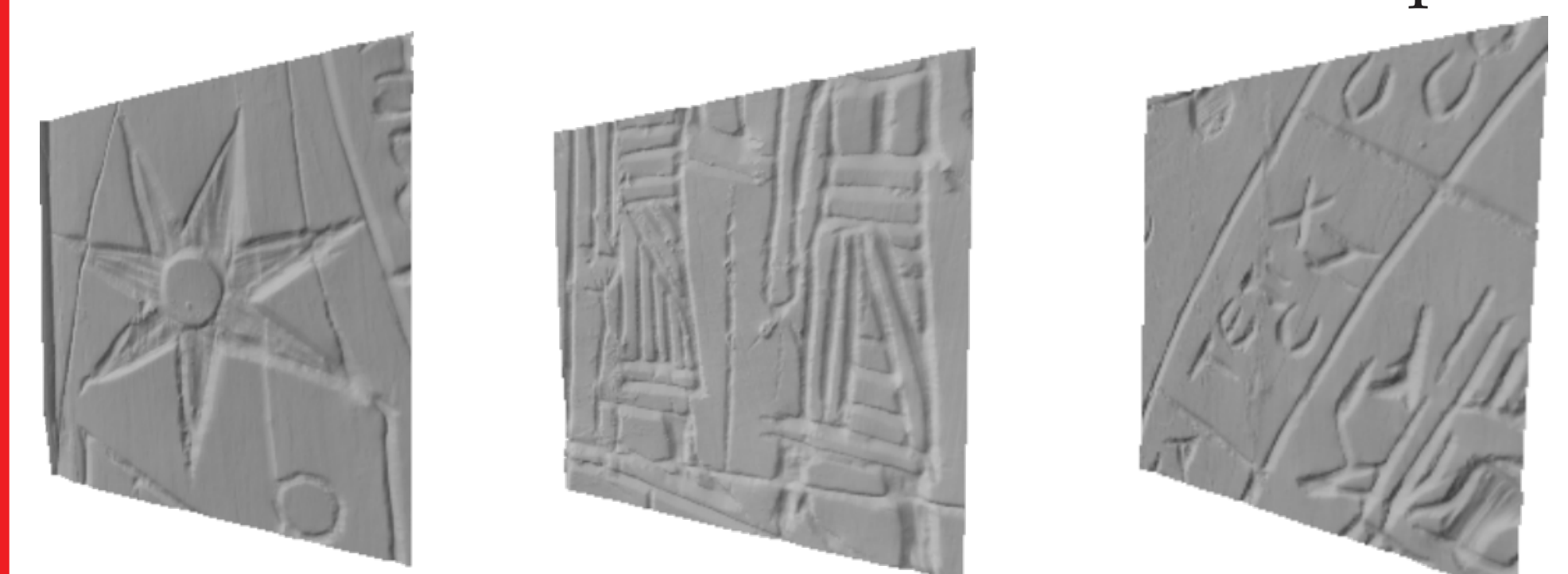
## ZODIACAL TABLET



One of the input pictures.



Estimated albedo and normal map.



Zooms on the reconstructed depth in perspective view.

## “DAME DE SAINT-SERNIN” STATUE-MENHIR



One of the input picture. Estimated albedo. Estimated normal map. Depth map details.

## CONCLUSION

- Adapting PS to archeology.
- PS: 3D-models + Intrinsic color.
- Accuracy limited by the pixel size.

## PERSPECTIVES

- Light calibration without sphere.
- Transforming RTI data into PS data.
- Multi-view photometric stereo.

## REFERENCE

[1] Durou, J.-D., Falcone, M., Quéau, Y., Tozza, S. A Comprehensive Introduction to Photometric 3D-reconstruction, in *Advances in Photometric 3D-Reconstruction*, Springer, 2020.