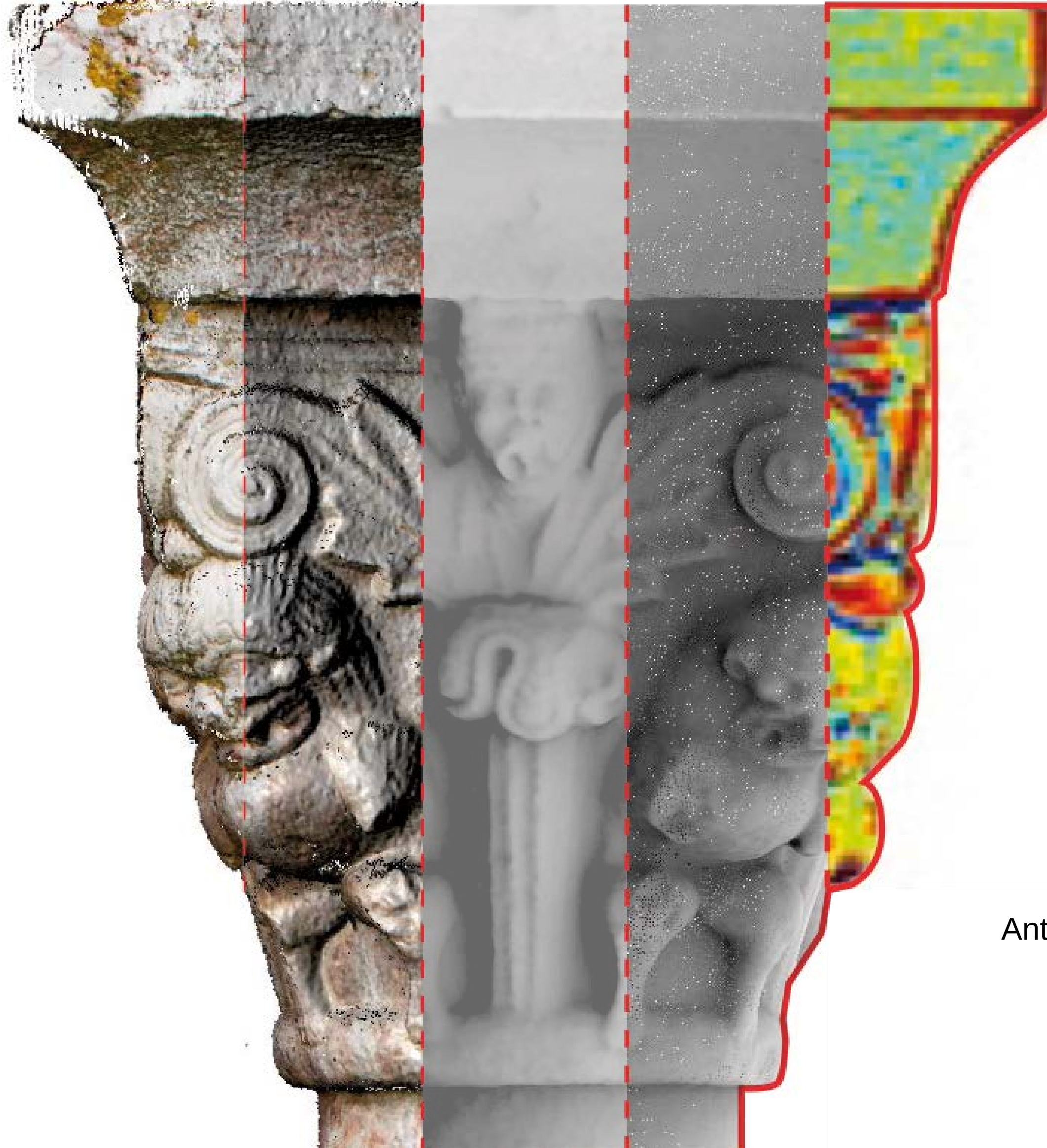


MORPHOLOGICAL ANALYSIS OF SHAPE

SEMANTICS



An approach from
curvature-based signatures

Case study of the 31
romanesque columns of the
cloister of Saint-Michel de
Cuxa



Anthony PAMART_MAP-GAMSAU UMR 3495/MCC CNRS

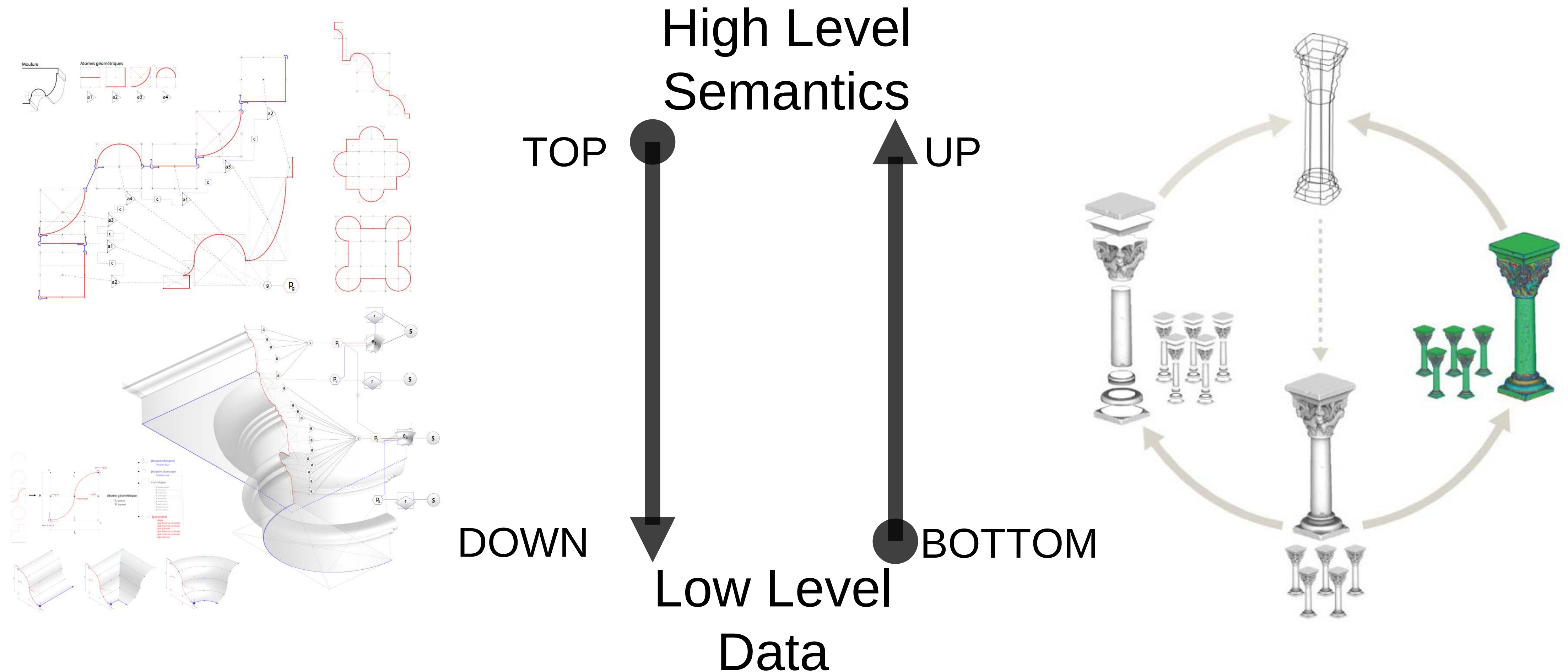
anthony.pamart@map.cnrs.fr

LEONARDO DA VINCI FELLOW (2014-15)

CENTER FOR KHMER STUDIES FELLOW (2013-14)

GRADUATED ARCHITECT (2012)

1/12 A SINGULAR SHAPE-ANALYSIS :



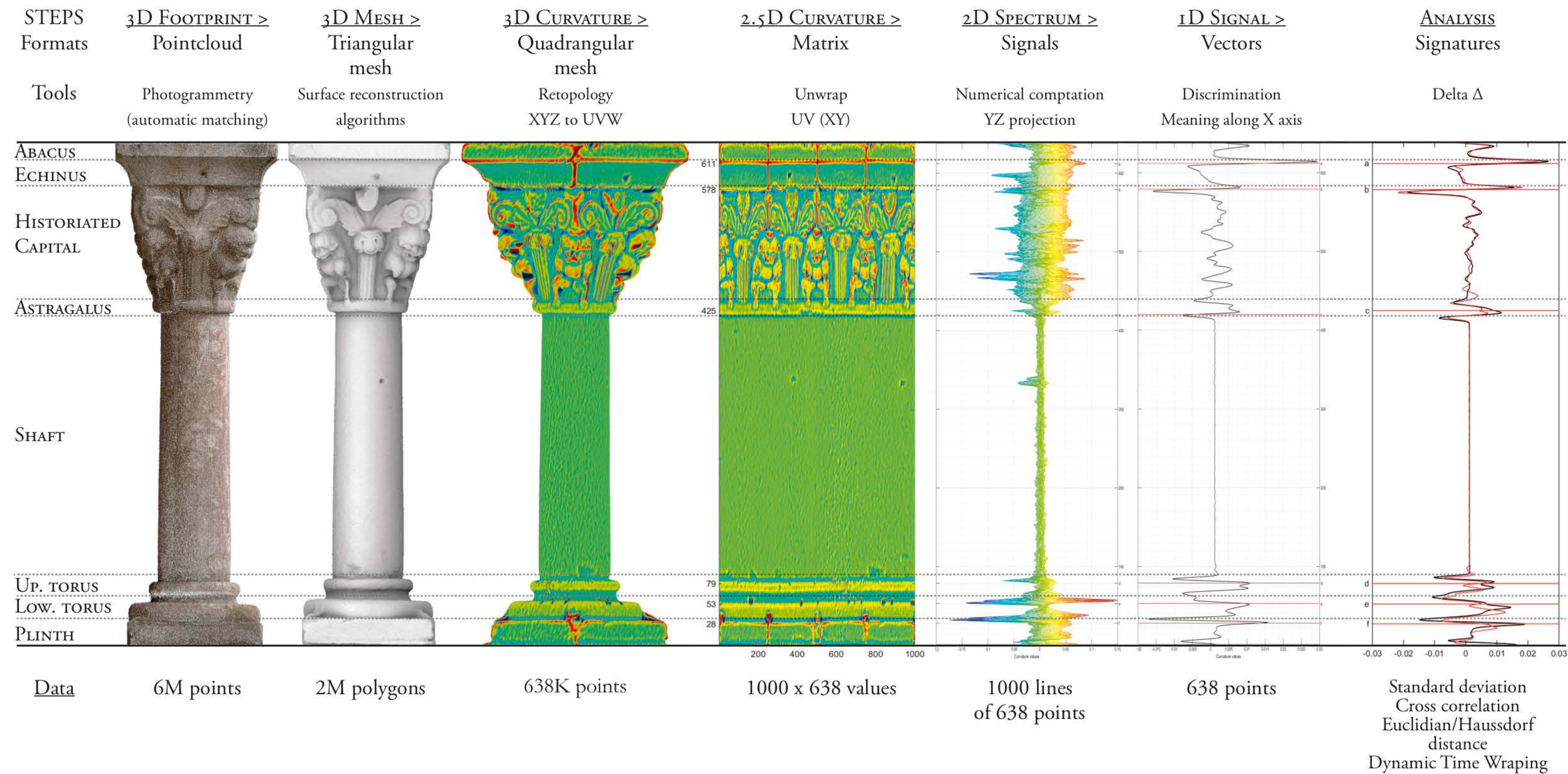
LO BUGLIO, D., & DE LUCA, L. (2011). « Critical Review of 3D Digitization Methods and Techniques Applied to the Field of Architectural Heritage: Methodological and Cognitive Issues. » In Vast. The 12th International Symposium on Virtual Reality, Archaeology and Cultural Heritage, pp. 5-12.

LO BUGLIO, D., LARDINOIS, V., & DE LUCA, L. (2015). « What do thirty-one columns tell about a 'theoretical' thirty-second? ». In A C M Journal on Computing and Cultural Heritage, 8(4).

ADRIAN, J., BUGLIO, D. L., & DE LUCA, L. (2014). « Evaluating the Curvature Analysis as a Key Feature for the Semantic Description of Architectural Elements. » In 12th EUROGRAPHICS Workshop on Graphics and Cultural Heritage (Darmstadt, Germany), pp.43-44.

1/12 A SINGULAR SHAPE-ANALYSIS :

An approach based on curvature signatures ?



2/12 IMAGE-BASED MODELING :

- Photogrammetric data reprocessing (acquired in 2010)
- Fully automatic image matching (Micmac C3DC)



BENEFITS

Accuracy
Completeness
Less time-consuming

INCONVENIENCES

(OVER)load of data
complexity
AND
multiplicity

PROBLEMATIC

INTELLIGIBILITY ?



3/12 SURFACE RECONSTRUCTION :

Screened Poisson Surface Reconstruction [Version 6.13a] (Kazhdan & Hoppe 2013)



BUT

Approximation (smooth)

Decimation (interpolation)

EVEN IF

Affined parametrization of the
algorithm

AIM : CLOSEST TO RAW DATA

4/12 MESH REPARAMETRIZATION :

FROM TRIANGULAR MESH

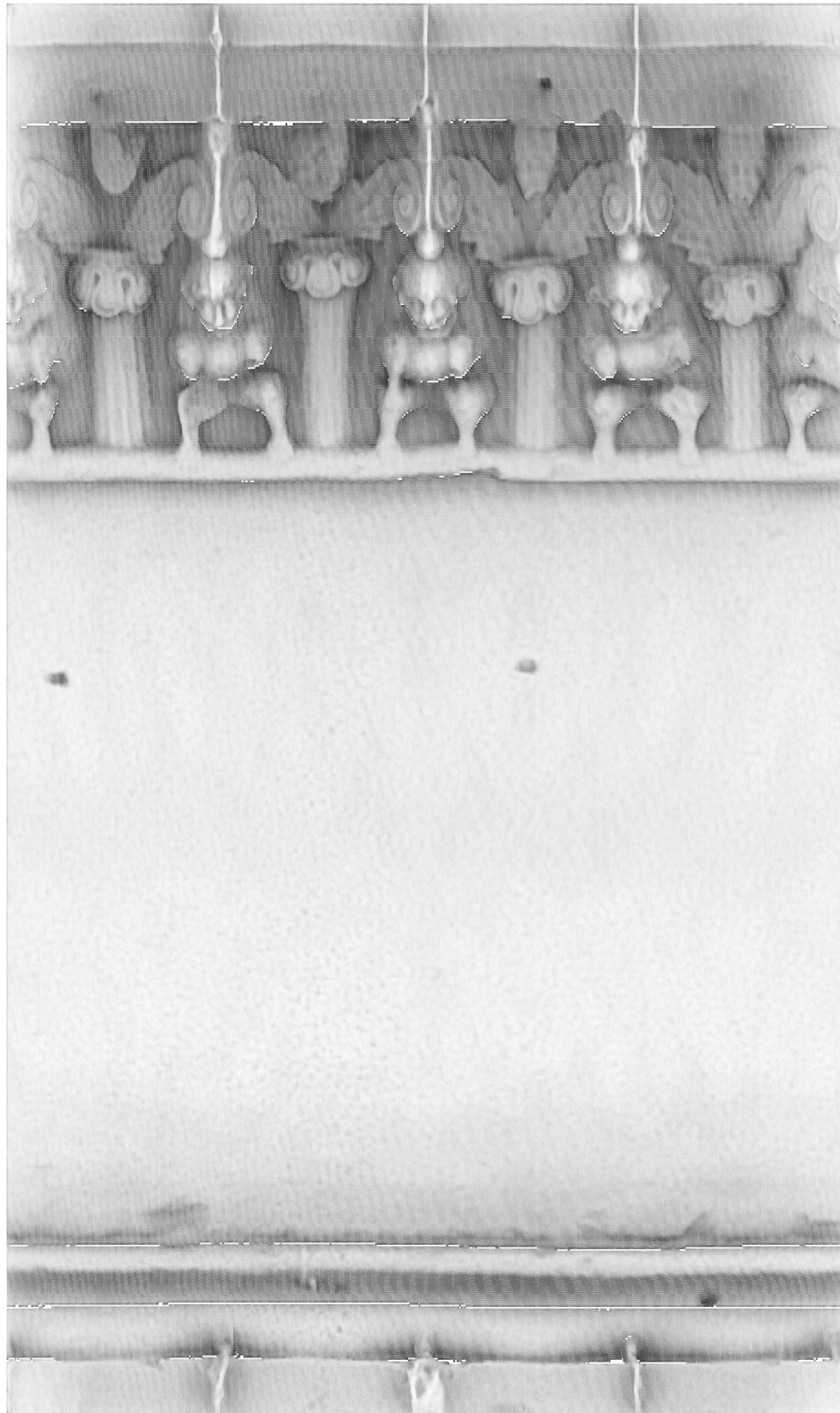
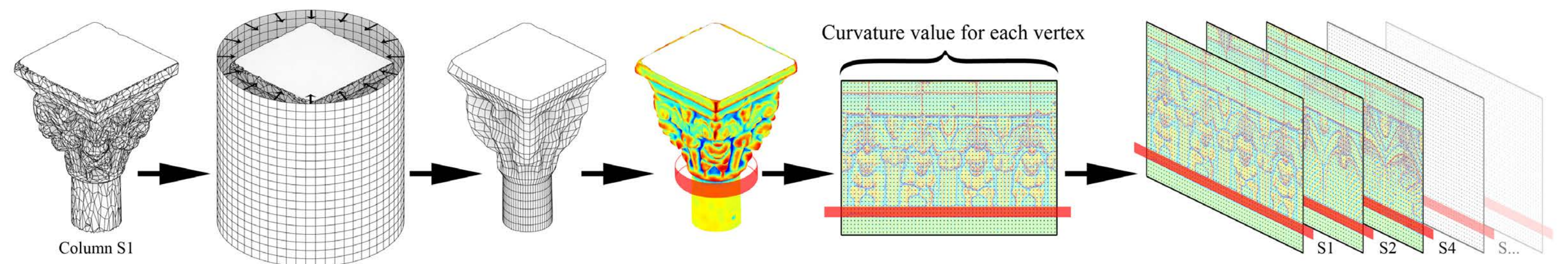
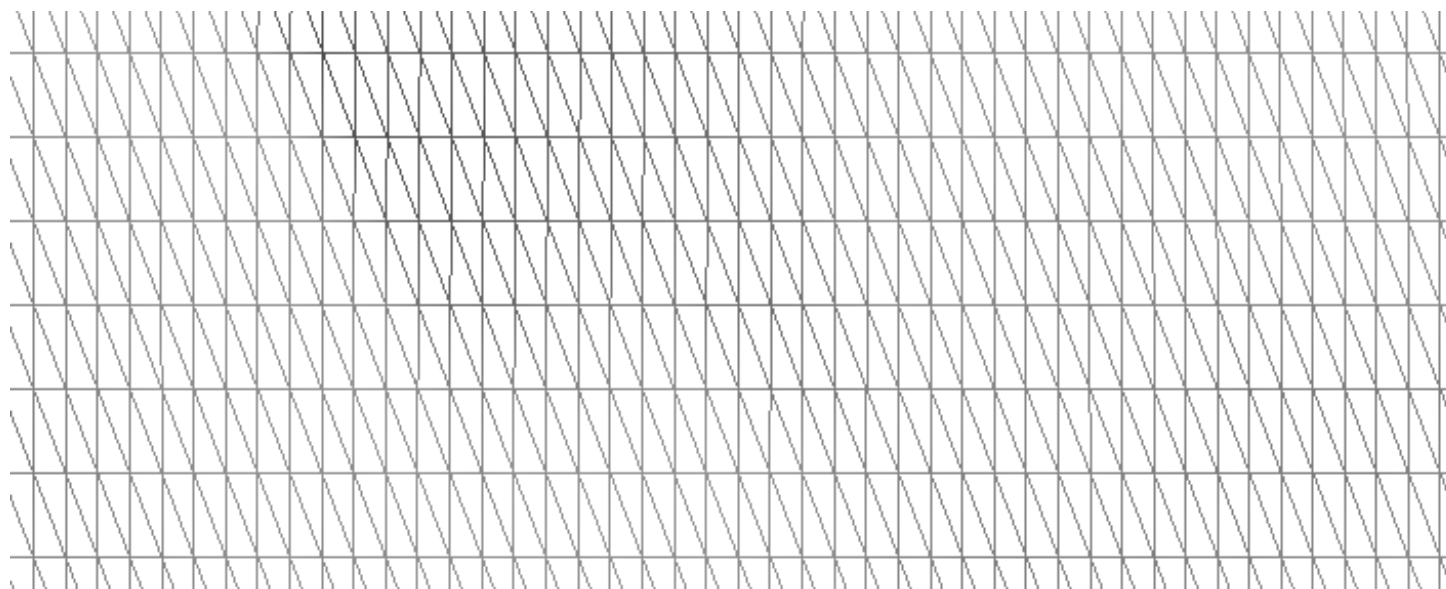
TO REGULAR QUAD-MESH

Decimation preserving details

Turnable into digital matrix (table)

Fixed facets and vertices numbers

indexed mesh (surface comparison)

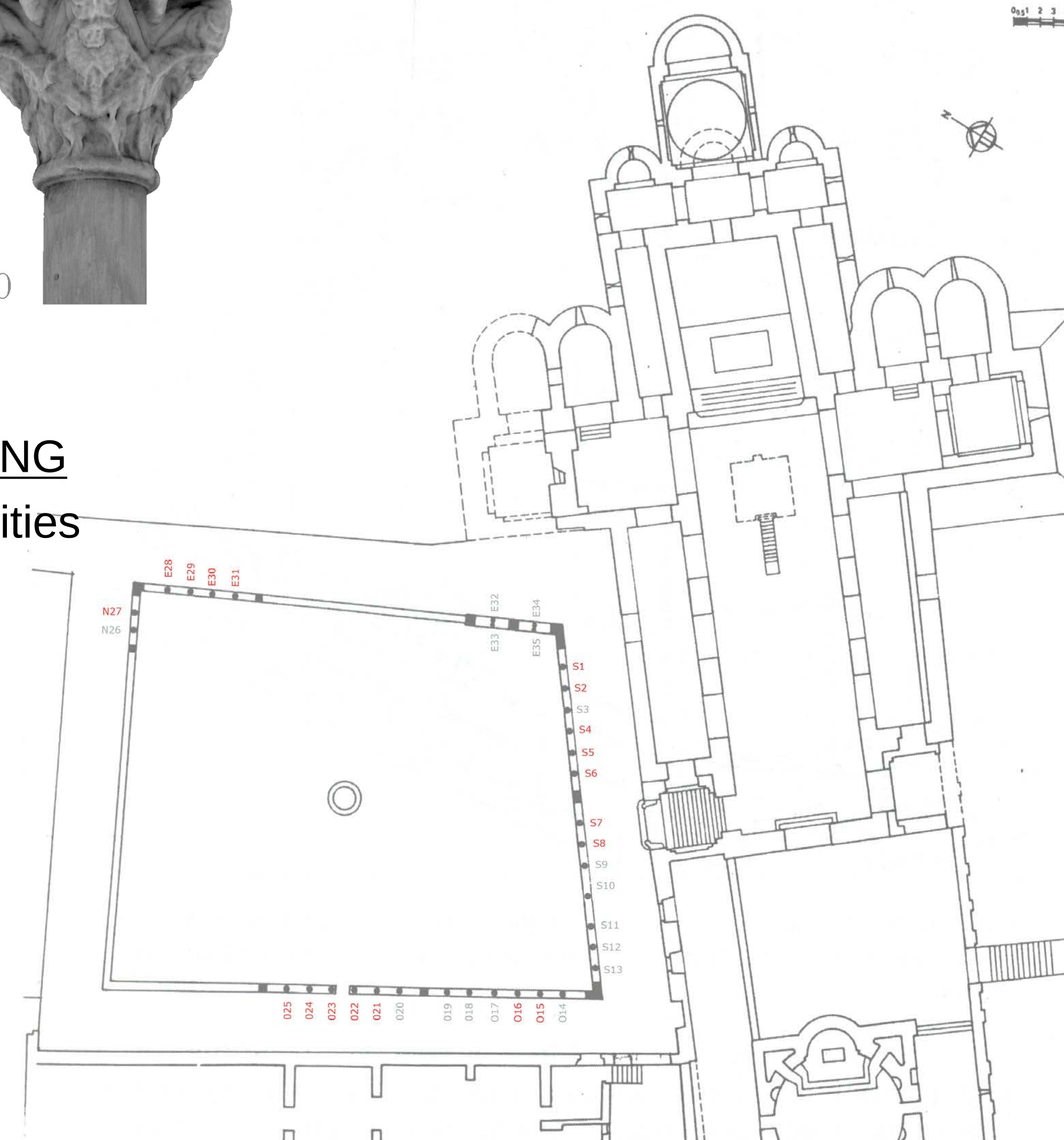
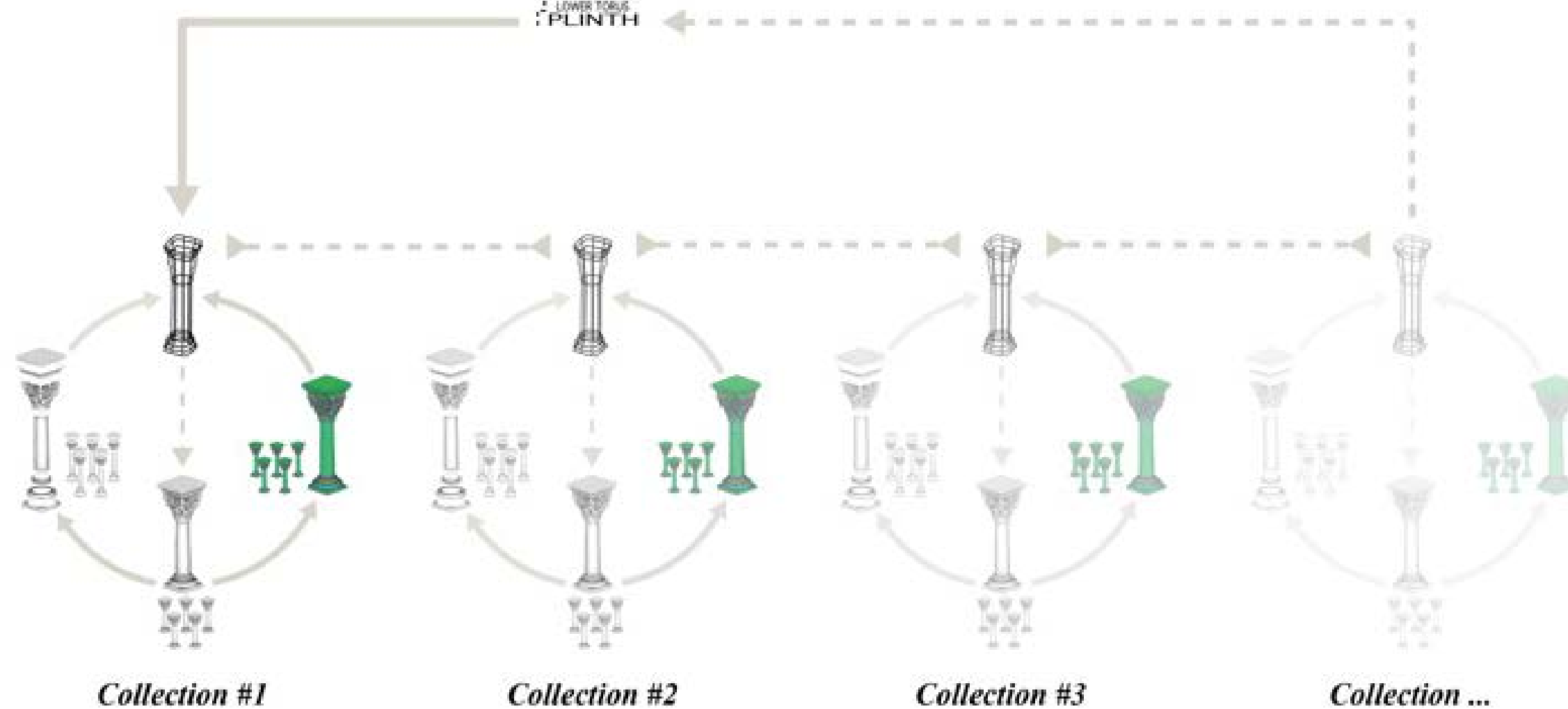


5/12 GEOMETRIC REFERENCE MODEL :

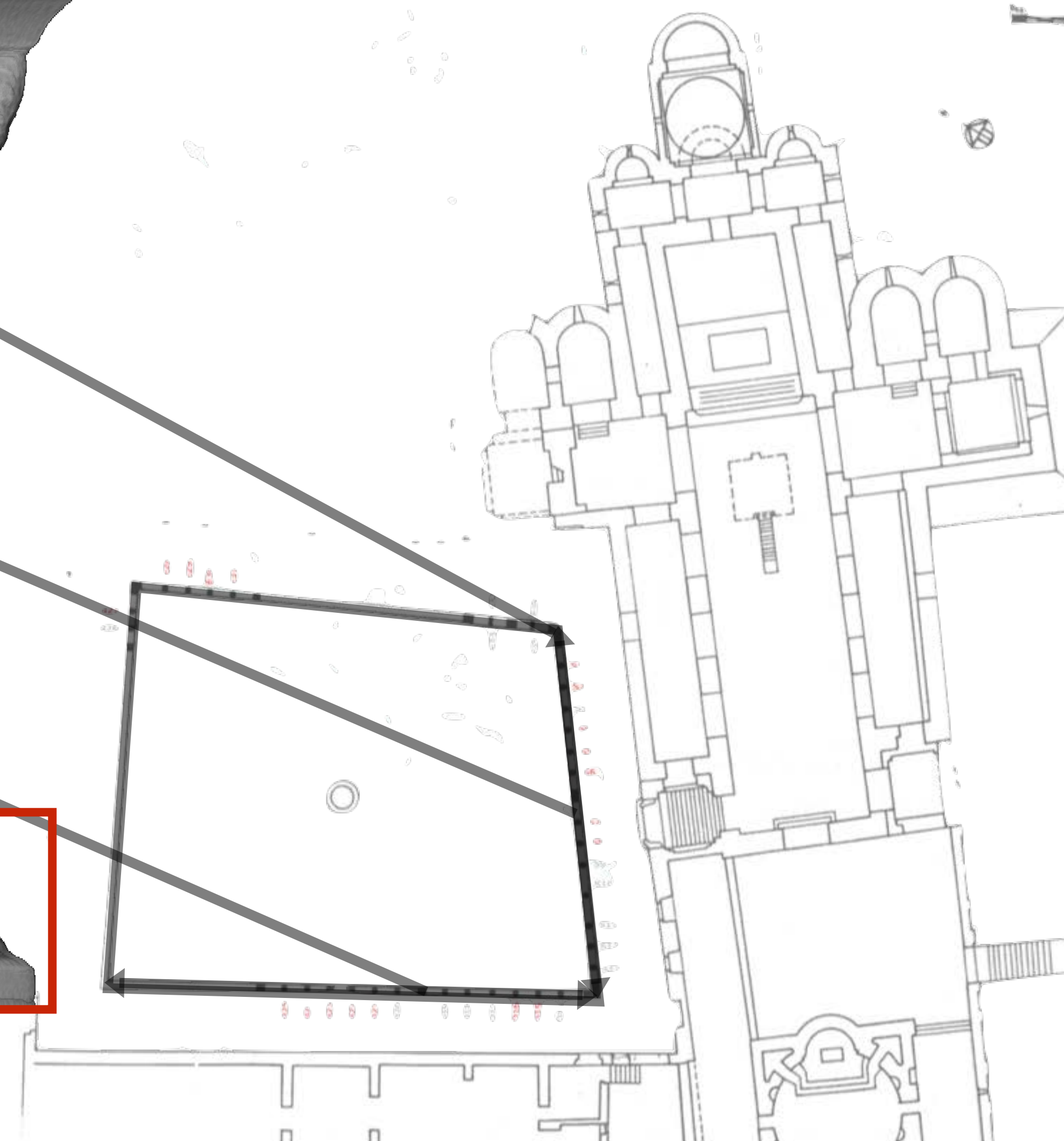
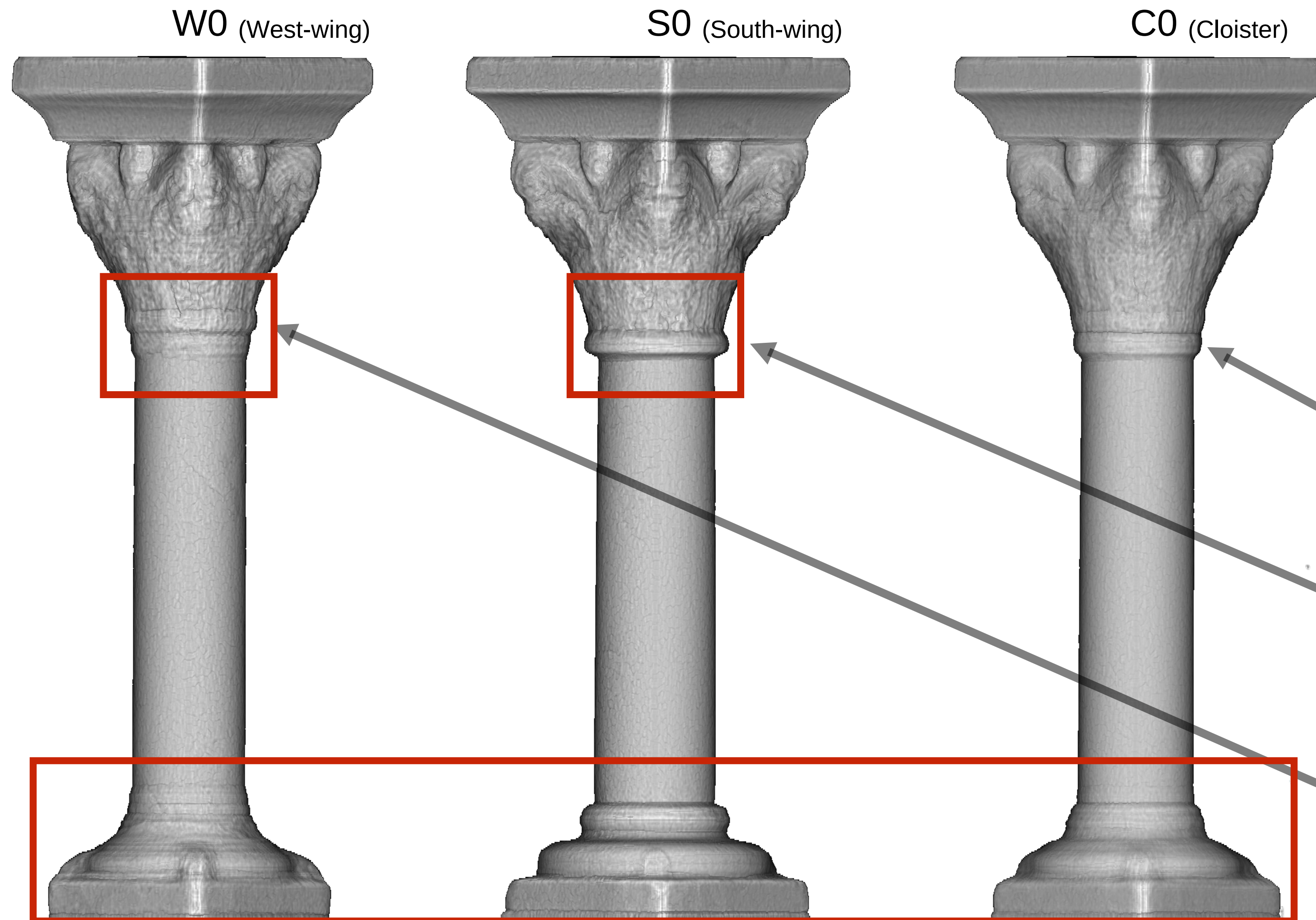


ABACUS
ECHINUS
CAPITAL
SHAFT
UPPER TORUS
LOWER TORUS
PLINTH

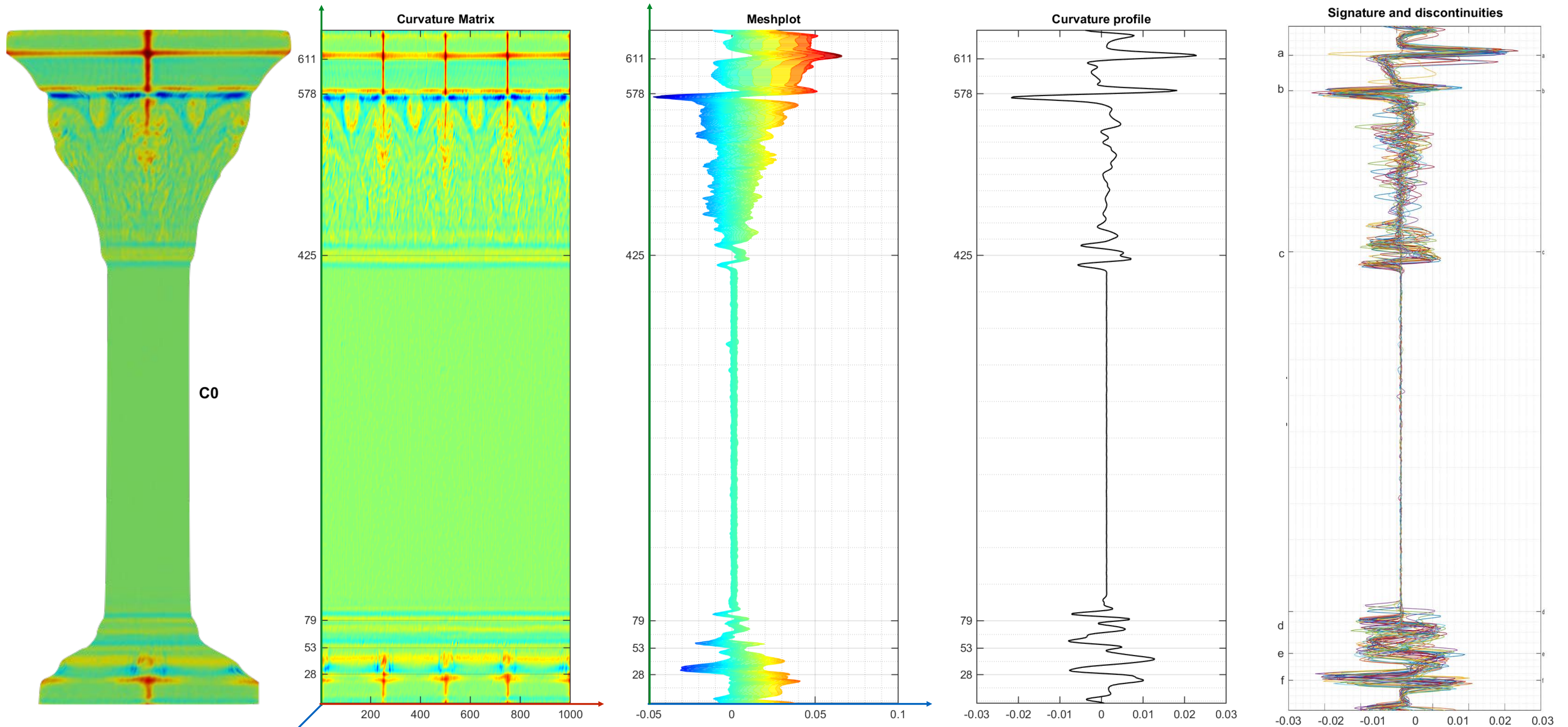
ARITHMETIC MEANING
Assessment of Similarities
AND
Disparities



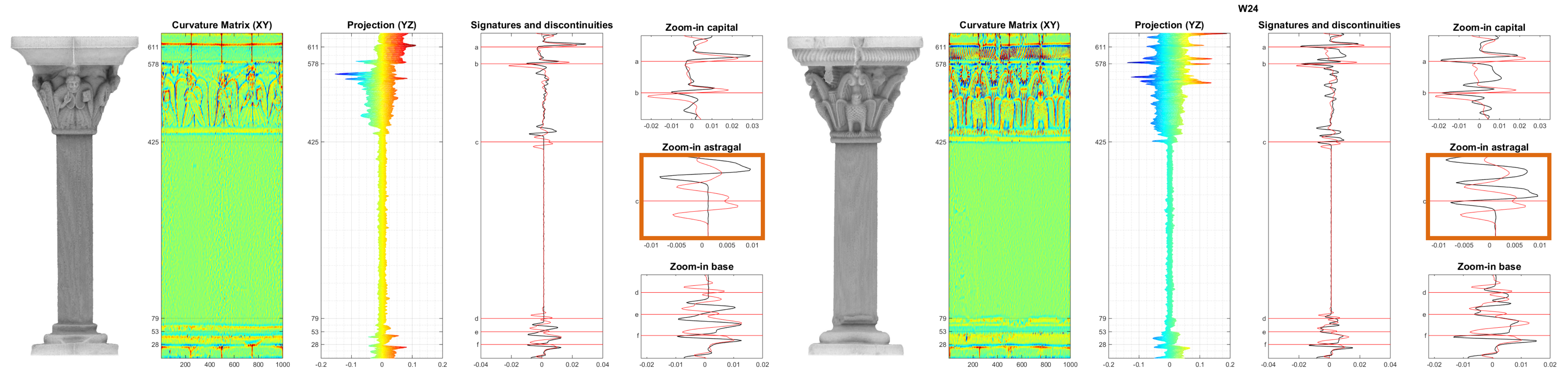
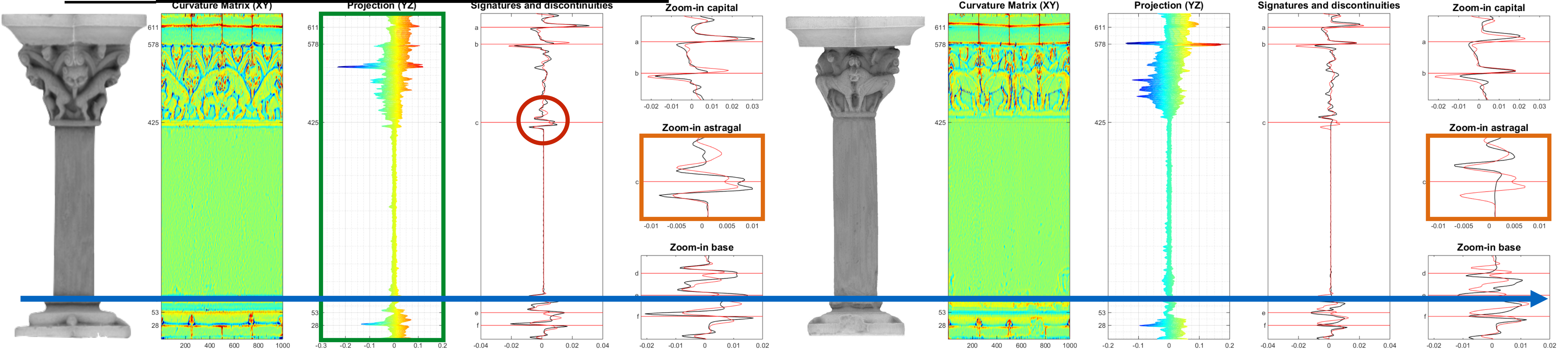
5/12 GEOMETRIC REFERENCE MODEL :



6/12 DISCRETE SURFACE CURVATURES :



7/12 DATA ANALYSIS :

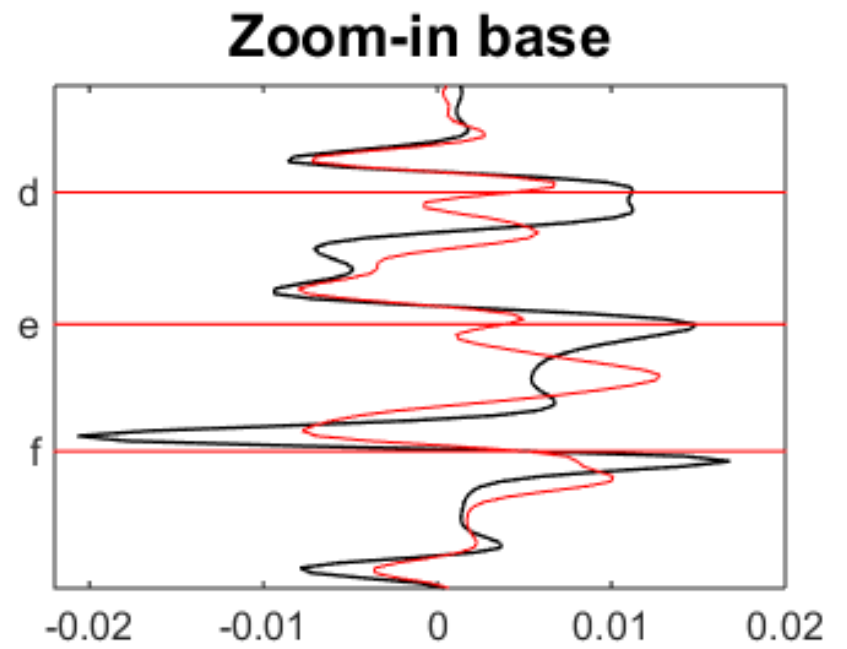
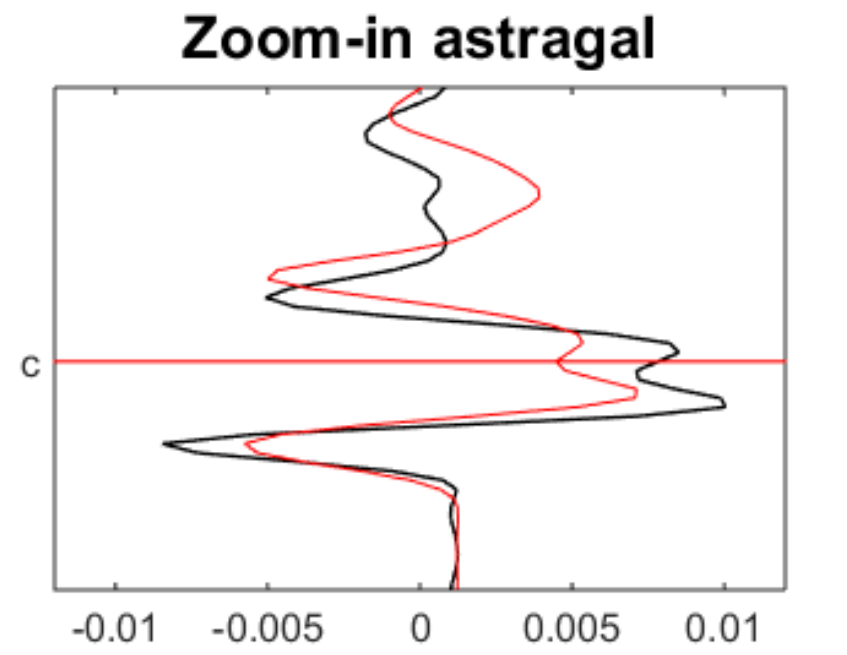
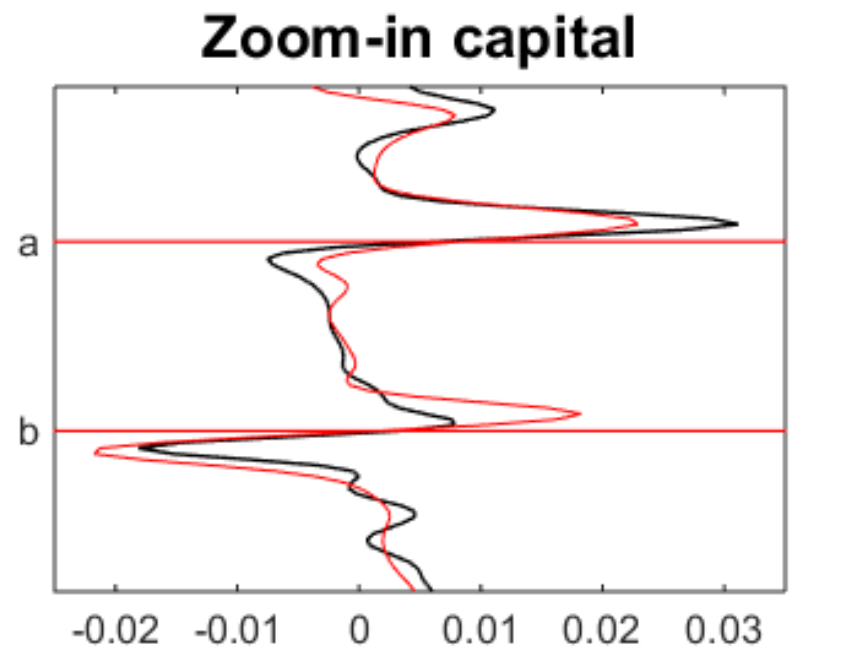
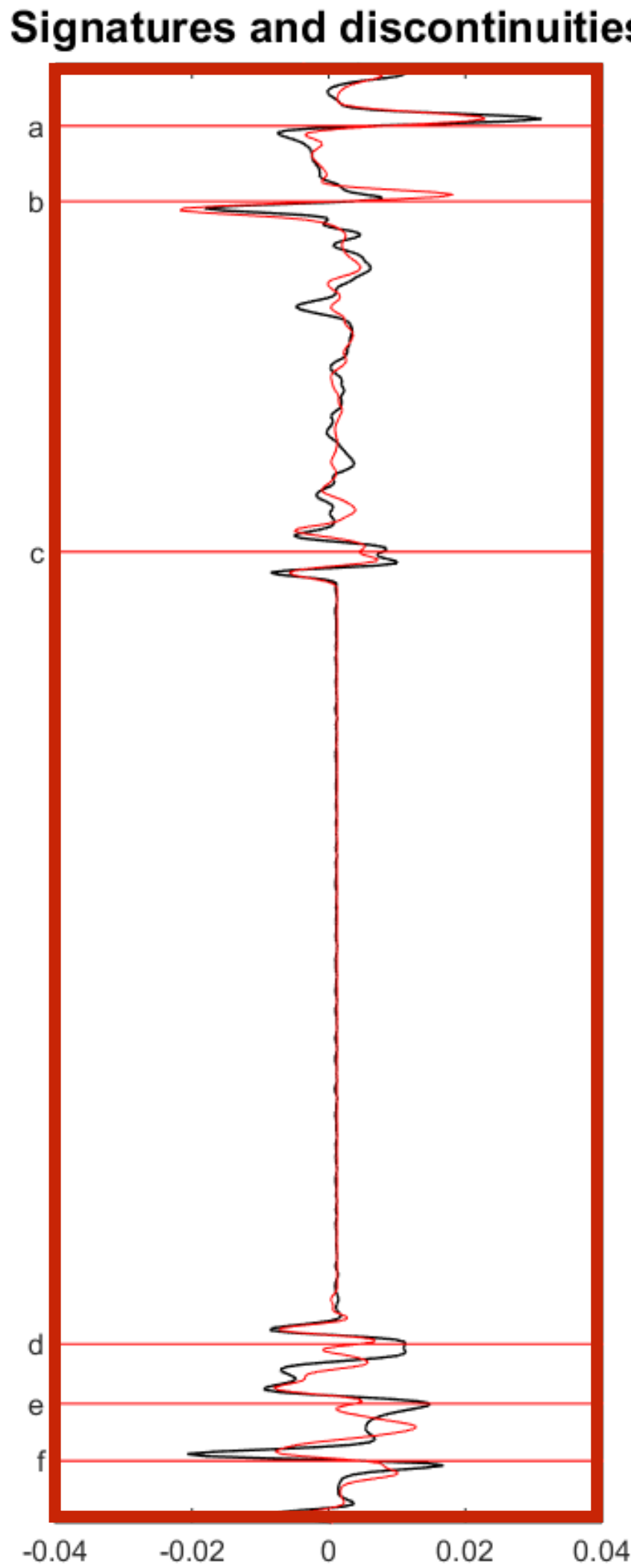
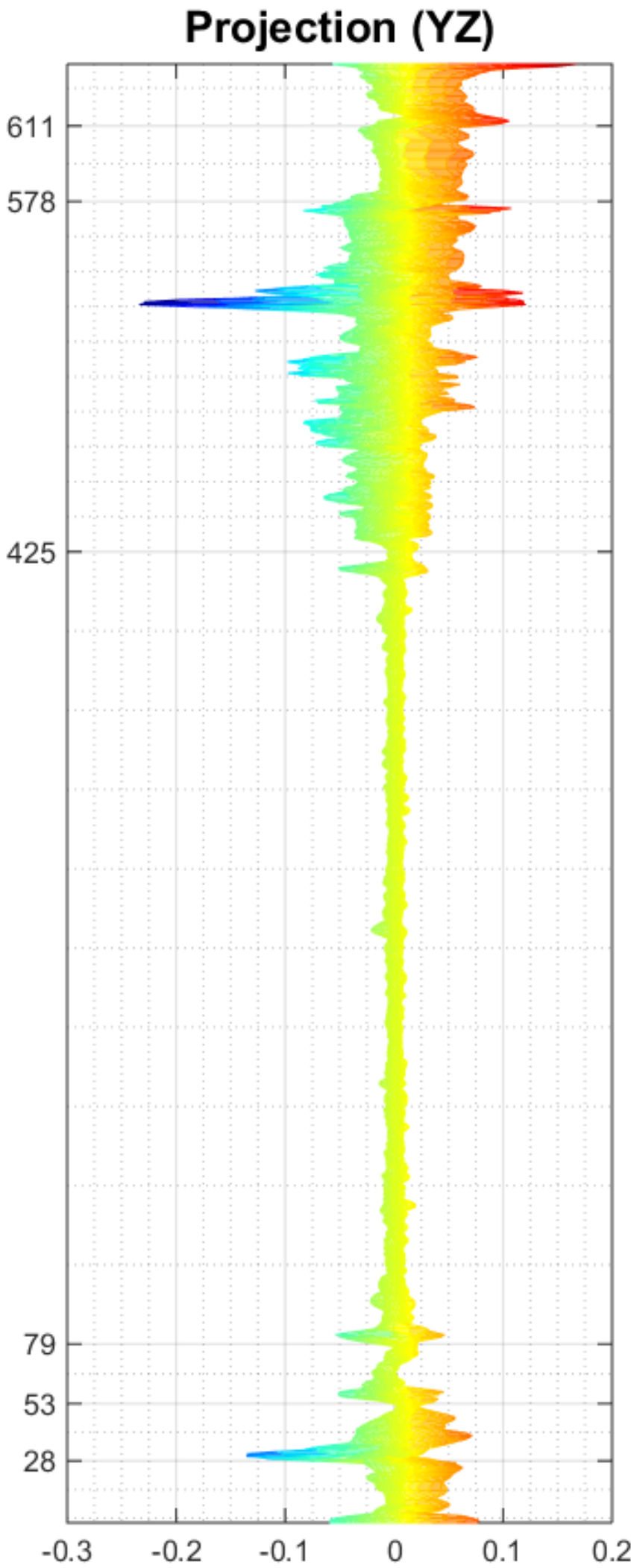
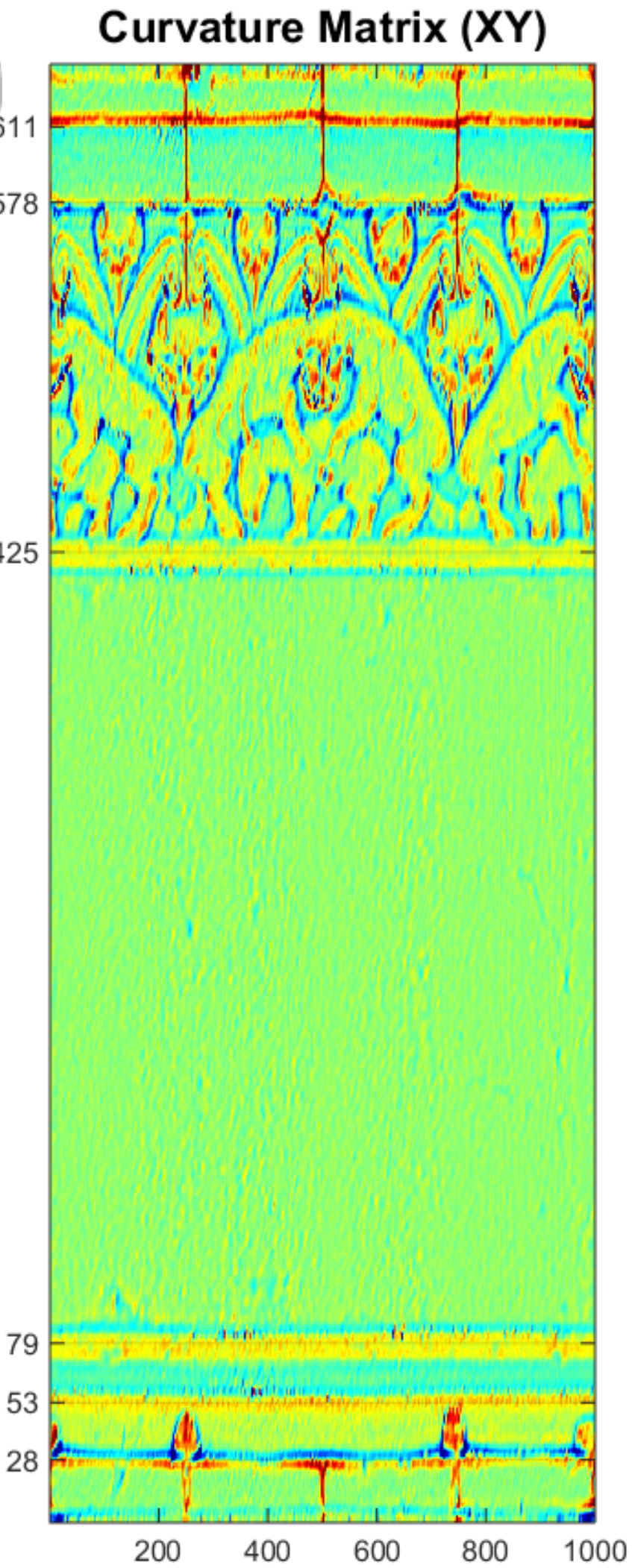


W24

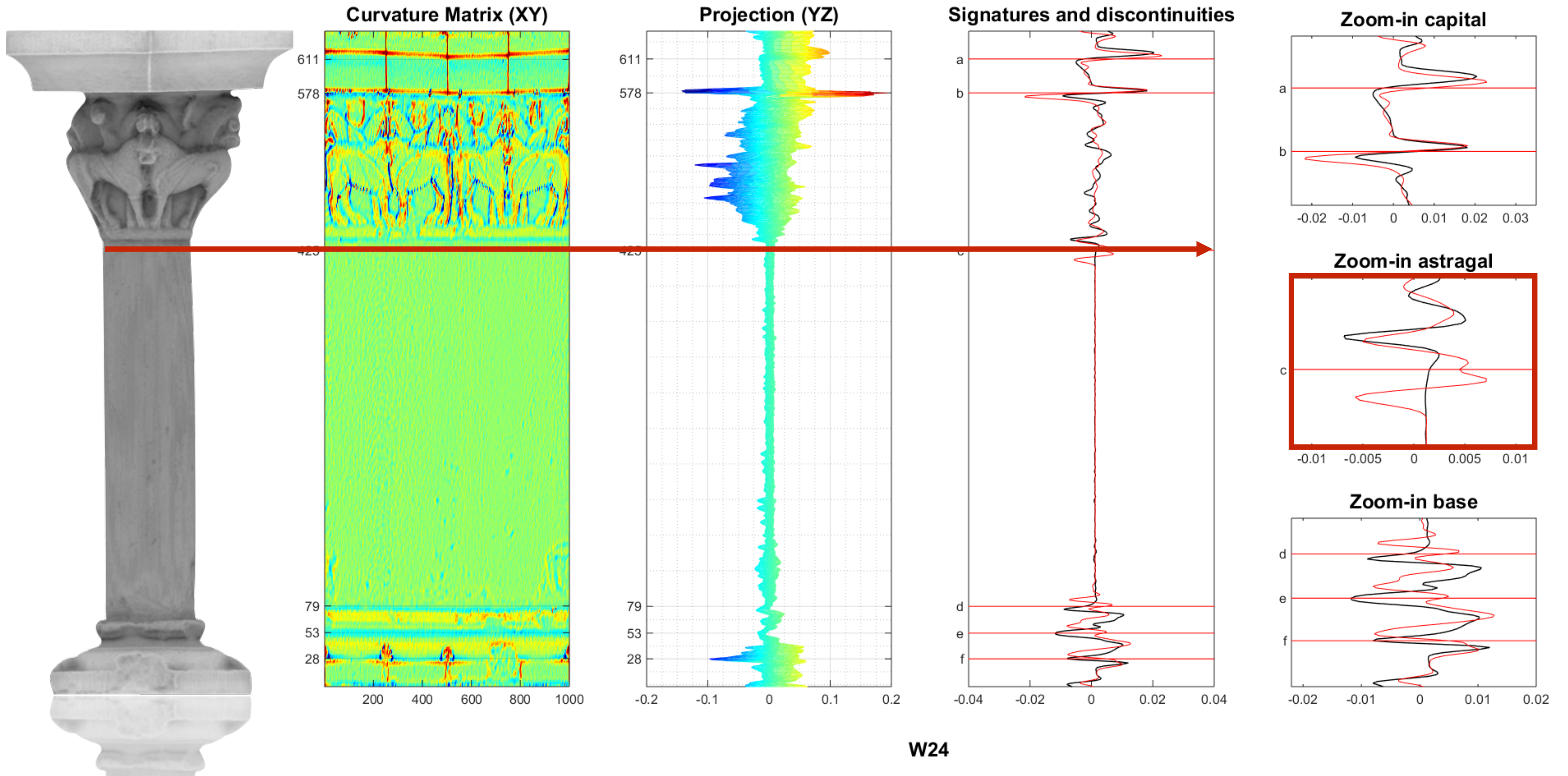
N27

E28

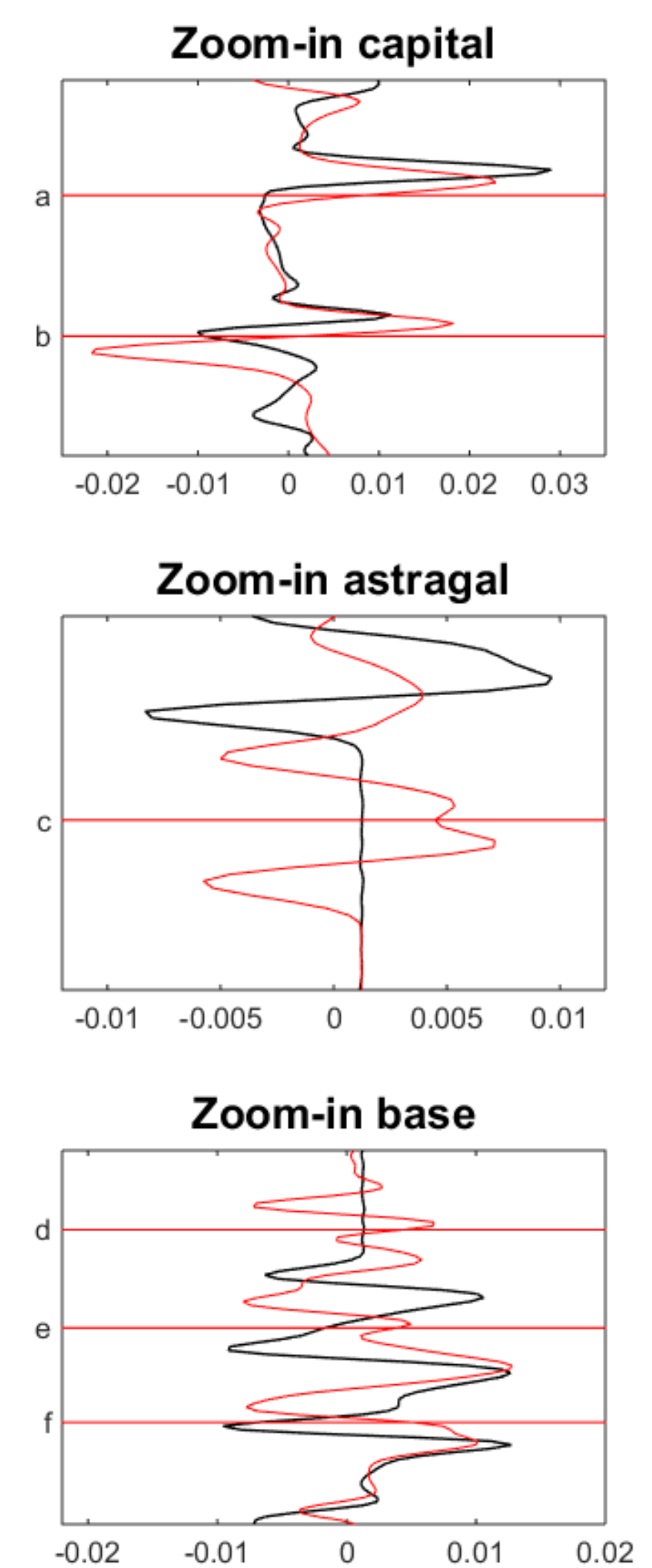
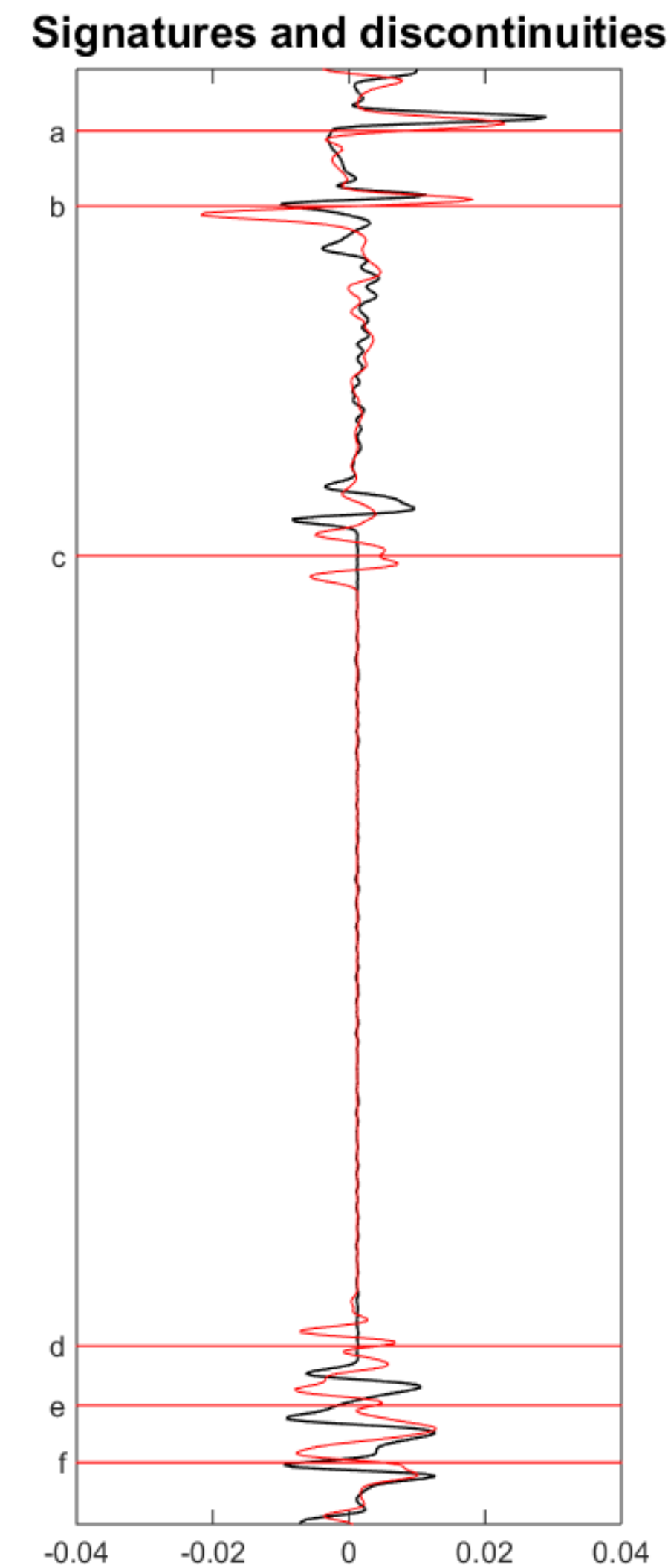
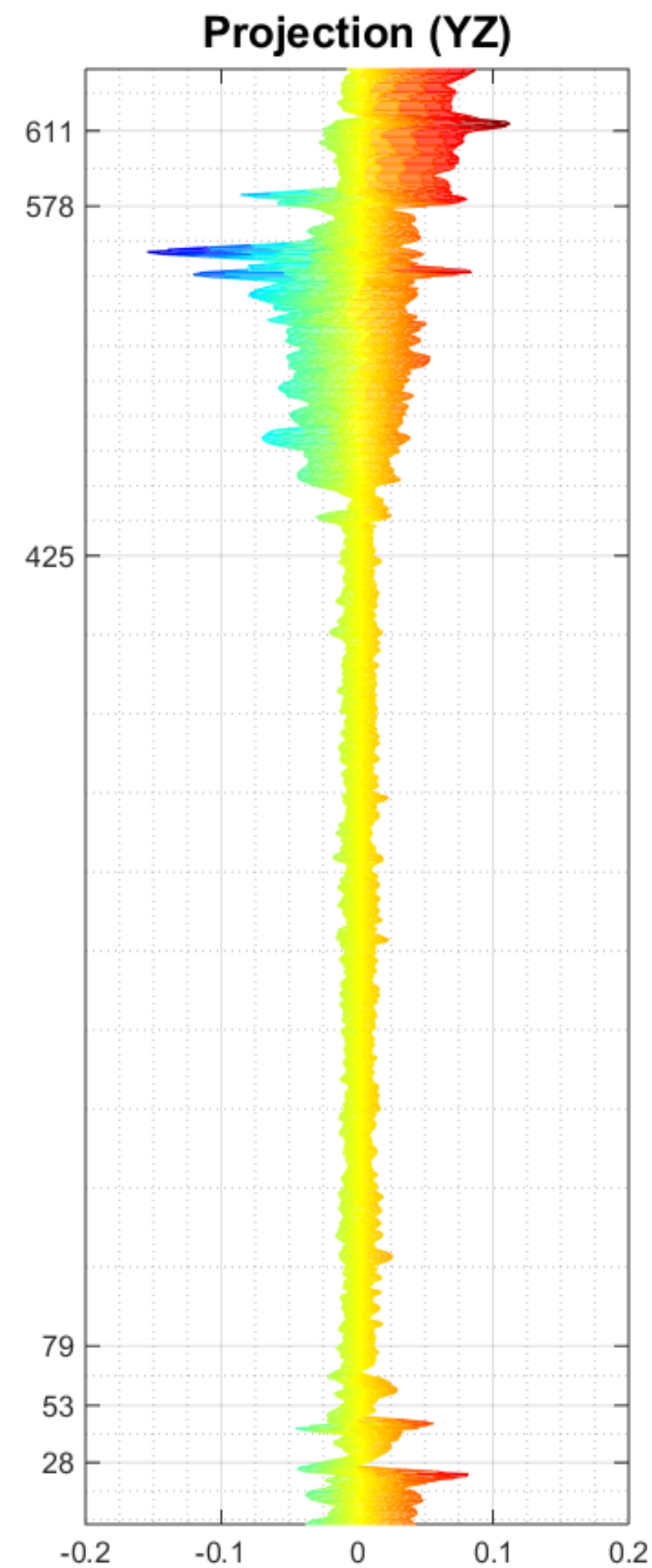
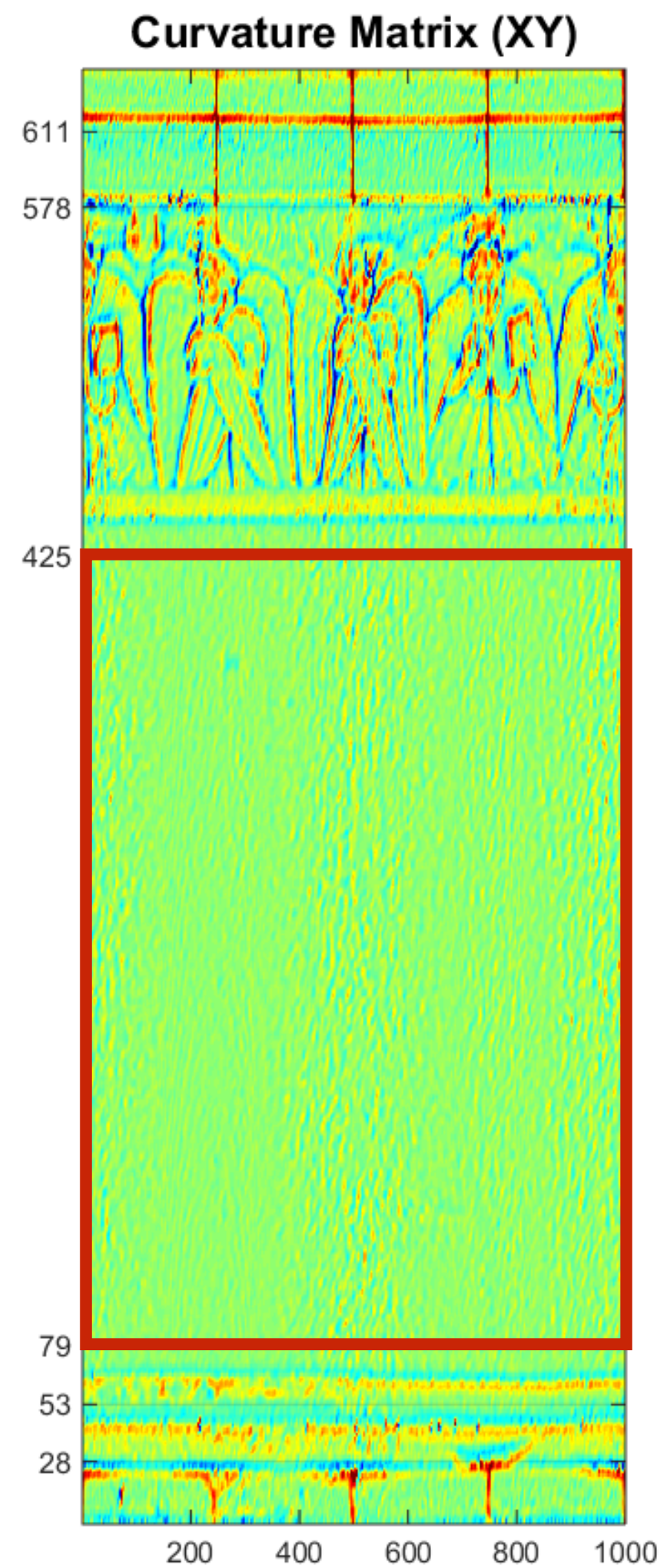
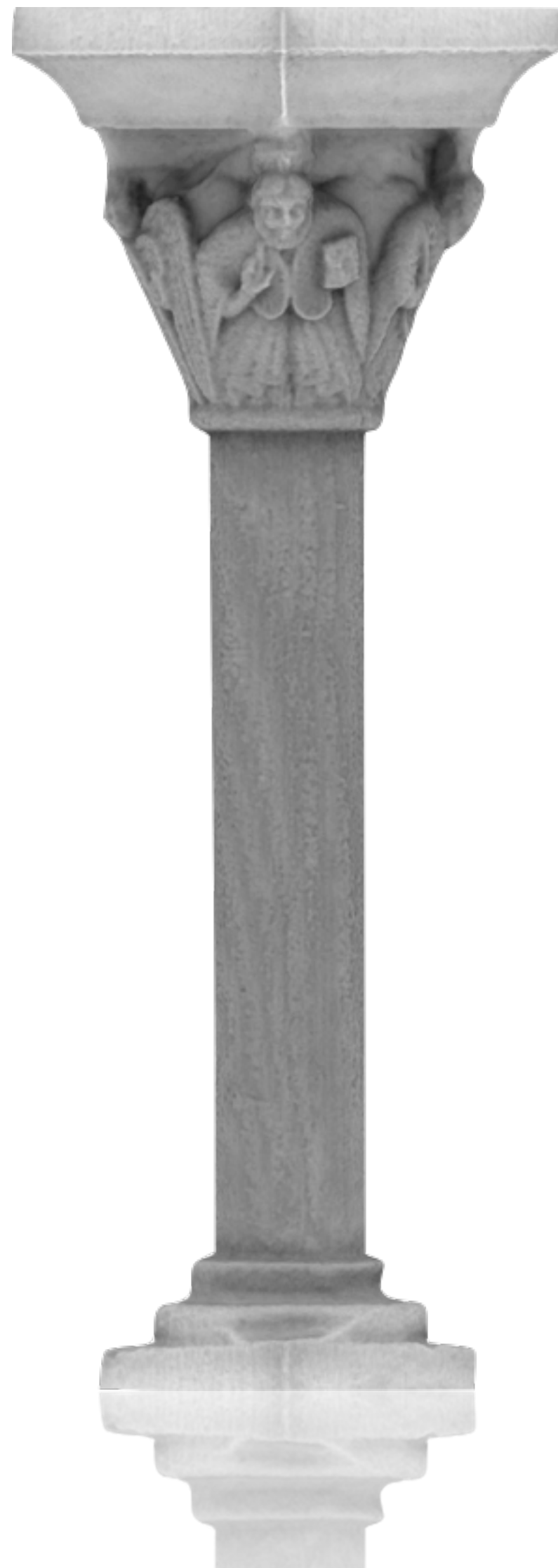
7/12 DATA ANALYSIS :



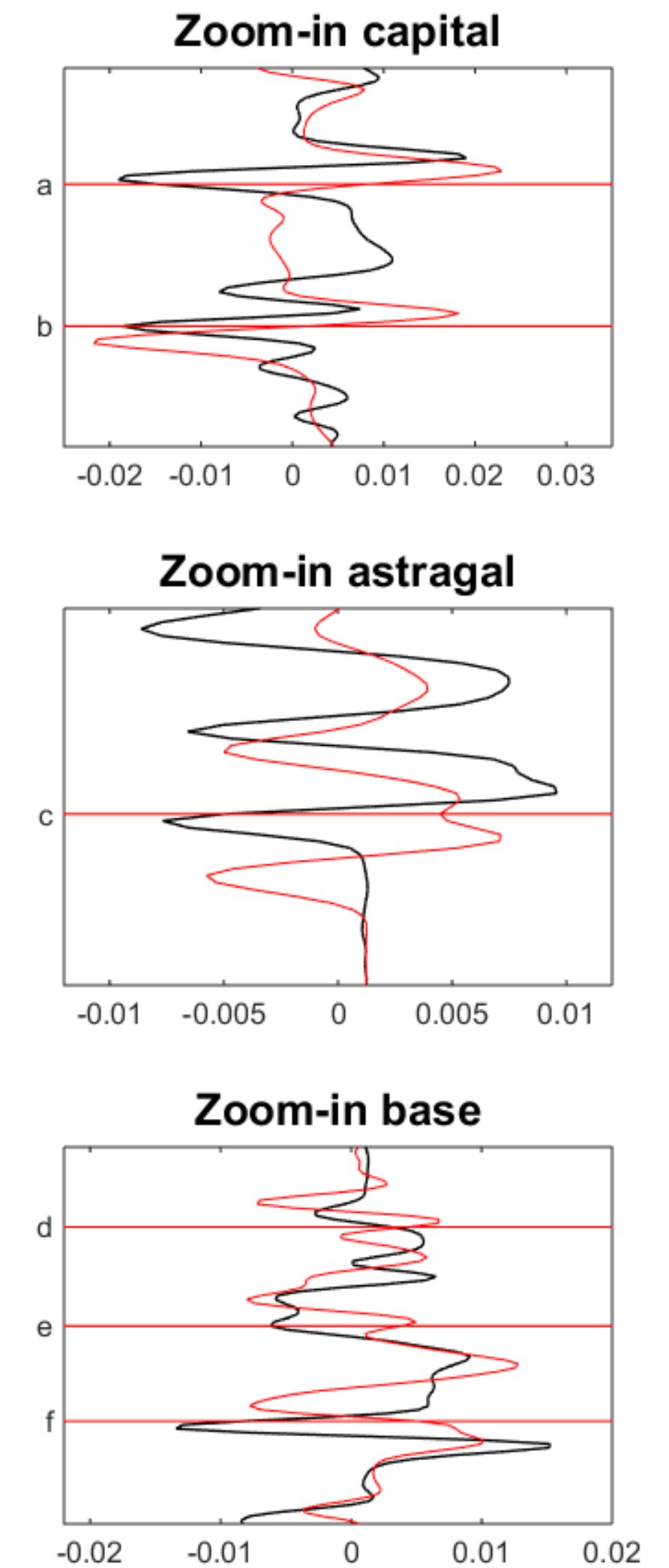
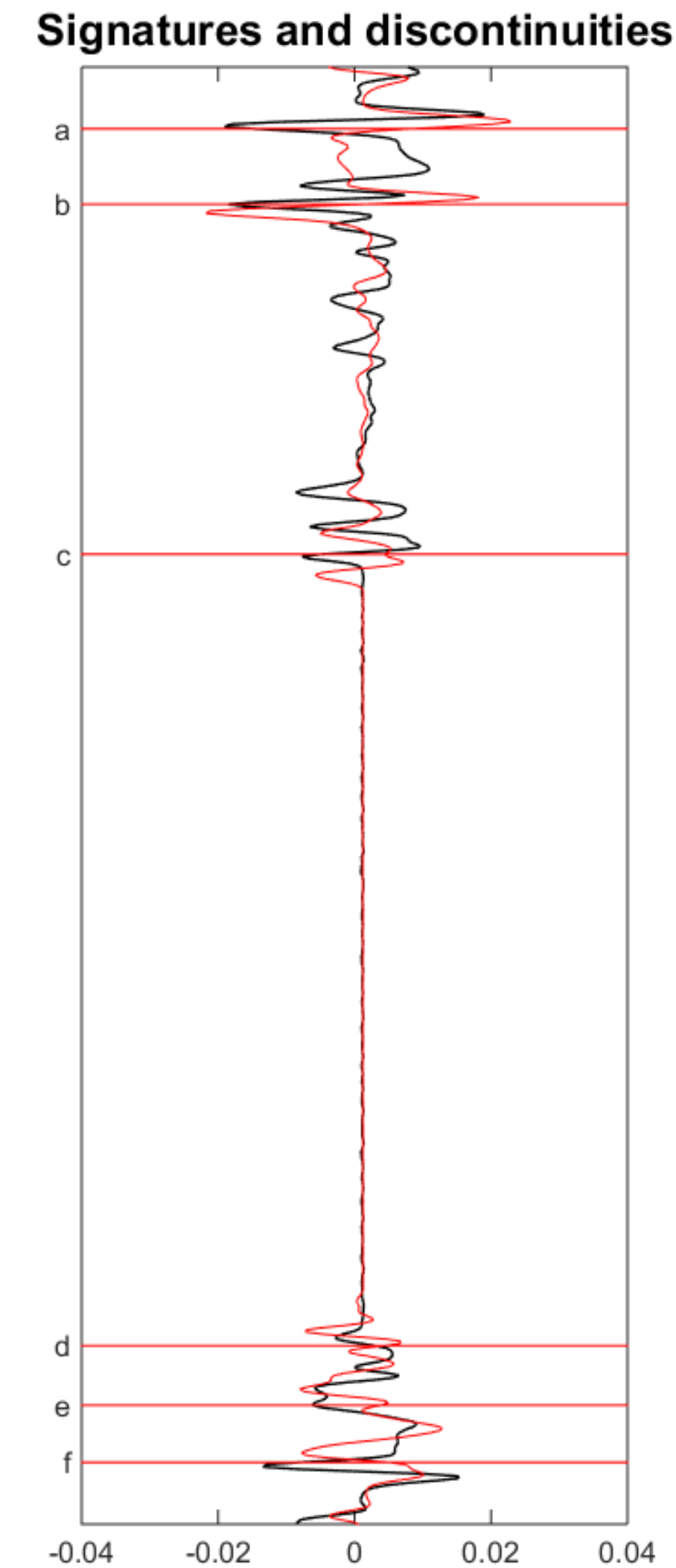
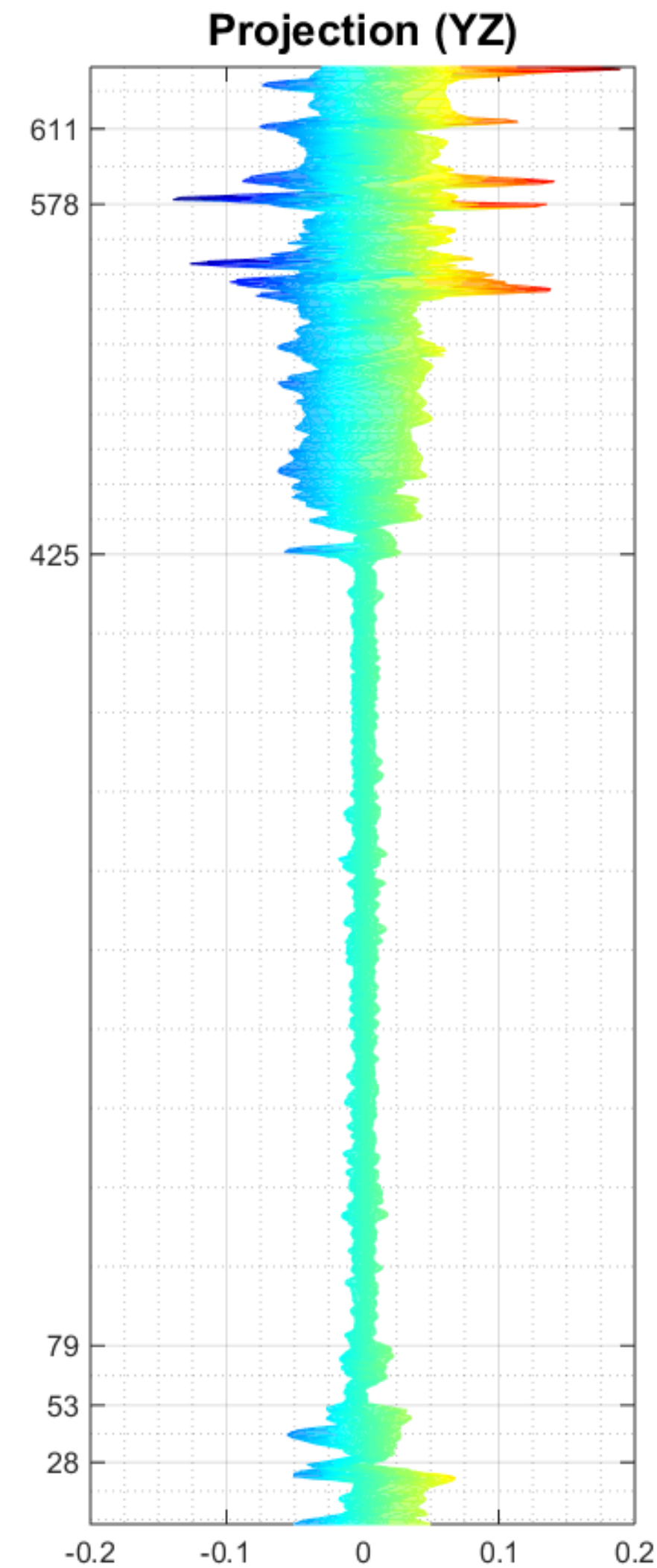
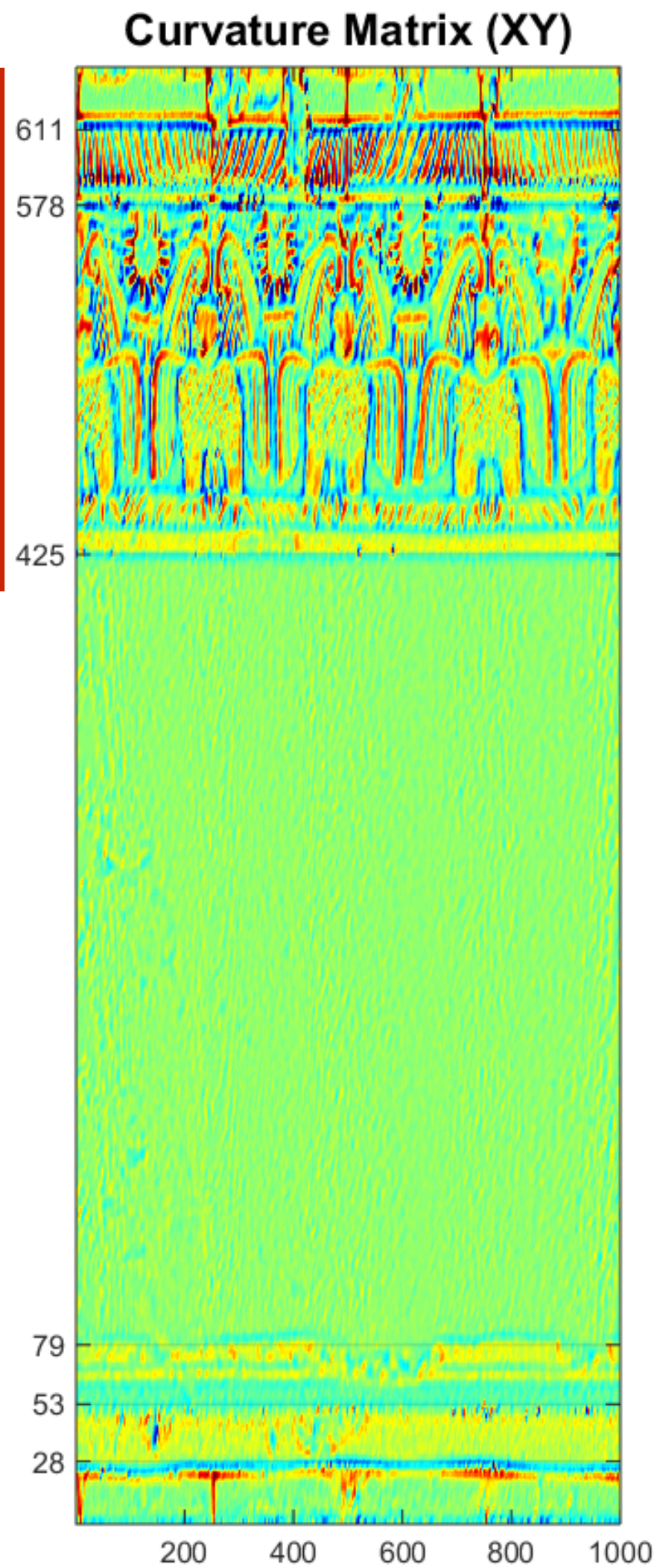
7/12 DATA ANALYSIS :



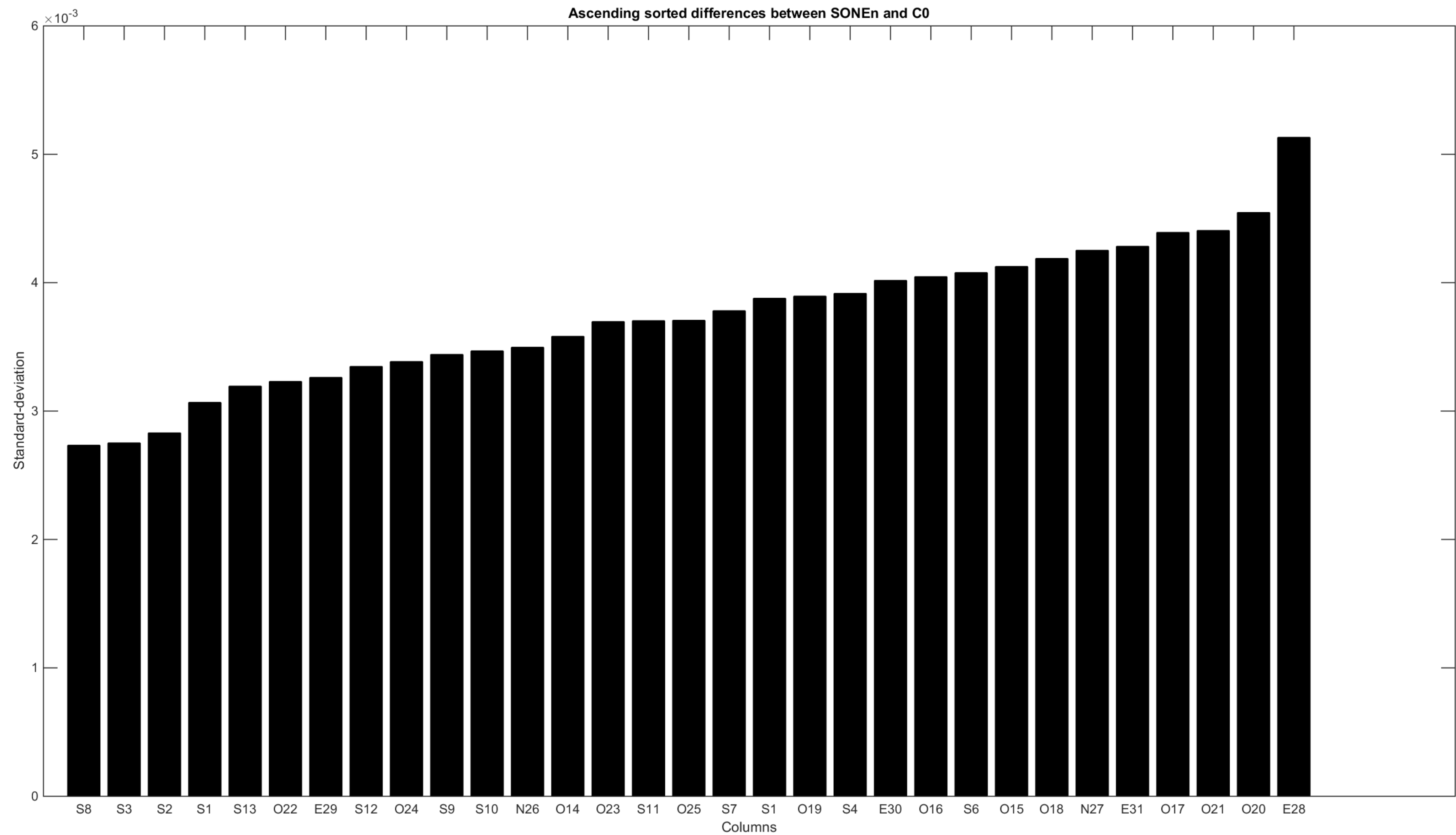
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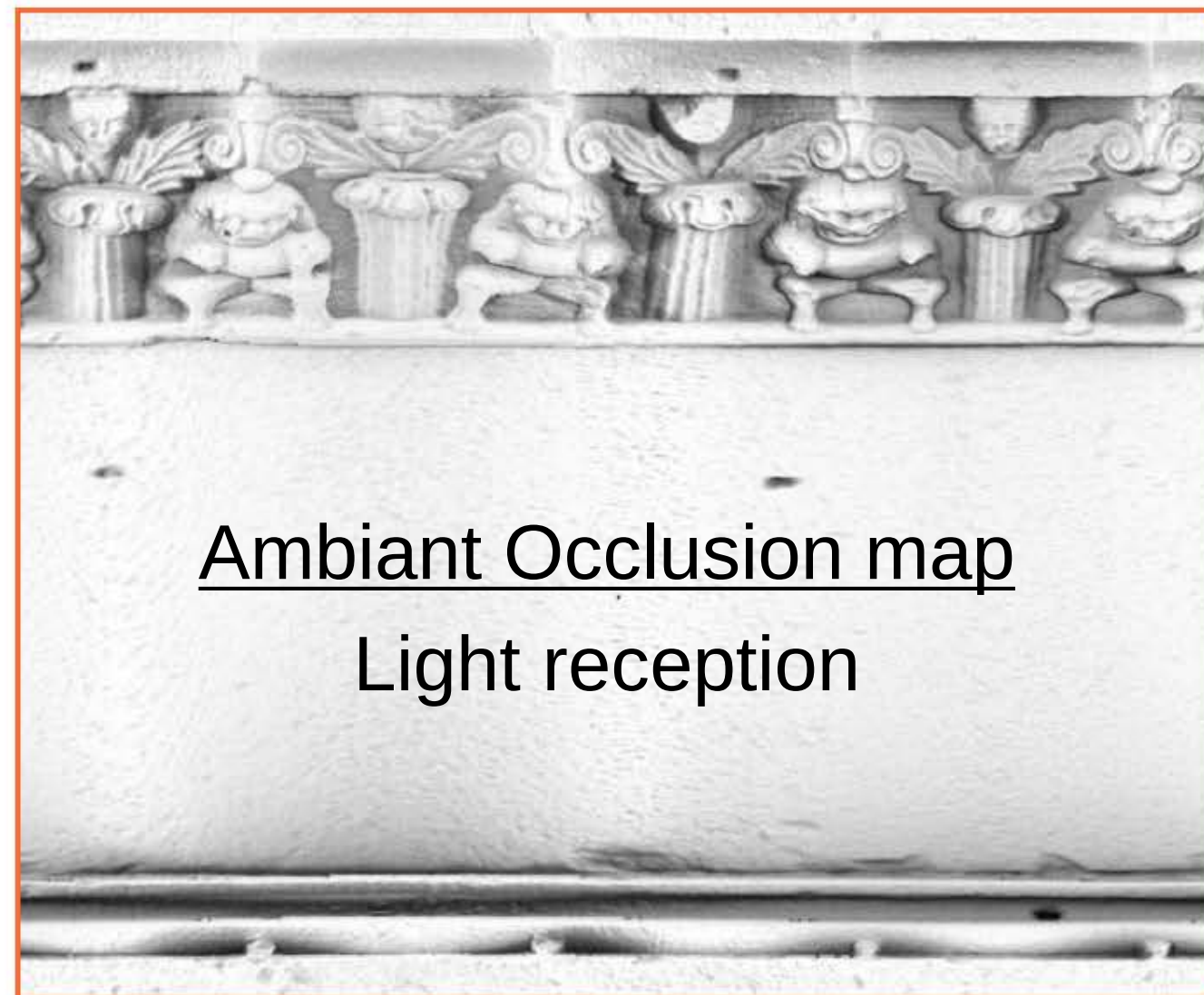
7/12 DATA ANALYSIS :



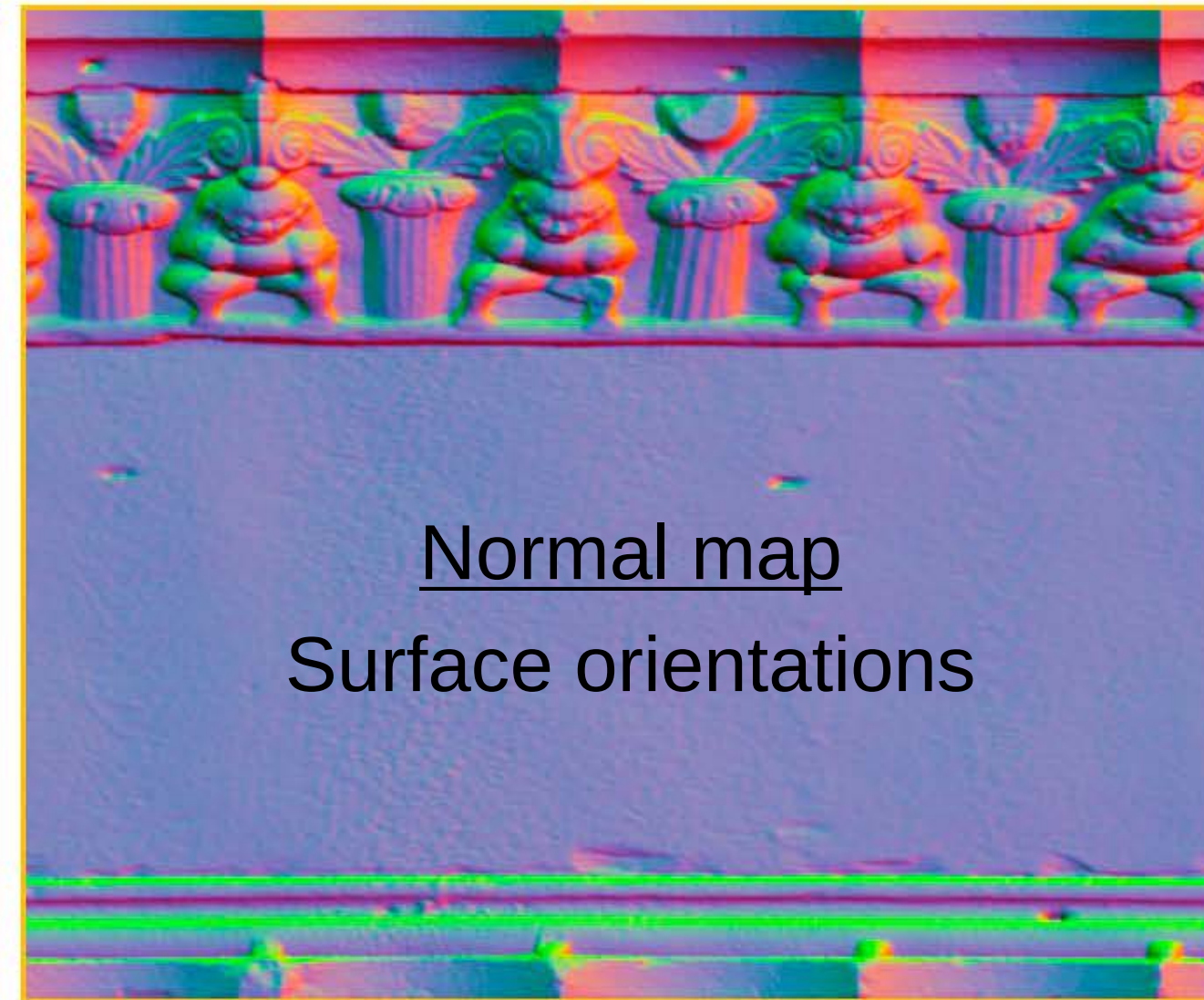
8/12 DELTA ANALYSIS :



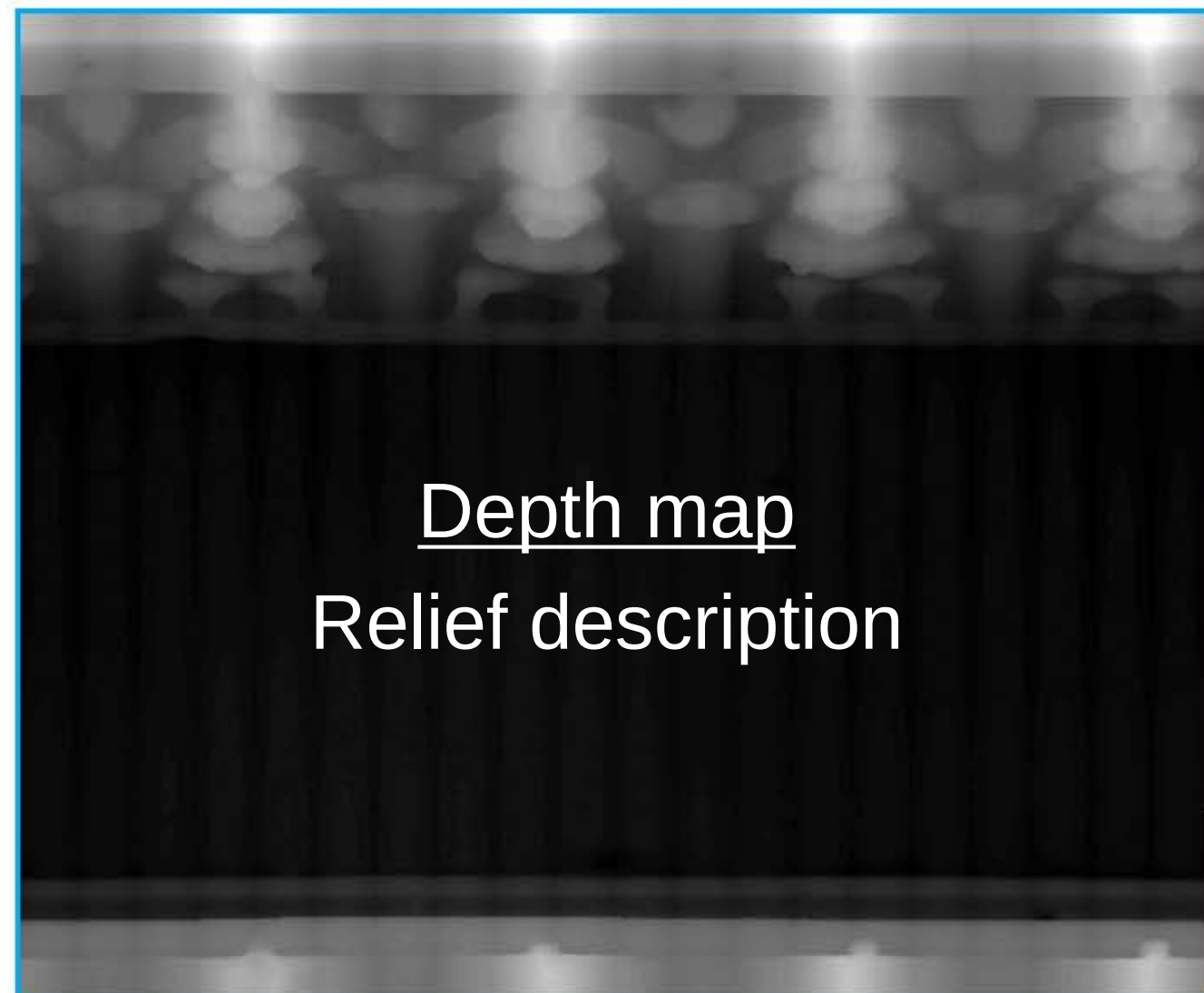
9/12 MULTIPLES DESCRIPTORS :



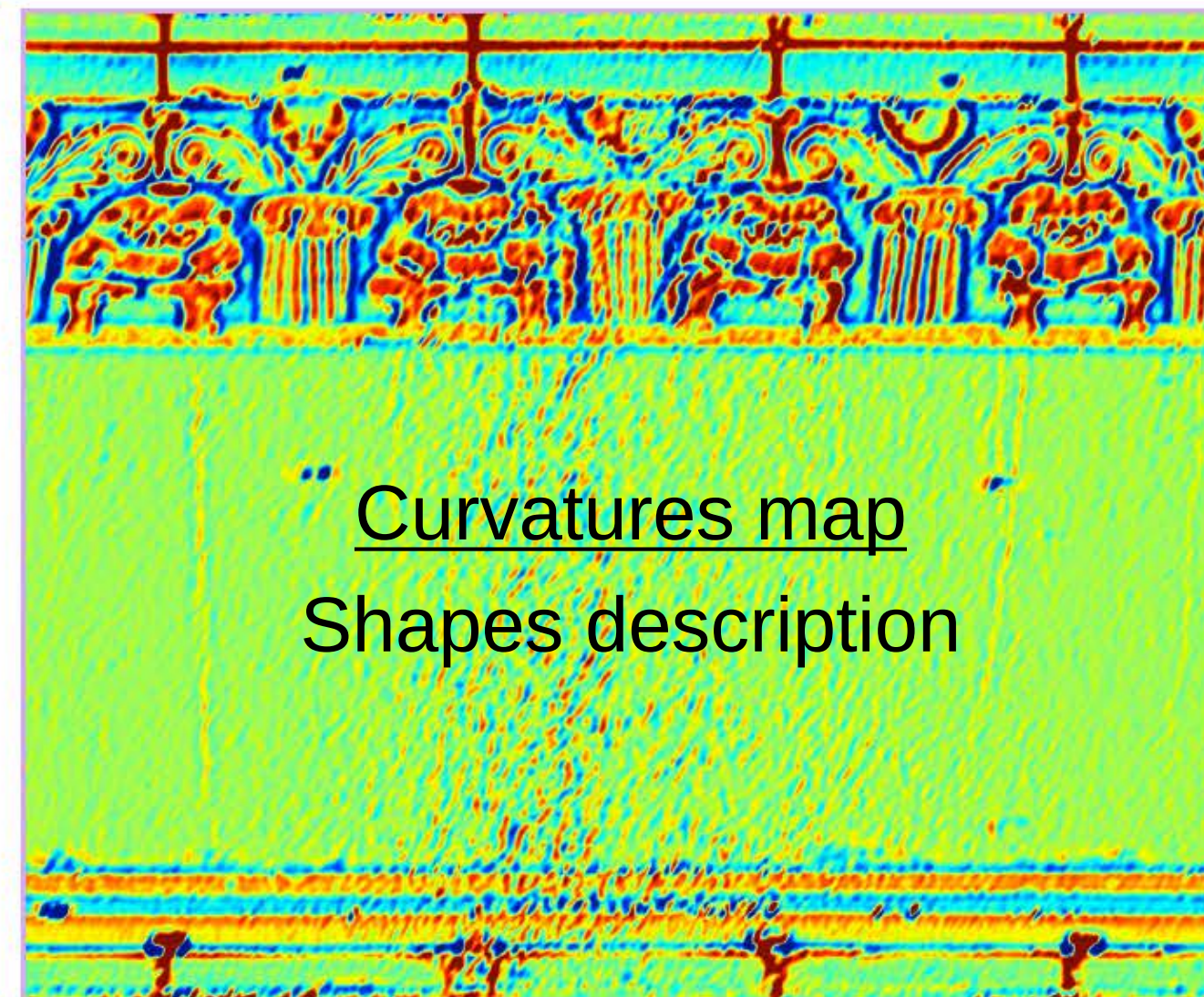
Ambient Occlusion map
Light reception



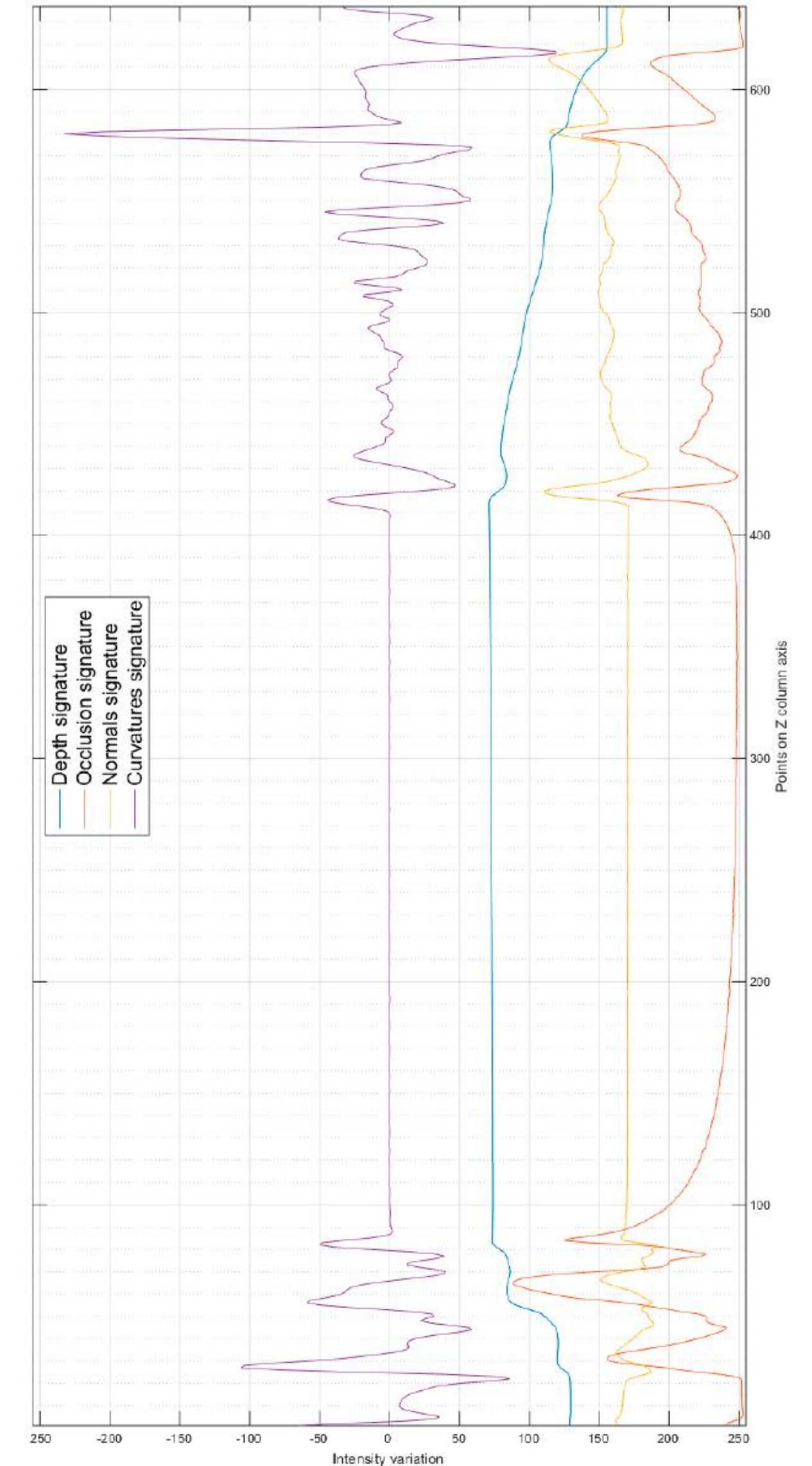
Normal map
Surface orientations



Depth map
Relief description

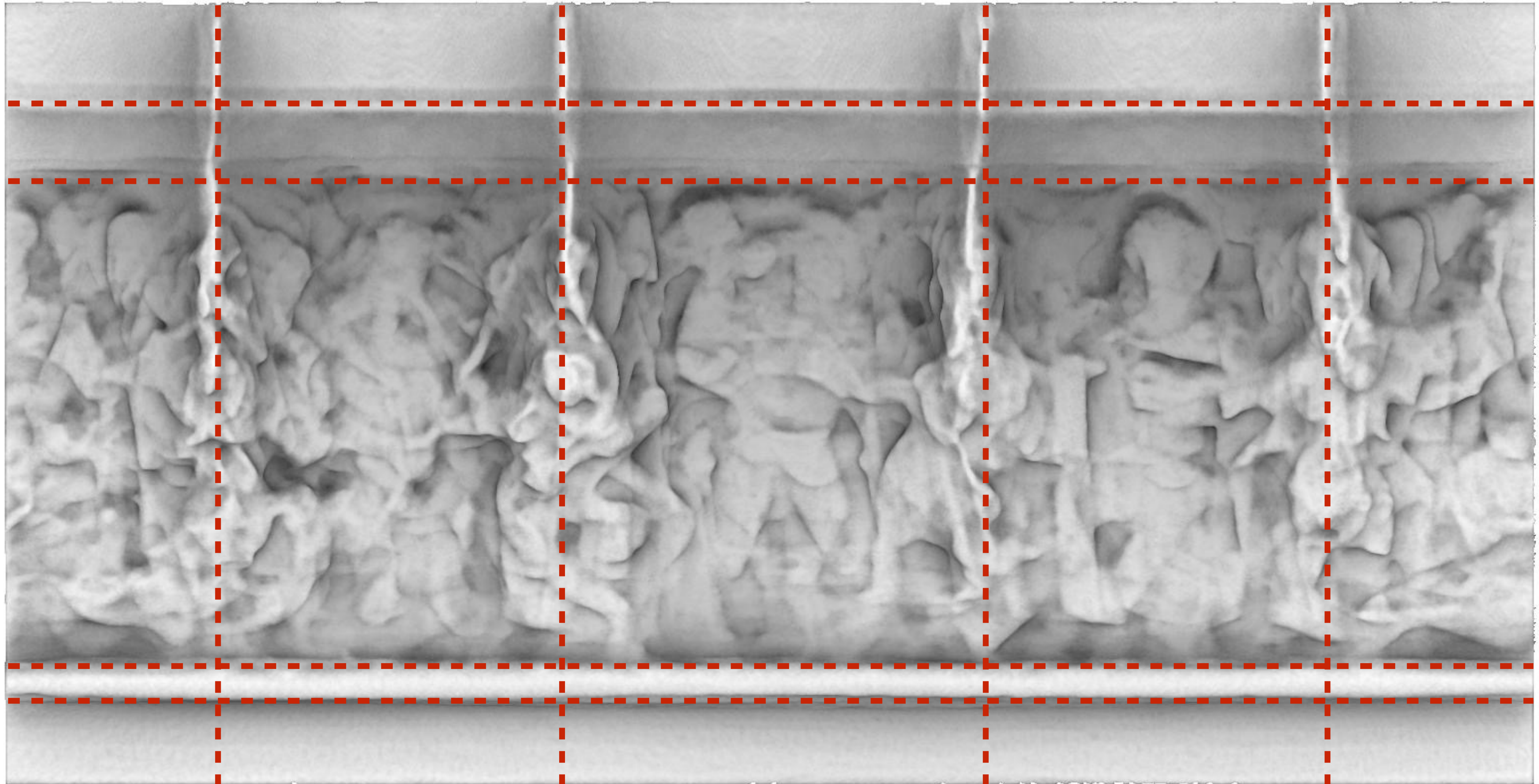


Curvatures map
Shapes description

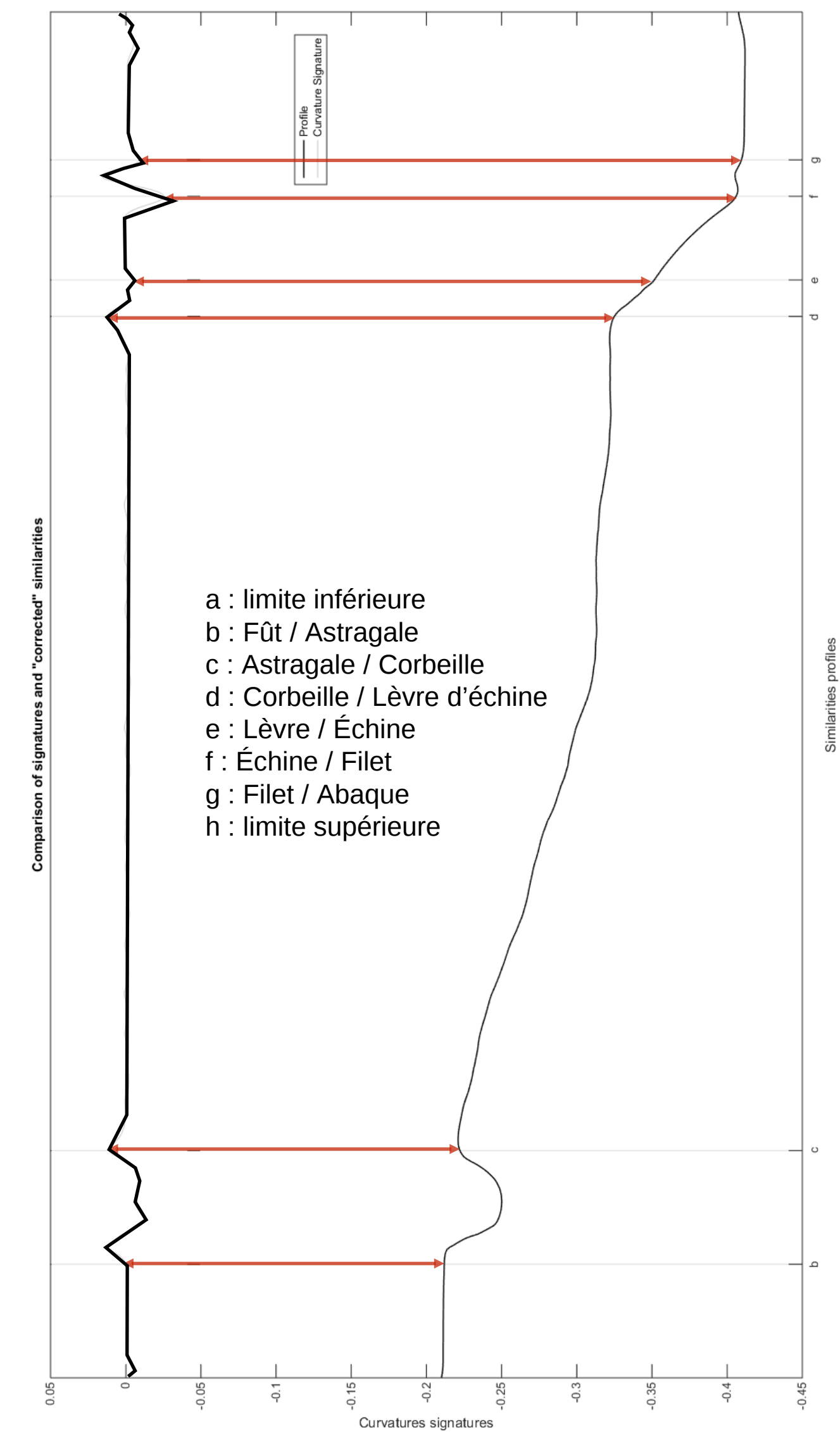
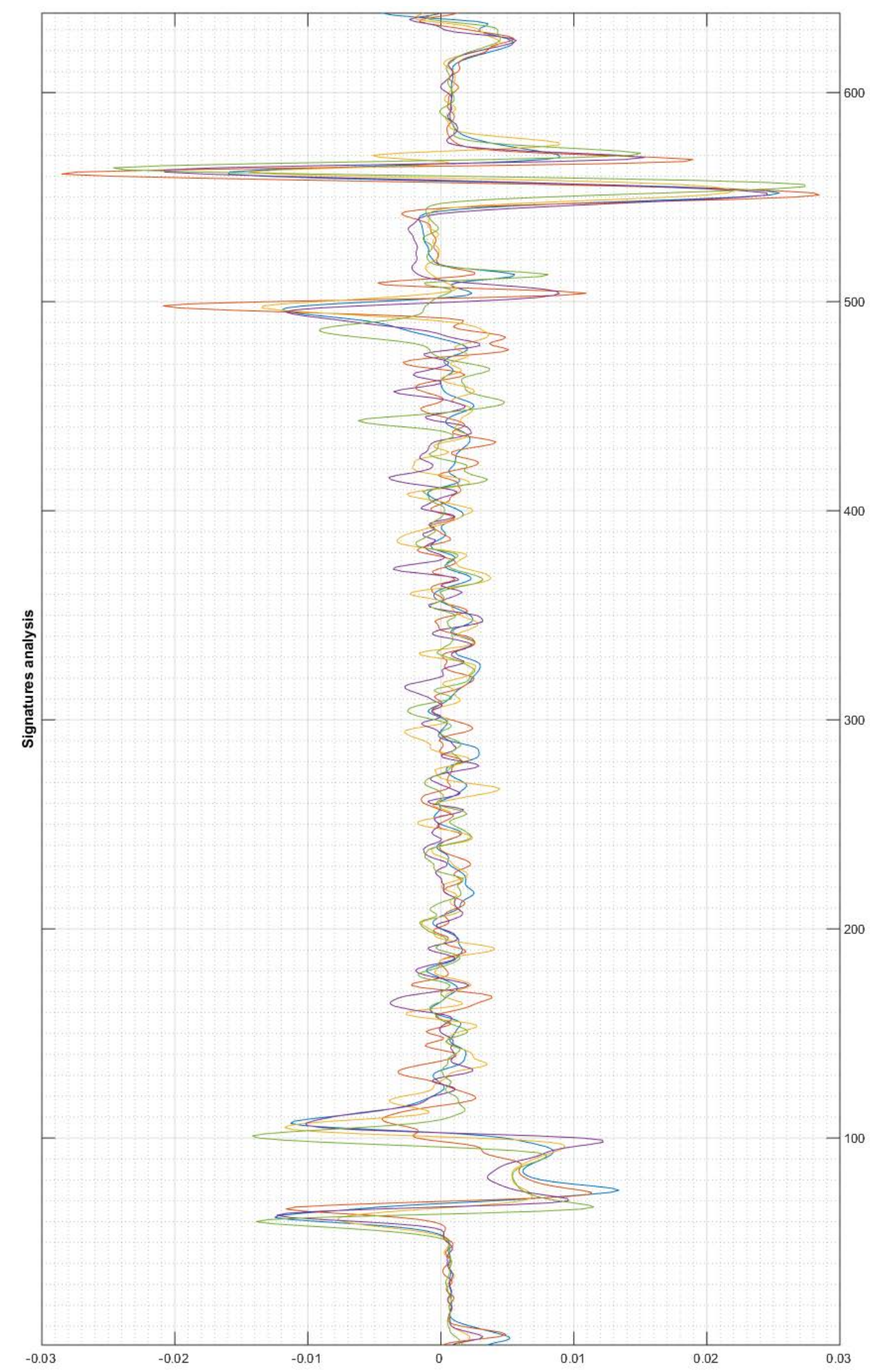
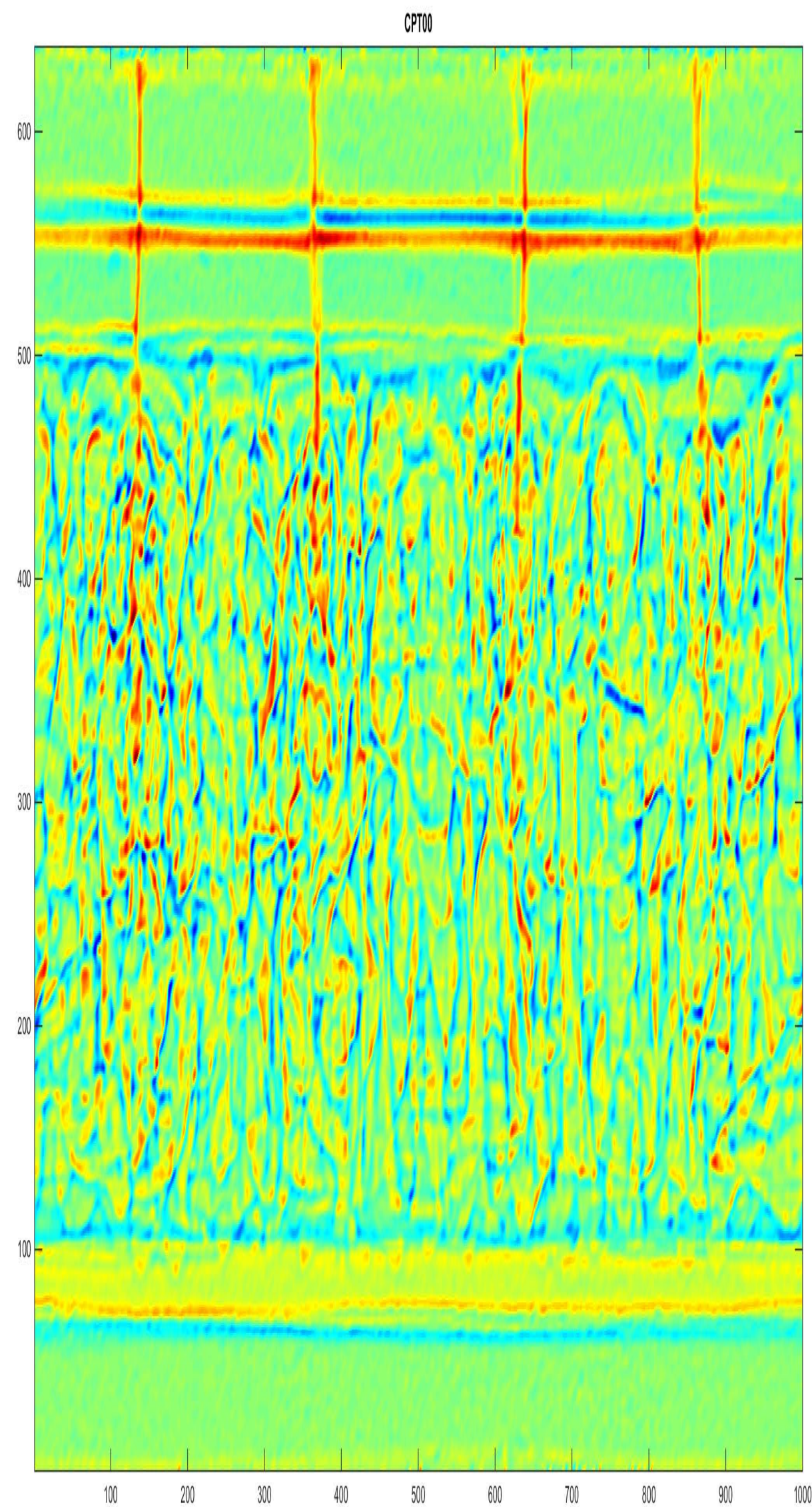


10/12 REVEALING SEMANTIC LAYOUT :

- 4 casted capitals from the Galerie des Moulages, Cité de l'Architecture et du Patrimoine, Paris



10/12 REVEALING SEMANTIC LAYOUT :



12/12 CONCLUSIONS & PERSPECTIVES :

Morphological Analysis from Curvature-based Signatures :

Need to control acquisition and processing to create a homogenous dataset
(Almost) fully automated pipeline
Efficient data discrimination/shape description

Limits (work in progress):

Non-automated semantic recognition (annotation tool?)
Non-applicable on all geometries/morphologies

On-going :

Exploring other descriptors and their possible correlations
Investigating signal processing (PCA, cross-correlation...)

