

# 3D recording of archaeological objects with photogrammetric techniques

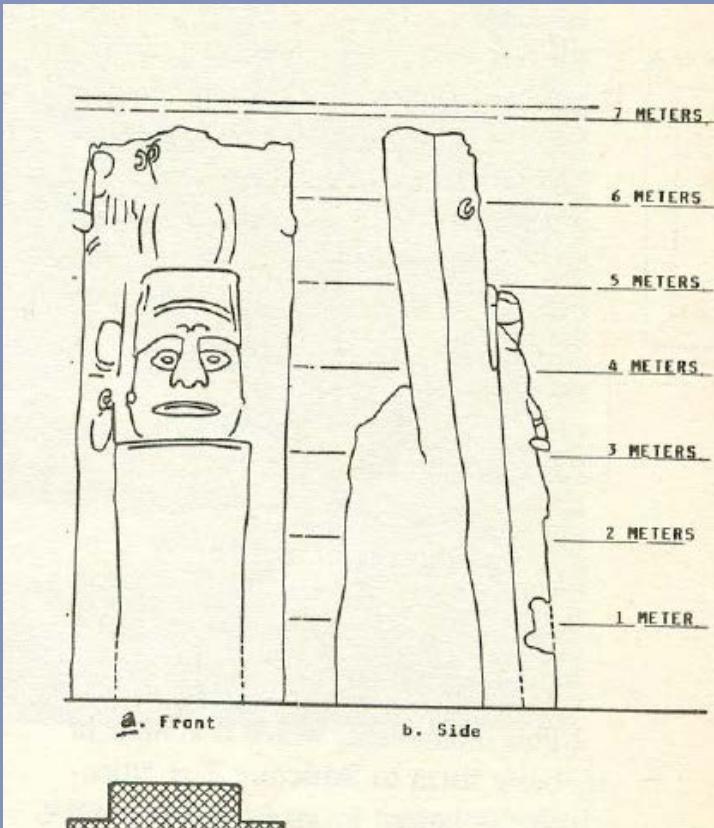
Manuel May Castillo/Gabriel Gómez Pastor



Universiteit Leiden  
The Netherlands

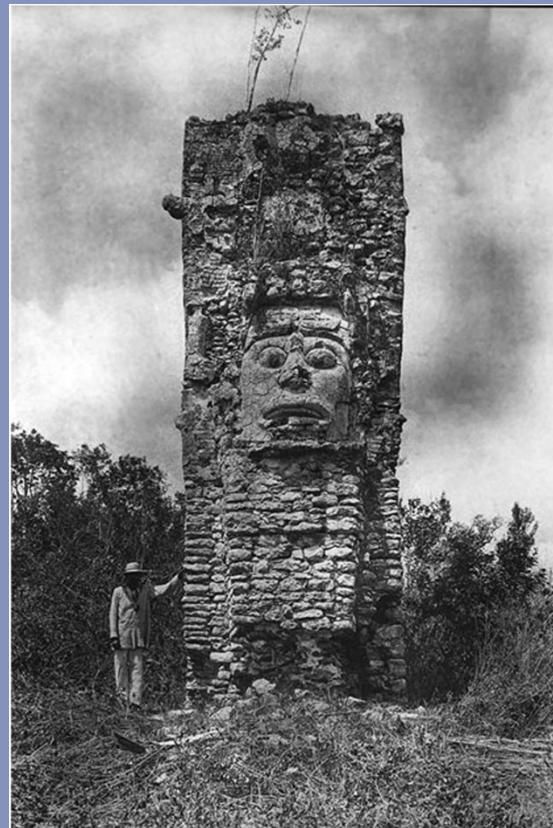
In Guatemala and México:

- Nowadays most of archaeologycal interventions are made without previous diagnosis



Drawing by Pollock 1970?

Nocuchich, México



Teoberto Maler 1842-1917

Leiden University, Faculty of Archaeology.

# Testing a method

- Developing a method for scientific study of architecture and other samples (archaeological) of material culture by using new technologies

Main Conditions:

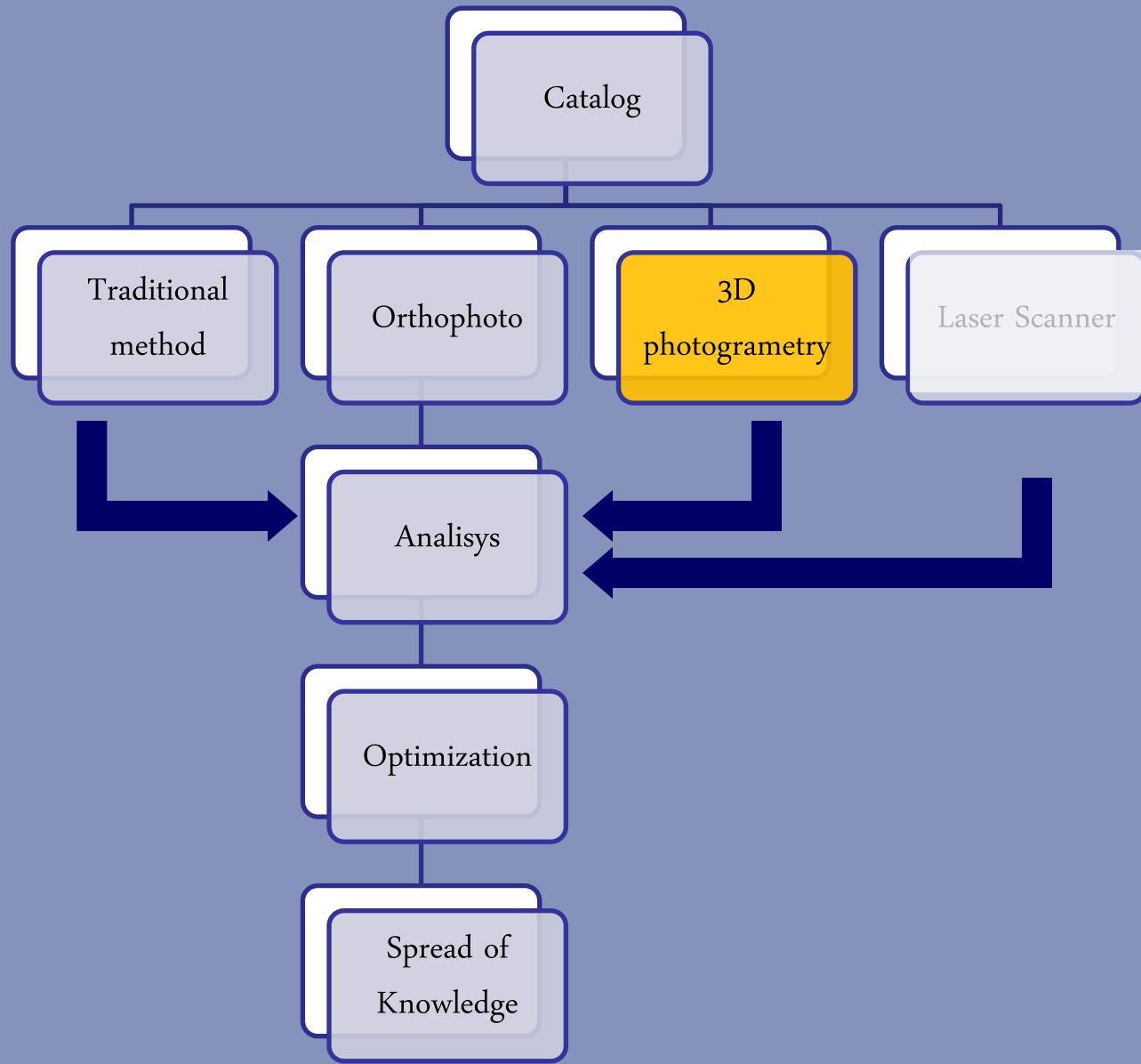
1. Efficiency
2. Economic
3. Economic







# The method



**FICHA DE ANALISIS (2)**  
ANALISIS ARQUITECTONICO DE LOS ESPACIOS EXTERIORES  
NAKUM-N-2B  
PROM: 03/07/2015

**1. DIMENSIONES**

1.1 GENERALES	ESPACIO: <input checked="" type="checkbox"/> EDIFICIO: <input type="checkbox"/>	TIPO: <input type="checkbox"/> GRUPO: <input checked="" type="checkbox"/> ACROPOLIS SUR			
1.2 DIMENSIONES	LARGO (m): <input type="checkbox"/> 1,60	ANCHO (m): <input type="checkbox"/> 0,45	ALTO (m): <input type="checkbox"/> 1,90	DIRECCION: <input type="checkbox"/> NORTE	OESTE: <input checked="" type="checkbox"/> SURESTE
1.3 MATERIALES	TIPO: <input type="checkbox"/> PIEDRA	TIPO: <input type="checkbox"/> MADERA			

**2. Muros**

2.1 GENERALES	ALTO (m): <input type="checkbox"/> 1,95	ESPESOR (m): <input type="checkbox"/> 0,05	DECORACION: <input type="checkbox"/> PRO-AÑADIDA		
2.2 MATERIALES EN MUROS	TIPO DE MATERIALES EN MUROS:	A: <input type="checkbox"/> PIEDRA	B: <input type="checkbox"/> GRANITO	C: <input type="checkbox"/> MADERA	
2.3 ELEMENTOS EN MUROS	<input type="checkbox"/> PORTAVARAS	<input type="checkbox"/> CORTINEROS	<input type="checkbox"/> ABERTURAS	<input type="checkbox"/> BAQUETAS	<input type="checkbox"/> ANILLOS
2.4 PUEBAS	PUEBAS*: ALTO (m) ANCHOR (m) ESPESOR (m) FORMA DECORACION	PUEBAS: <input type="checkbox"/> 1,10	<input type="checkbox"/> 0,47	<input type="checkbox"/> 0,05	<input type="checkbox"/> NUEVA
2.5 JAMASAS	JAMASAS*: ALTO (m) ANCHOR (m) ESPESOR (m) FORMA PRO-AÑADIDA	JAMASAS: <input type="checkbox"/> 2,00	<input type="checkbox"/> 1,54	<input type="checkbox"/> 0,05	<input type="checkbox"/> RECTANGULAR SILLARES
2.6 TIPS	TIPS: ALTO (m) ANCHOR (m) ESPESOR (m) FORMA DECORACION	TIPS: <input type="checkbox"/> 1,80	<input type="checkbox"/> 1,56	<input type="checkbox"/> 0,05	<input type="checkbox"/> RECTANGULAR SILLARES
2.7 DENTILLES*	DENTILLES*: ALTO (m) ANCHOR (m) ESPESOR (m) FORMA PRO-AÑADIDA	DENTILLES: <input type="checkbox"/> 0,80	<input type="checkbox"/> 0,67	<input type="checkbox"/> 0,05	<input type="checkbox"/> RECTANGULAR DE MADERA
2.8 BOVEDAS	BOVEDAS: VOLADIZO DE ARRANQUE (m) ALTO (m) ANCHOR (m) FORMA	BOVEDAS: <input type="checkbox"/> 0,10	<input type="checkbox"/> 0,43	<input type="checkbox"/> 0,42	<input type="checkbox"/> C3
2.9 OBSERVACIONES	TIPOS DE BLOQUES:				
2.10 ELEMENTOS EN BODRAS	CLAVES: <input type="checkbox"/> SI	TRABAJOS DE MADERA: <input type="checkbox"/> SI	OTROS:		

**3. BODEDAS**

**4. CROQUIS**

**5. BOVEDAS**

**6. AUTORES**

DDN\_N-2\_B  
Dibujo de Autor  
Manuel Ray Castillo y Beatriz Martín Domínguez

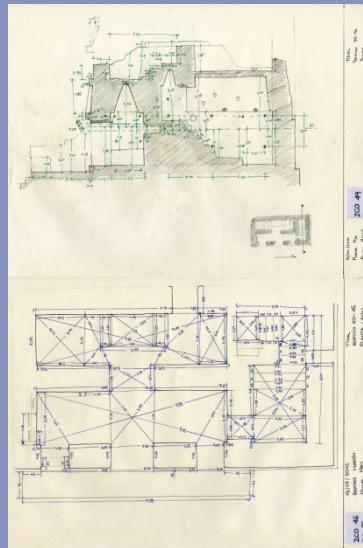
**6. DESCRIPCION Y OBSERVACIONES**

A.1 DESCRIPCION

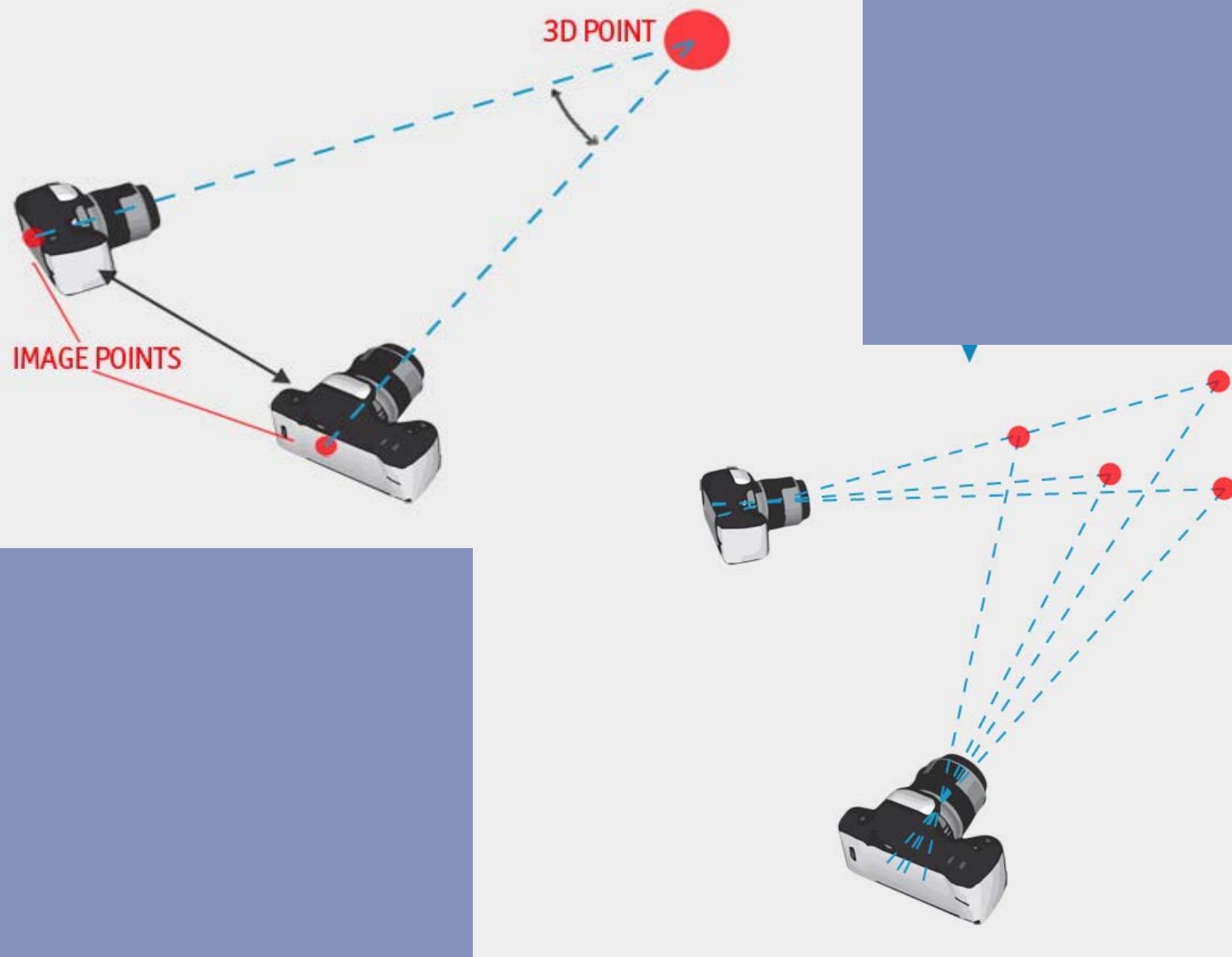
La parte superior arquitectónica del interior del cuarto 2 del edificio 2 de Nakum. El cuarto se encuentra completo, sin pérdidas importantes de material. Se observan a simple vista grietas menores en el muro este del cuarto y en ambas jambas.

**B. CROQUIS**

A.1 CROQUIS Y DETALLES GRÁFICOS



# 3D Models

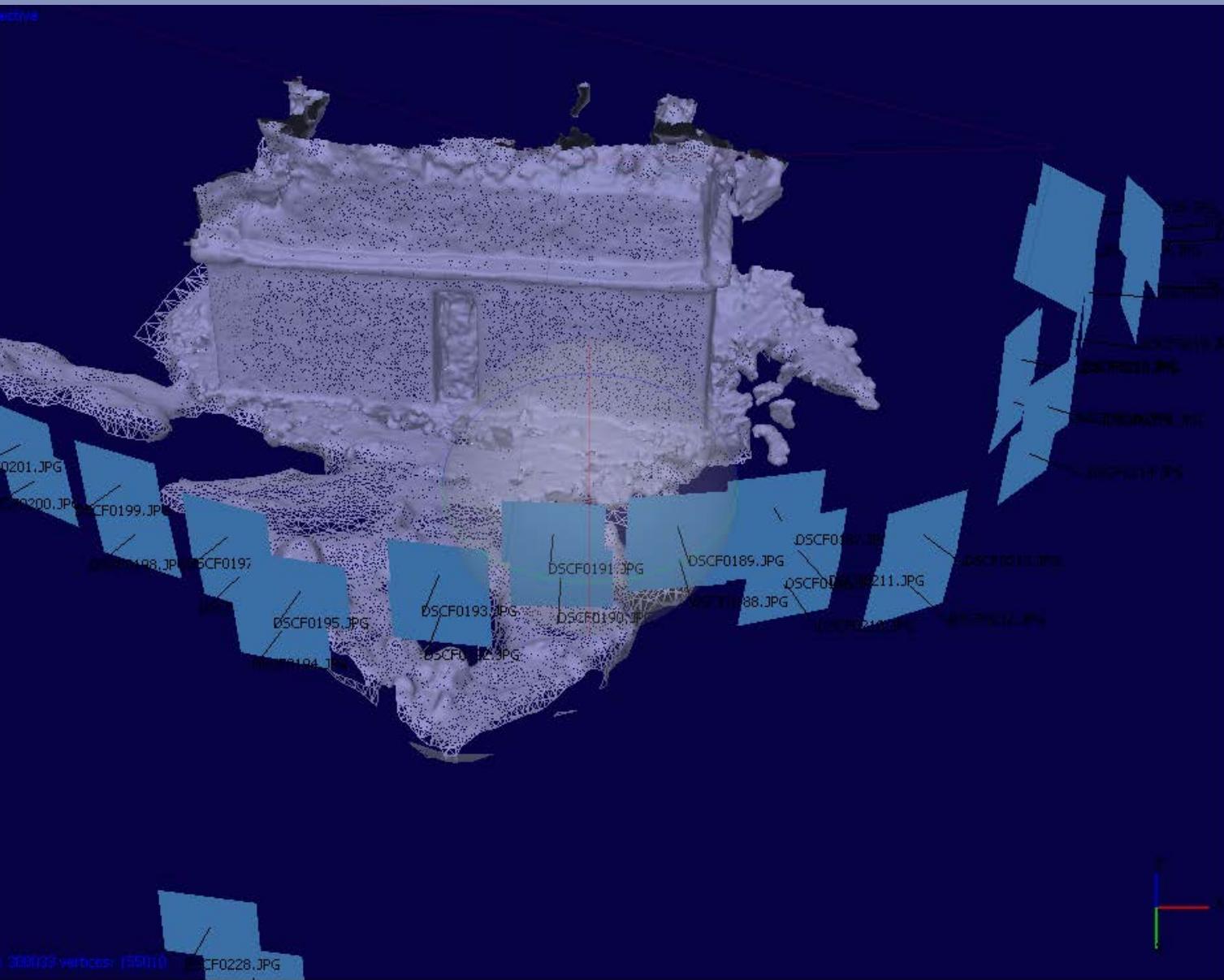


Fryer, J. (2007). *Applications of 3D Measurement from Images*. (H. D. Mitchell & J. D. Chandler, Eds.). Dunbeath: Whittles Publishing.

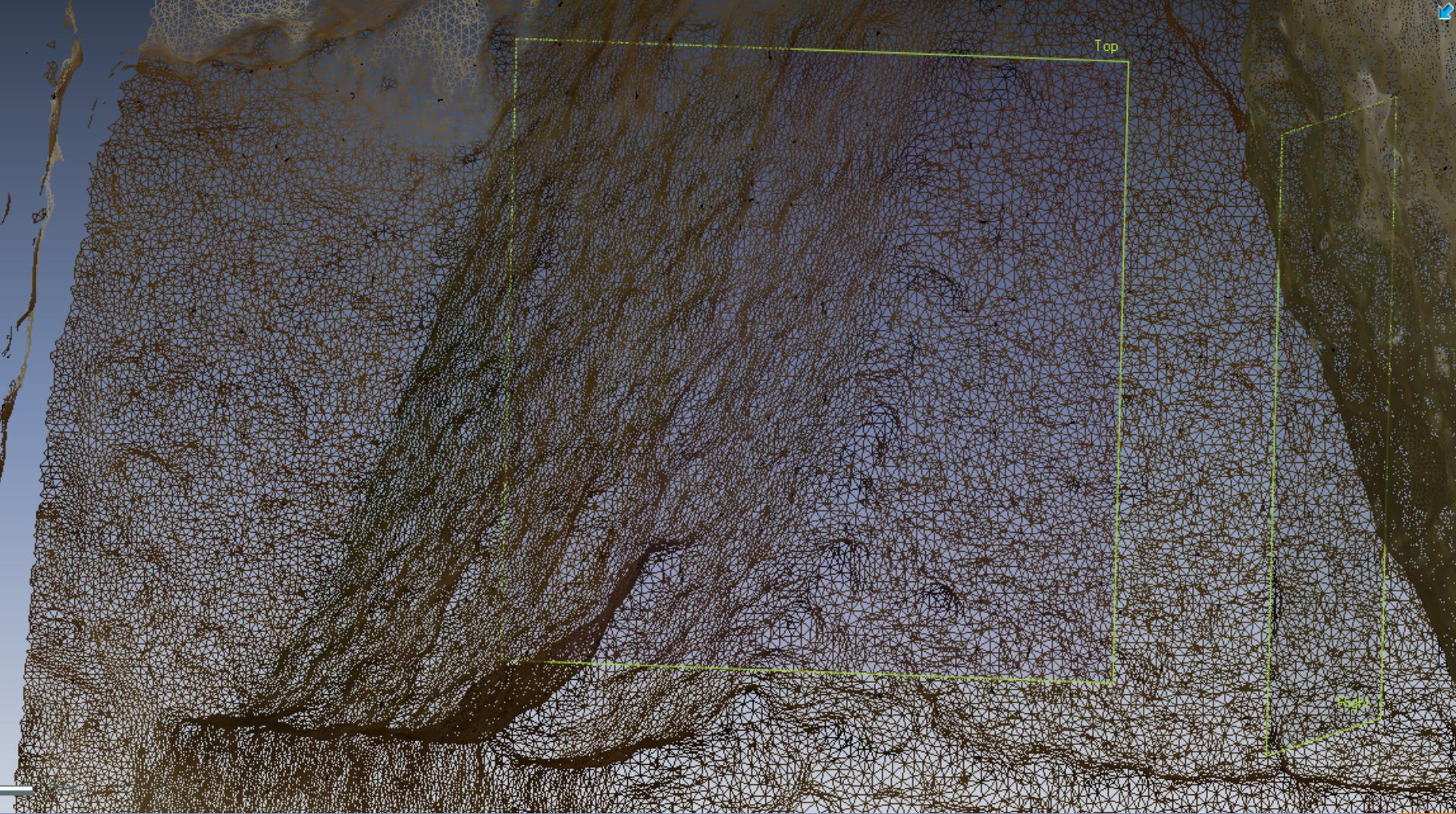
Perspective

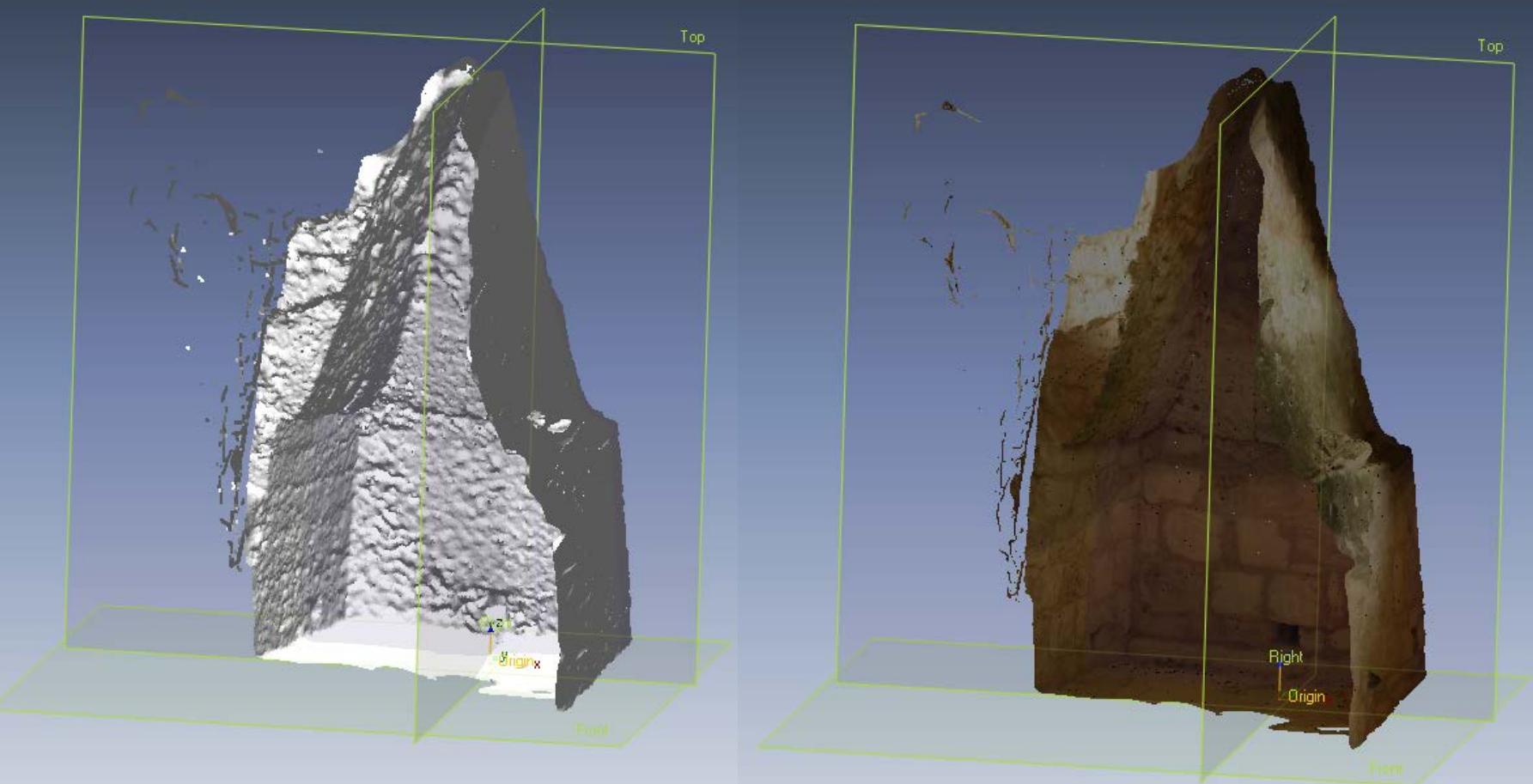


Cloud points with 66,279,578 points including RGB data

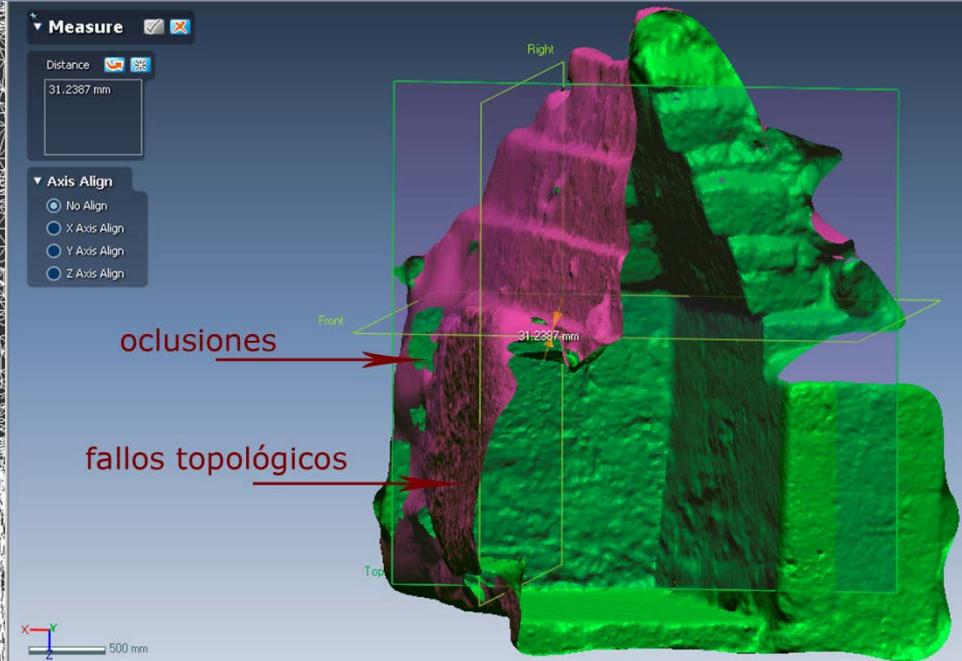
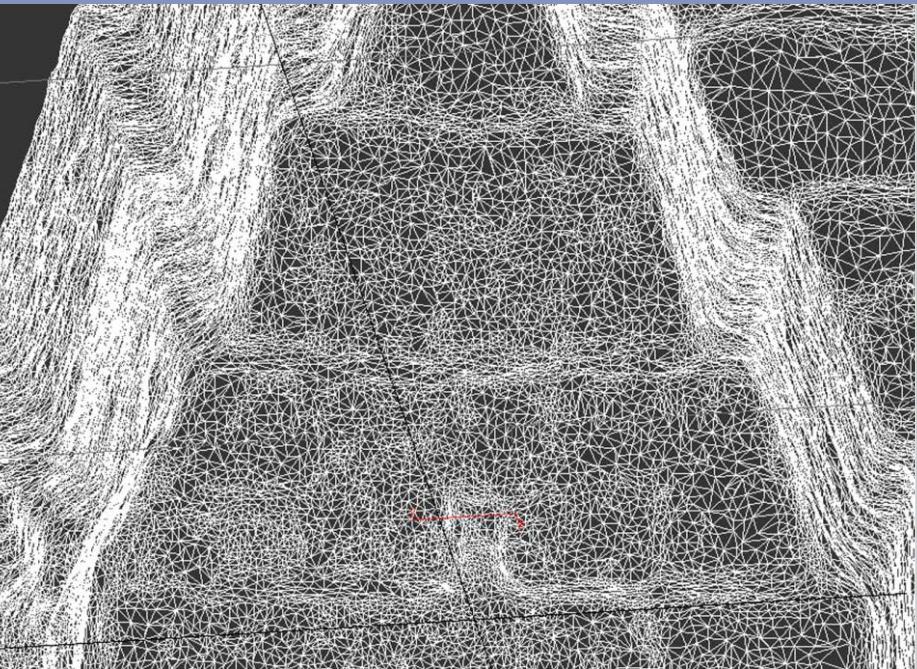


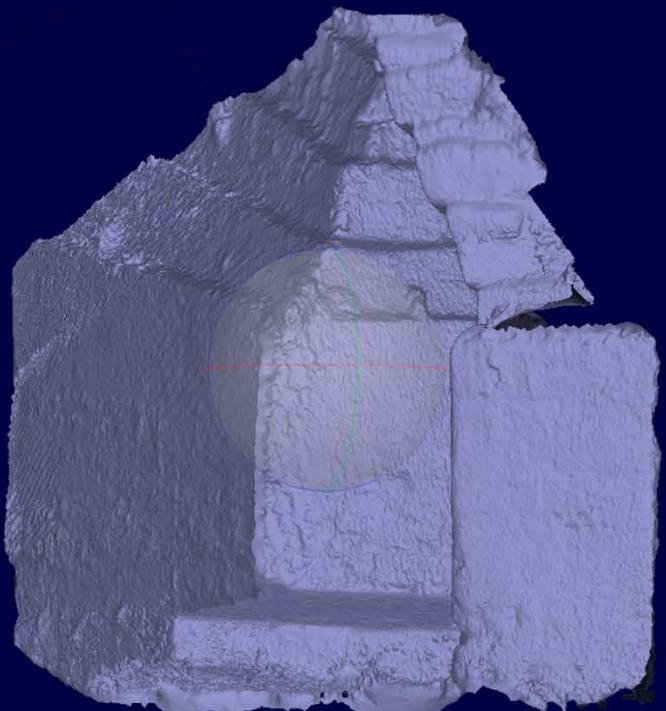






“triangles net”





modelo con 3,939,696 de polígonos

10,7 p/cm<sup>2</sup>22



modelo con textura de color aparente

[faces: 1029696 vértices: 1970293 selección: 1]



tk 160.jpg



tk 164.jpg



tk 170.jpg



tk 171.jpg



tk 190.jpg



tk 195.jpg



tk 196.jpg



tk 208.jpg



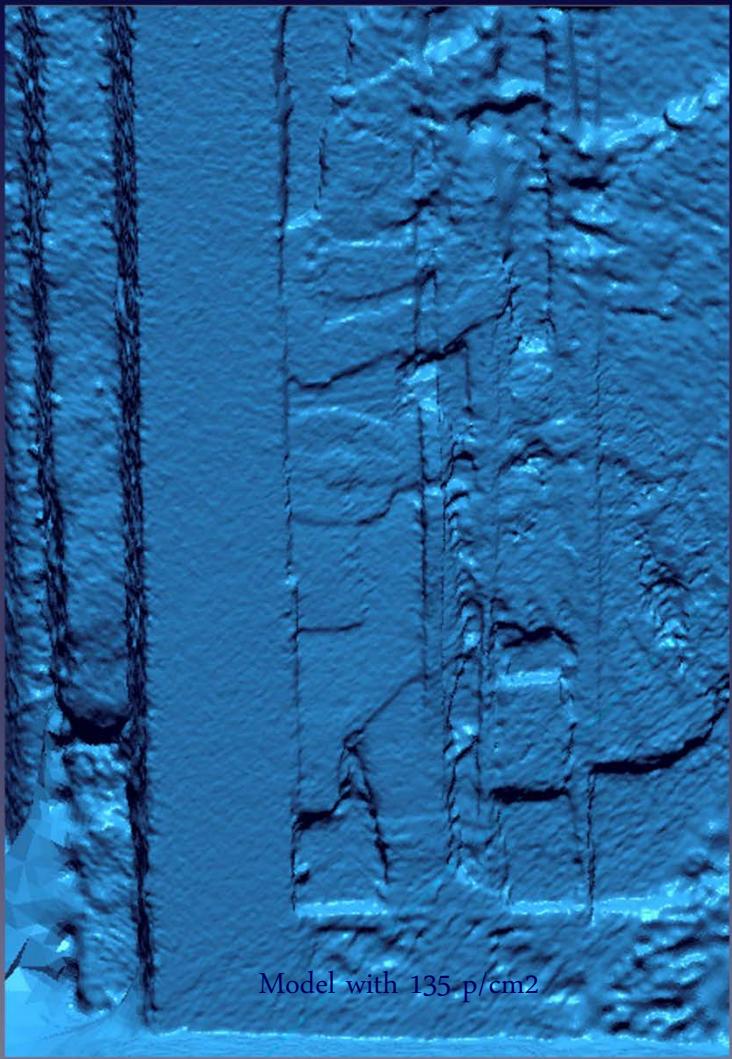
tk 211.jpg



tk 218.jpg



tk 223.jpg



(A)

Dintel 2, Templo III, Tikal



(B)

Leiden University, Faculty of Archaeology.

# Study Case 1



El Chilonché

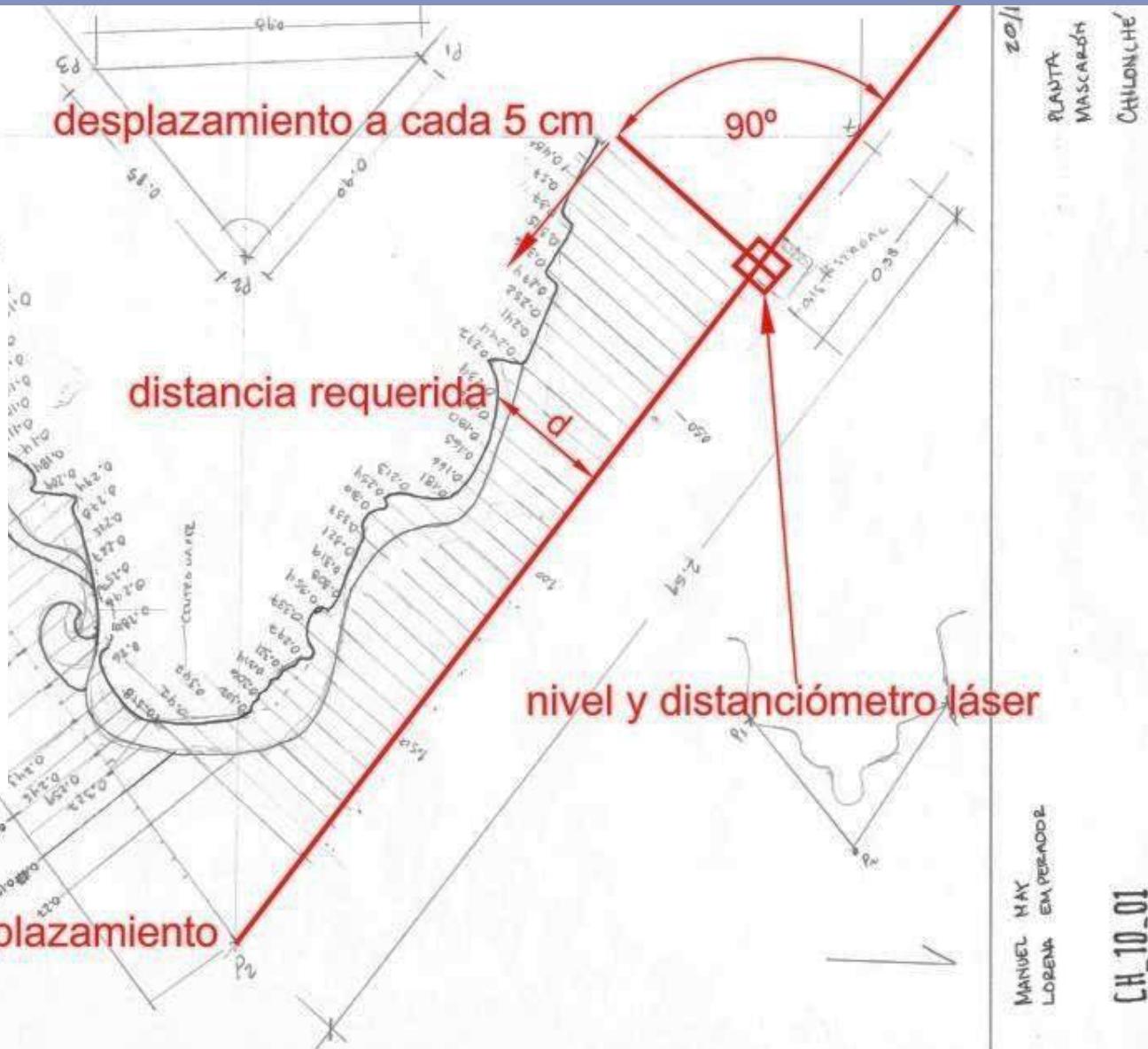


Mascarón, El Chilonché, Aprox. 1500 years old

Leiden University, Faculty of Archaeology.



eje de desplazamiento



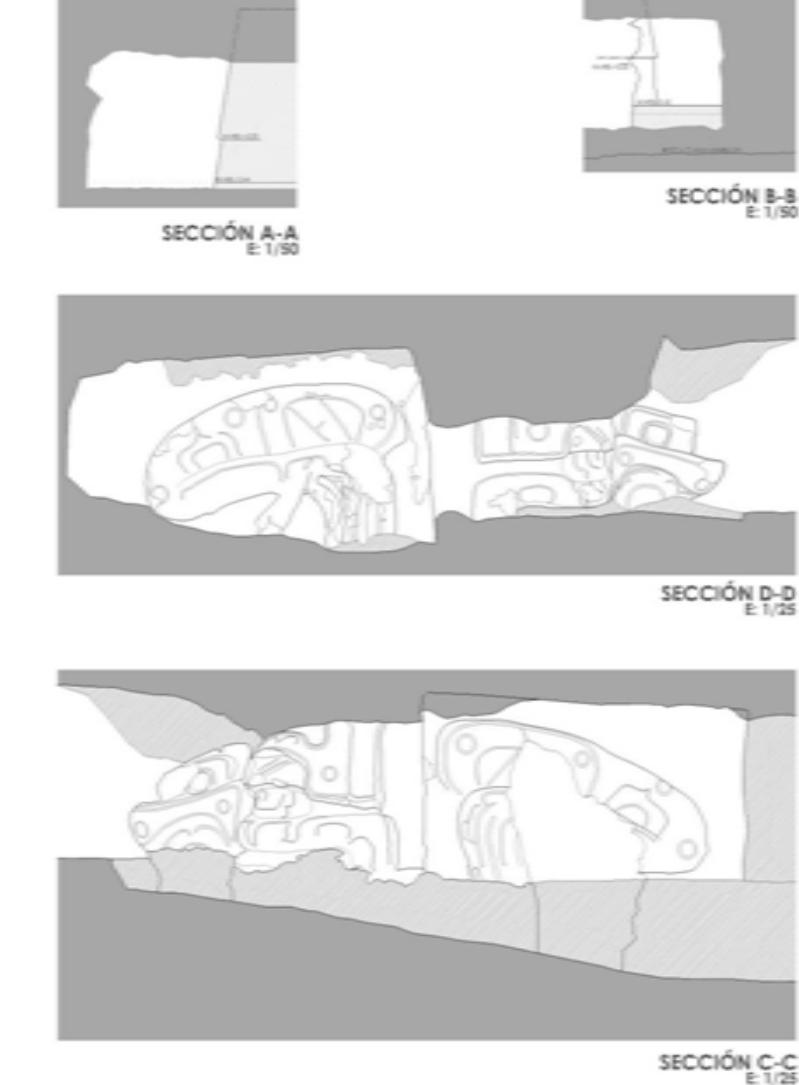
ZOL  
PLANTA  
MASCARA  
CHILONCHE'

MANUEL  
LORENZO  
EM PERADDI

CH\_10\_01



PLANTA MASCARÓN  
E 1/50



**Scalene Triangle**

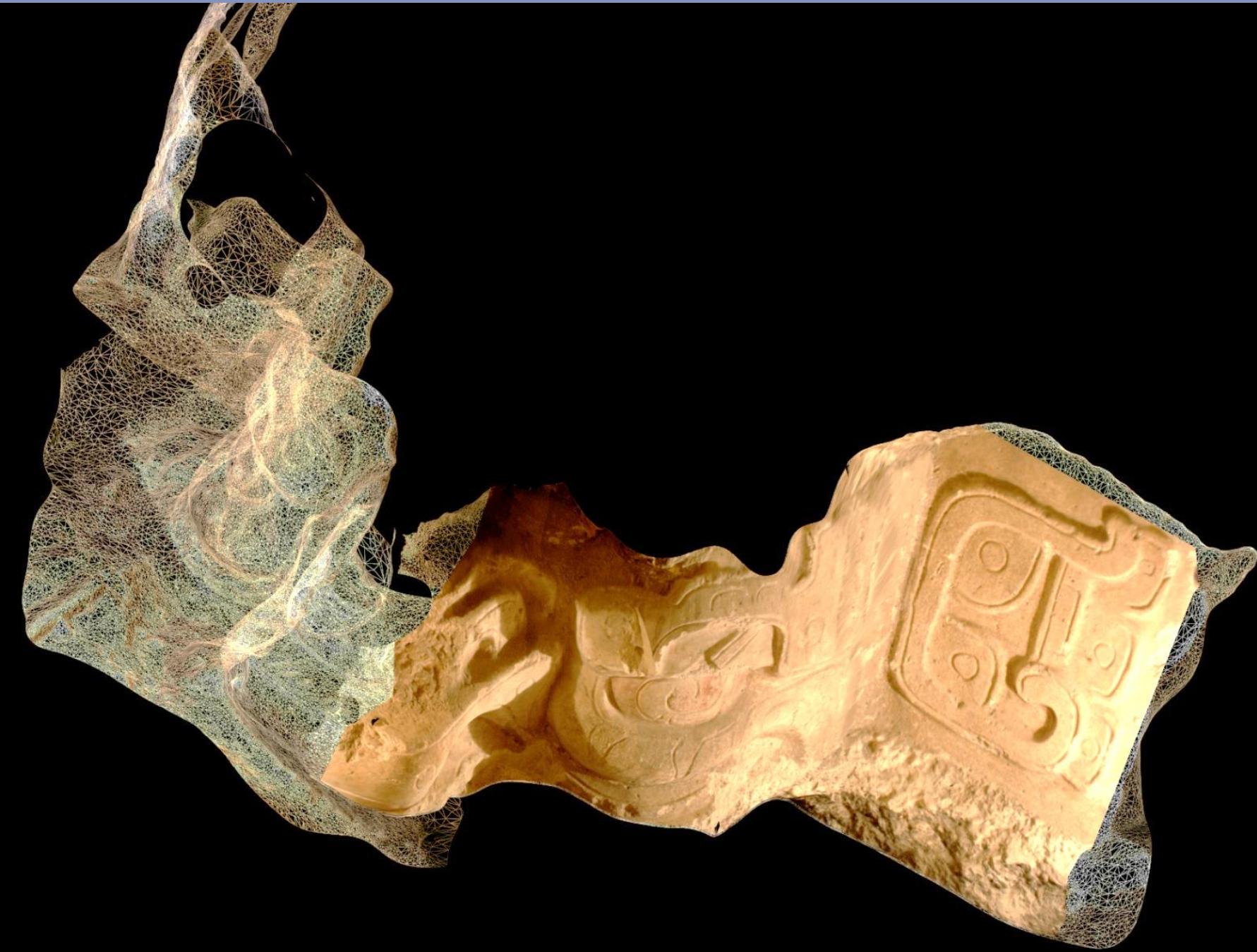
Volume 1 Number 2

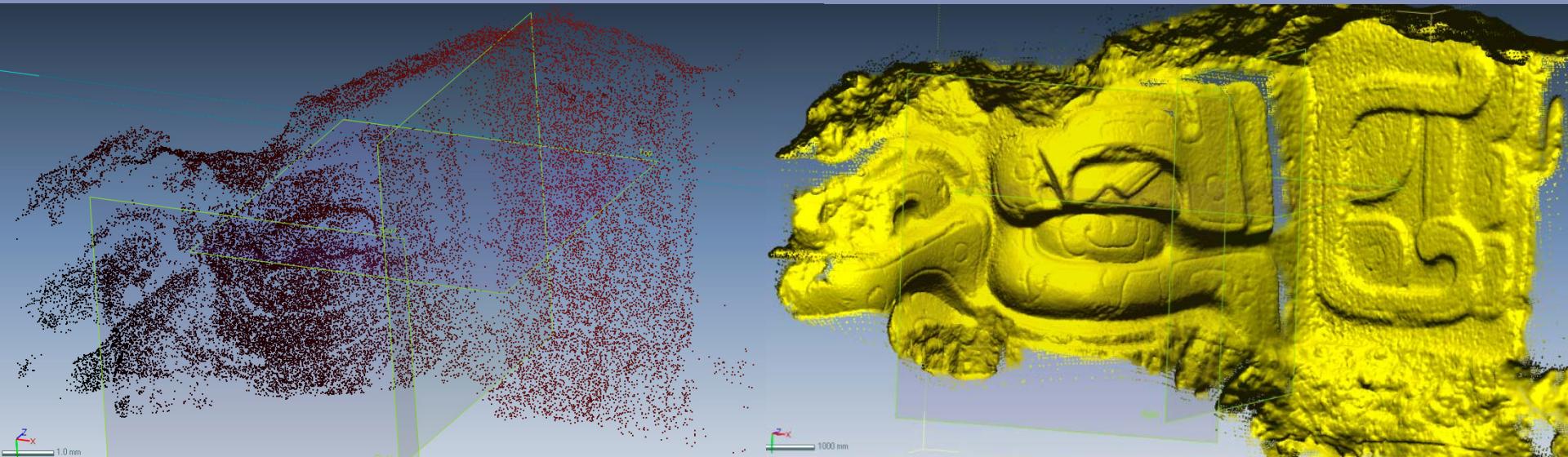
**CHILONCHE: Mascarón  
PROYECTO LA BLANCA - GUATEMALA**

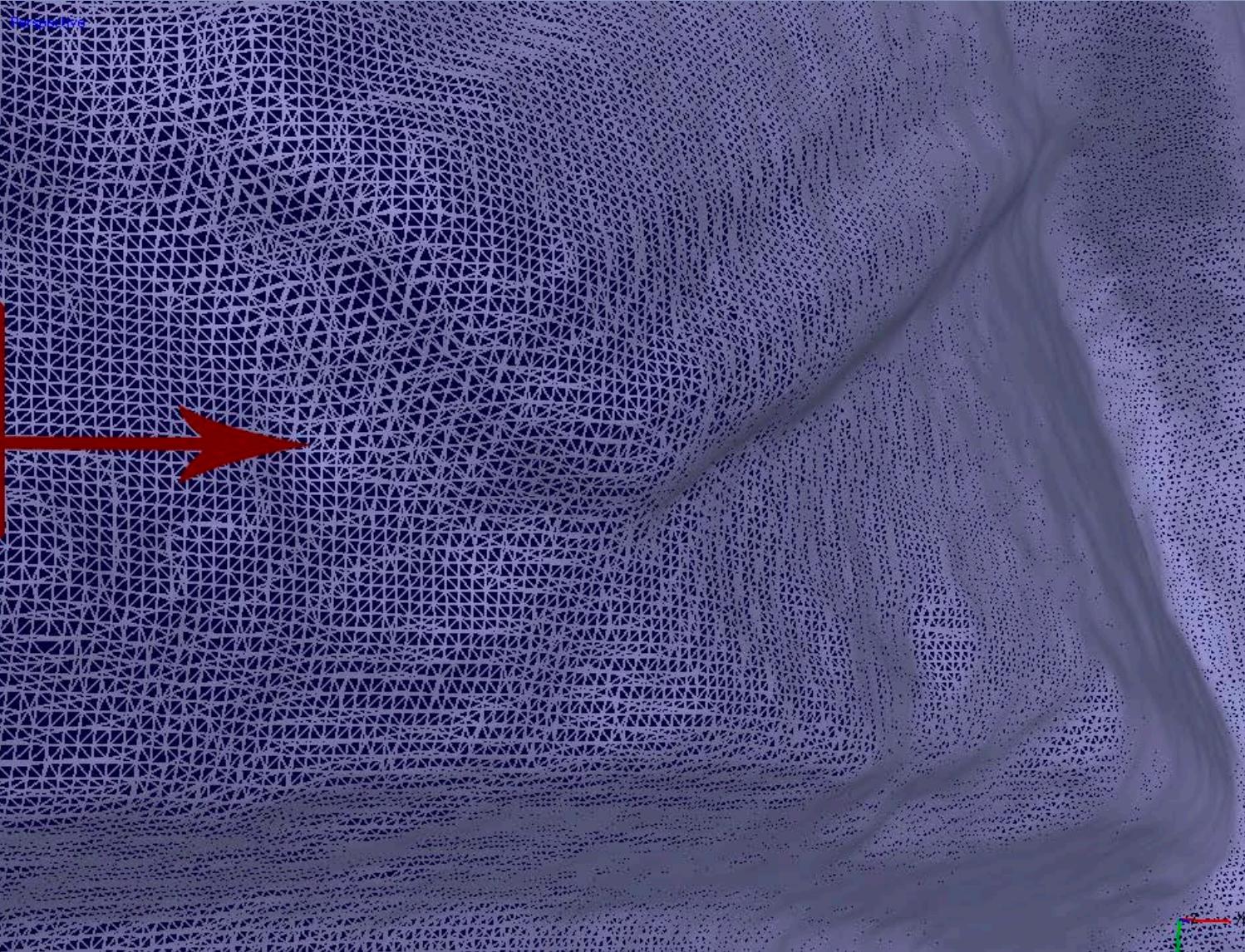
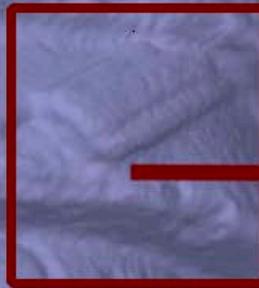
EQUIPO DEL LEVANTAMIENTO

Glossary  
Glossary

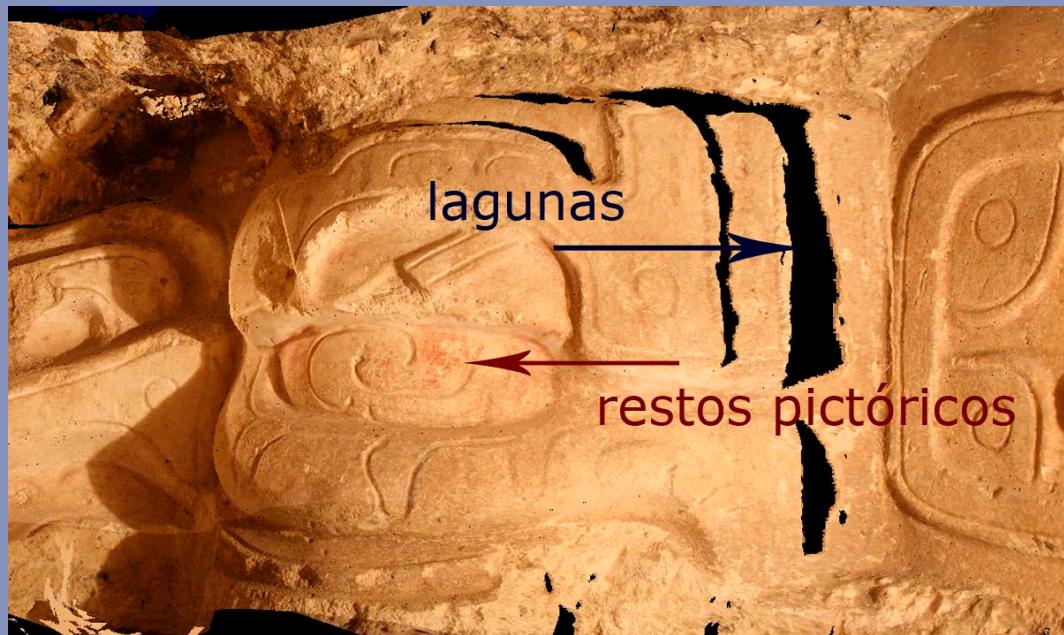


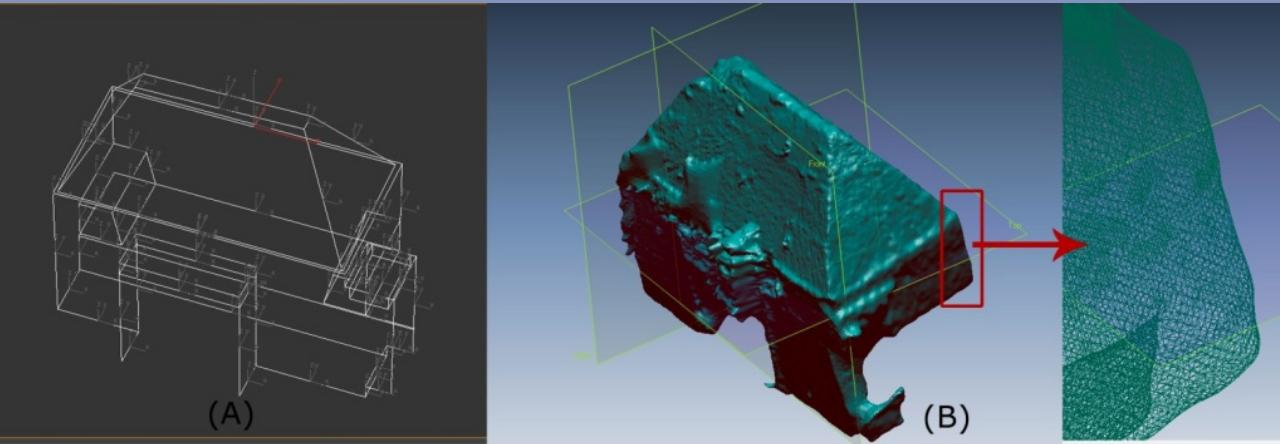




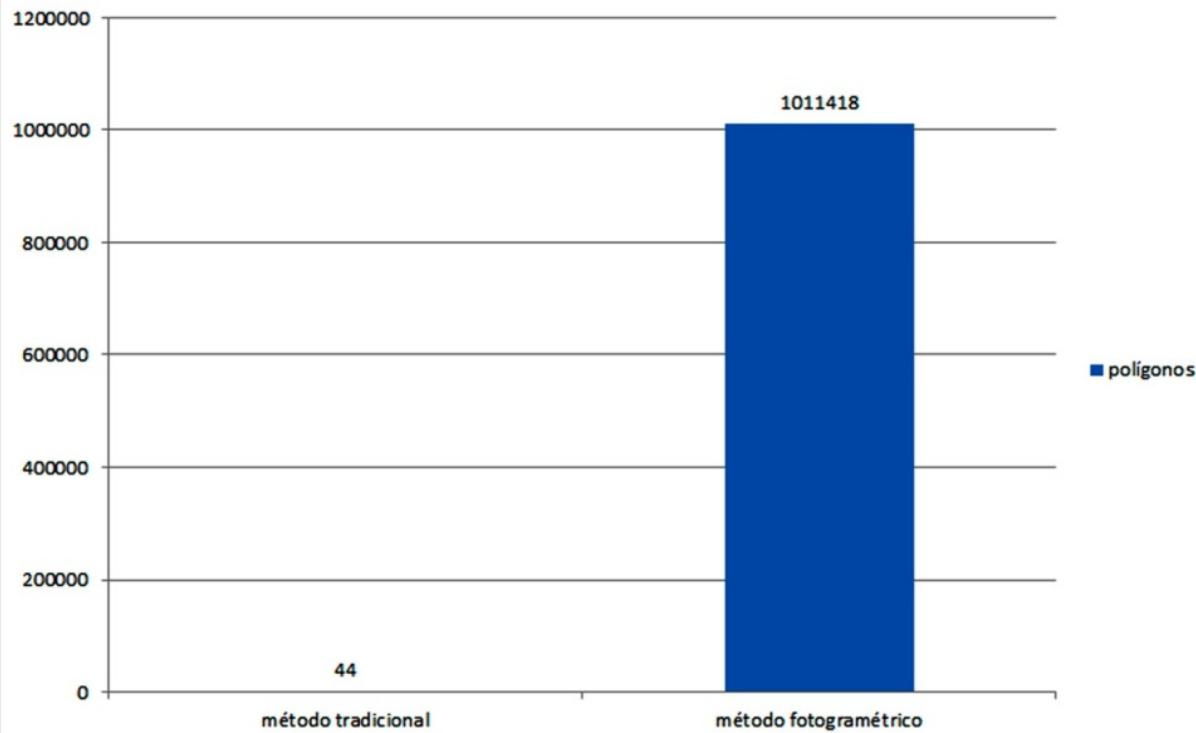


78 p/cm<sup>2</sup>

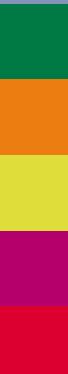




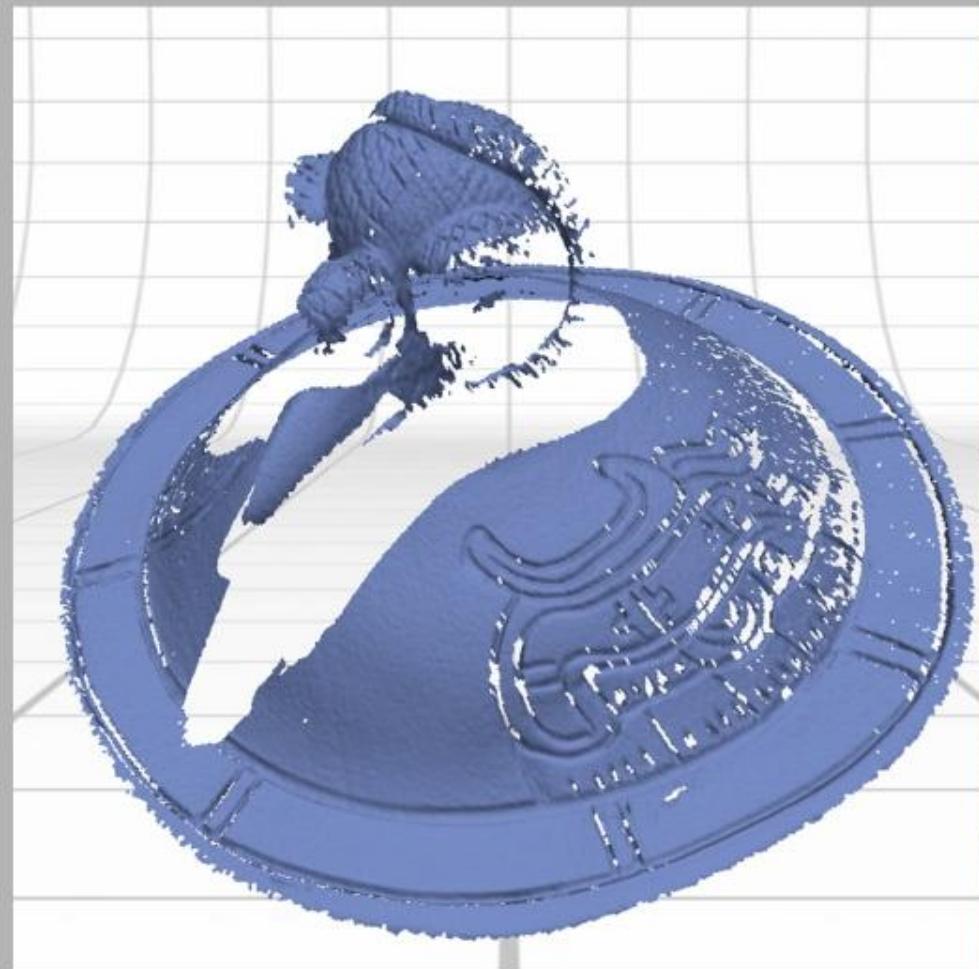
número de polígonos en modelo 3D según el método



laser scanner



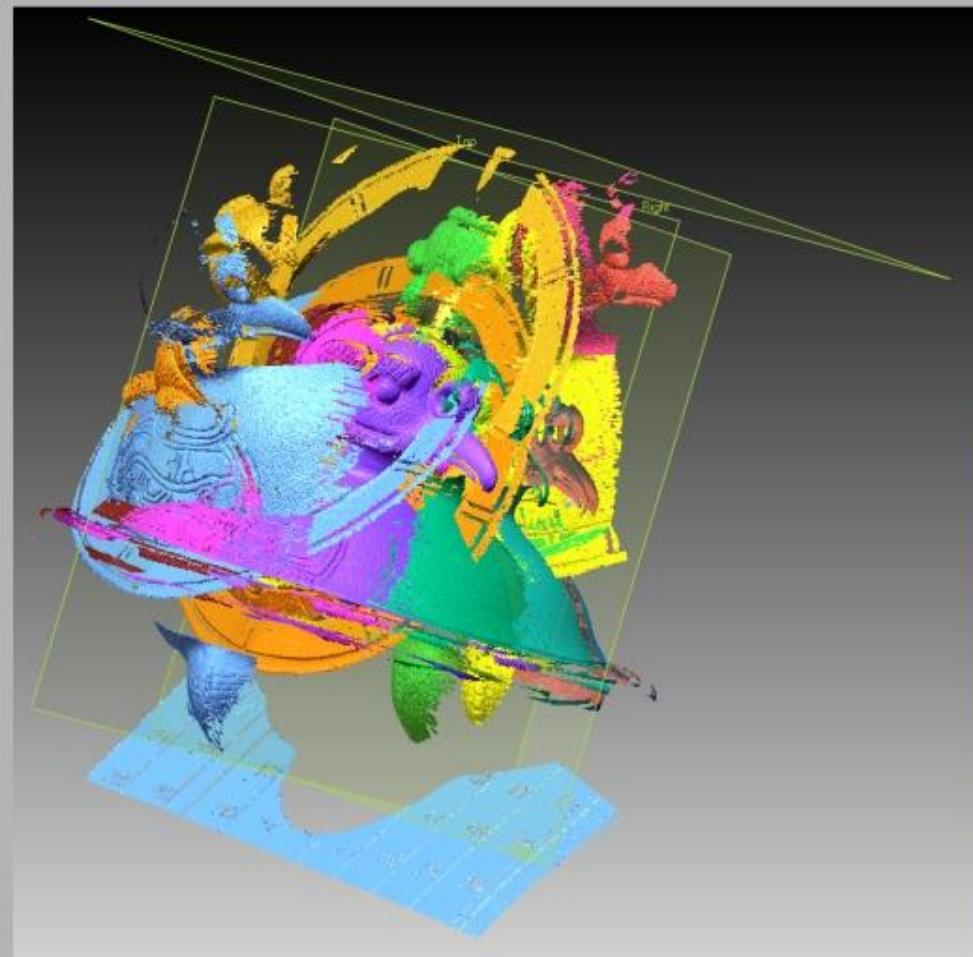




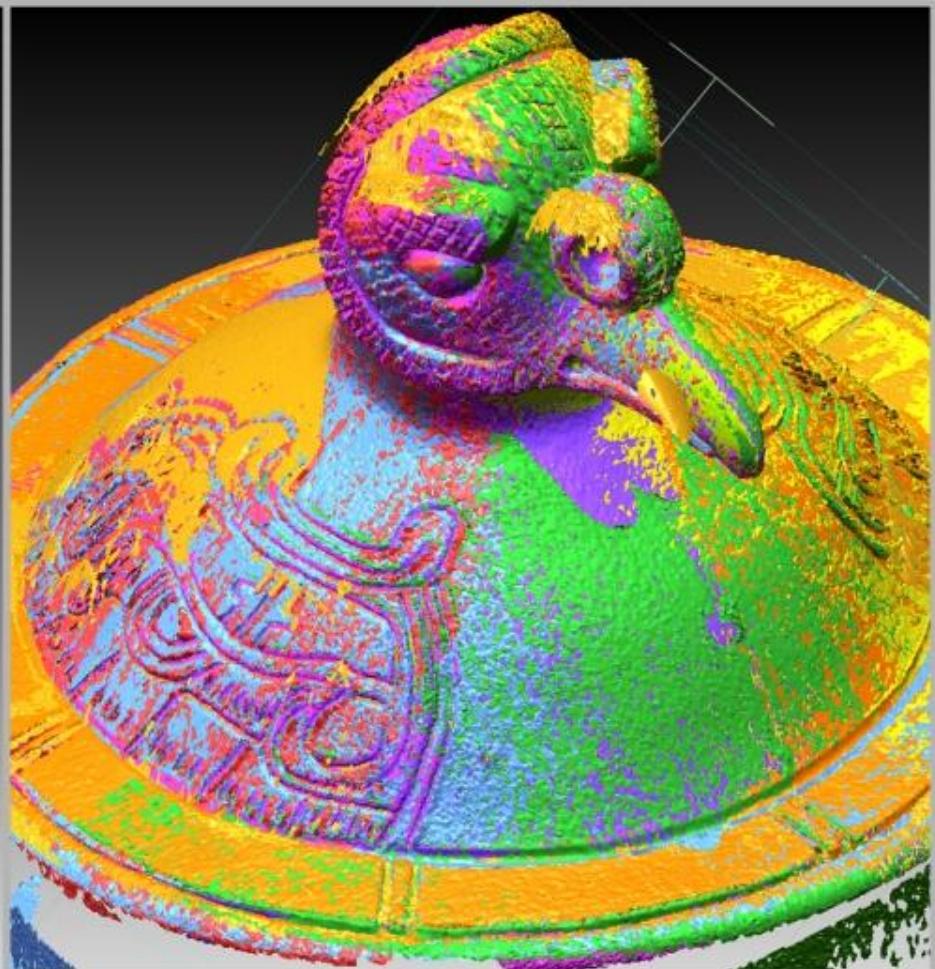
(a)



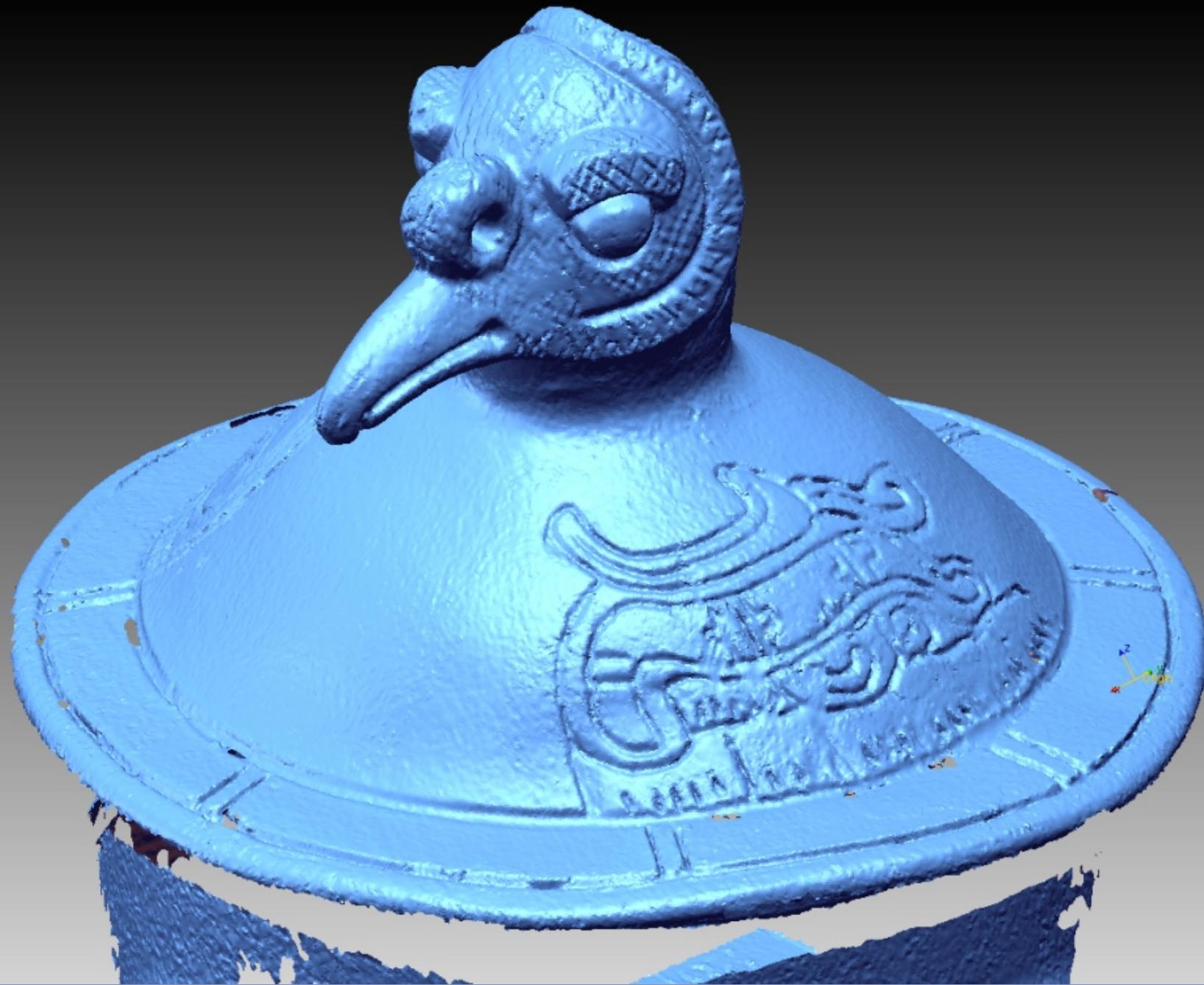
(b)

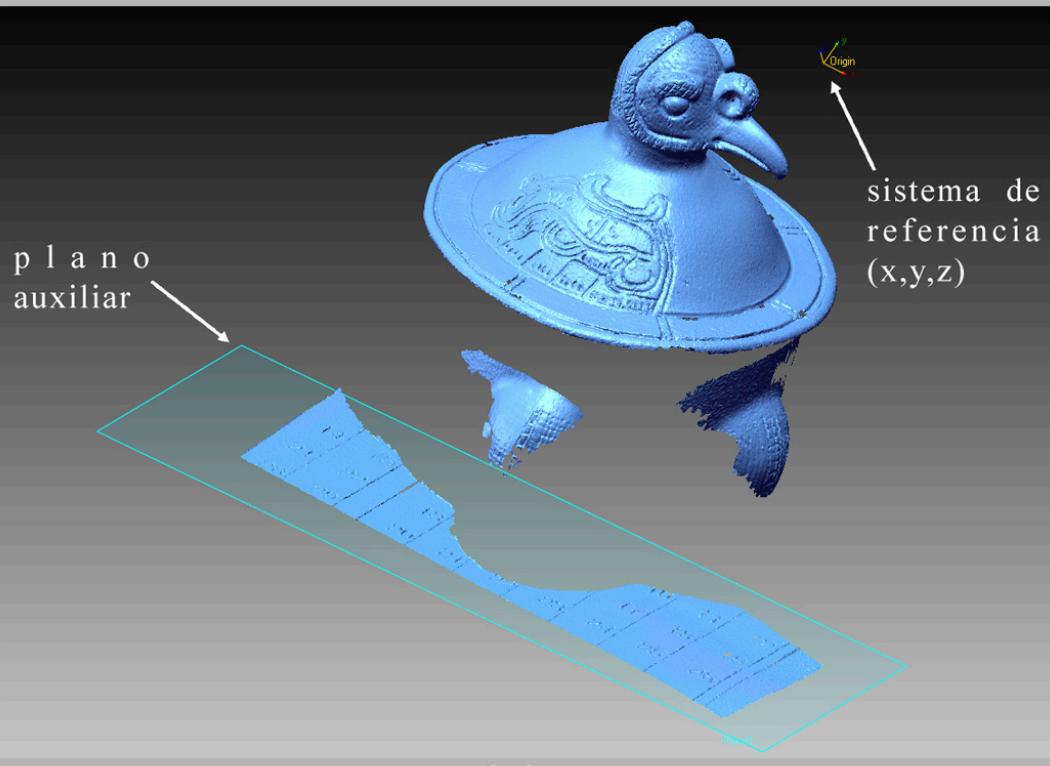


(a)

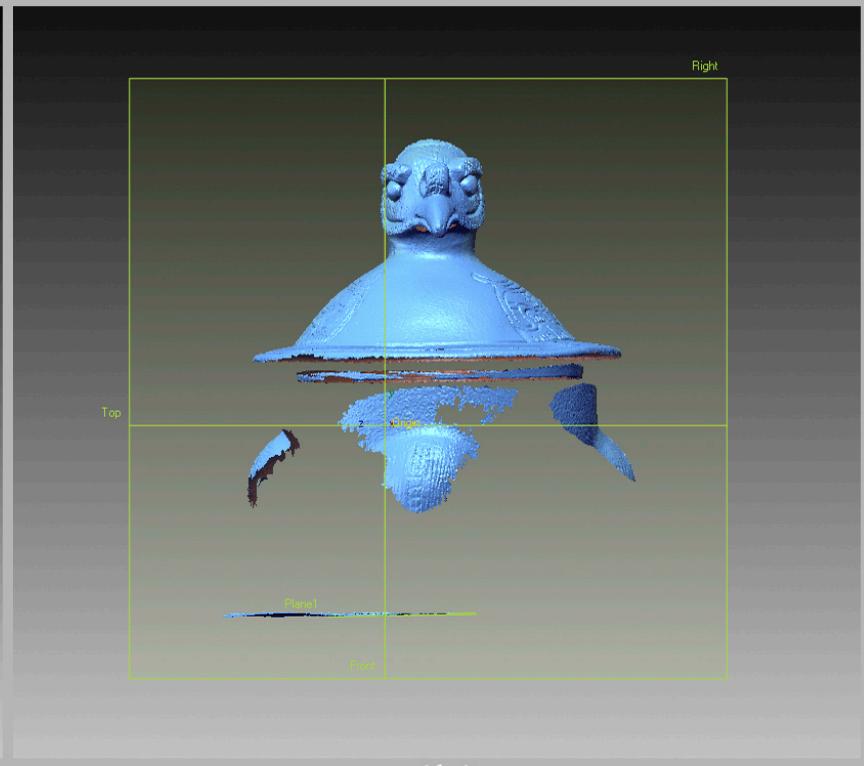


(b)

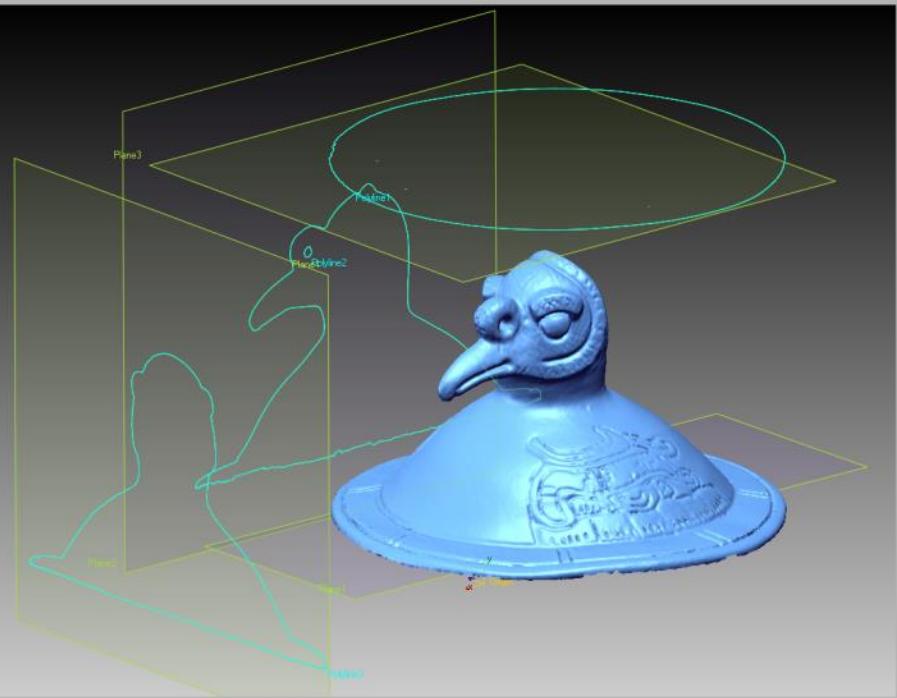




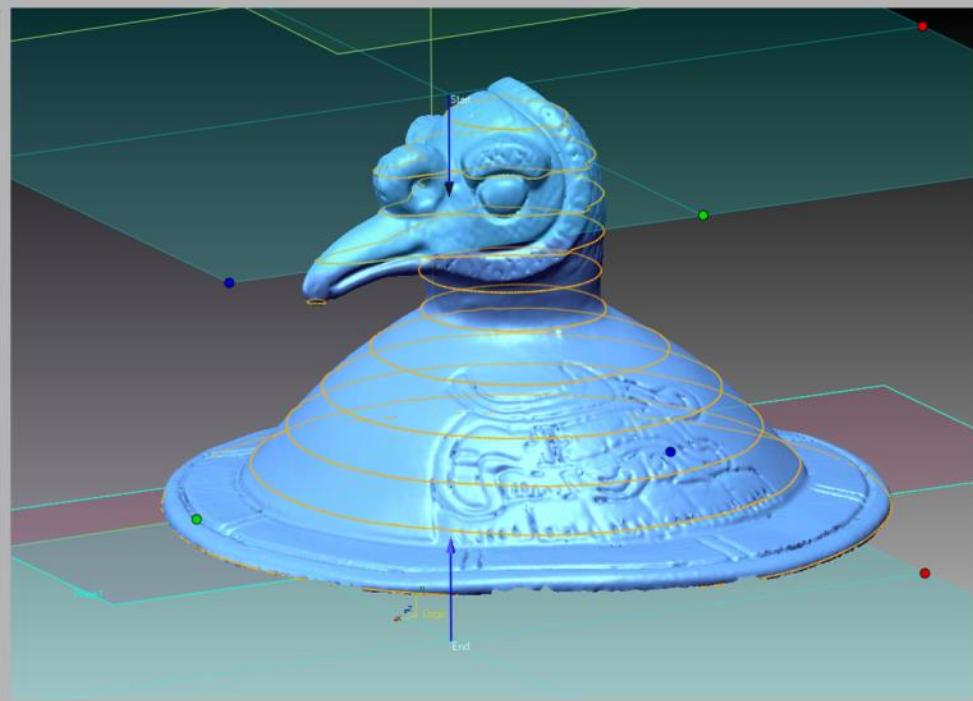
(a)



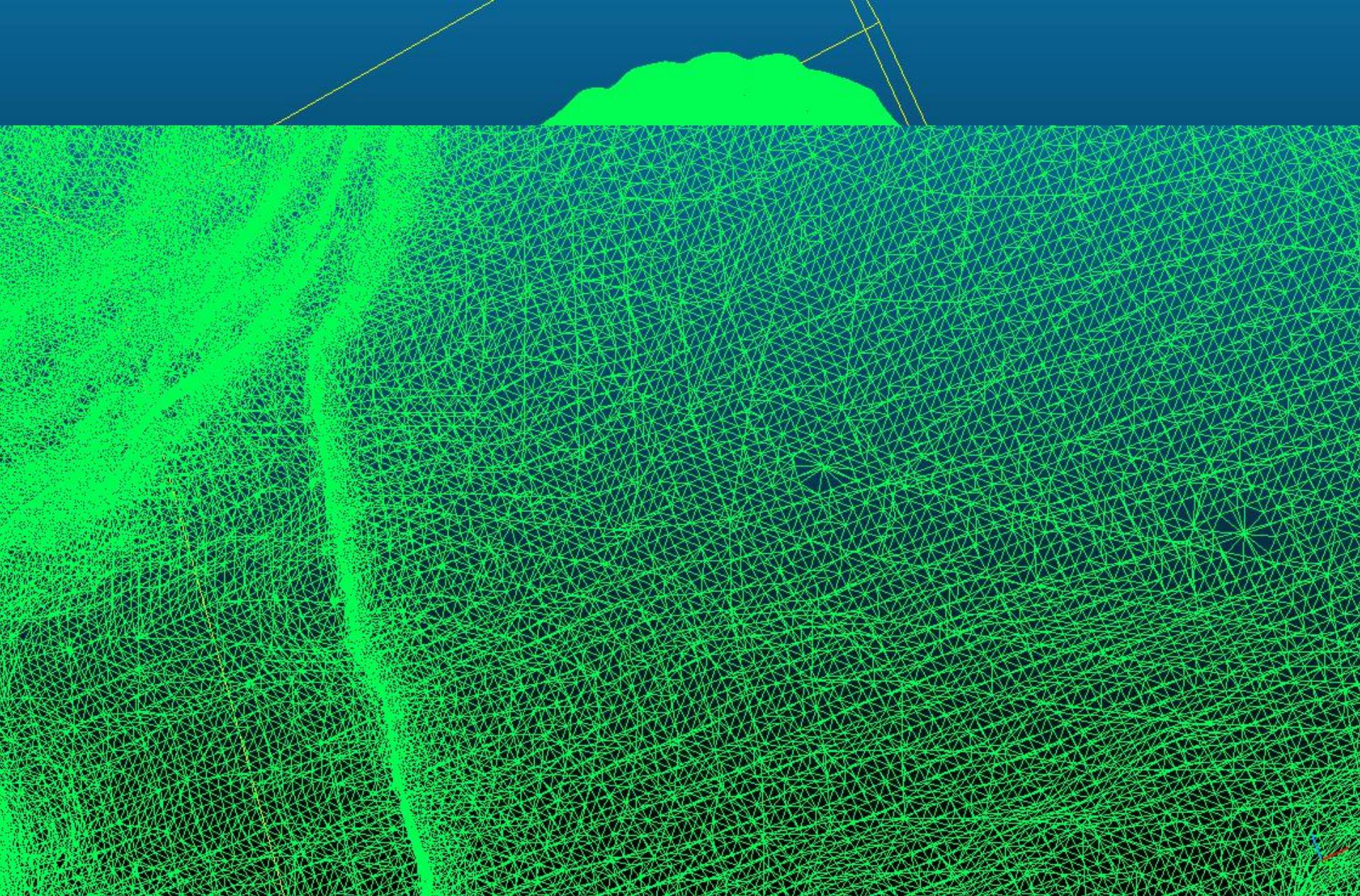
(b)



(a)



(b)



# Photogrammetry vs. Laser scanner

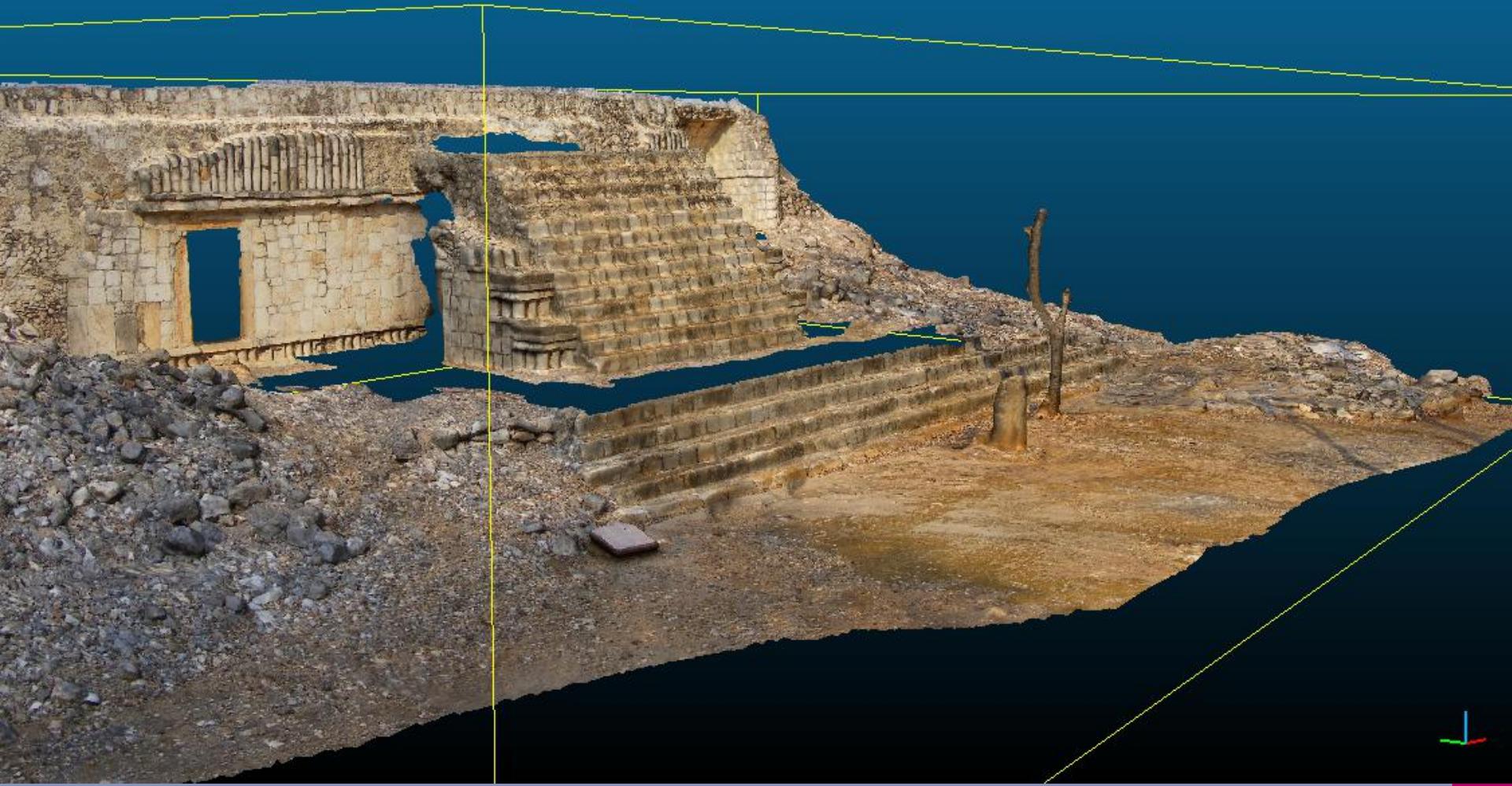
## Láser Scanner

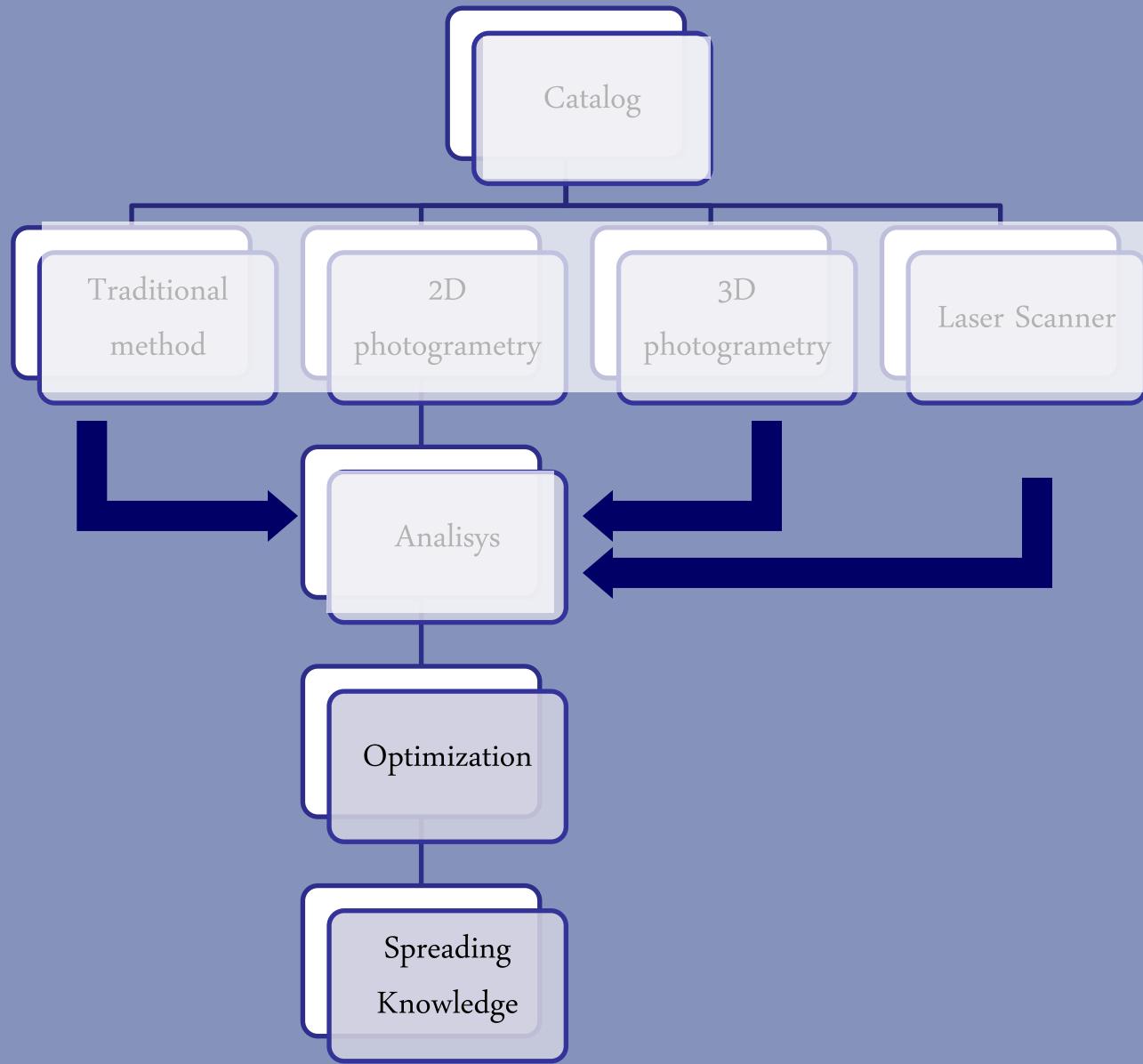
1 point each 5mm (8 p./cm<sup>2</sup>)  
1 point each 1mm in ceramic, (200 p./cm<sup>2</sup>)  
Expensive  
Join pieces for a model  
Texture (some models LS, FARO)  
High quality for scientific research  
“Heavy” files for websites  
Optimization required  
High accuracy

## Photogrammetry

135 p./cm<sup>2</sup> (sculpture)  
2889 p./cm<sup>2</sup> (fossil)  
Low cost  
Join pieces also  
“Aparent ColorTexture”  
High quality for scientific research  
“Heavy” files for websites  
Optimization required  
High accuracy (but depends on human control)







# Optimization



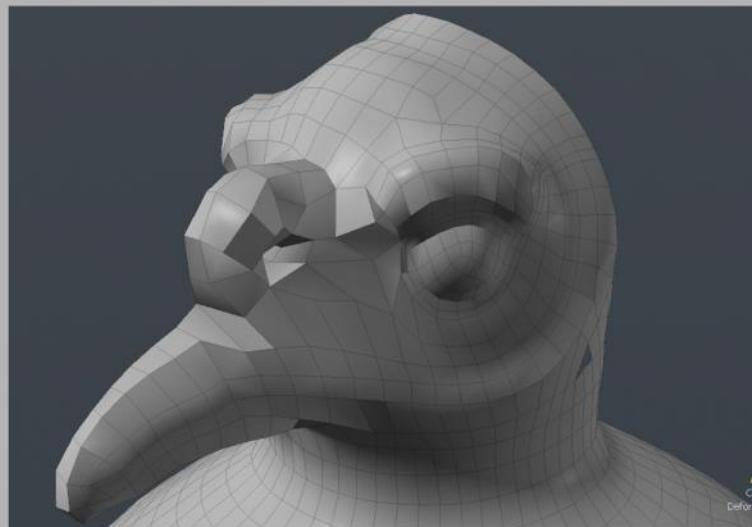
Modelo alto detalle:  
Tamaño medio de los bordes = 0,38 mm  
Número polígonos = 1317384



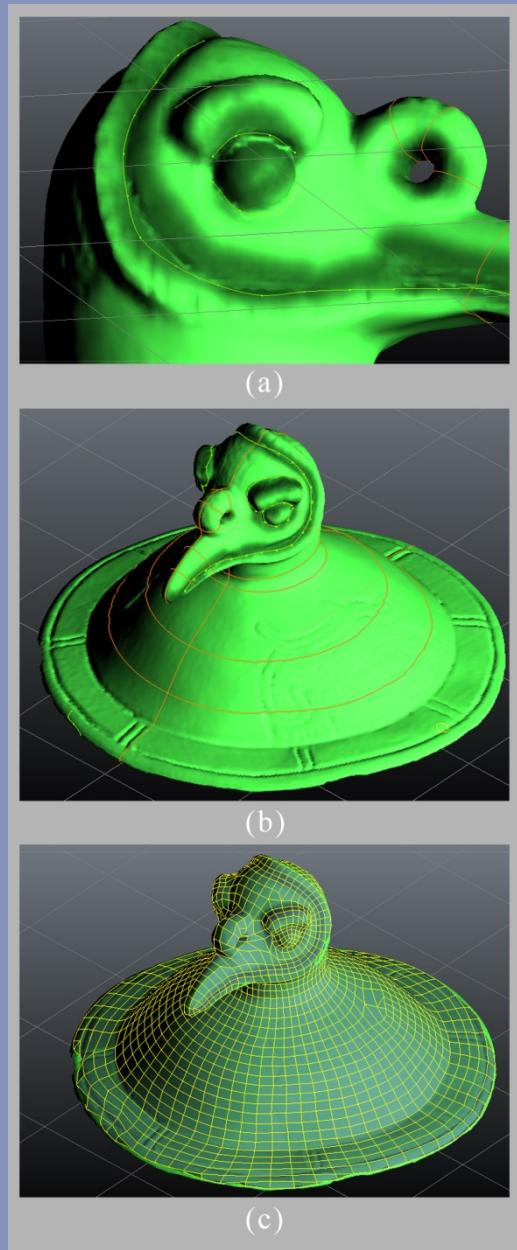
Modelo detalle intermedio:  
Tamaño medio de los bordes = 1,12 mm  
Número polígonos = 131738



Modelo bajo detalle:  
Tamaño medio de los bordes = 2,24mm  
Número polígonos = 25248

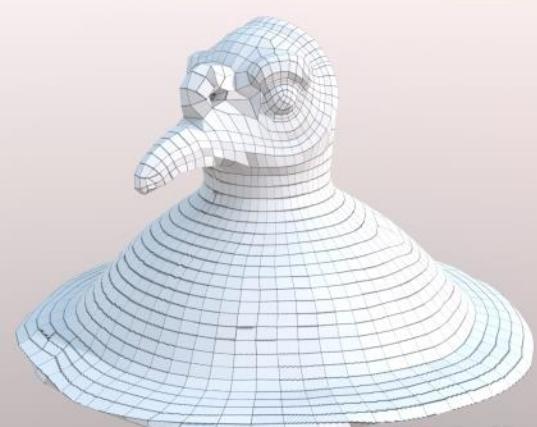
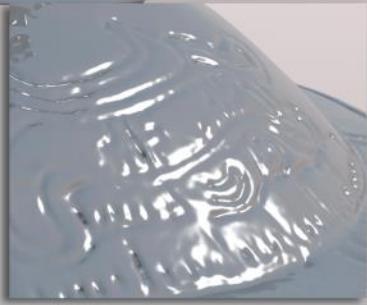


Modelo bajo detalle (quad dominant):  
Tamaño medio de los bordes = 6,0148mm  
Número polígonos = 2914

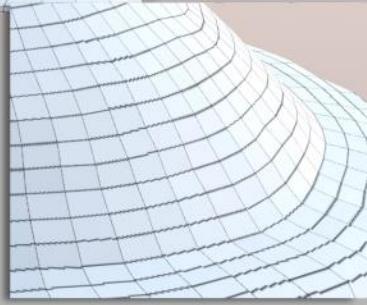




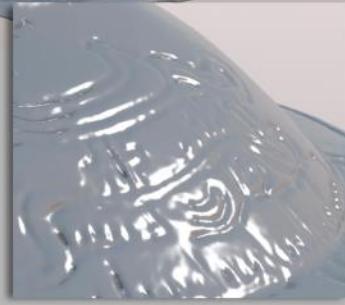
Modelo de  
alto detalle:  
1317384  
polígonos

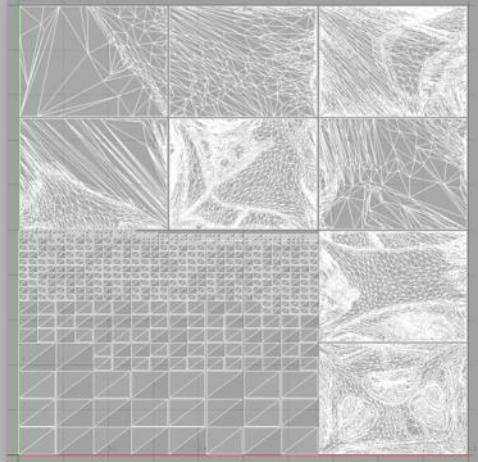


Modelo  
obtenido por  
retopología:  
2999  
polígonos



Modelo  
dispalced subD





Sistema de referencia  
(u,v)



Resolución textura:  
1536x2048



Modelo de bajo detalle con textura del color aparente: 25233 polígonos

<http://www.uv.es/arsmaya/index2.html>



