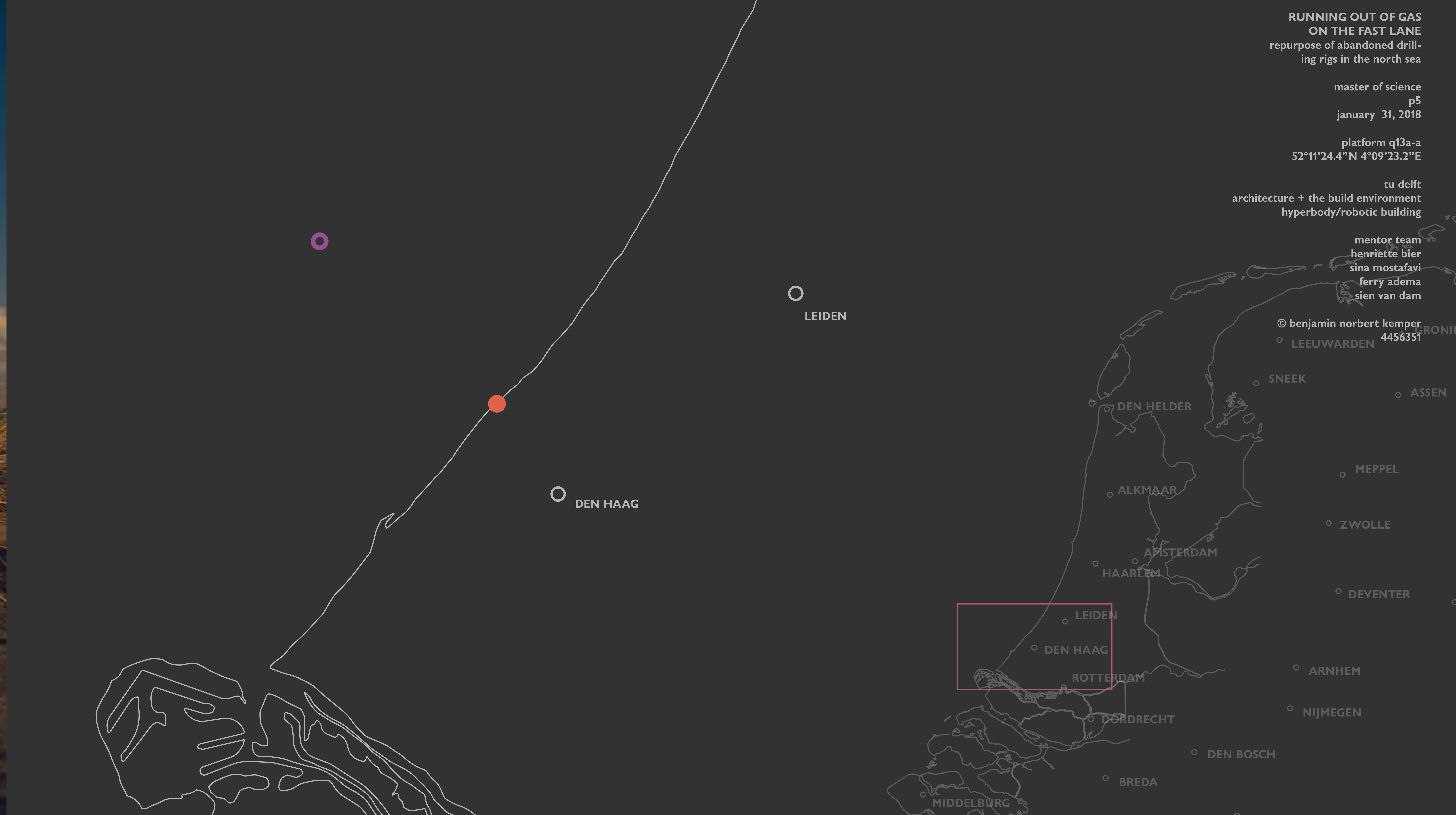
https://youtu.be/1IBBGfbStlY

running out of gas on the fast lane

benjamin norbert kemper

4456351



RUNNING OUT OF GAS ON THE FAST LANE

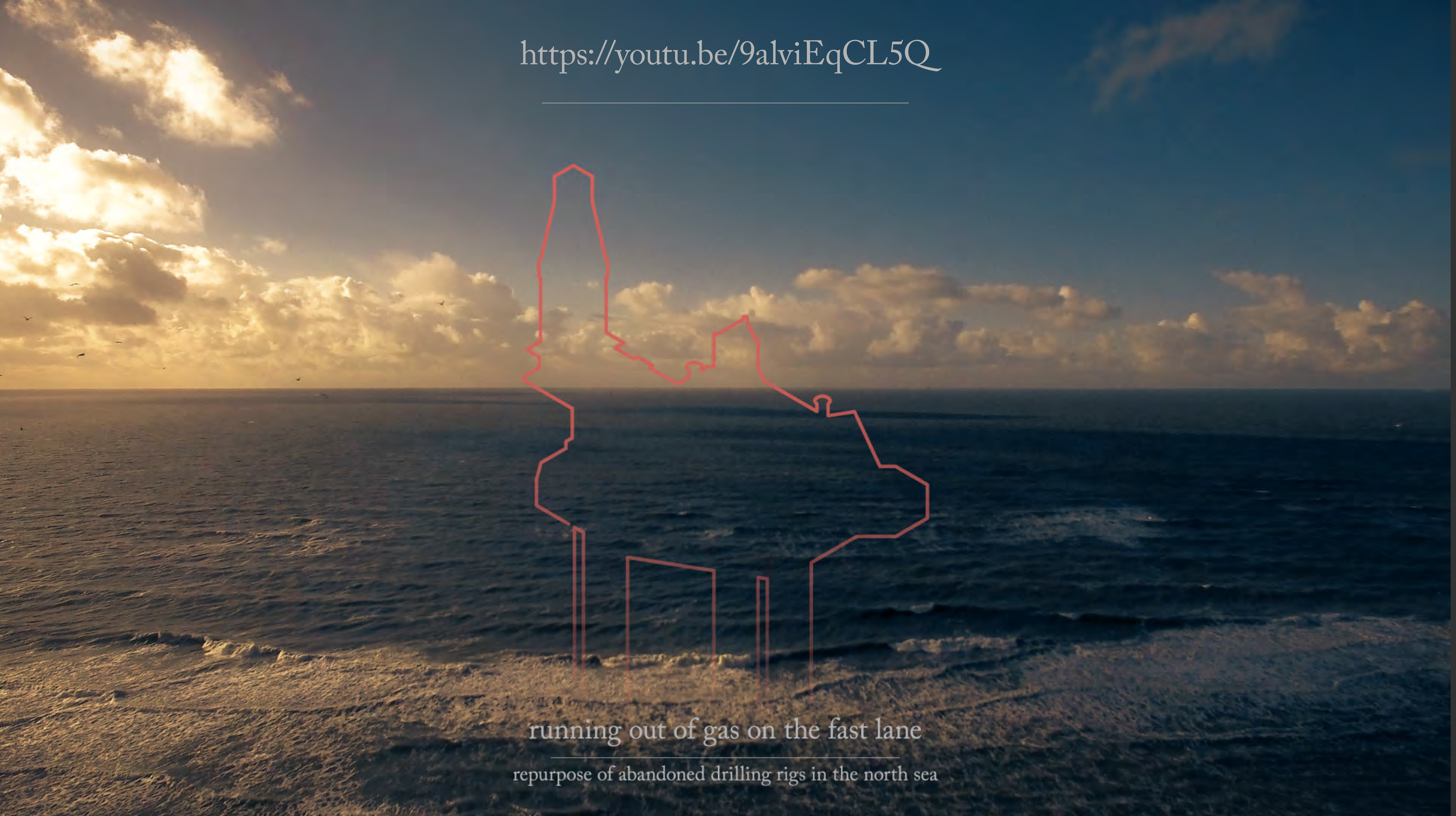
repurpose of abandoned drilling rigs in the north sea

master of science
p5
january 31, 2018

platform q13a-a
52°11’24.4”N 4°09’23.2”E

tu delft
architecture + the build environment
hyperbody/robotic building

mentor team
henriette bier
sina mostafavi
ferry adema
sien van dam



RUNNING OUT OF GAS ON THE FAST LANE
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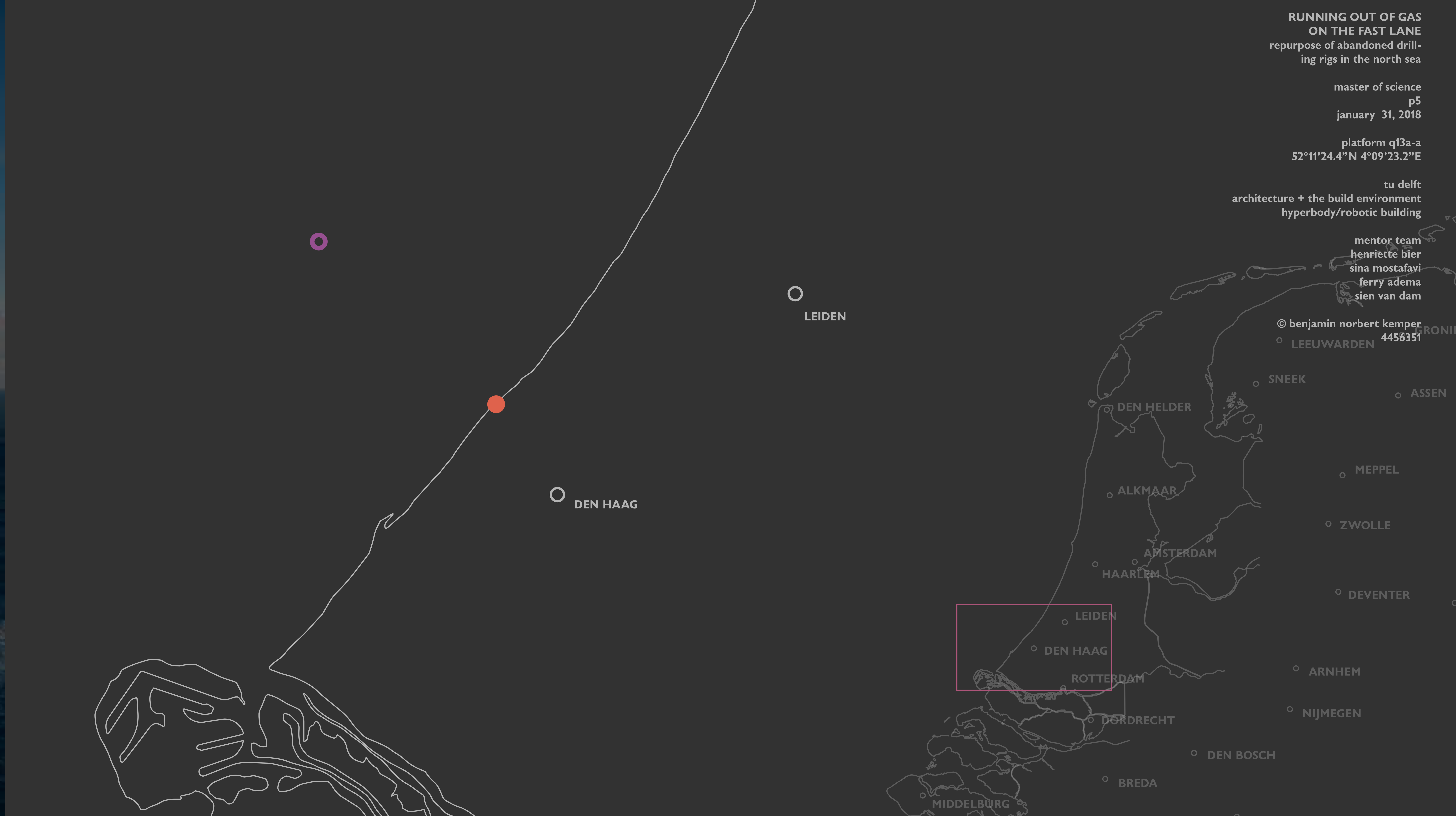
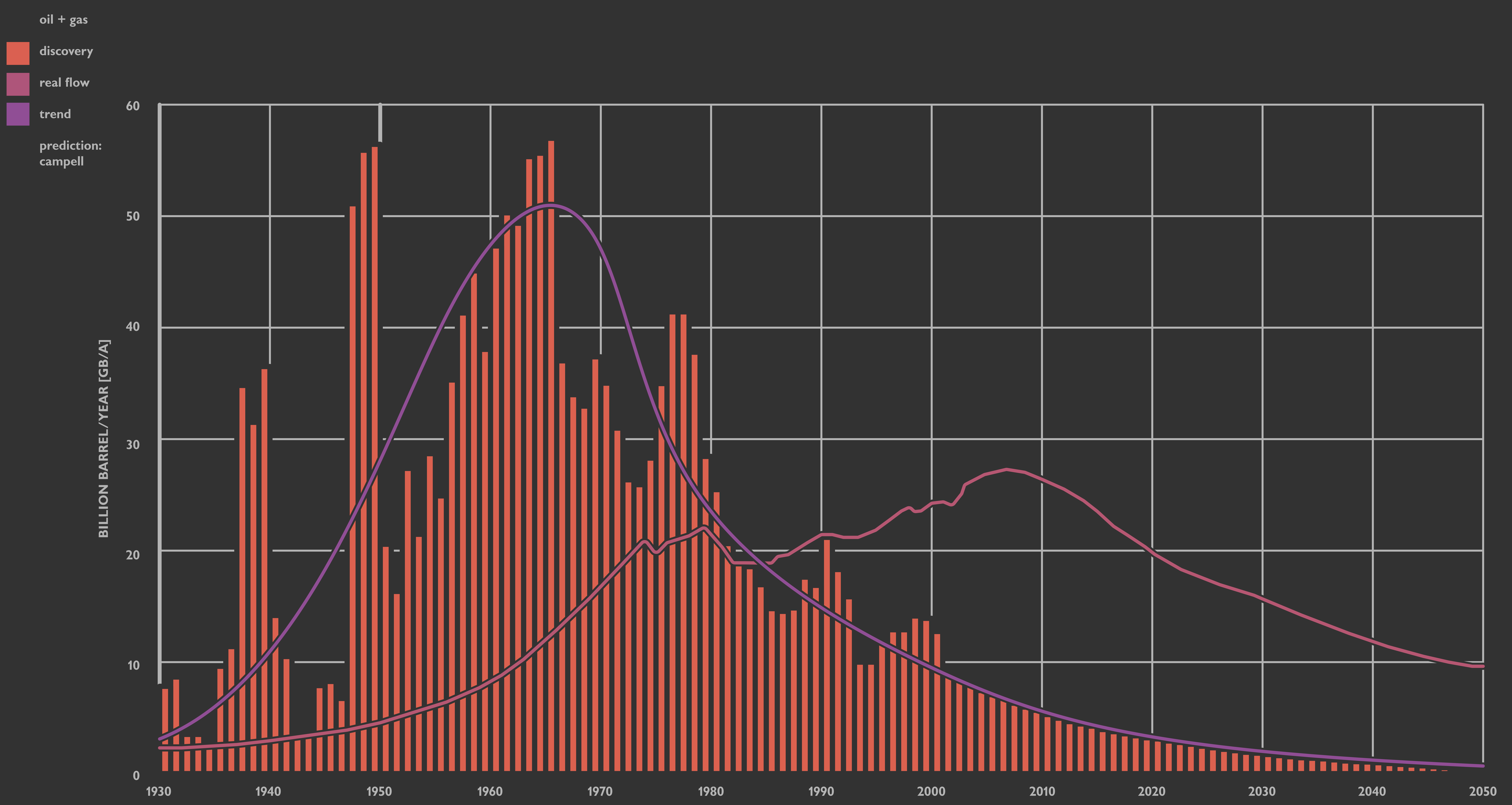


$1\emptyset^{12}$

tera

$1\emptyset^{12} = 1.\emptyset\emptyset\emptyset.\emptyset\emptyset\emptyset.\emptyset\emptyset\emptyset.\emptyset\emptyset\emptyset$



concept

flow + discovery of oil + gas

sources

#1
drone raw footage clip - oil & gas, offshore video peter scheid shooting in malaysia - borneo island

© peter scheid, 2016

#2
drone oil rig fly over

© rob matters vlog style, 2017

#3
kim heng marine & oilfield world largest jackup rig - noble lloyd noble

© kim heng - singapore, 2017

#4
maersk oil - maersk highlander rig move (dji phantom 4 drone fligh in 4k)

© graeme skelly, 2016

https://youtu.be/fZKgJ8SMq4Y

drilling platforms

active

passive

source

delfstoffen en aardwarmte in nederland 2014, ministry of economic affairs

concept

number of offshore structures in dutch territory

https://youtu.be/R_guJjfIM4Ø

source

af decom offshore - demolition offshore installations

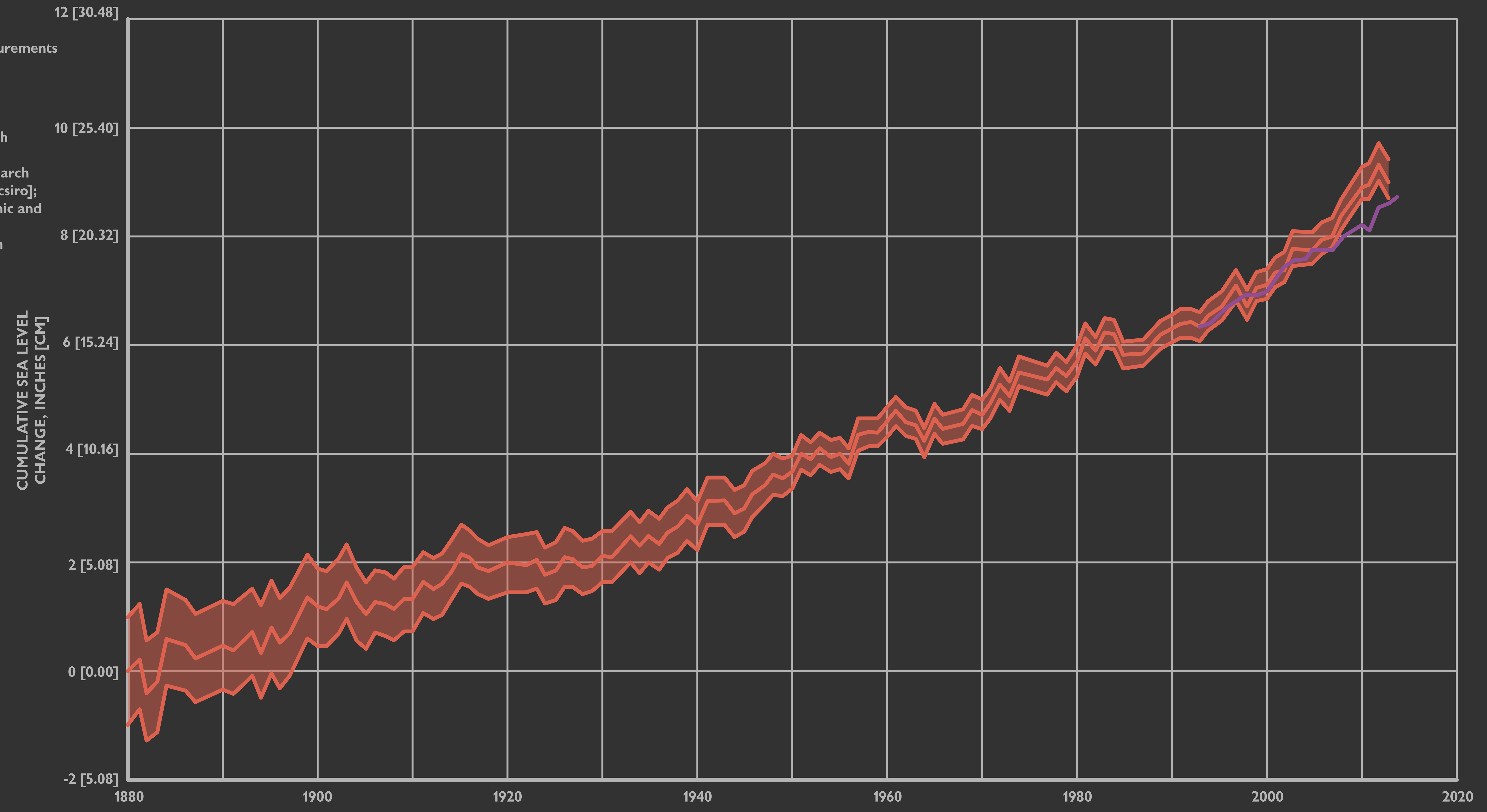
global average
absolute sea level change

trend based
on tide gauge

satellite measurements

sources

commonwealth
scientific and
industrial research
organisation [csiro];
national oceanic and
atmospheric
administration
[noaa]



concept

sea level rise

north

coast line

exclusive economic zone

city

sea level rise [1m]

scale

NEW LOCATIONS

OIL + GAS PLATFORMS

DESIGN FOR UNCON-
VENTIONAL PLACES

COPING WITH THE EXIST-
ING UNFAMILIAR + DAN-
GEROUS PARAMETERS

APPROACH TO CLIMATE CHANGE

FUTURE CITY

CITY NETWORK OF
SMALL CITY ISLANDS

GROWING NETWORK

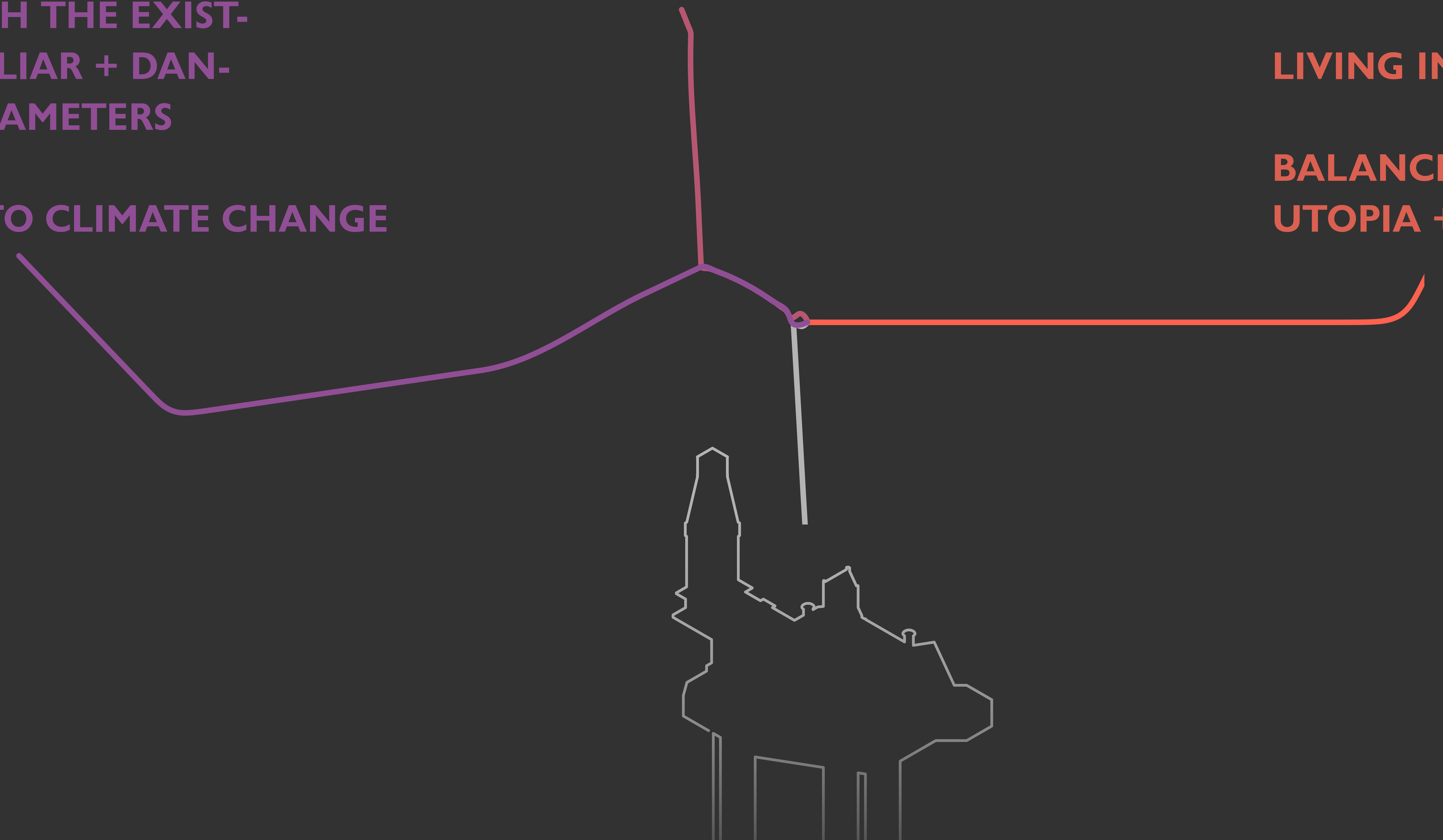
MODERN COMMUN-E/-TIY

CHANGE OF SOCIETY +
HUMAN BEHAVIOR

EXPONENTIAL PROG-
RESS OF TECHNOLOGY

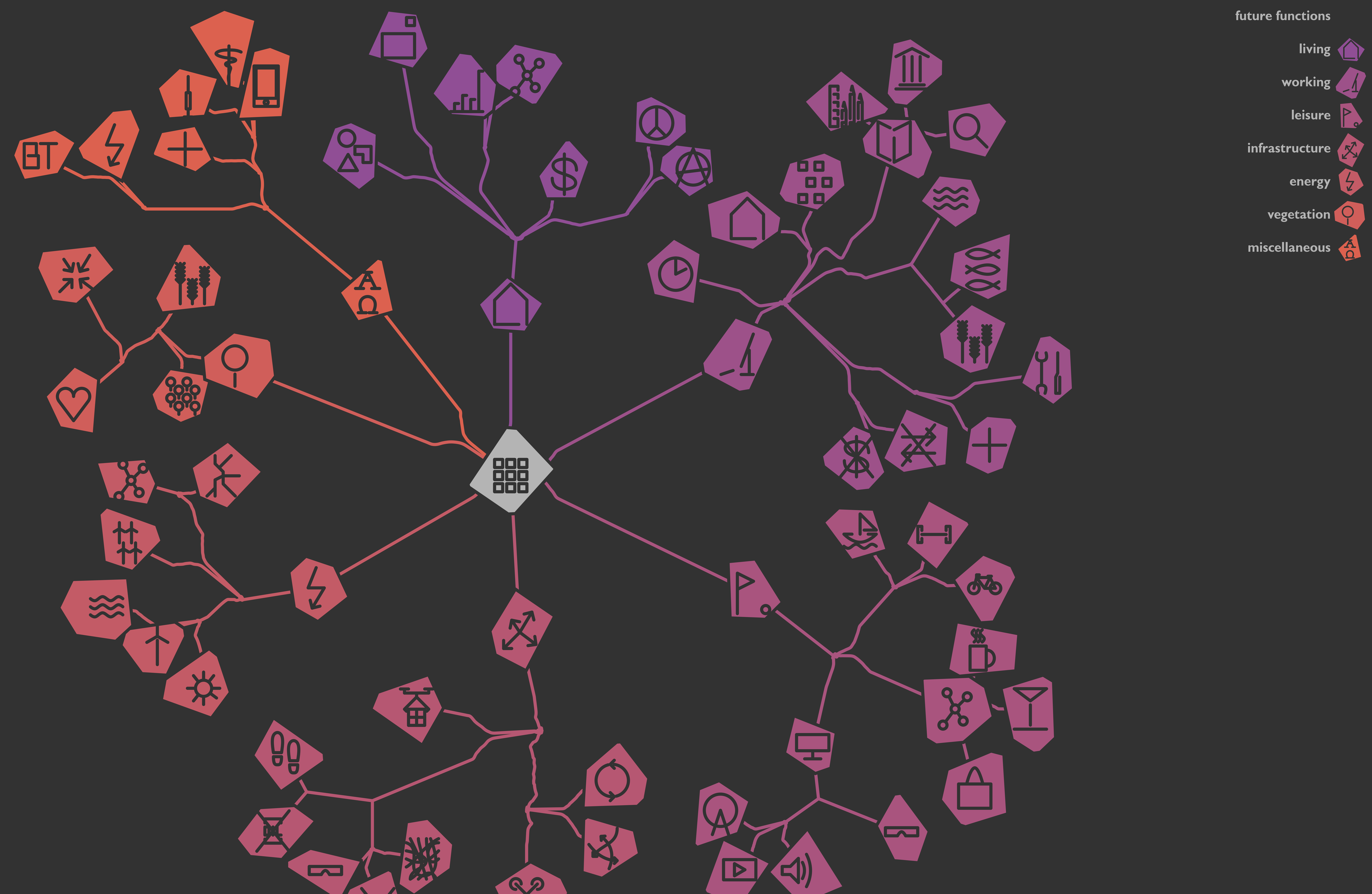
LIVING IN THE FUTURE

BALANCING ACT BETWEEN
UTOPIA + DYSTOPIA



concept

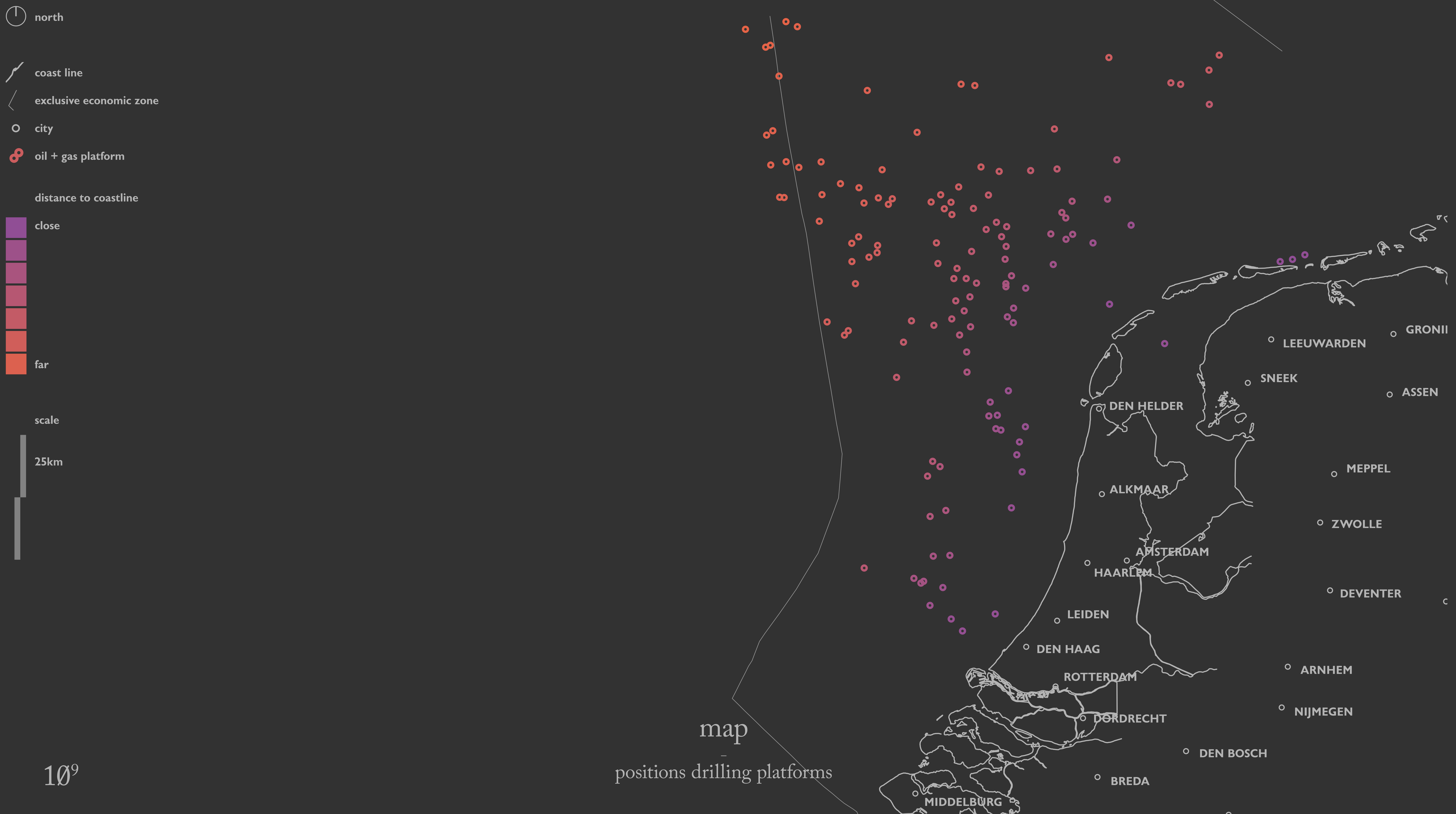
future functions



10^9

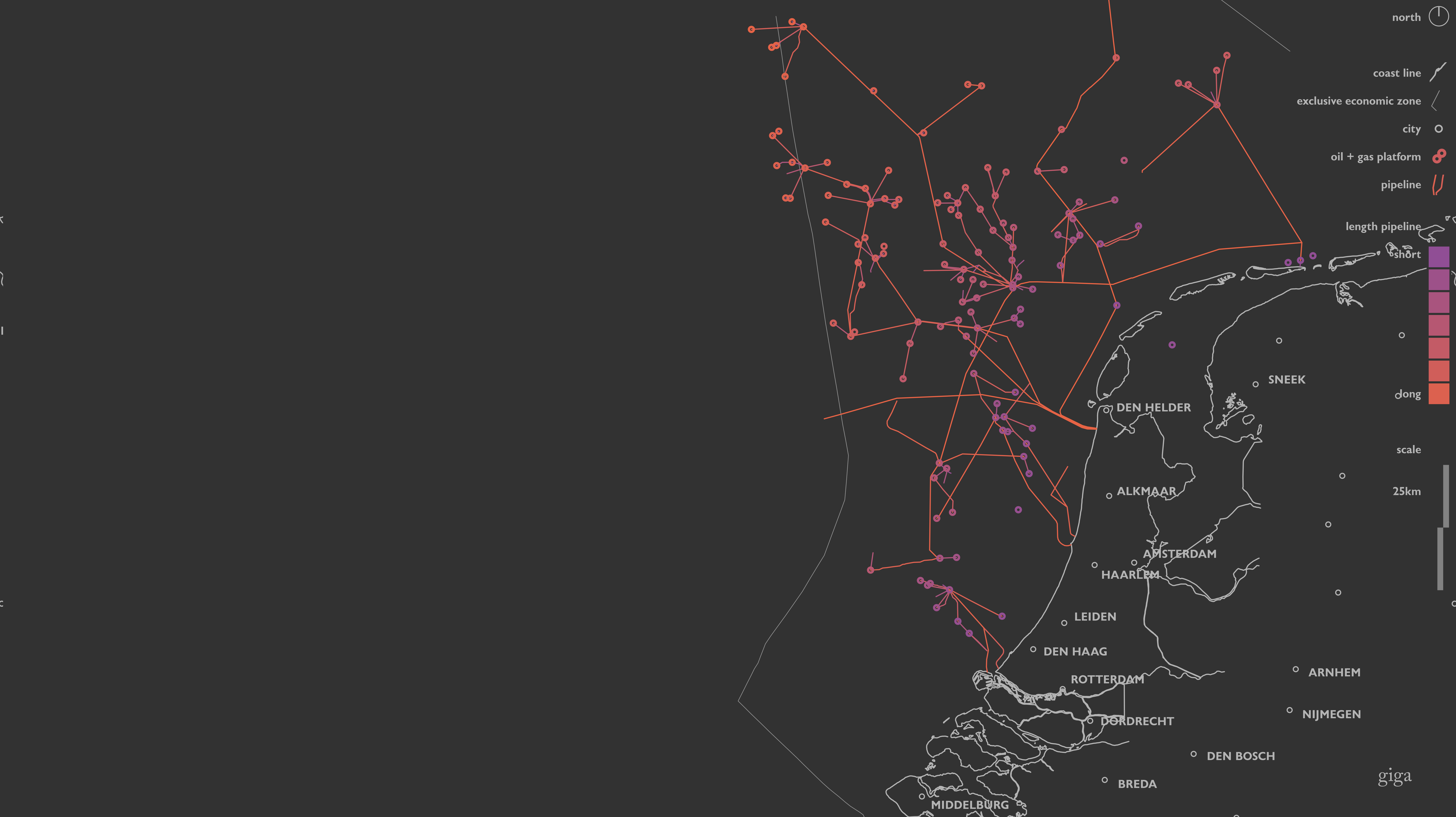
giga

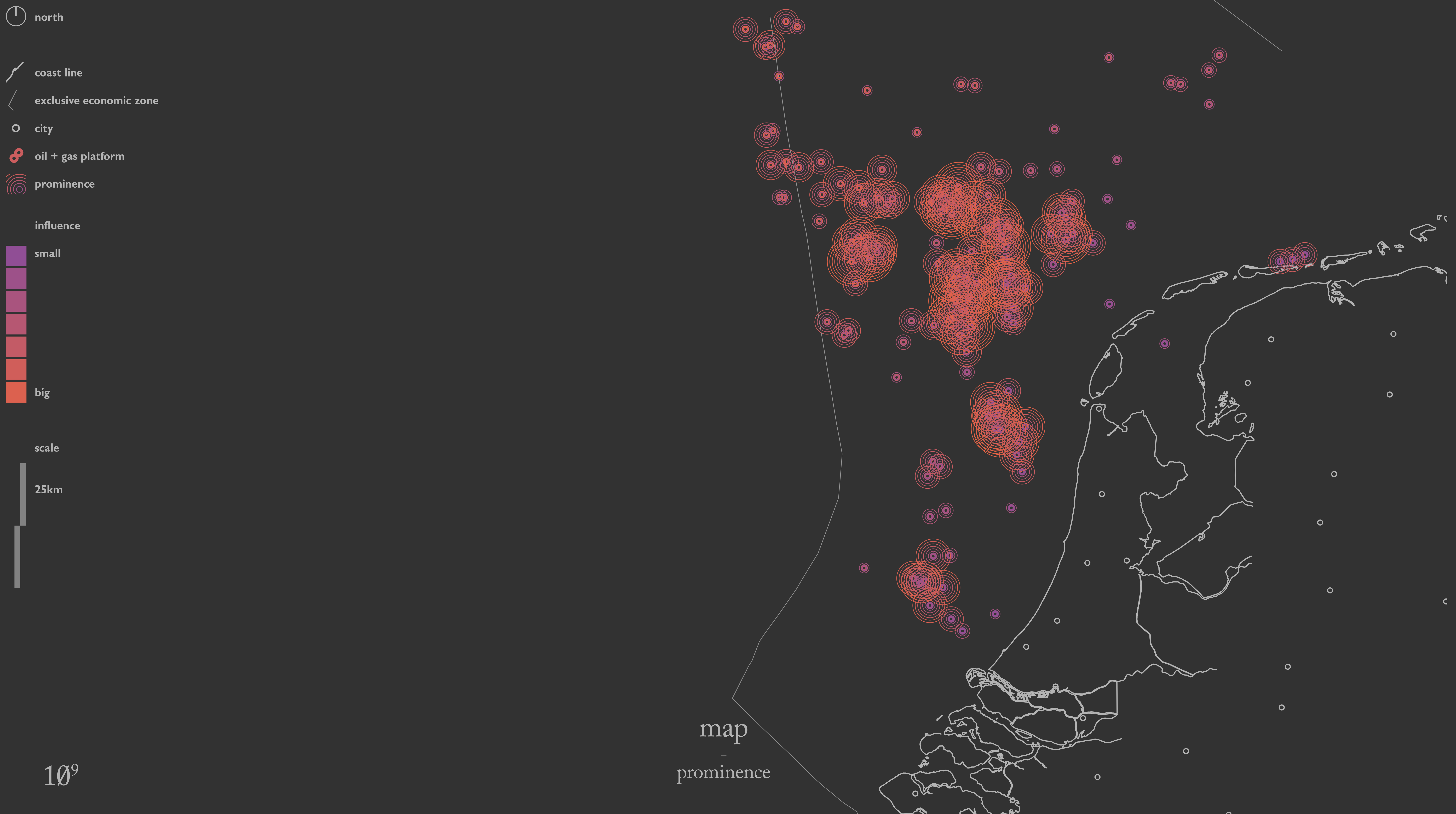
$10^9 = 1.000.000.000$



map

positions drilling platforms





map
-
prominence

10^9

giga

north

coast line

exclusive economic zone

city

oil + gas platform

smart network

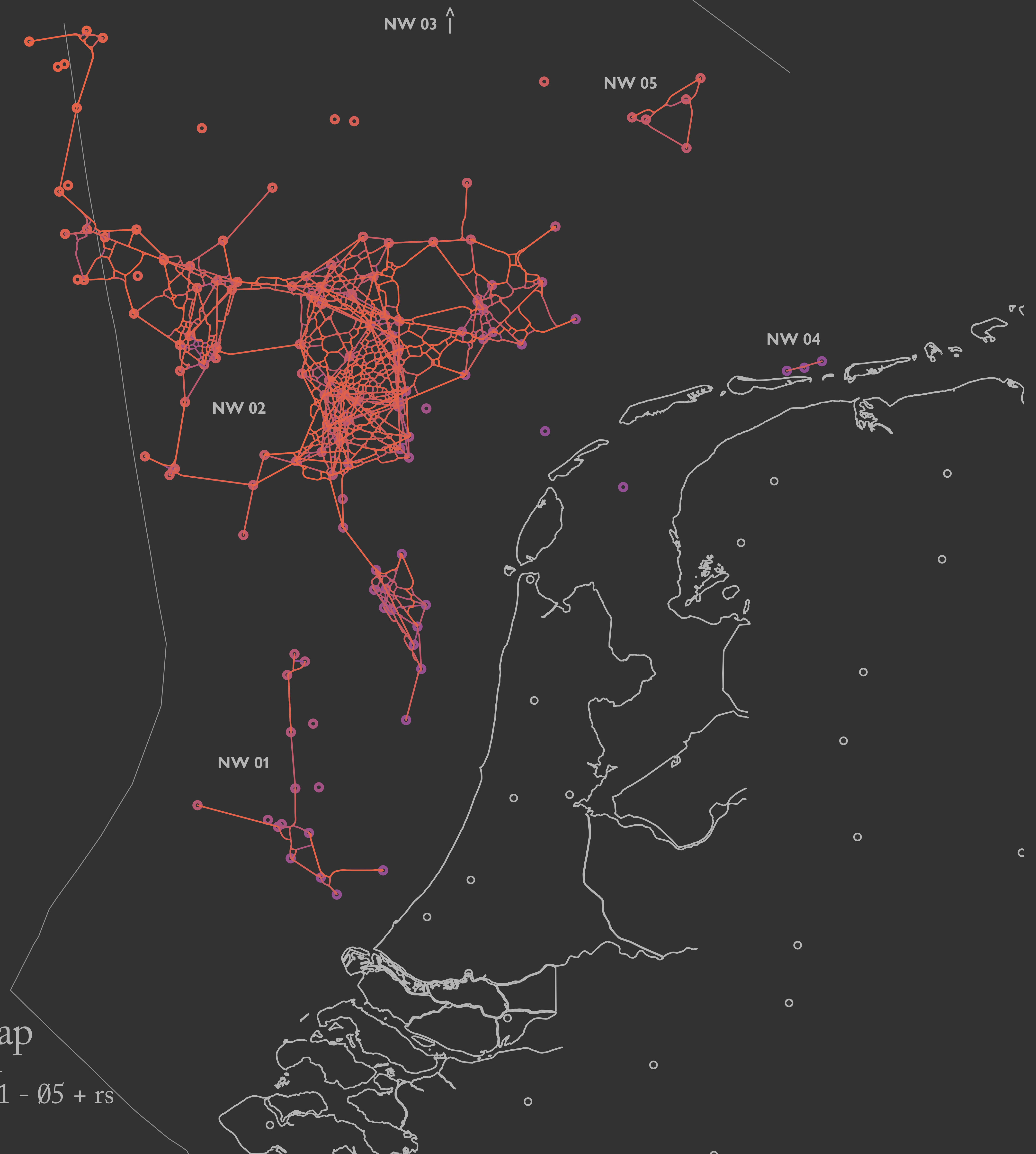
distance

small

big

scale

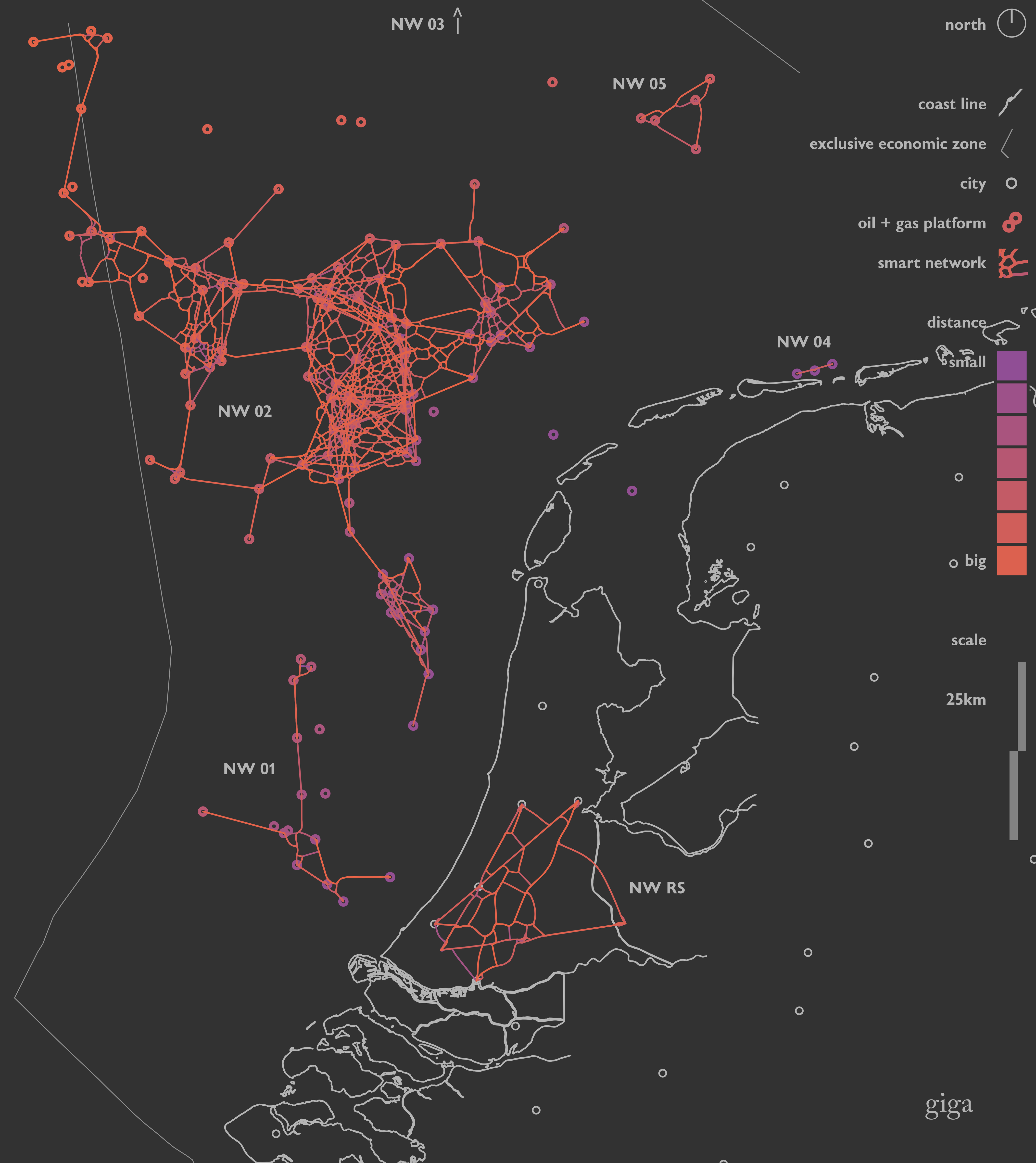
25km



map

-

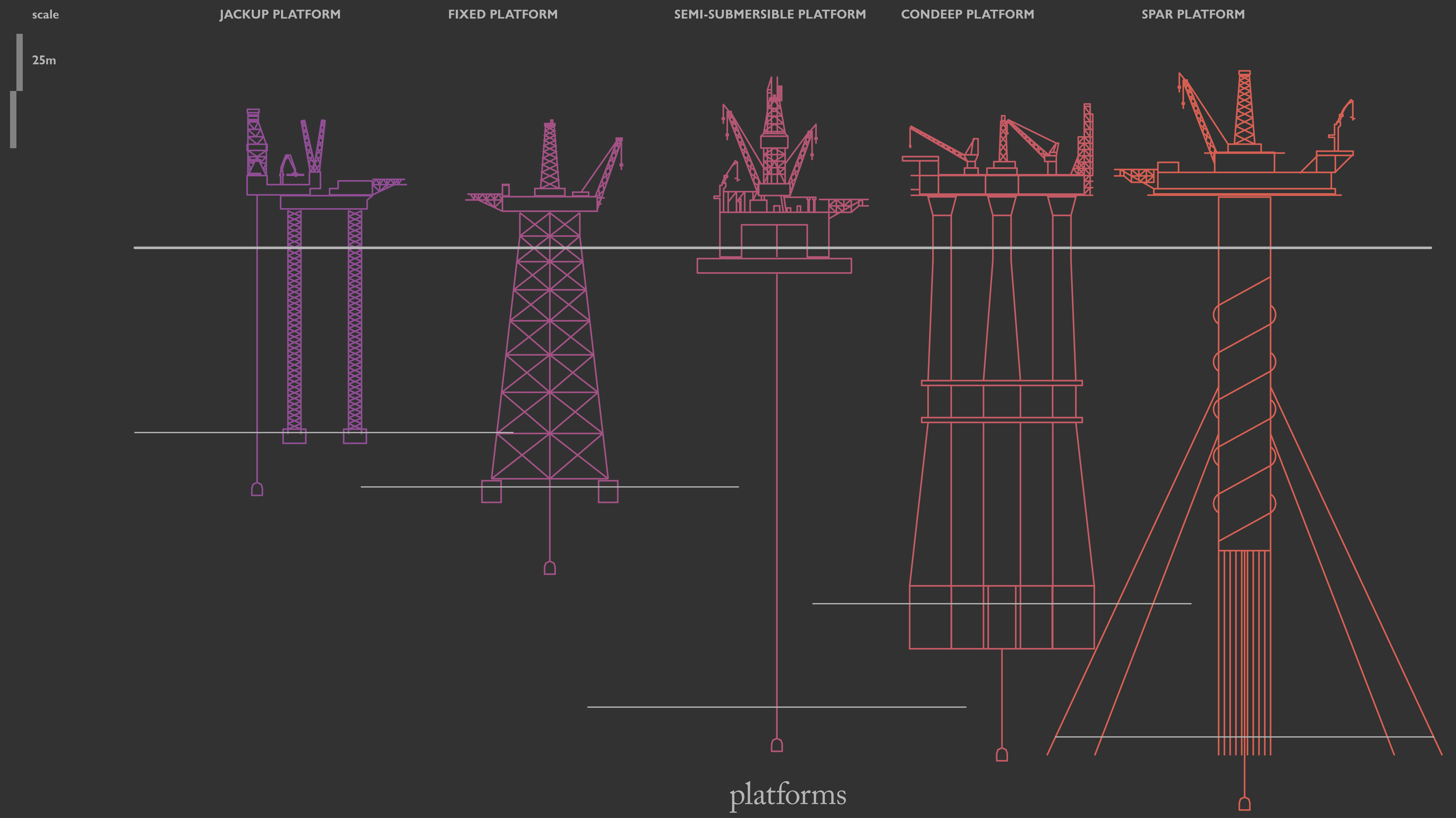
network Ø1 - Ø5 + rs



$1\emptyset^6$

mega

$1\emptyset^6 = 1.\emptyset\emptyset\emptyset.\emptyset\emptyset\emptyset$

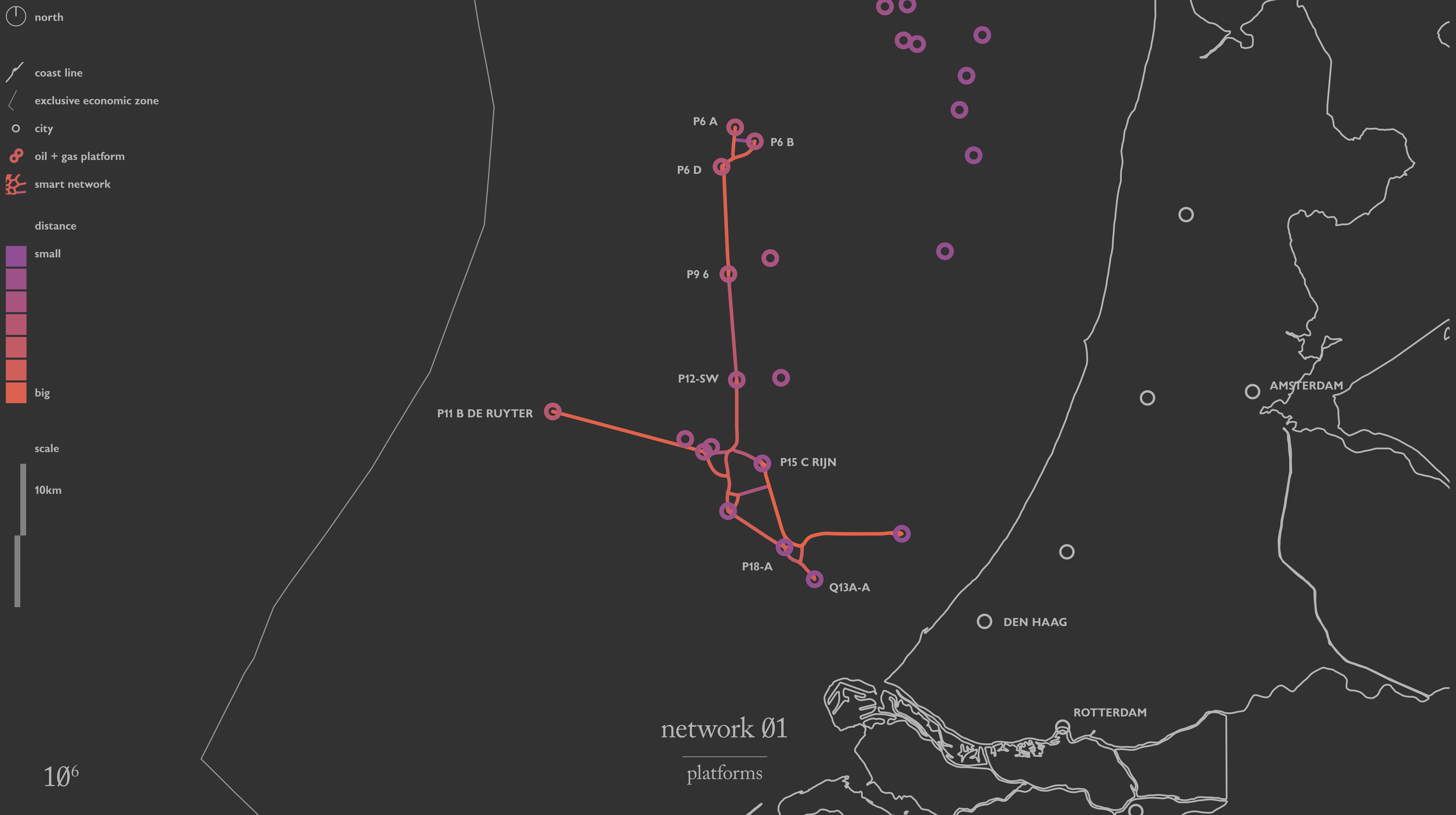


platforms

types

$1Ø^6$

mega



network Ø1

platforms

north

coast line

exclusive economic zone

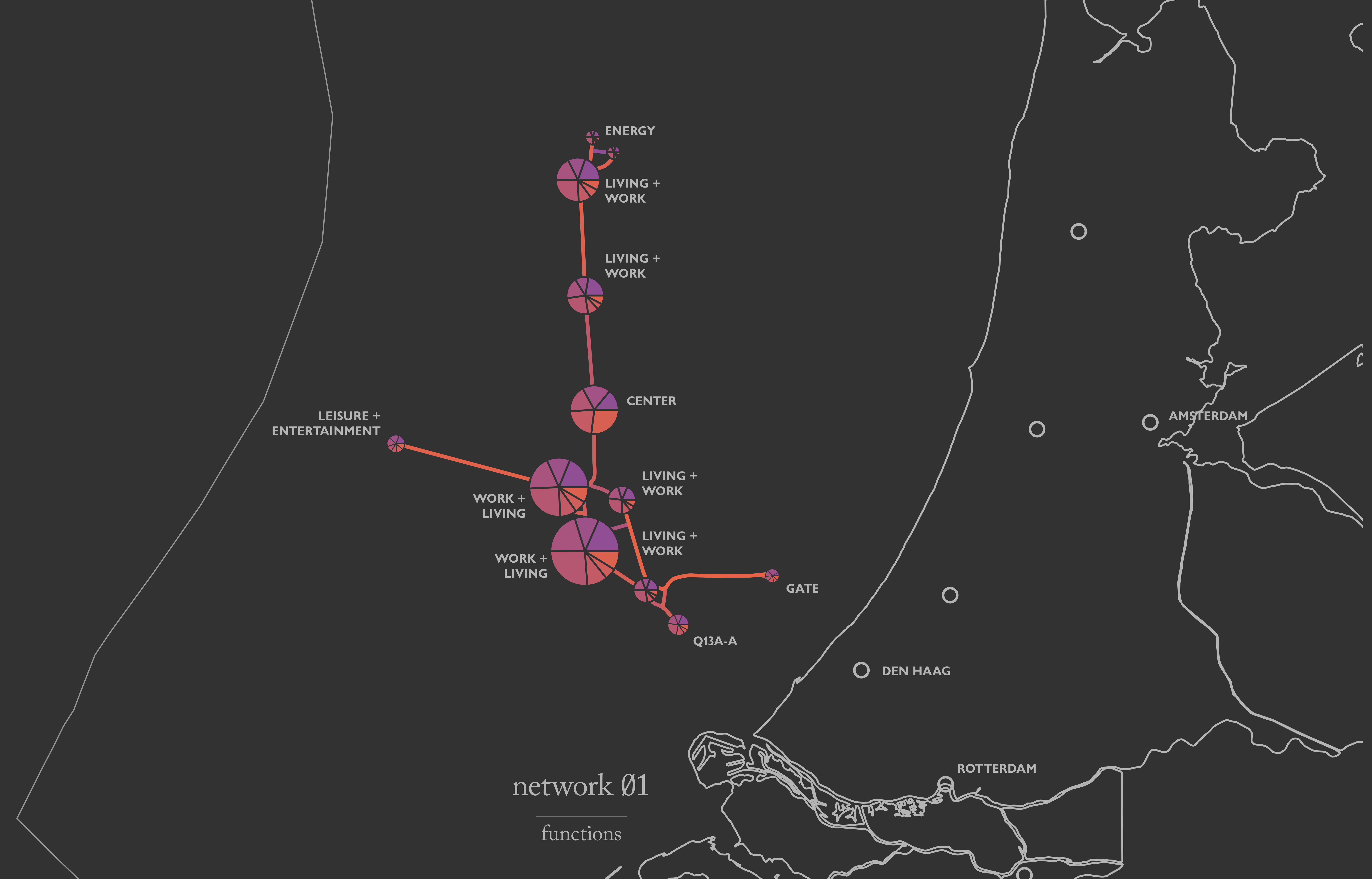
city

oil + gas platform

function distribution

scale

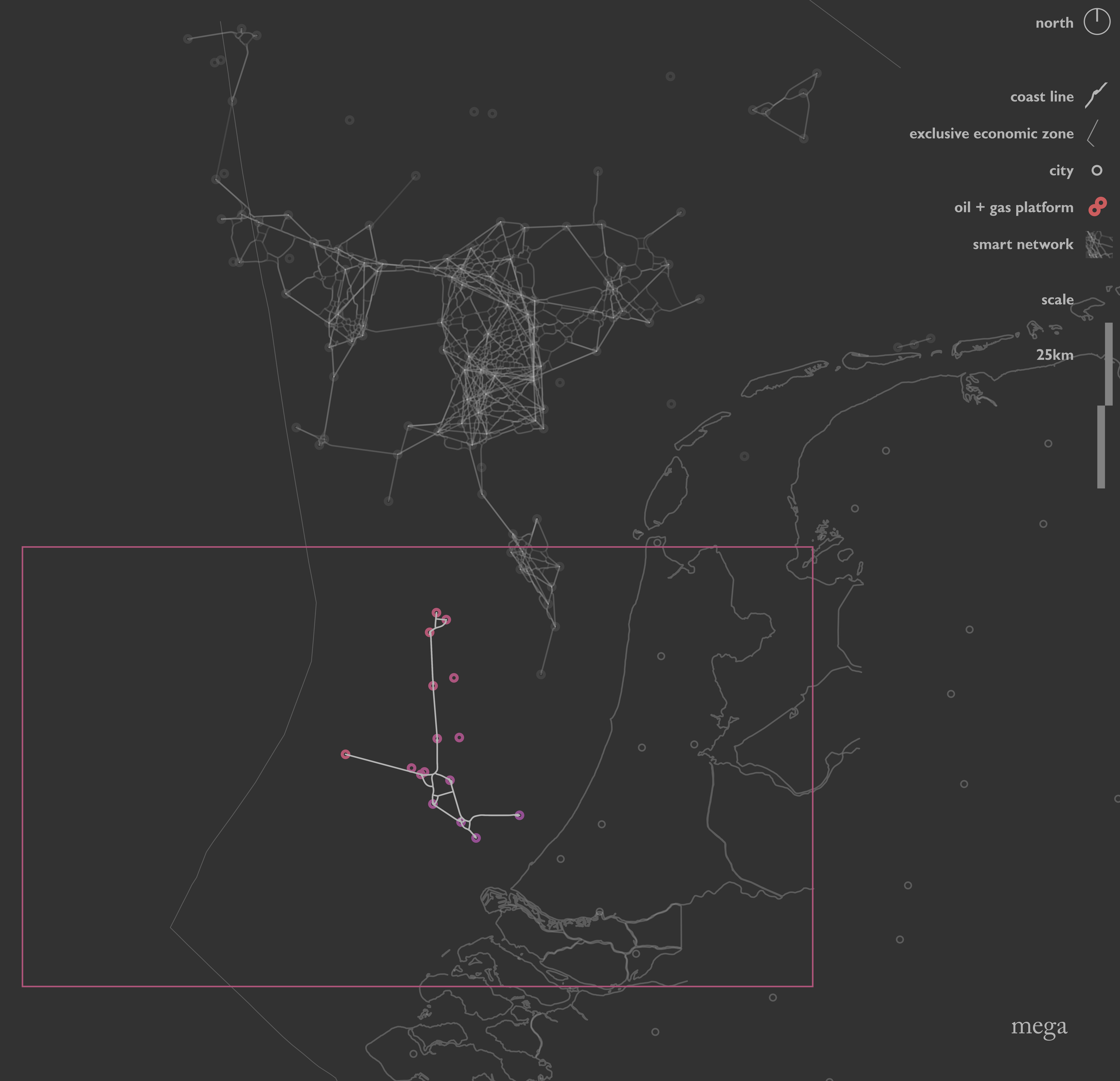
10km



network Ø1

functions

1Ø^6



north

coast line

exclusive economic zone

city

oil + gas platform

smart network

scale

25km

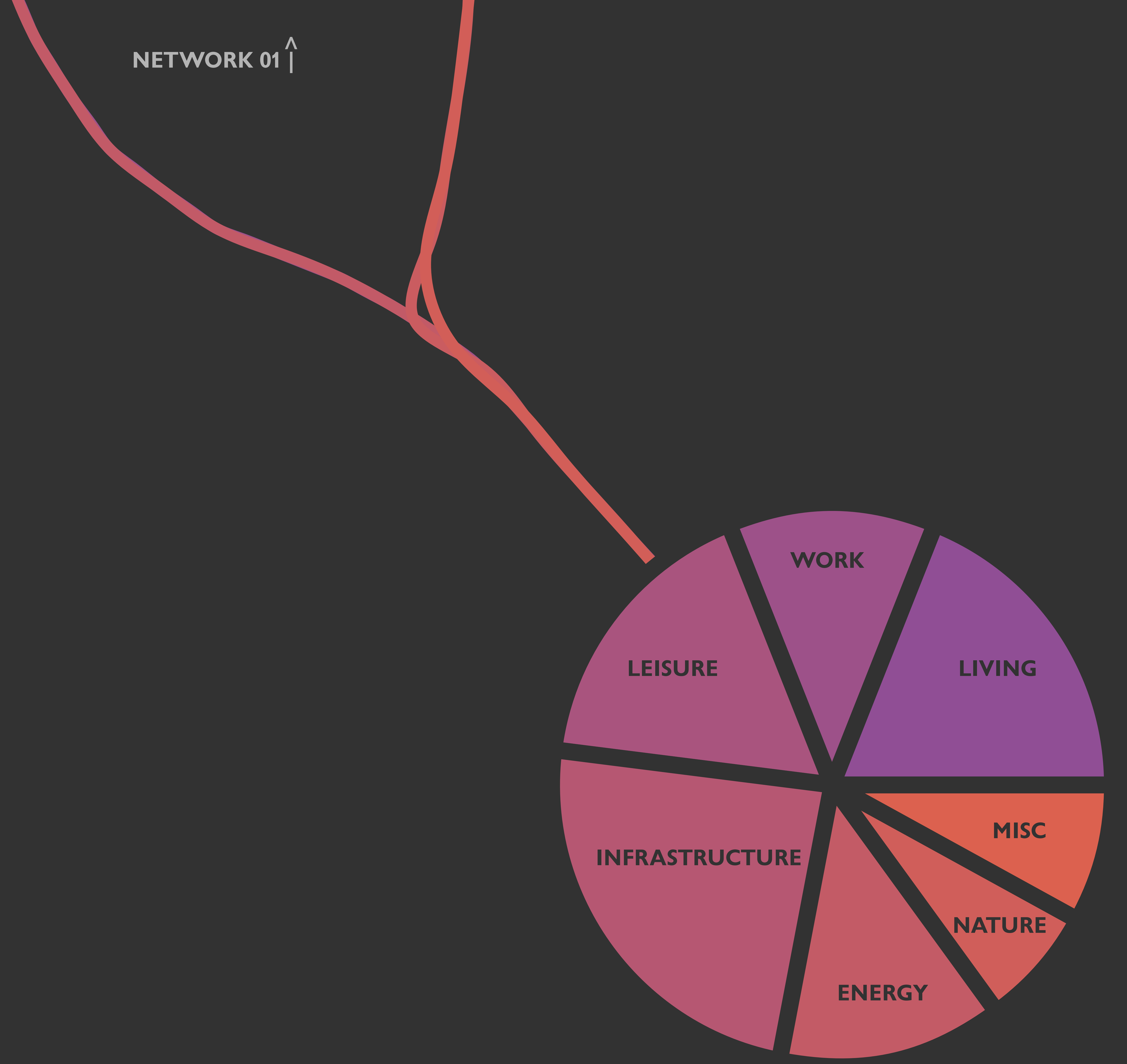
mega

north

function distribution

scale

500m



network Ø1

functions q13a-a

1Ø^{6}

north

coast line

exclusive economic zone

city

oil + gas platform

smart network

scale

25km

mega

source

engie

the q13a-a production platform (amstel field)

https://www.gdfsuezep.nl/en/gdf-suez-society/the-amstel-field-(q13a-a)

platform q13a-a

view from the hague

source

shipspotting.com

noble piet van ede l15-fa-1 - imo 8752805

© e. vroom

may 16, 2010

https://http://www.shipspotting.com/gallery/photo.php?lid=1207093

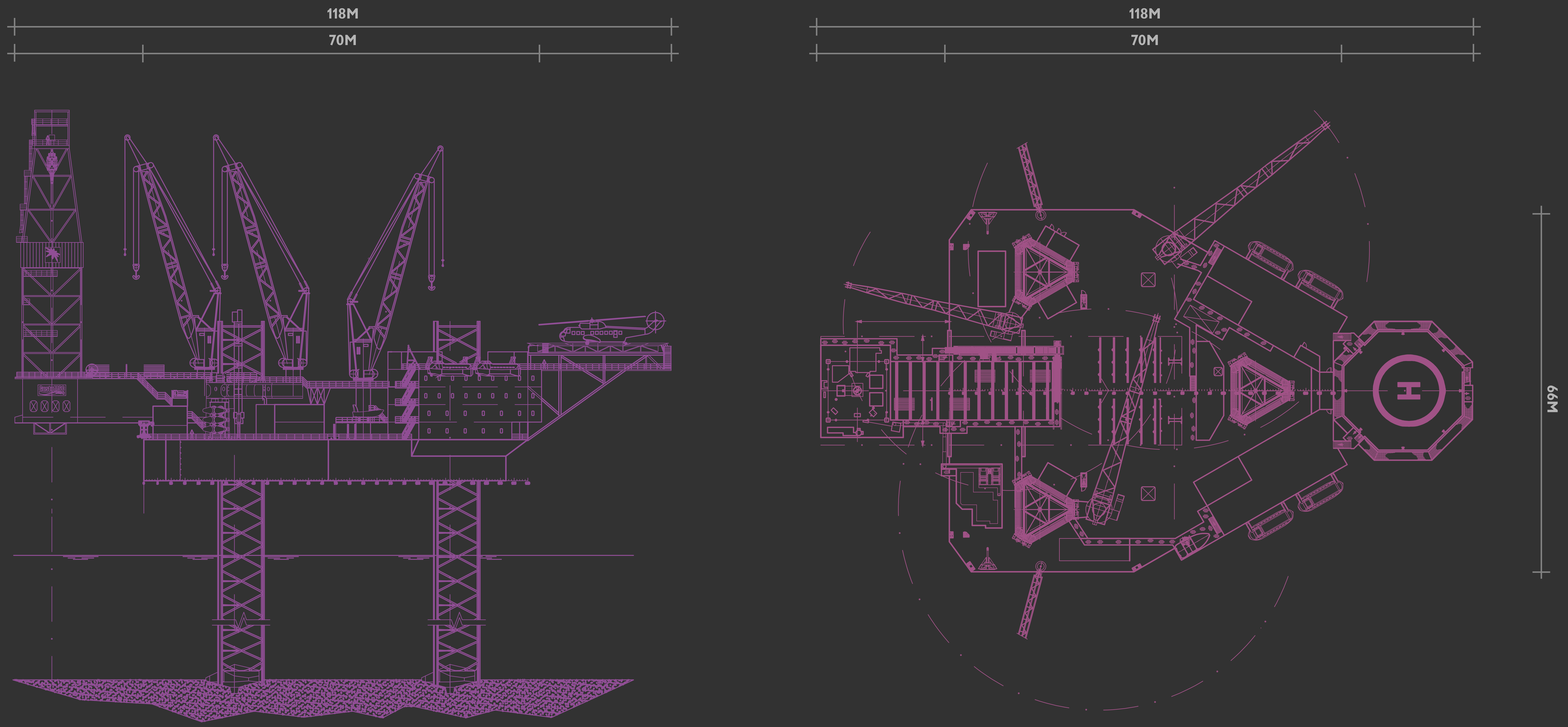
mega

north

area: 345m2

scale

10m

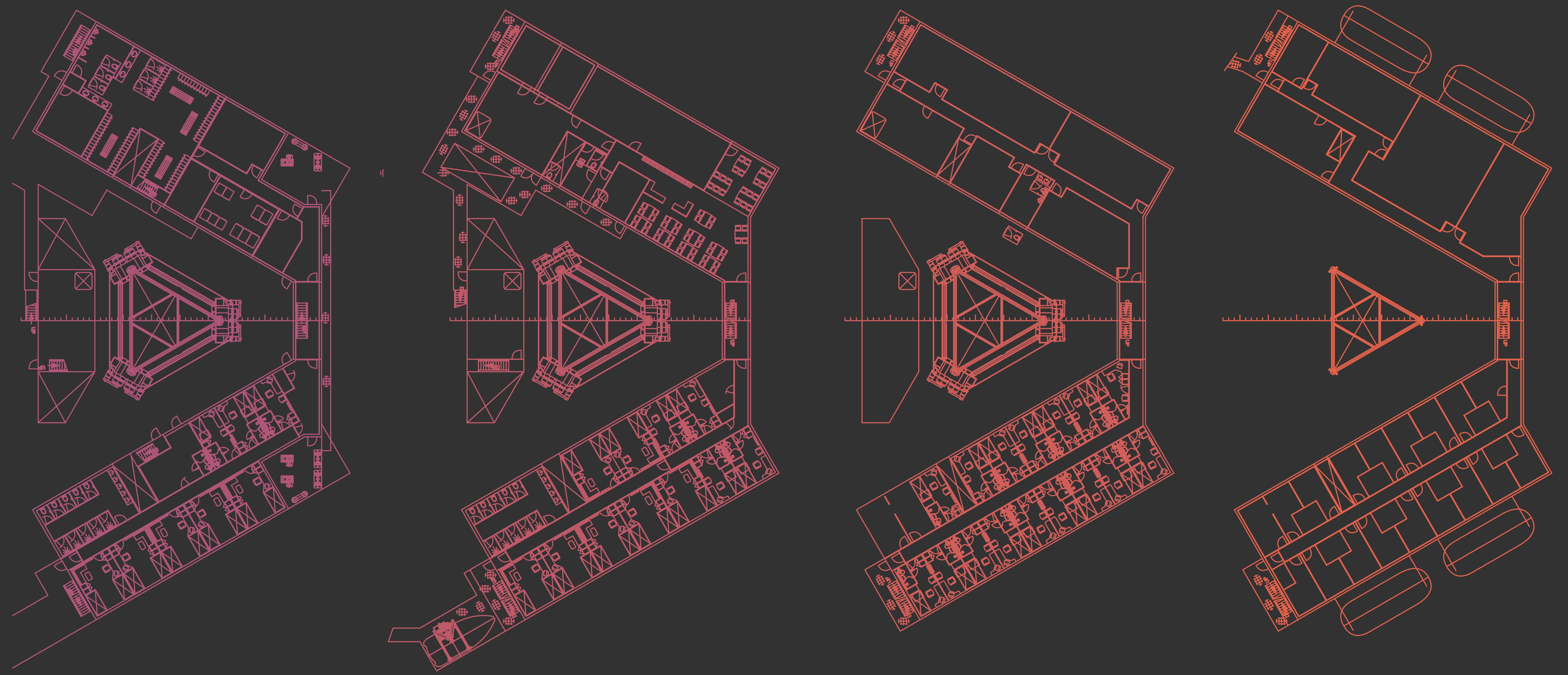


north

maindeck
a-deck
b-deck
c-deck

scale

5m



platform q13a-a

plans

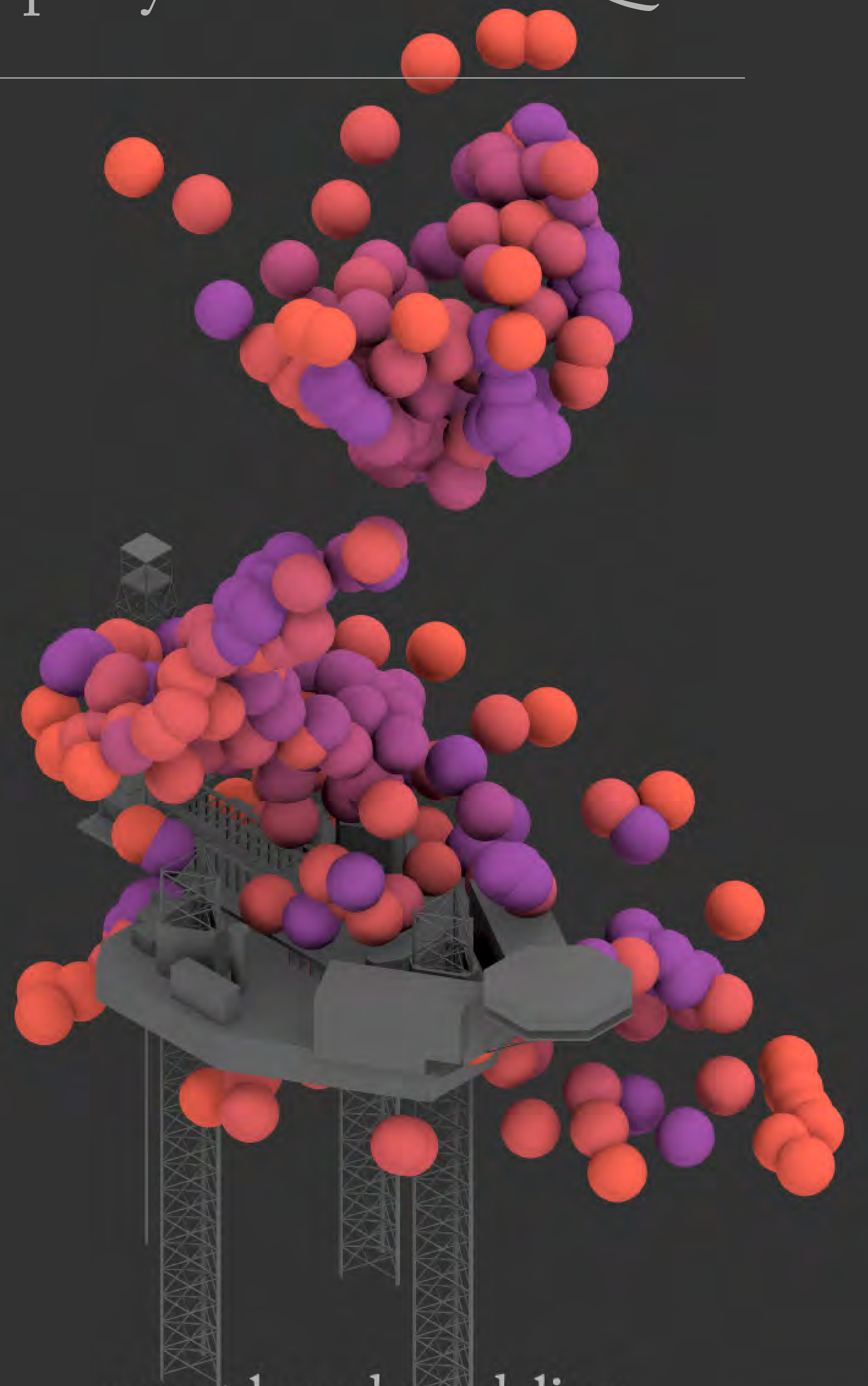
north

agent based modeling
BB C
ABM 4
var 4

functions

- living
- work
- leisure
- nature
- food
- energy

https://youtu.be/0Bx6zQcr5o4



agent based modeling

volume swarm

https://youtu.be/D5mcwzs6tKw

north

agent based modeling
BB C
ABM 4
var 4

functions

- living
- work
- leisure
- nature
- food
- energy

variations

overview

1Ø⁶

mega

north

agent based modeling
abm 2
variation C2.3

wrap mesh algorithm

functions

living

work

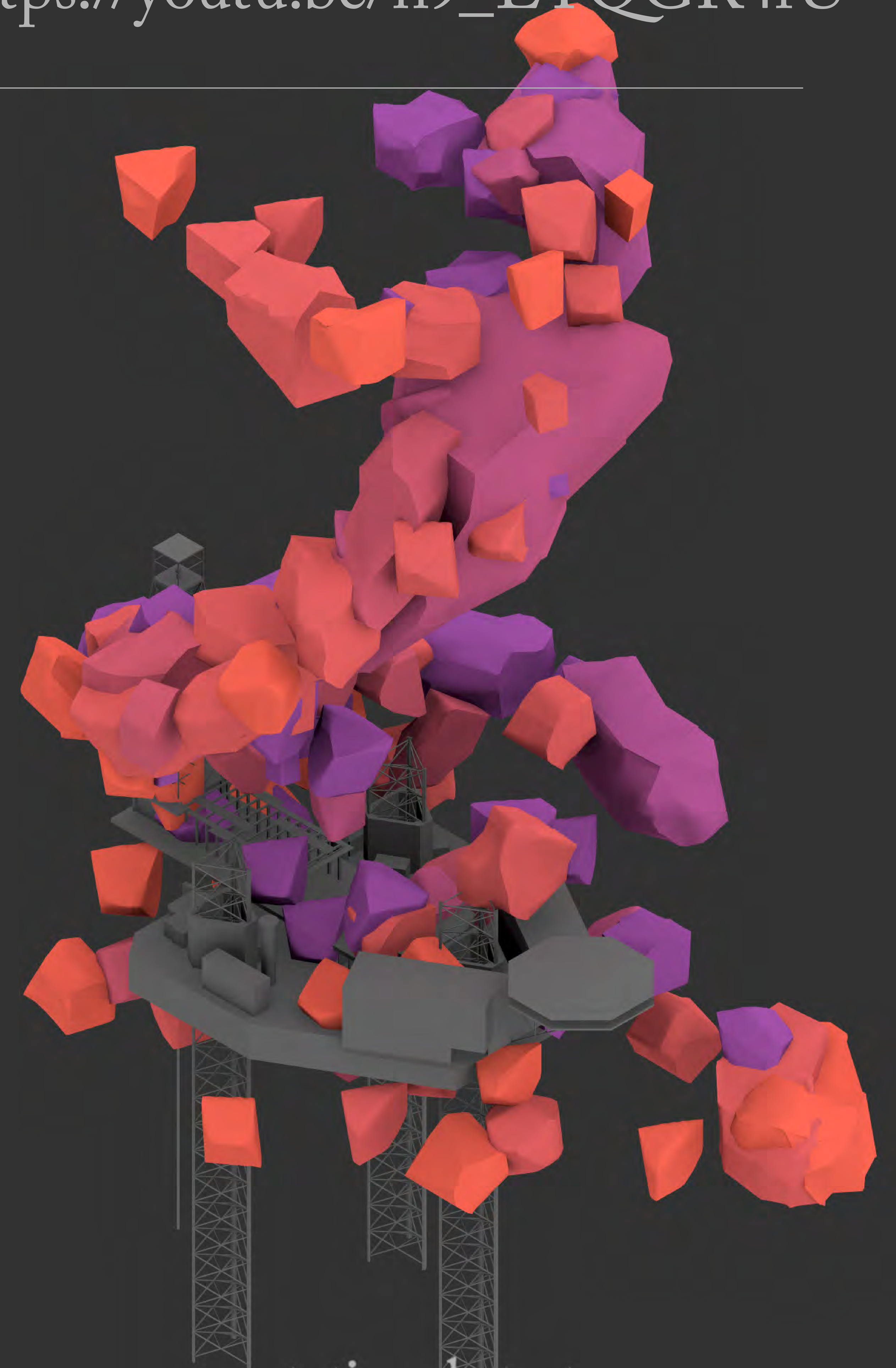
leisure

nature

food

energy

https://youtu.be/h9_EYQGR4rU



computational strategy

agent based modeling

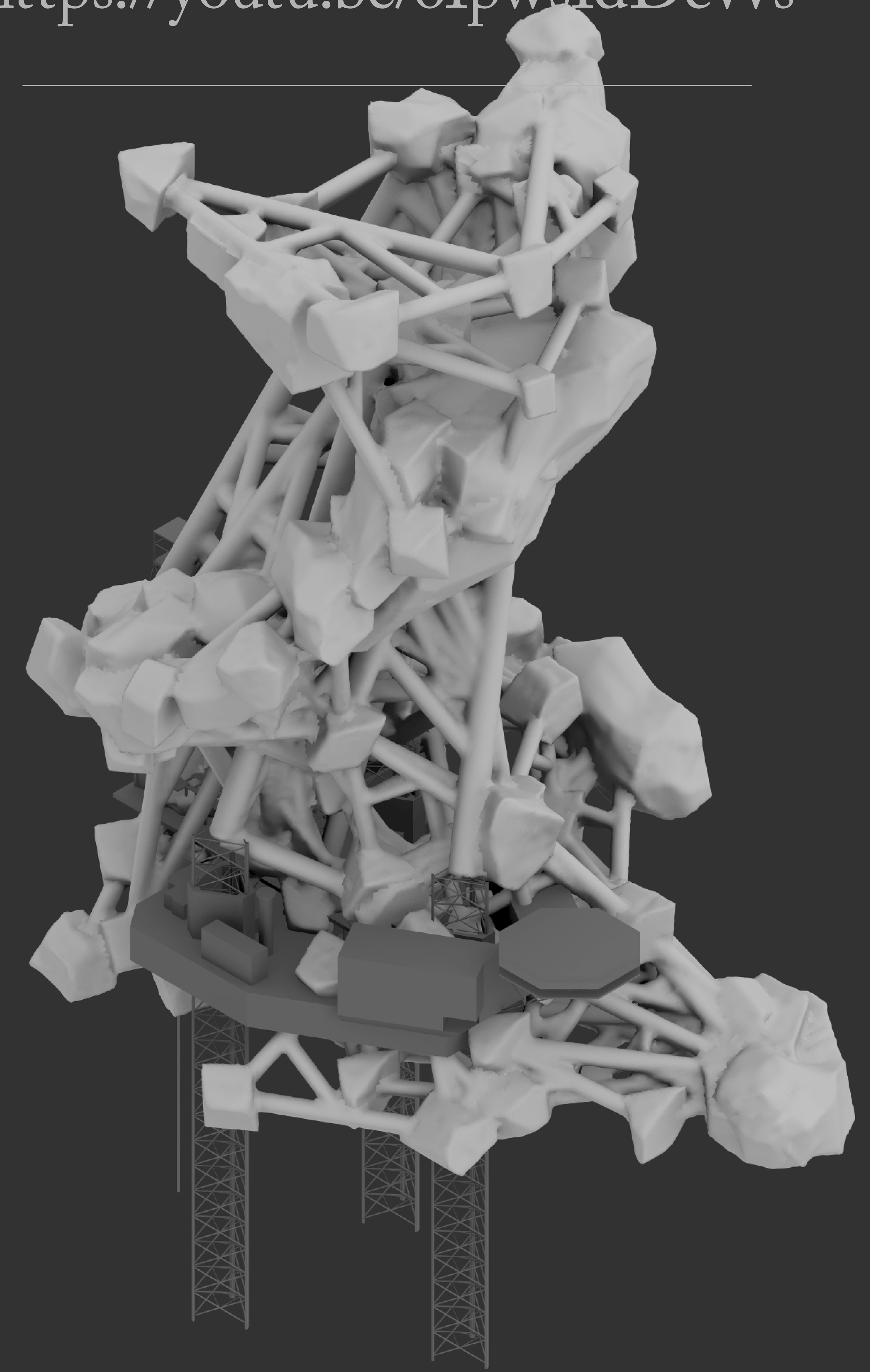
https://youtu.be/oIpwsIdDcWs

north

mesh smoothing algorithm
variation C2.3

1st iteration
zbrush dynamesh
resolution: 240, blur: 20

combined mesh



https://youtu.be/_vxALeaAFy4

geometry

approach

https://youtu.be/-mUsygNØiMk

geometry

site plan

strength attraction [%]

0

100

functions

living

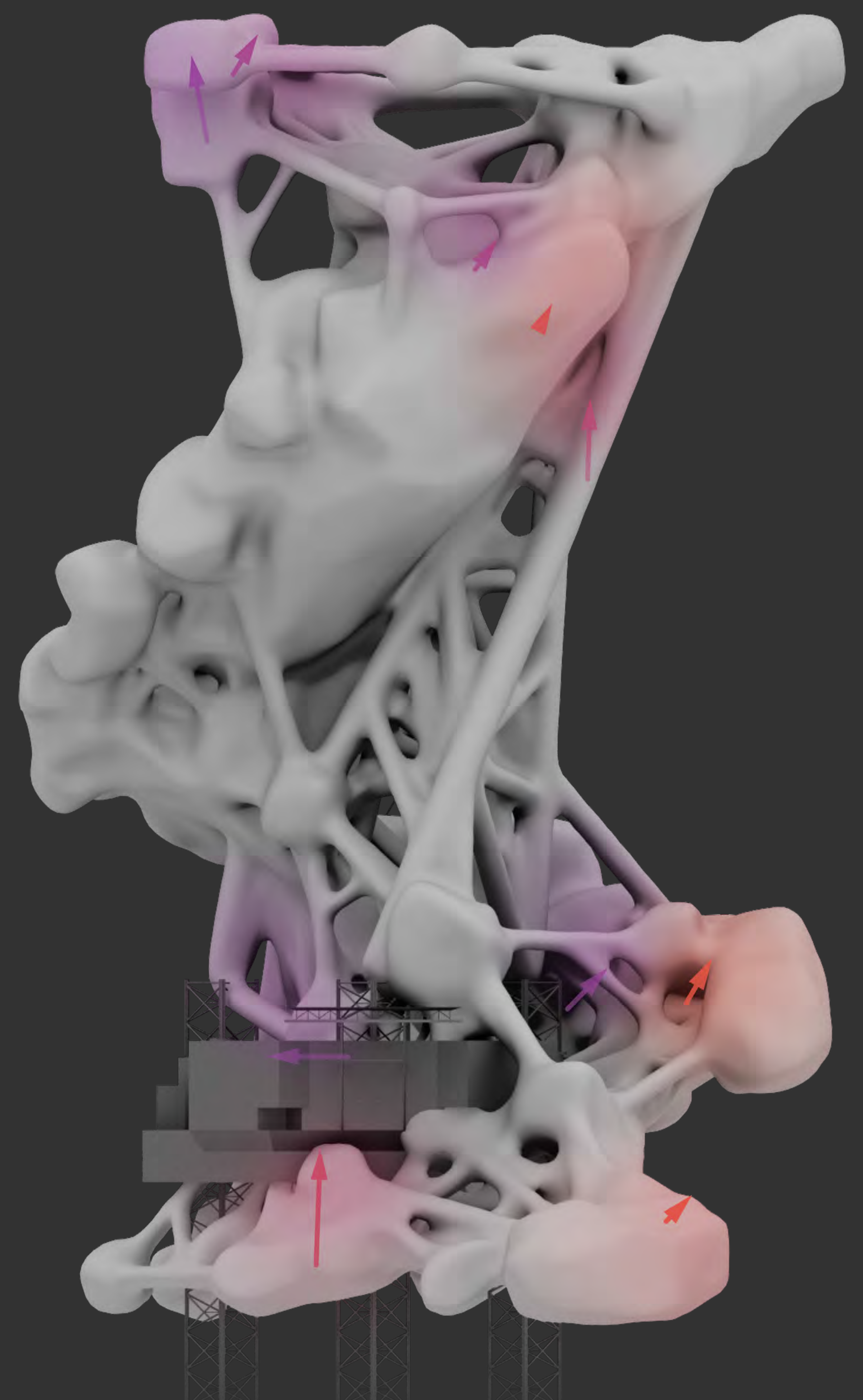
work

leisure

nature

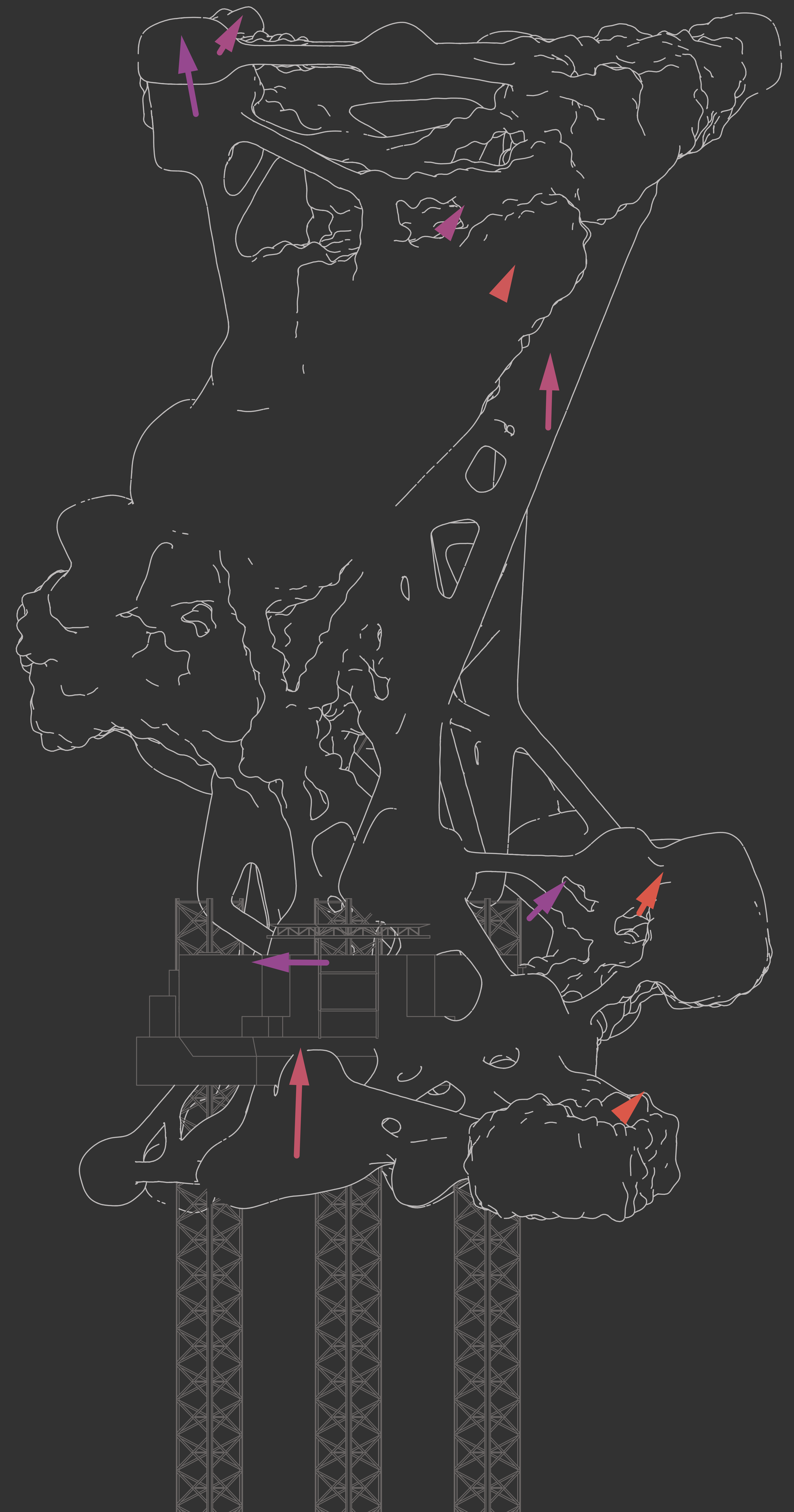
food

energy



differential growth

attraction



strength attraction [%]

0

100

functions

living

work

leisure

nature

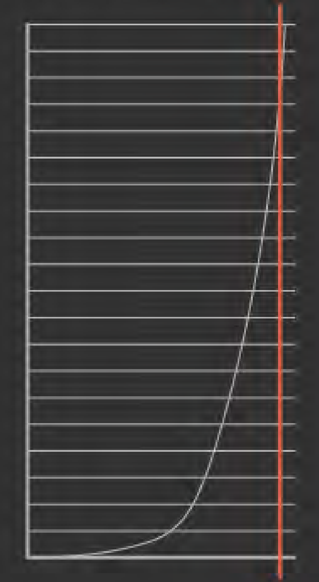
food

energy

north

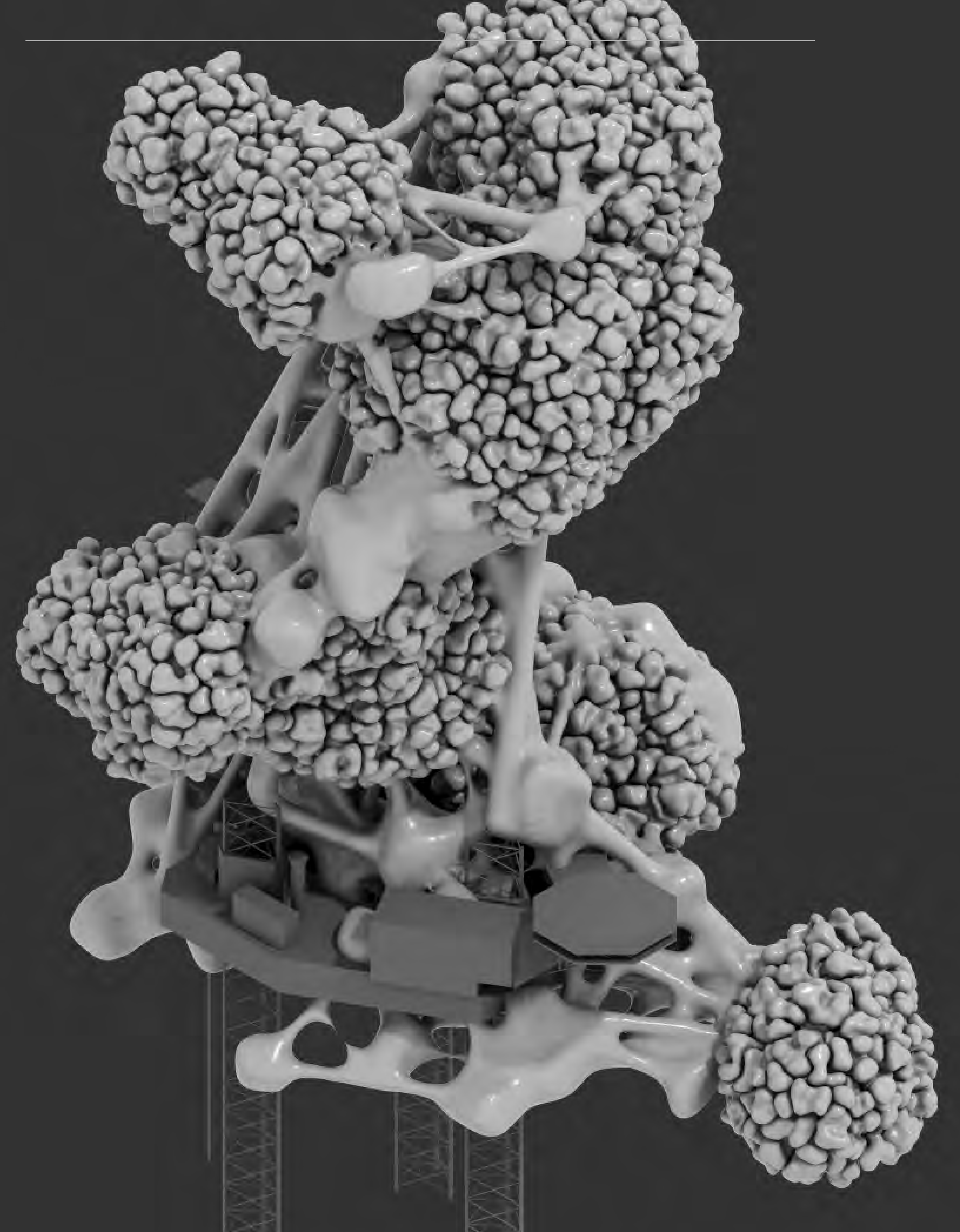
differential growth algorithm

total curvature



total area

https://youtu.be/_BGHag4yV-M



differential growth

isometry

1Ø^6

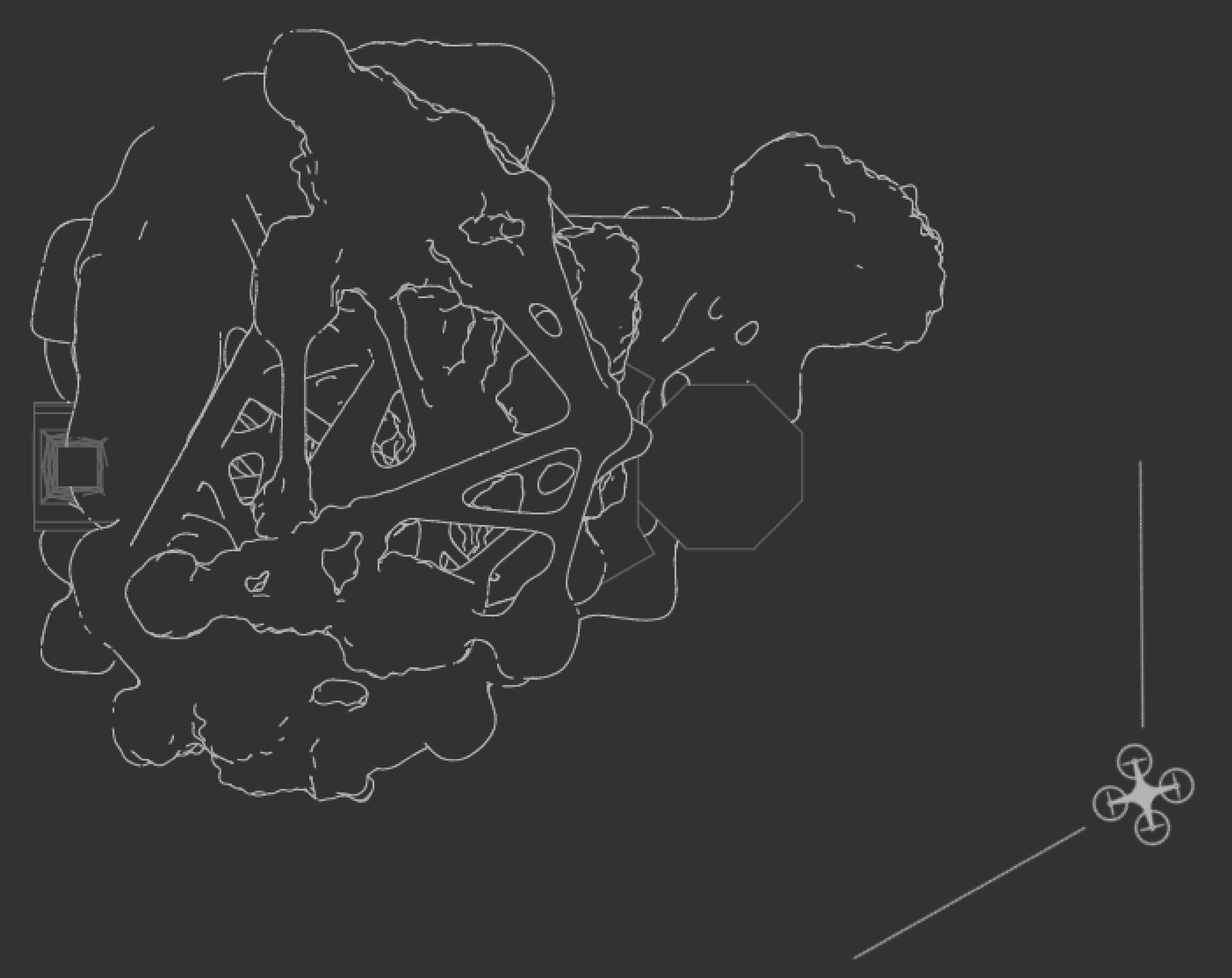
https://youtu.be/srZMU81tUSw

geometry

elevation

10^6

https://youtu.be/TpQWM3YICCM



mega

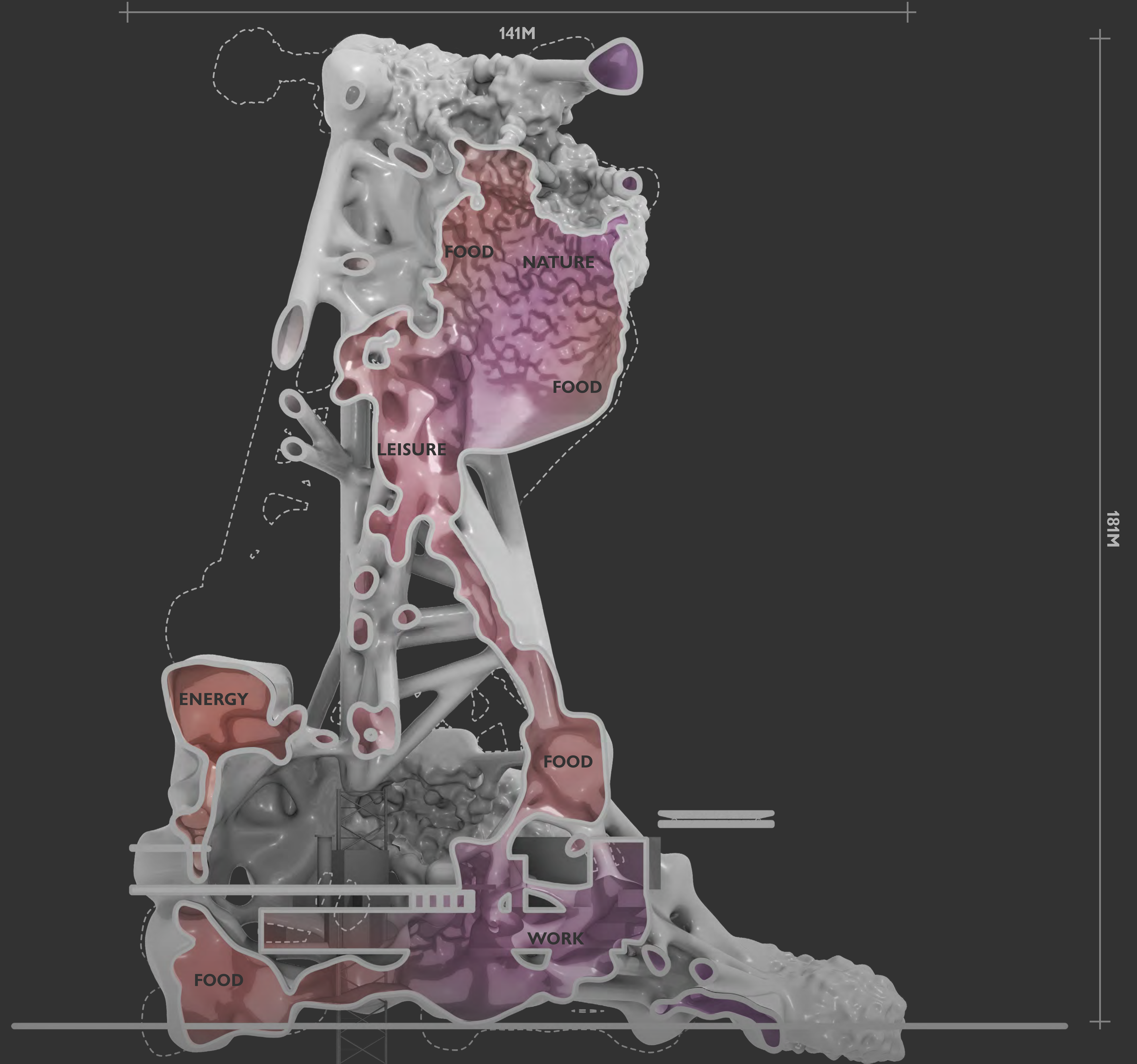
view: north

functions

- living
- work
- leisure
- nature
- food
- energy

scale

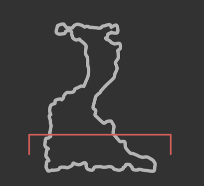
10m



geometry

section y

view: down

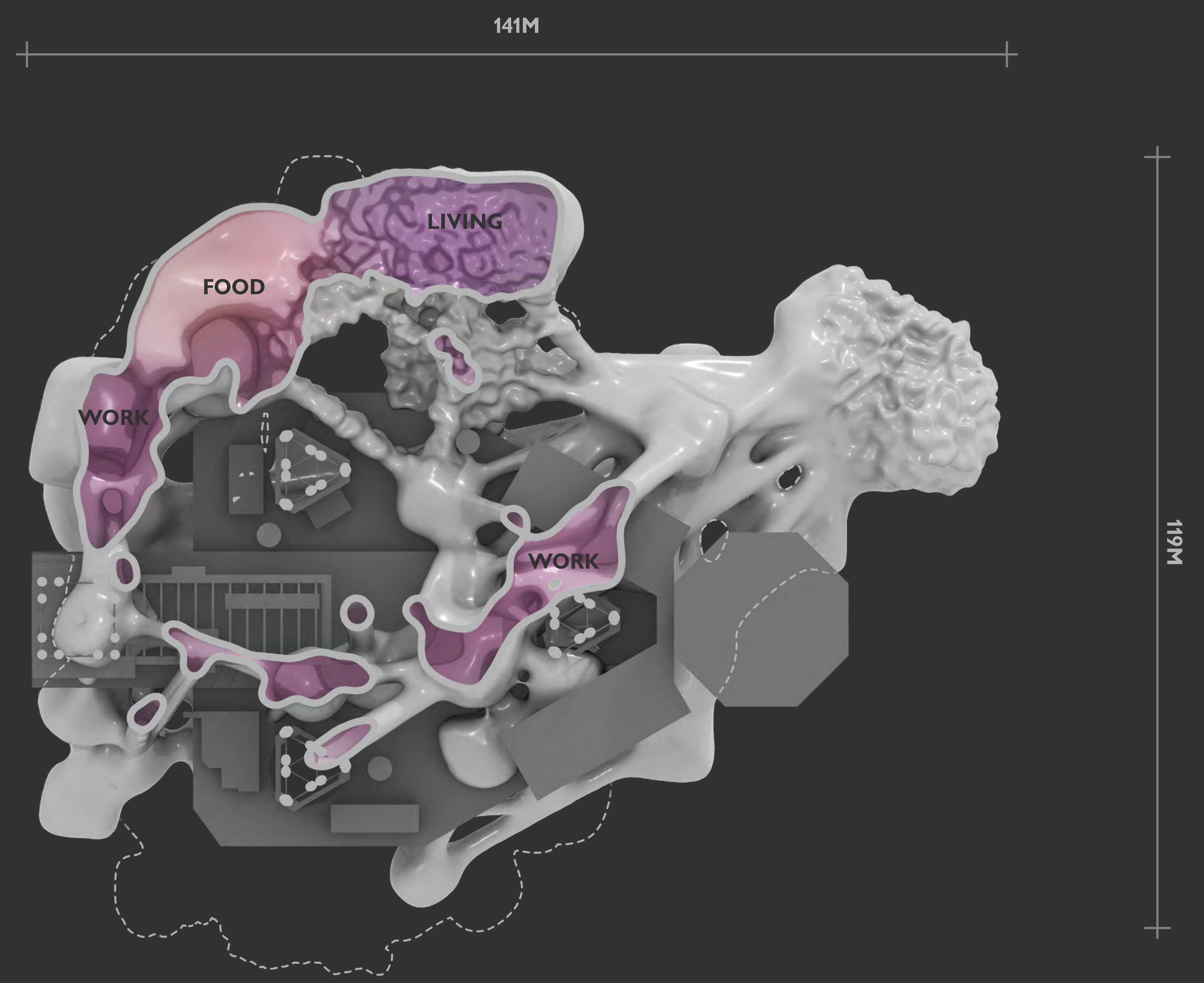


functions

- living
- work
- leisure
- nature
- food
- energy

scale

10m



geometry

section z

https://youtu.be/K28odOHYbMQ

geometry

ageing

https://youtu.be/SAsuD5IfgVA

ageing

years

0
+1
+2
+3
+4
+5
+10
+15
+20

https://youtu.be/fQrNhLhFlY8

geometry

close up

https://youtu.be/RNDmj56i3Oo

mega

10^3

kilo

$10^3 = 1.000$

source

© marc fornes / theverymany

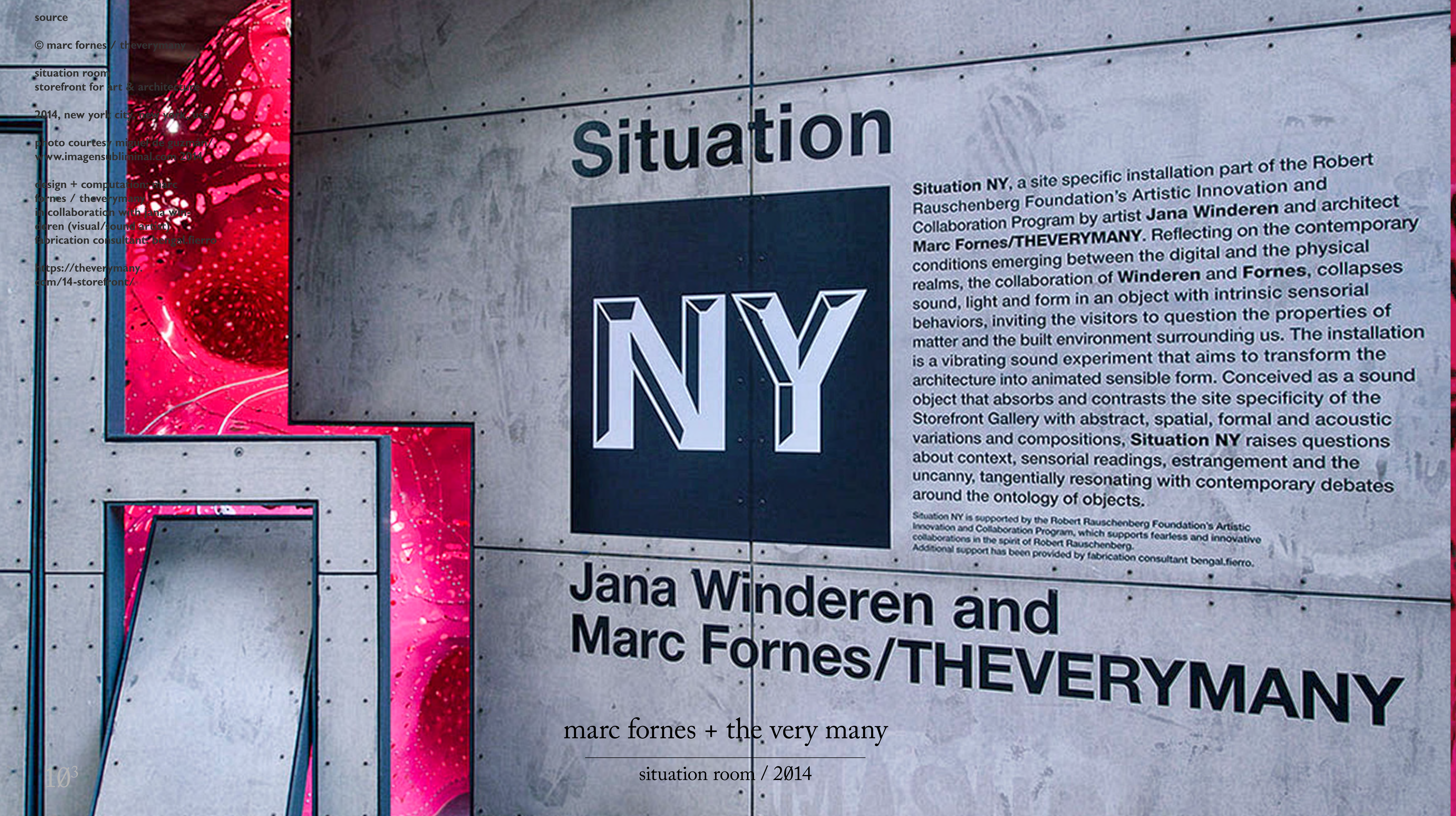
situation room
storefront for art & architecture

2014, new york city, new york, usa

photo courtesy miguel de guzmán/
www.imagensubliminal.com 2014

design + computation: marc fornes / theverymany
in collaboration with jana winderen (visual/sound artist)
fabrication consultant: bengal.fierro

https://theverymany.com/14-storefront/



source

© marc fornes / theverymany

situation room
storefront for art & architecture

2014, new york city, new york, usa

photo courtesy miguel de guzmán/
www.imagensubliminal.com 2014

design + computation: marc fornes / theverymany
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fabrication consultant: bengal.fierro

https://theverymany.com/14-storefront/

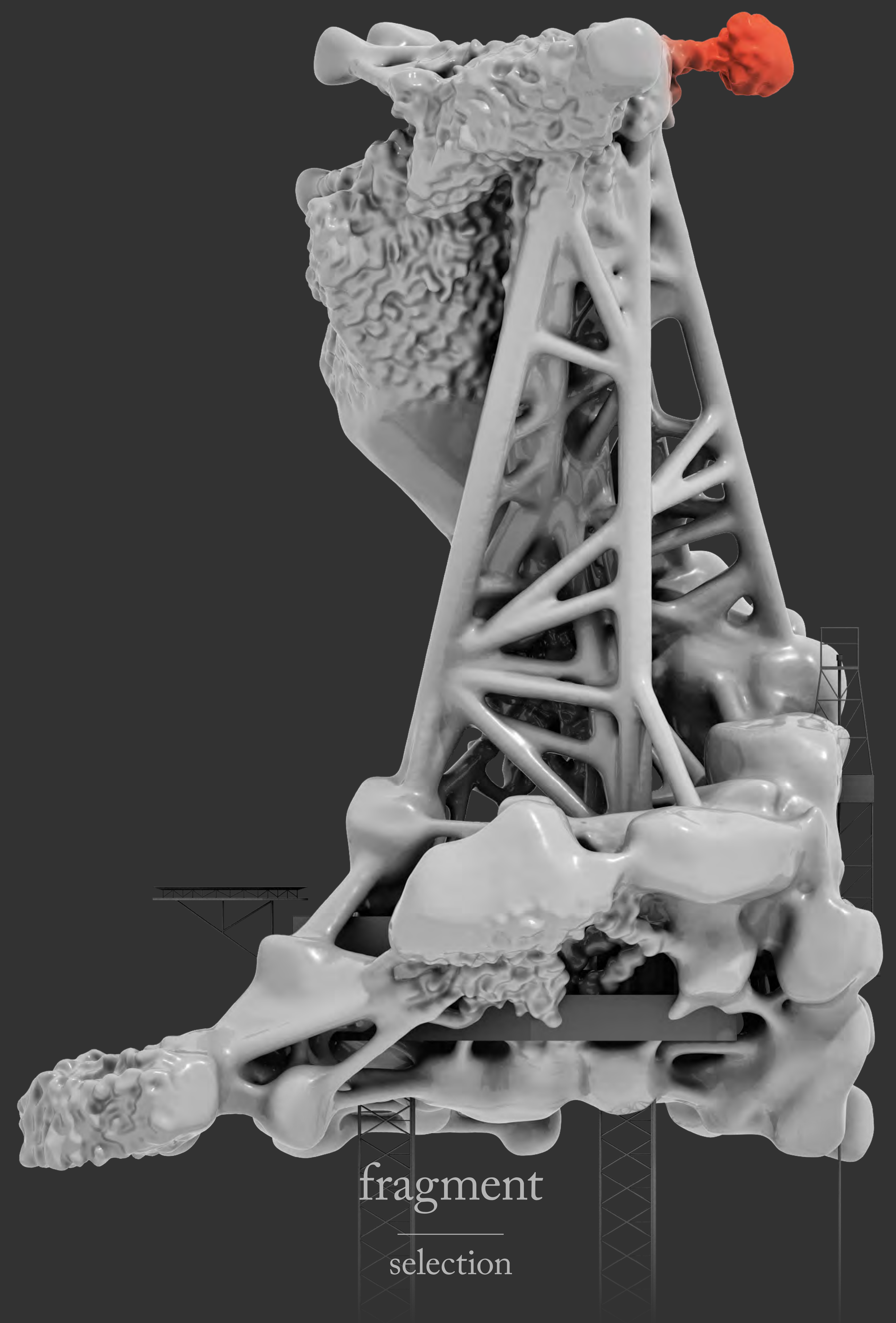
structure side view

structure

fragment

scale

10m



fragment

selection

10^3

structure side view

structure

fragment

scale

10m

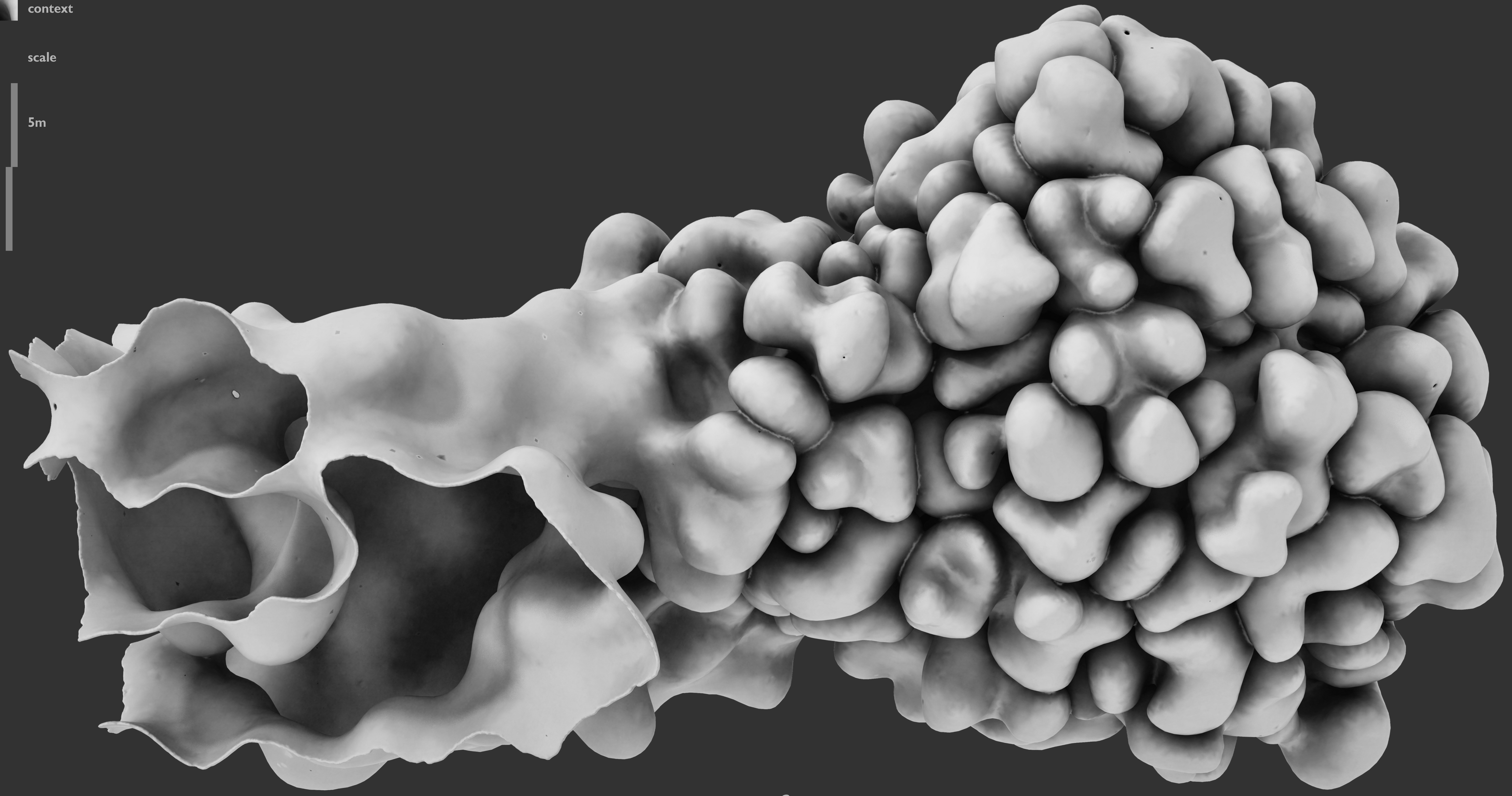
kilo

side view

context

scale

5m



fragment

selection

10^3

side view

context

scale

5m

kilo

side view

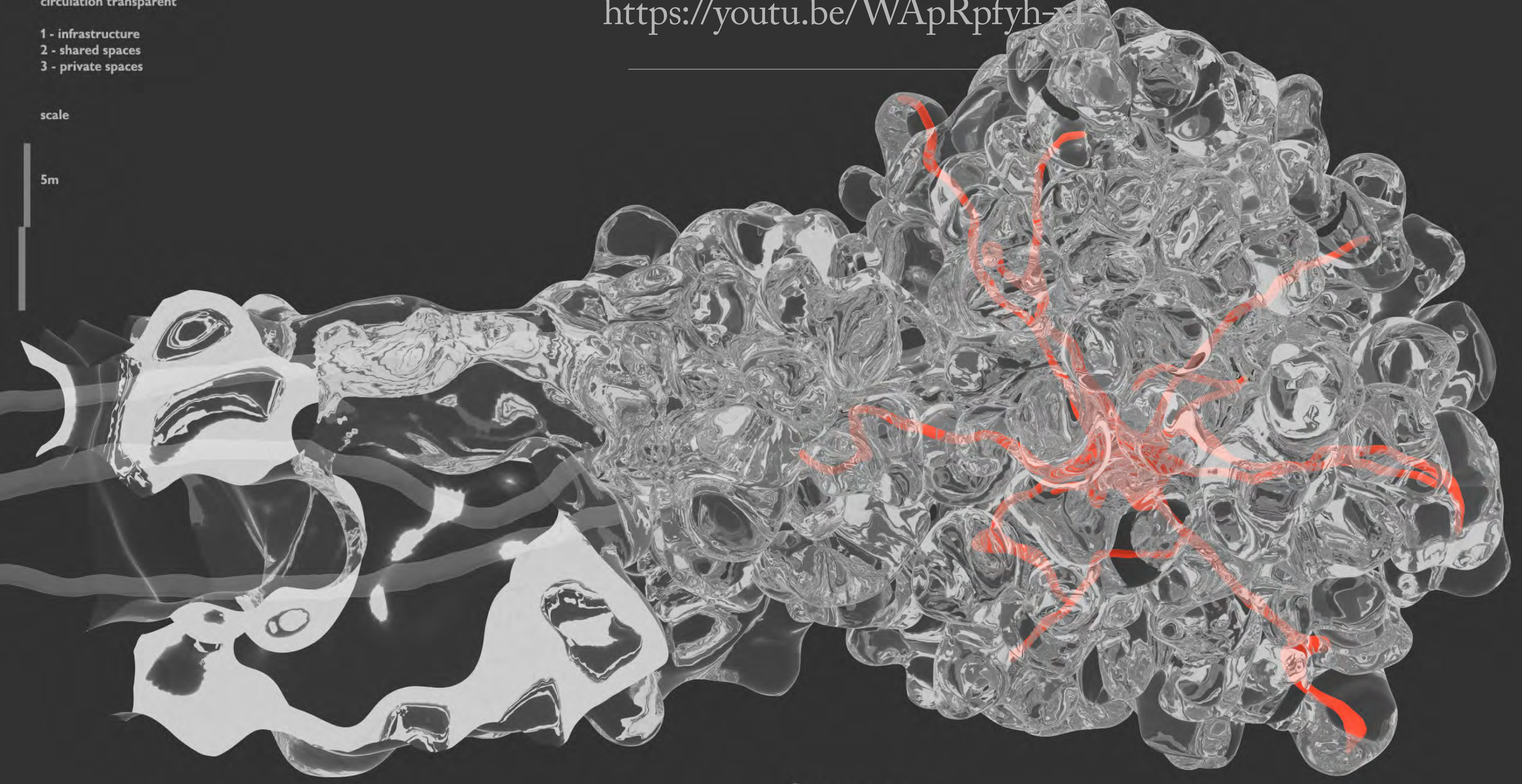
circulation transparent

1 - infrastructure
2 - shared spaces
3 - private spaces

scale

5m

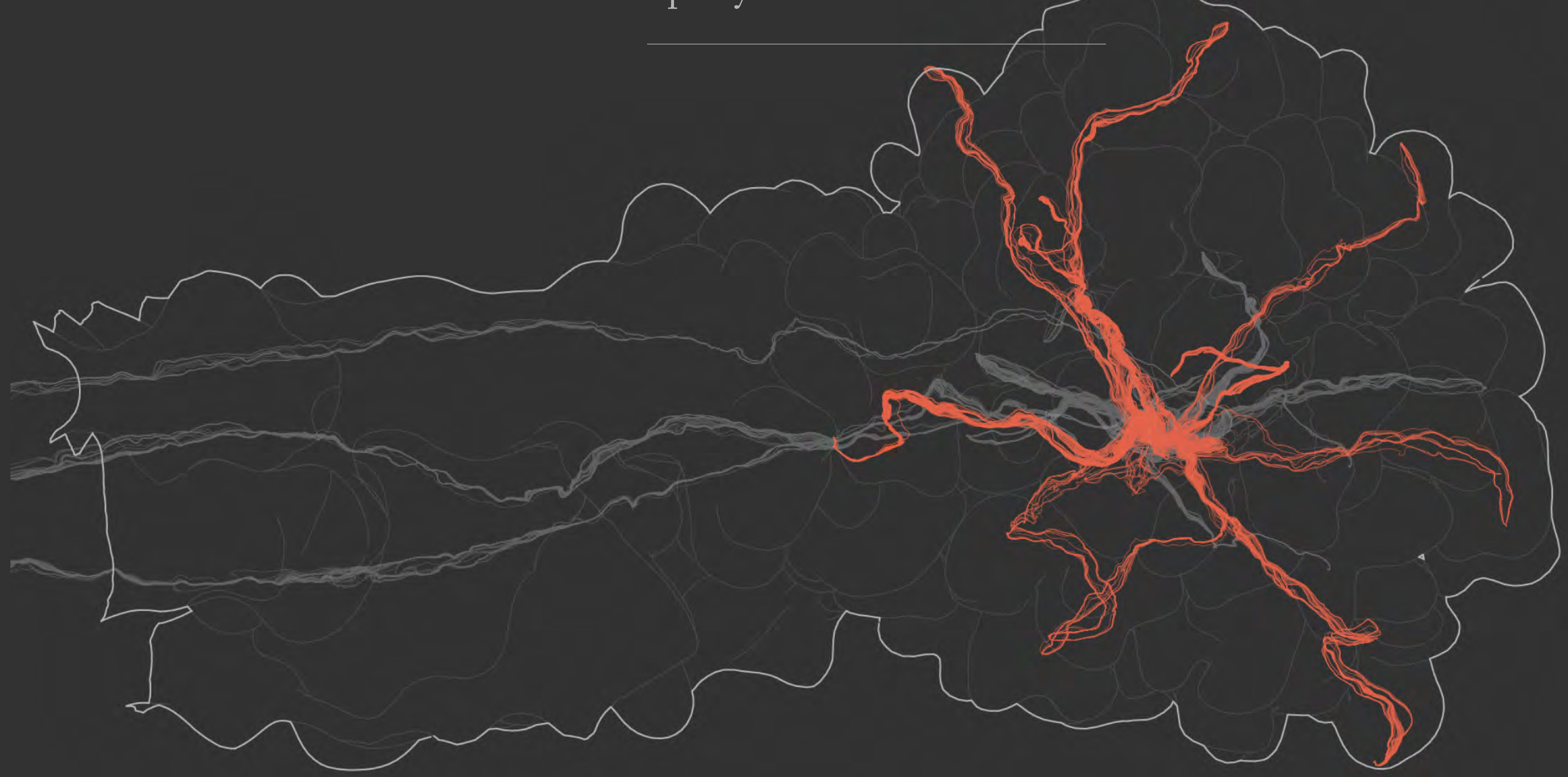
https://youtu.be/WApRpfyh-x



fragment

circulation

https://youtu.be/kcKDaw7cFuA



side view

circulation lw section

1 - infrastructure
2 - shared spaces
3 - private spaces

scale

5m

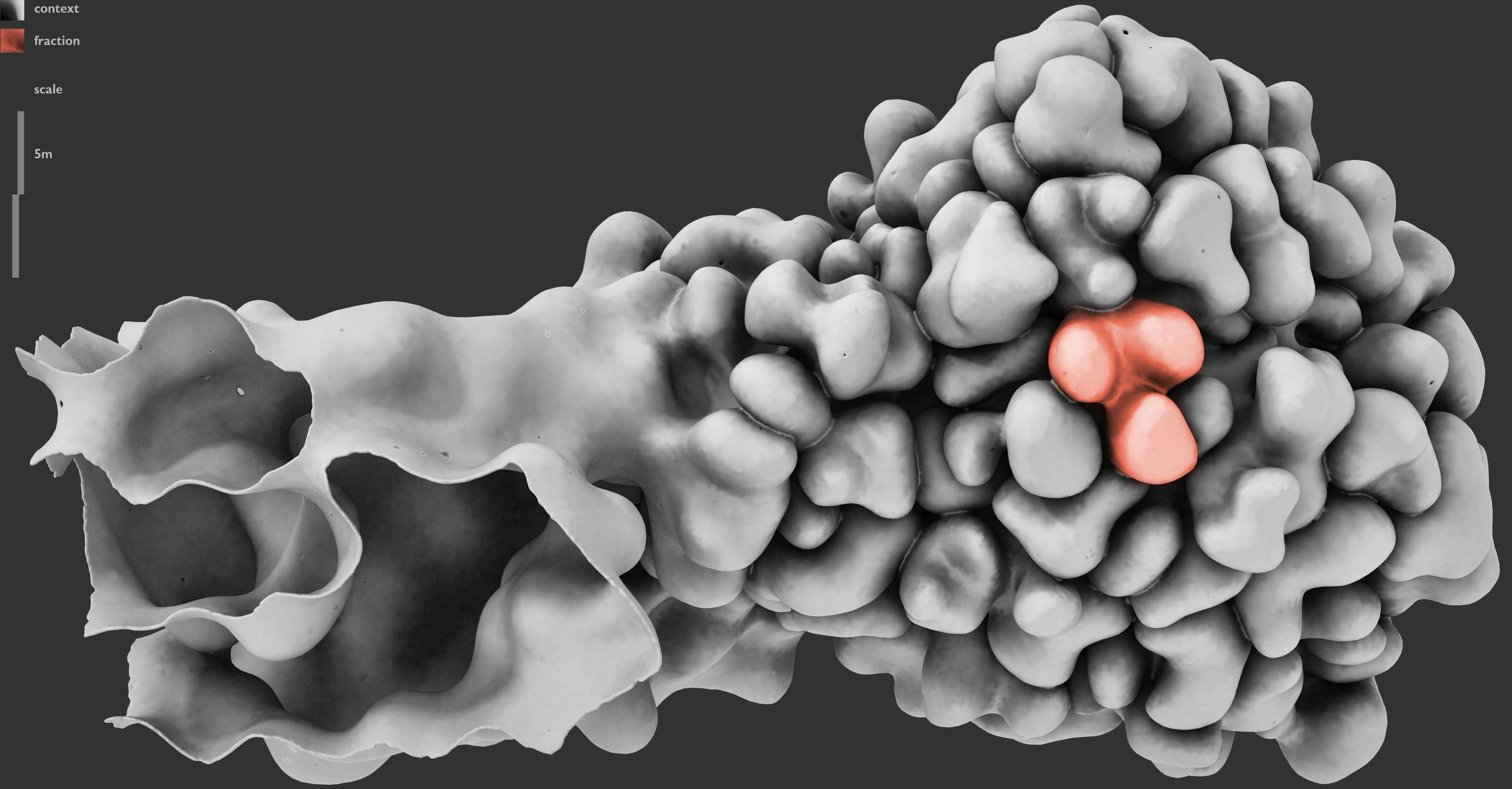
side view

context

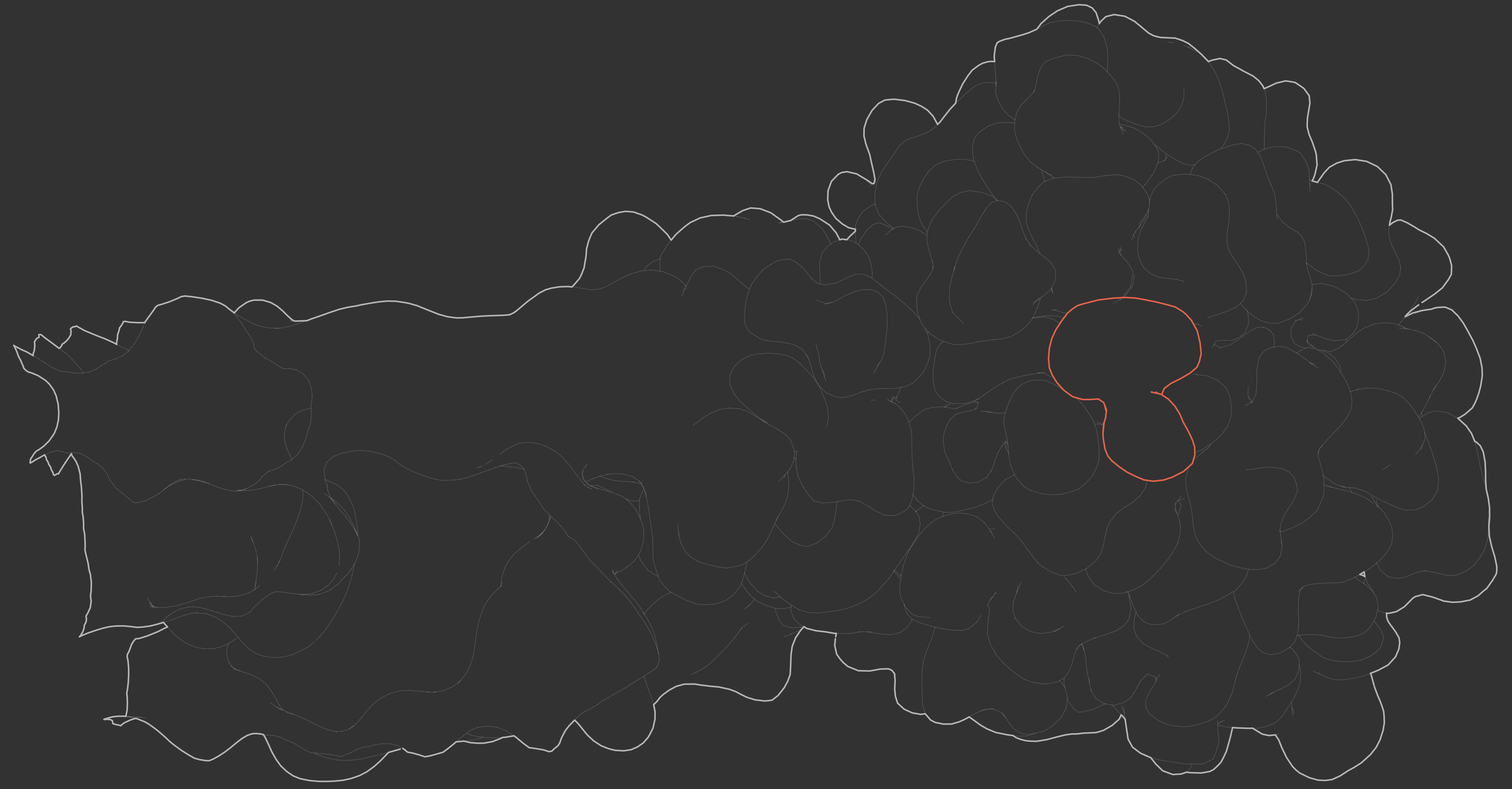
fraction

scale

5m



$\frac{\text{fragment}}{\text{context}}$



side view

context

fraction

scale

5m

$1\emptyset^3$

kilo

10^0

macro

$10^0 = 1$

scale

2m

scale

2m

fraction

volume

10^{0}

macro

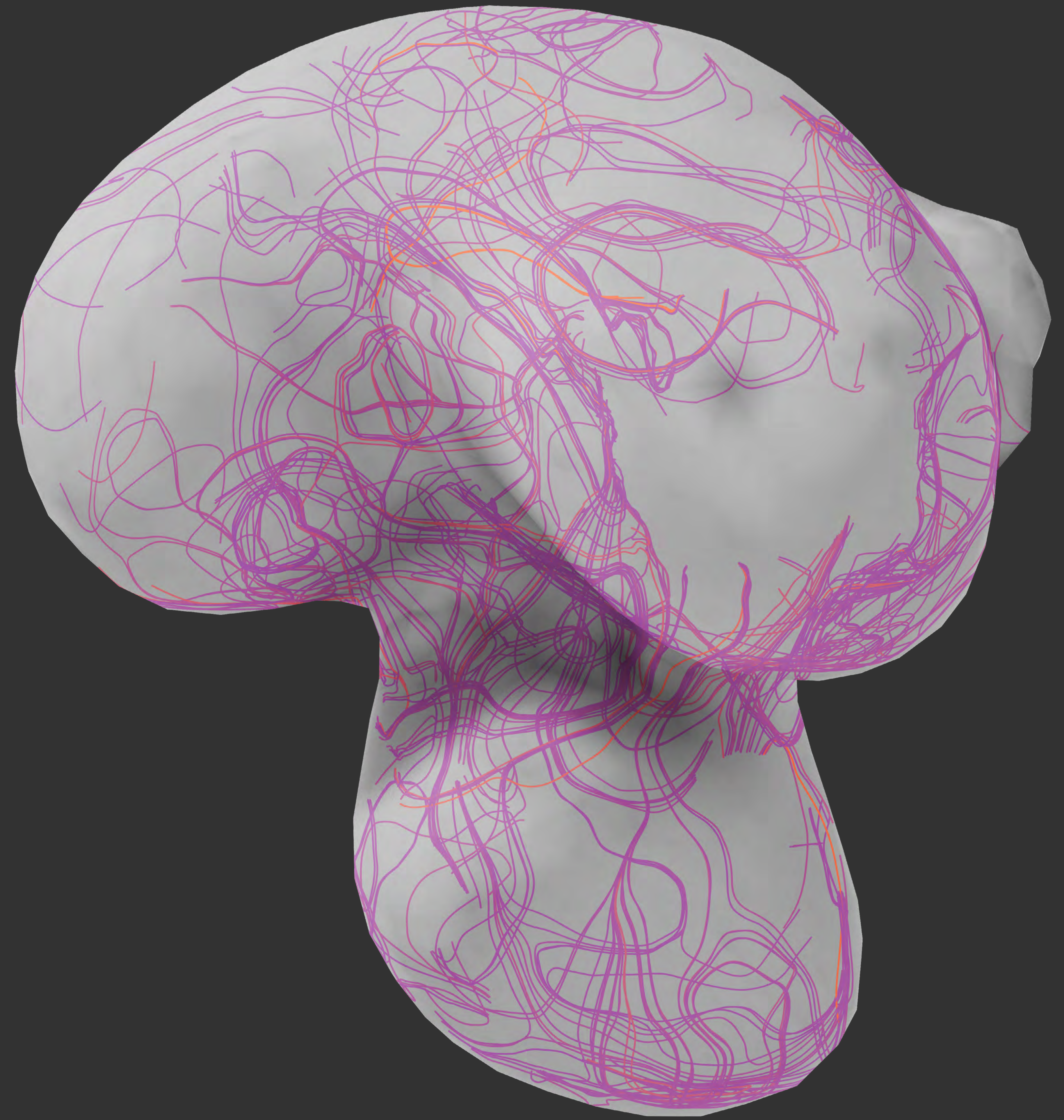
force flow

curve direction 1

curve direction 2

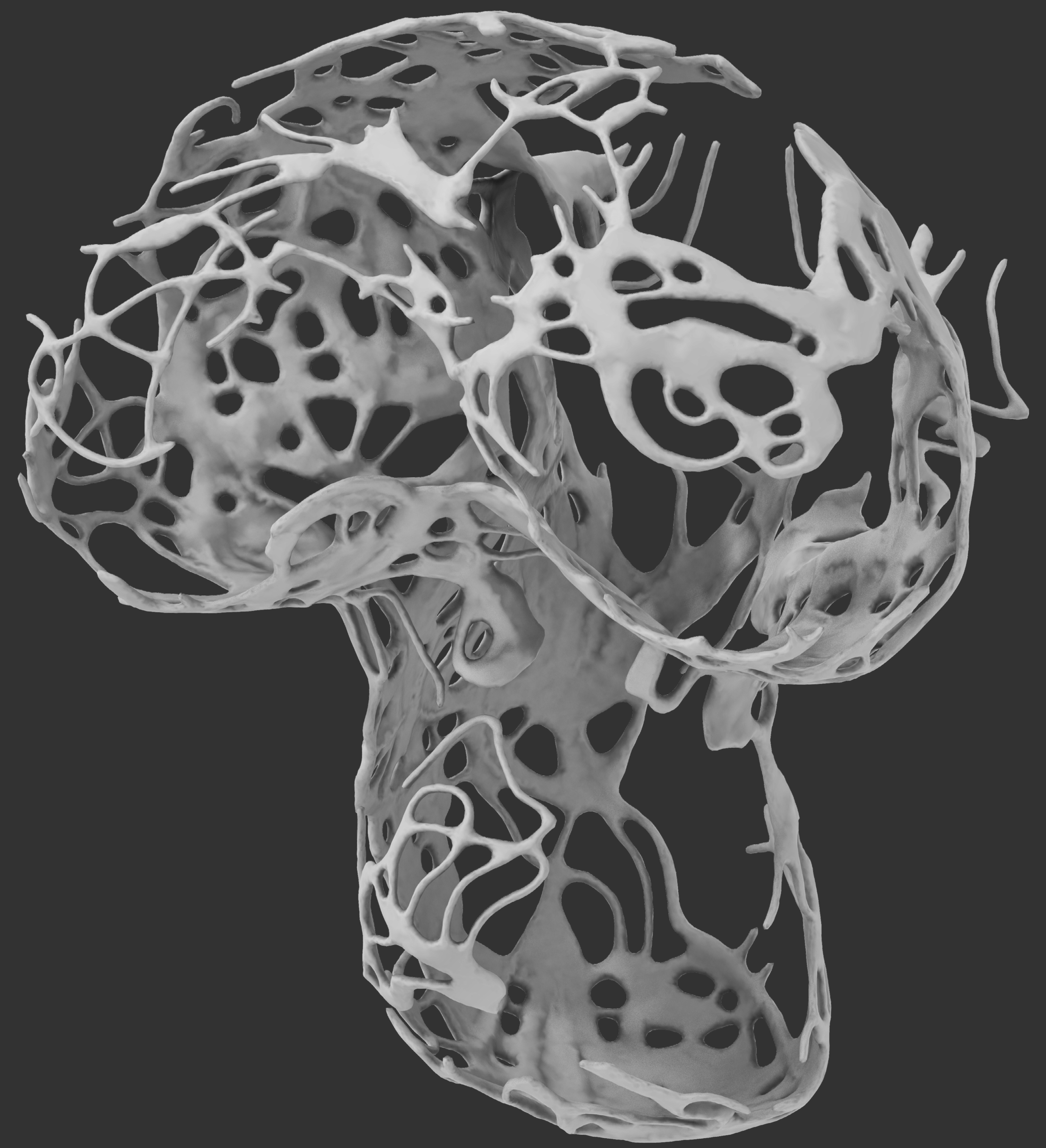
scale

2m



fraction

stress analysis



force flow

concrete core

scale

2m

$1\text{Ø}^{\text{Ø}}$

macro

forces + constraints

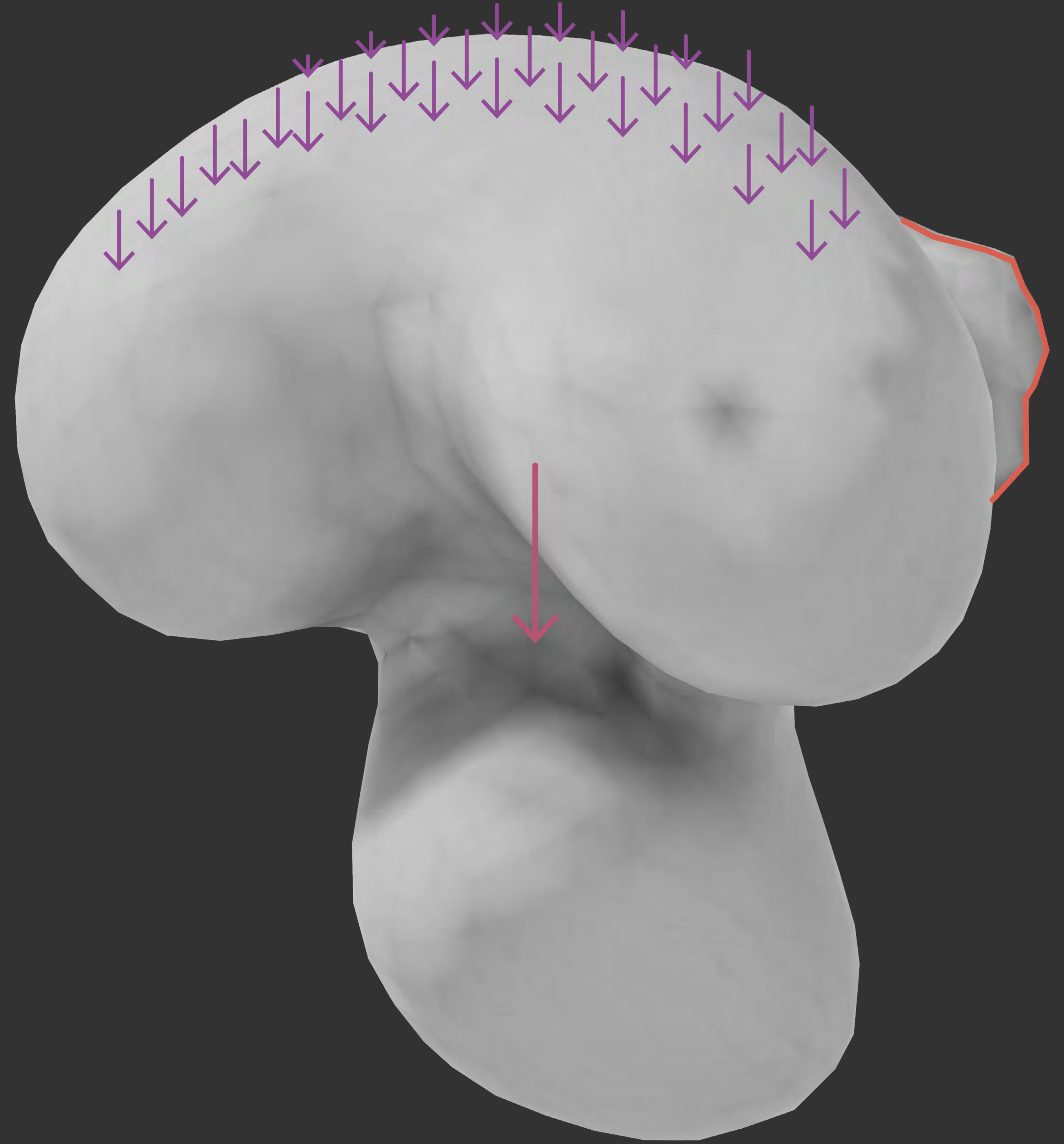
snow load

gravity

fixed constraint

scale

2m



fraction

loads + constraints

shape generator

raw topology

scale

2m

1Ø^{0}

macro

scale

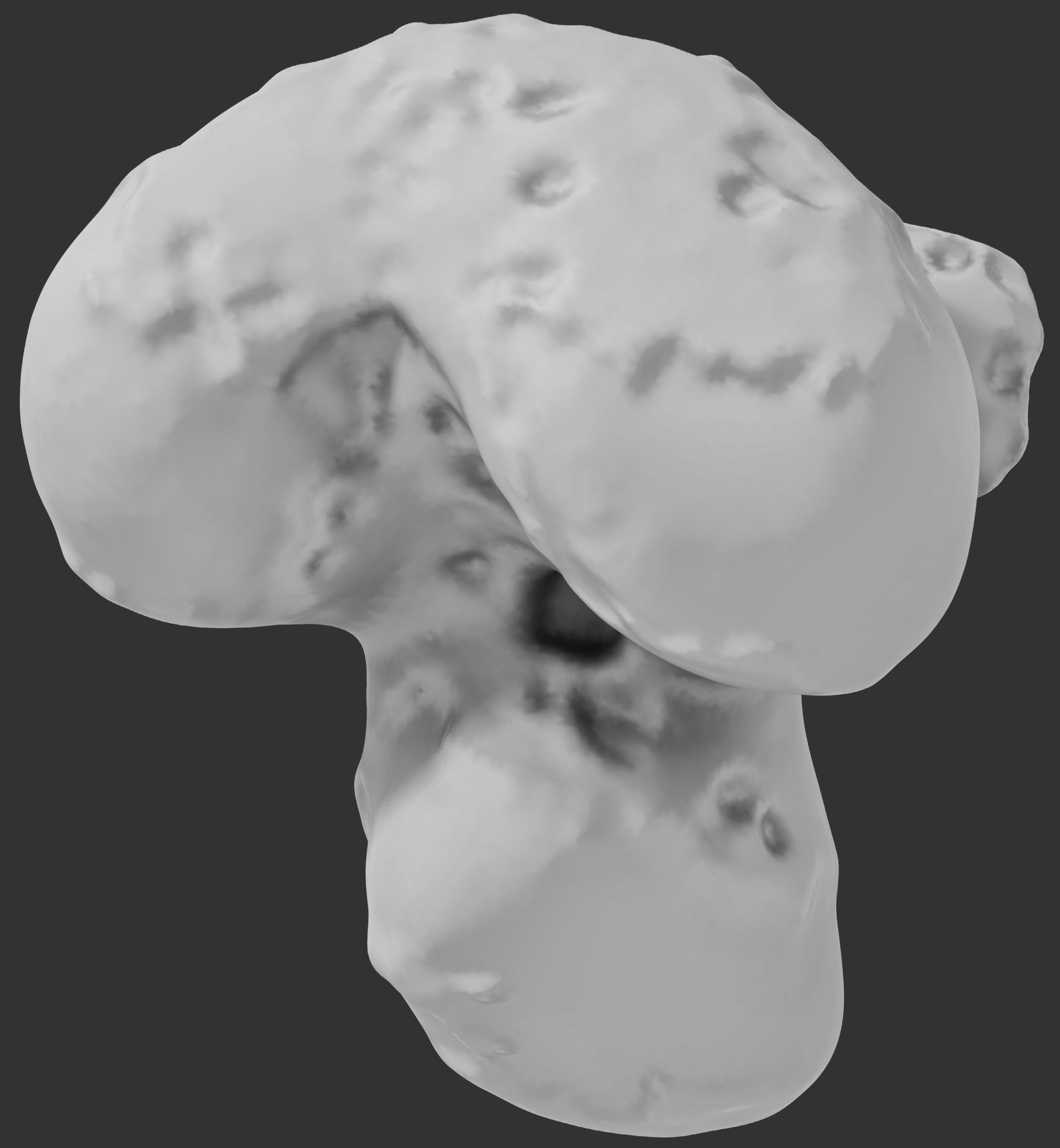
2m

fraction

topology optimization // smooth

scale

2m



scale

2m

1Ø^{0}

macro

source

a diffusion-limited aggregation (dla)
cluster. copper aggregate formed
from a copper sulfate solution
in an electrode position cell.

19 may 2006

diffusion limited aggregation

copper cluster

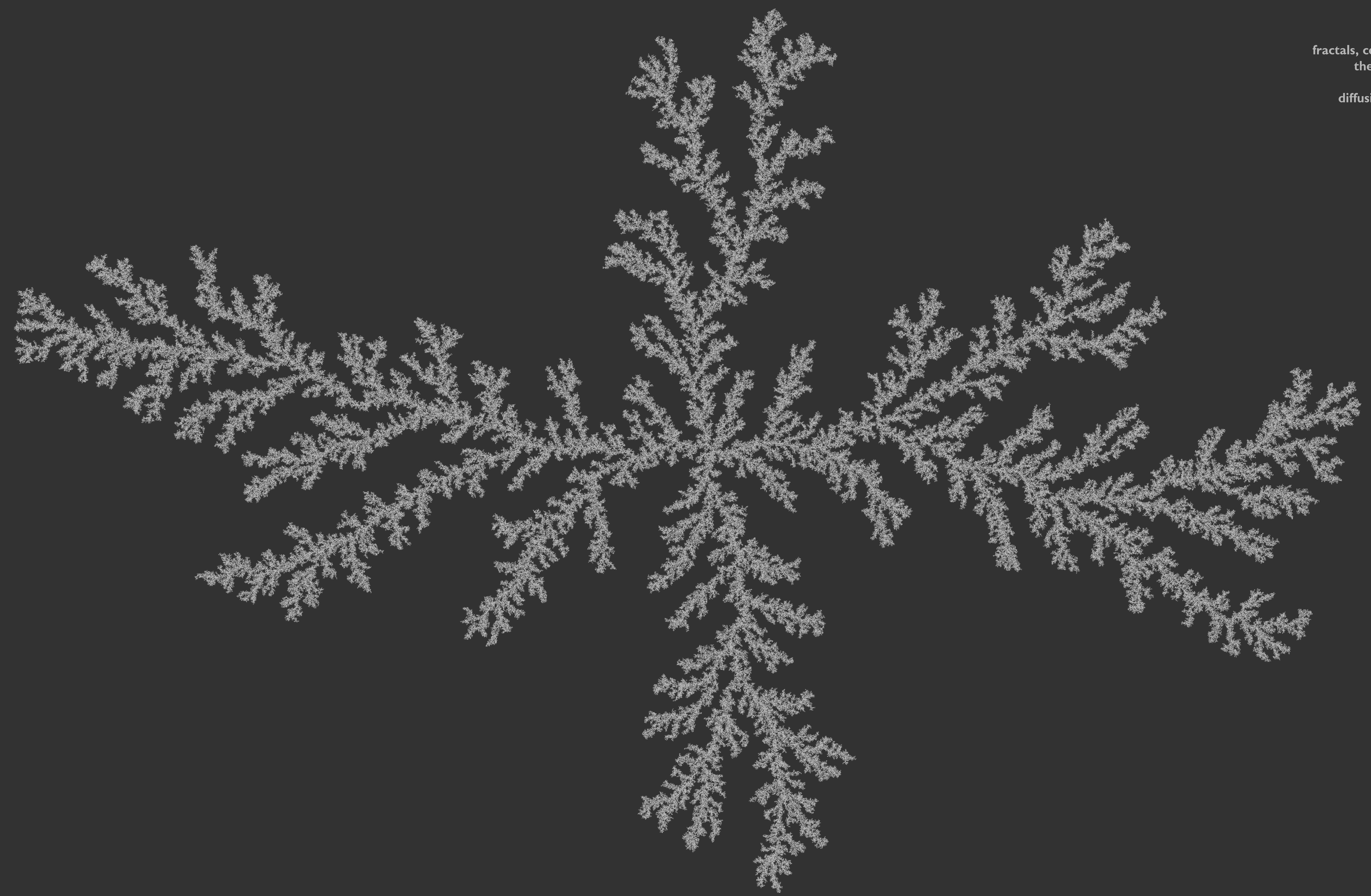
10^{0}

source

softology's blog
fractals, cellular automata, chaos
theory, science, space, etc

diffusion-limited aggregation

august 29, 2016



macro

dla static particle

static particle

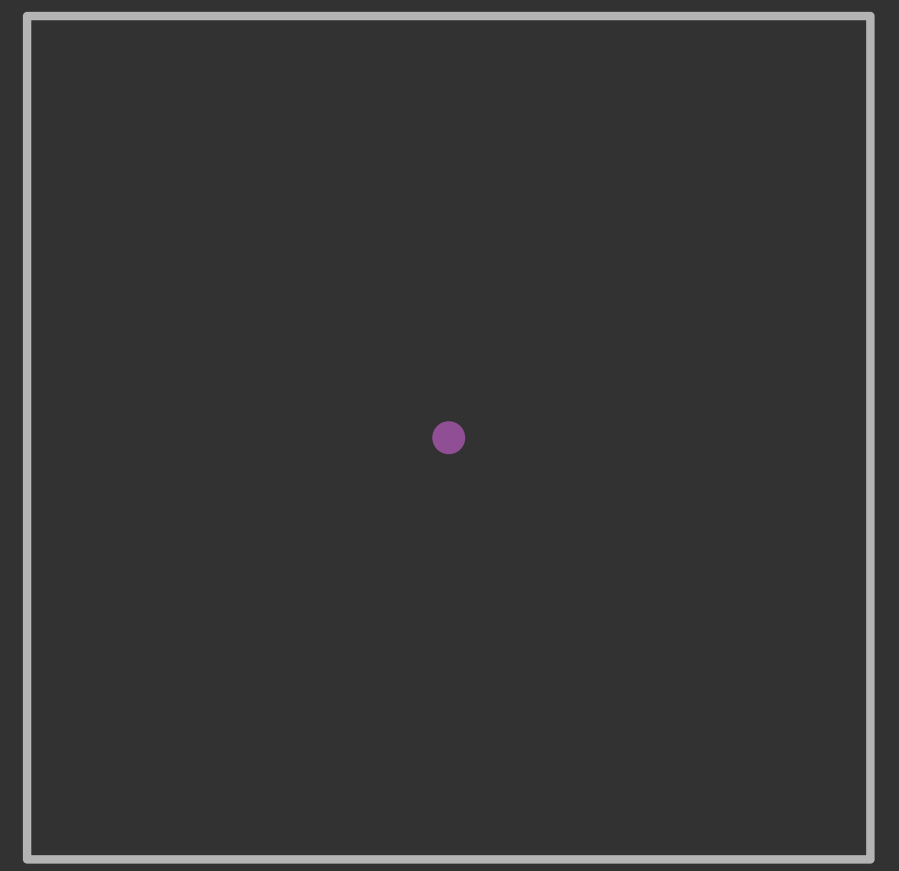
bounding volume

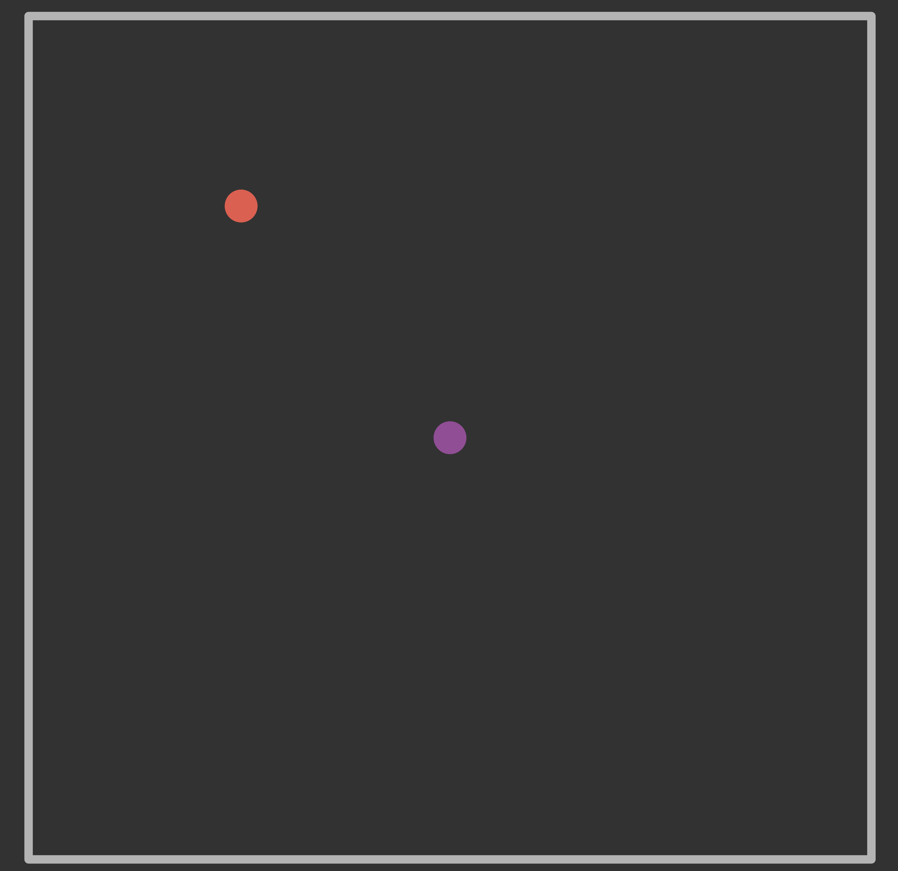
inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt





dla spawn particle

static particle

spawn particle

bounding volume

inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt

diffusion limited aggregation

static seed + rnd spawn

dla search radius

static particle

spawn particle

bounding volume

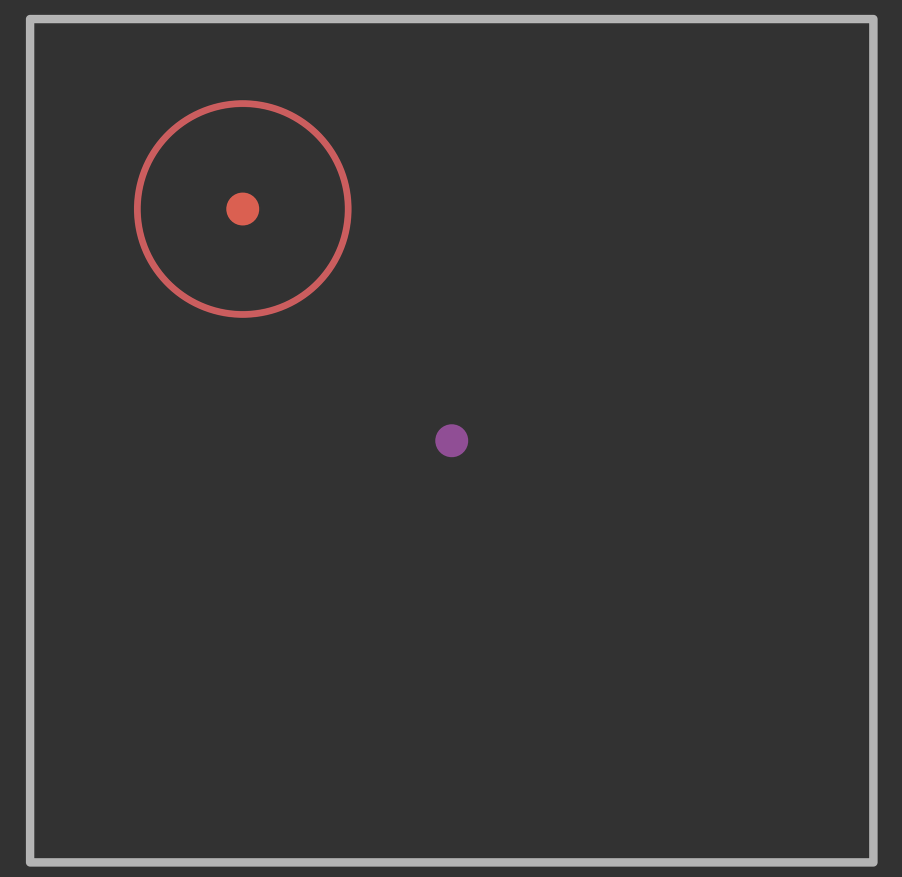
search radius

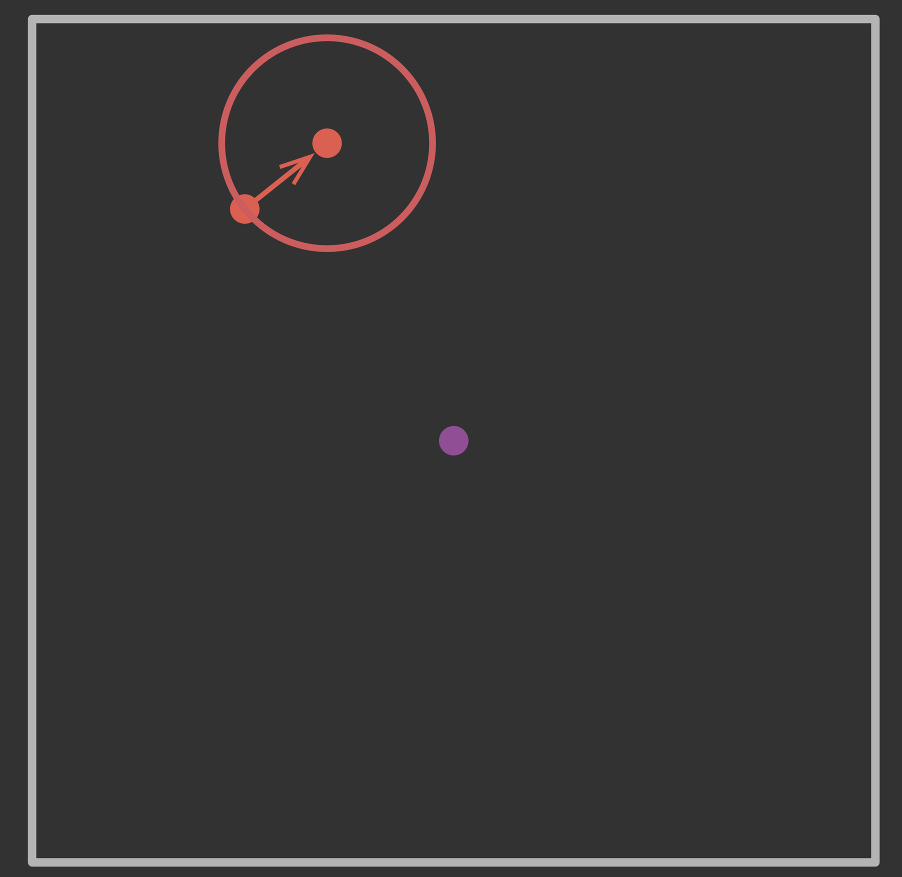
inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt





dla search radius

static particle

spawn particle

bounding volume

search radius

moving vector

inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt

diffusion limited aggregation

search radius

dla bounding volume

static particle

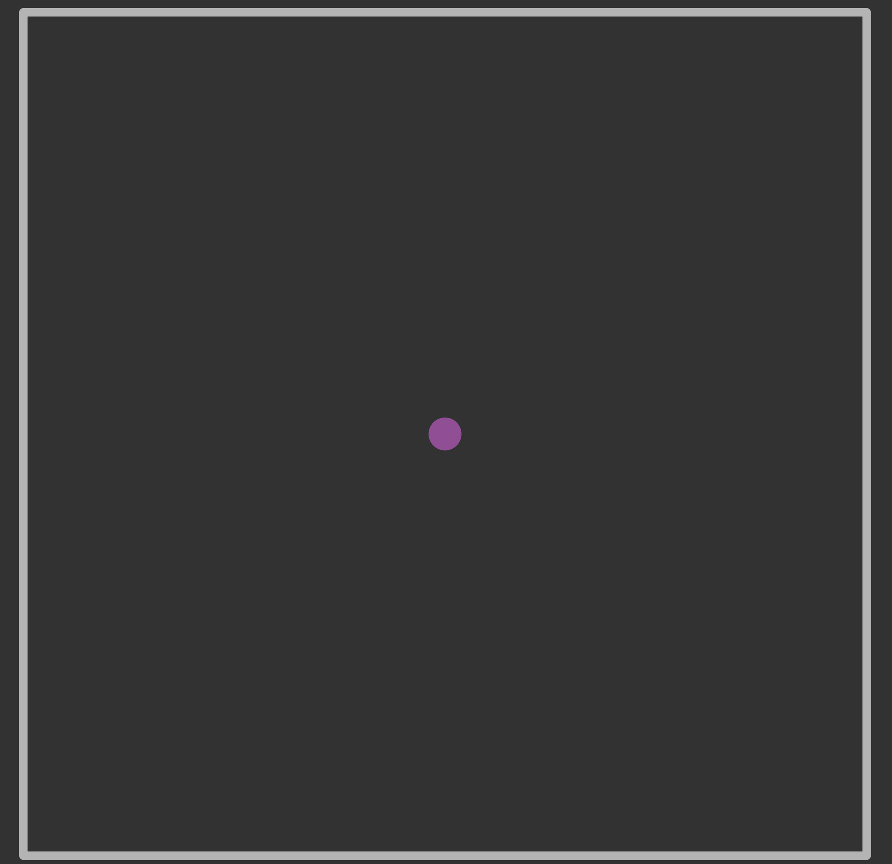
bounding volume

inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt

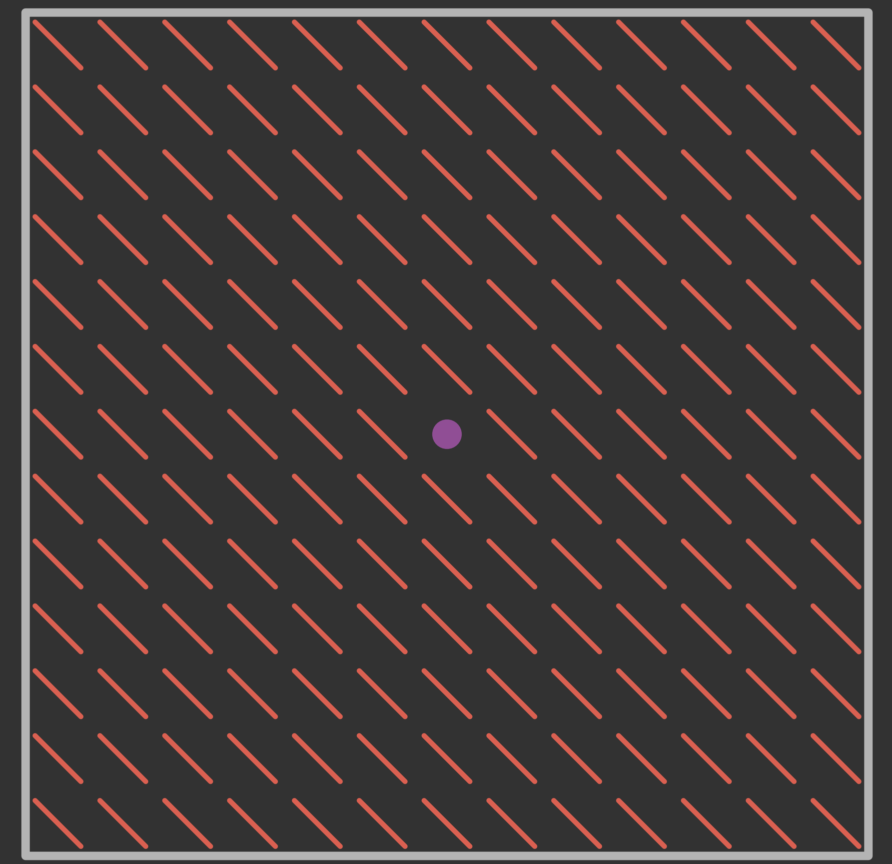


dla vector field

static particle

vector

bounding volume



diffusion limited aggregation

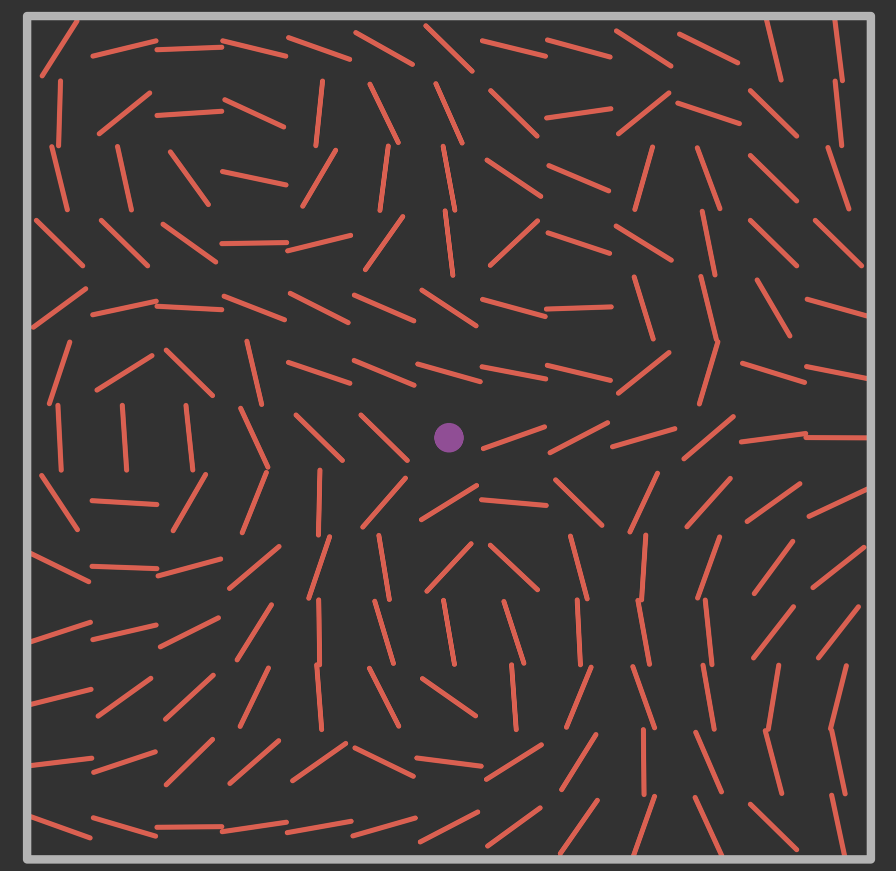
vector field

dla perlin noise

static particle

vector

bounding volume

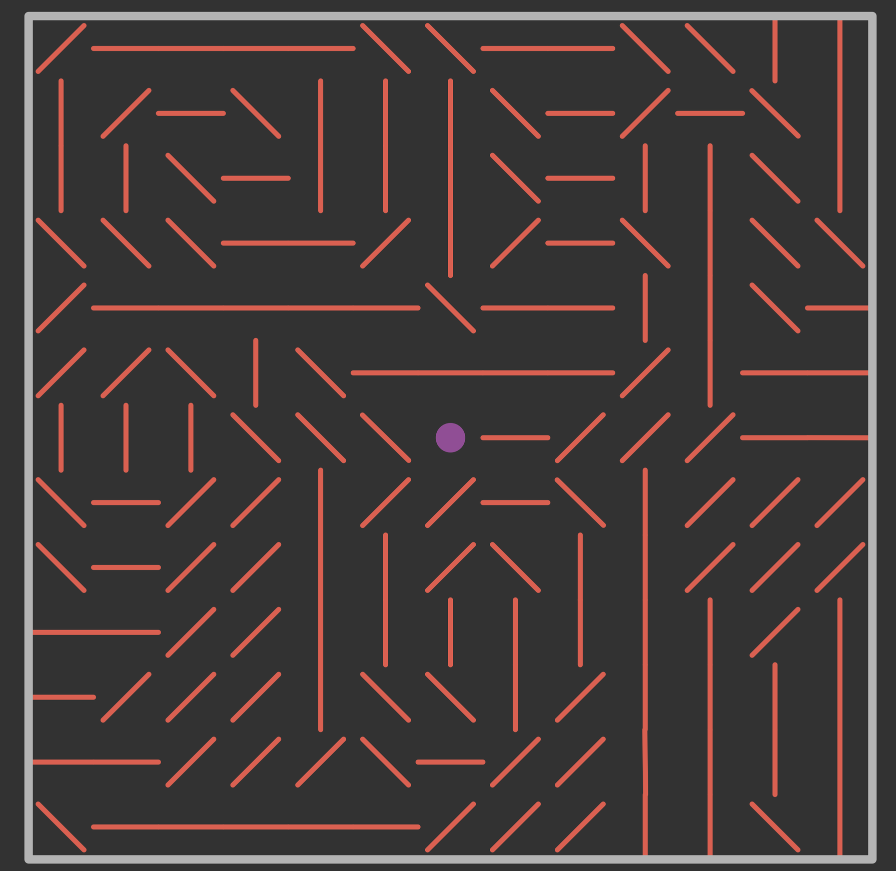


dla normalized noise

static particle

vector

bounding volume



diffusion limited aggregation

vector field

dla move 1

static particle

spawn particle

bounding volume

search radius

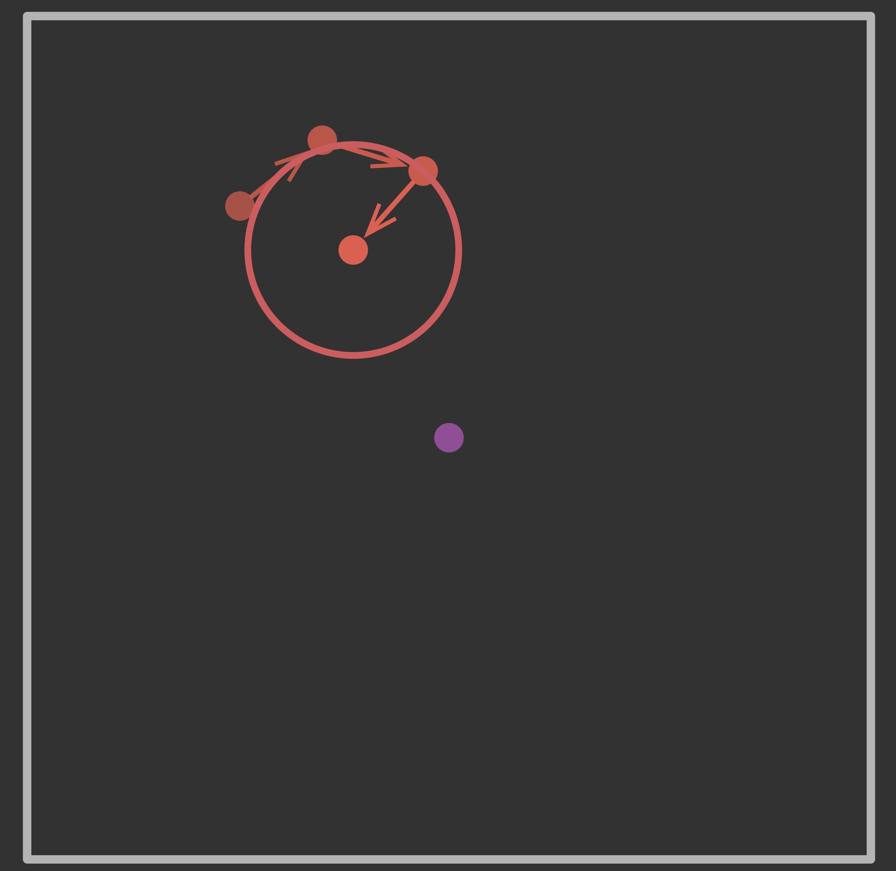
moving vector

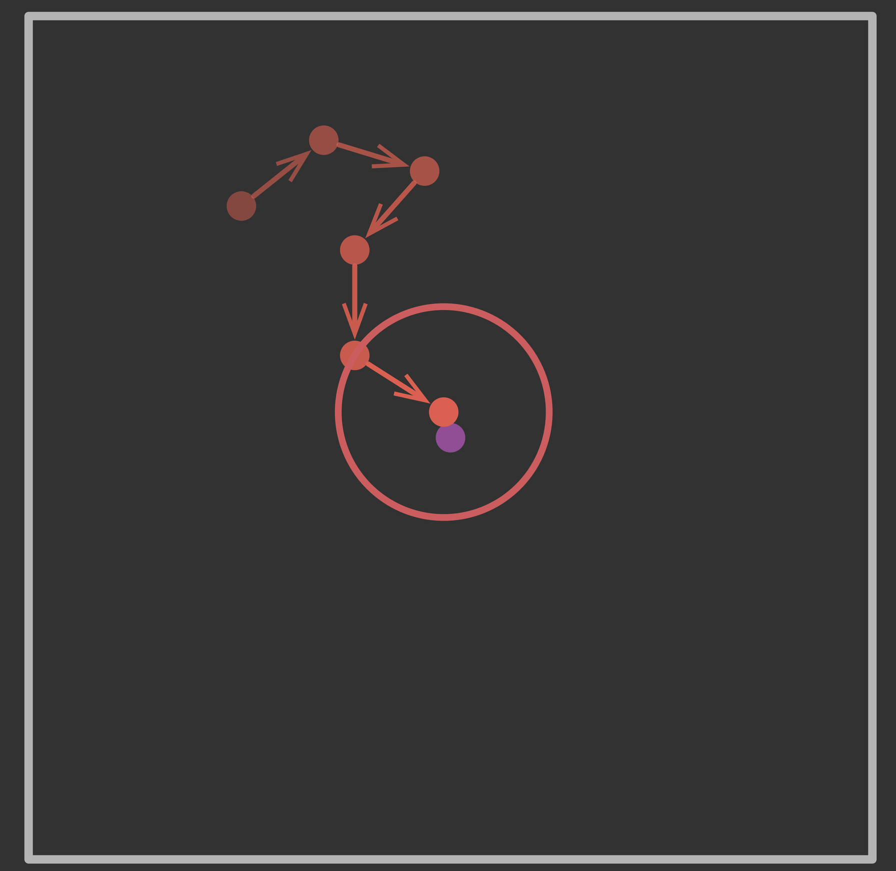
inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt





dla move 2

static particle

spawn particle

bounding volume

search radius

moving vector

inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt

diffusion limited aggregation

move

dla new spawn particle

static particle

spawn particle

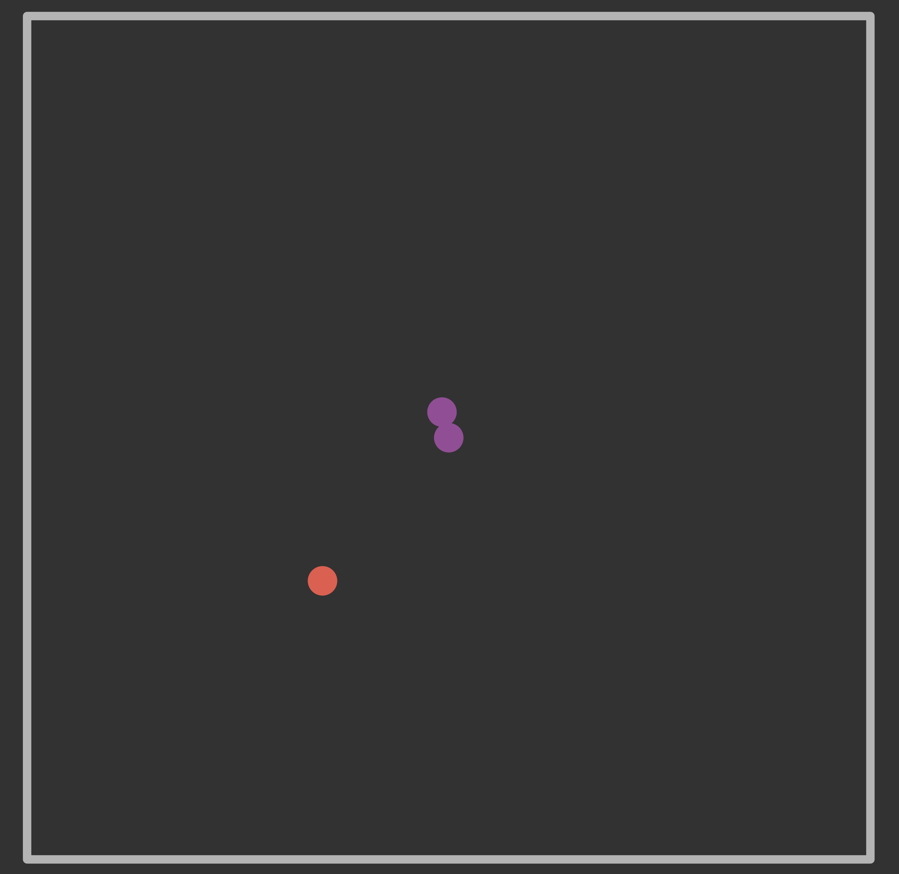
bounding volume

inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt



dla cluster

static particle

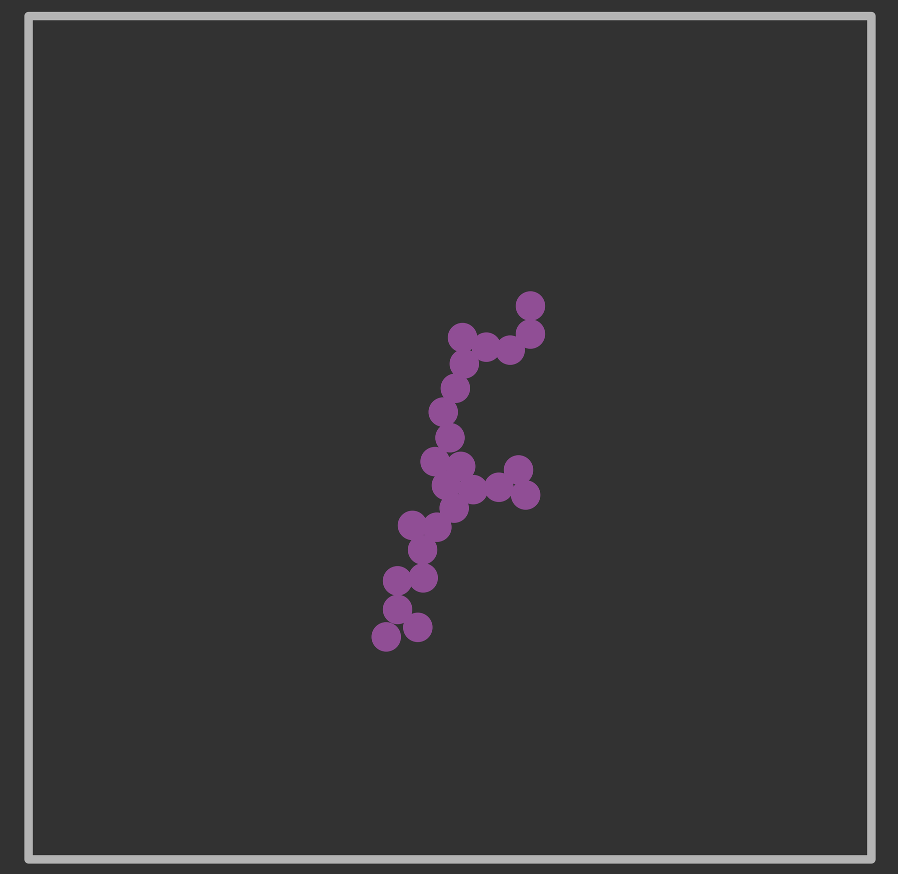
bounding volume

inspiration

entagma
vex in houdini

22 may 2017

moritz schwindt



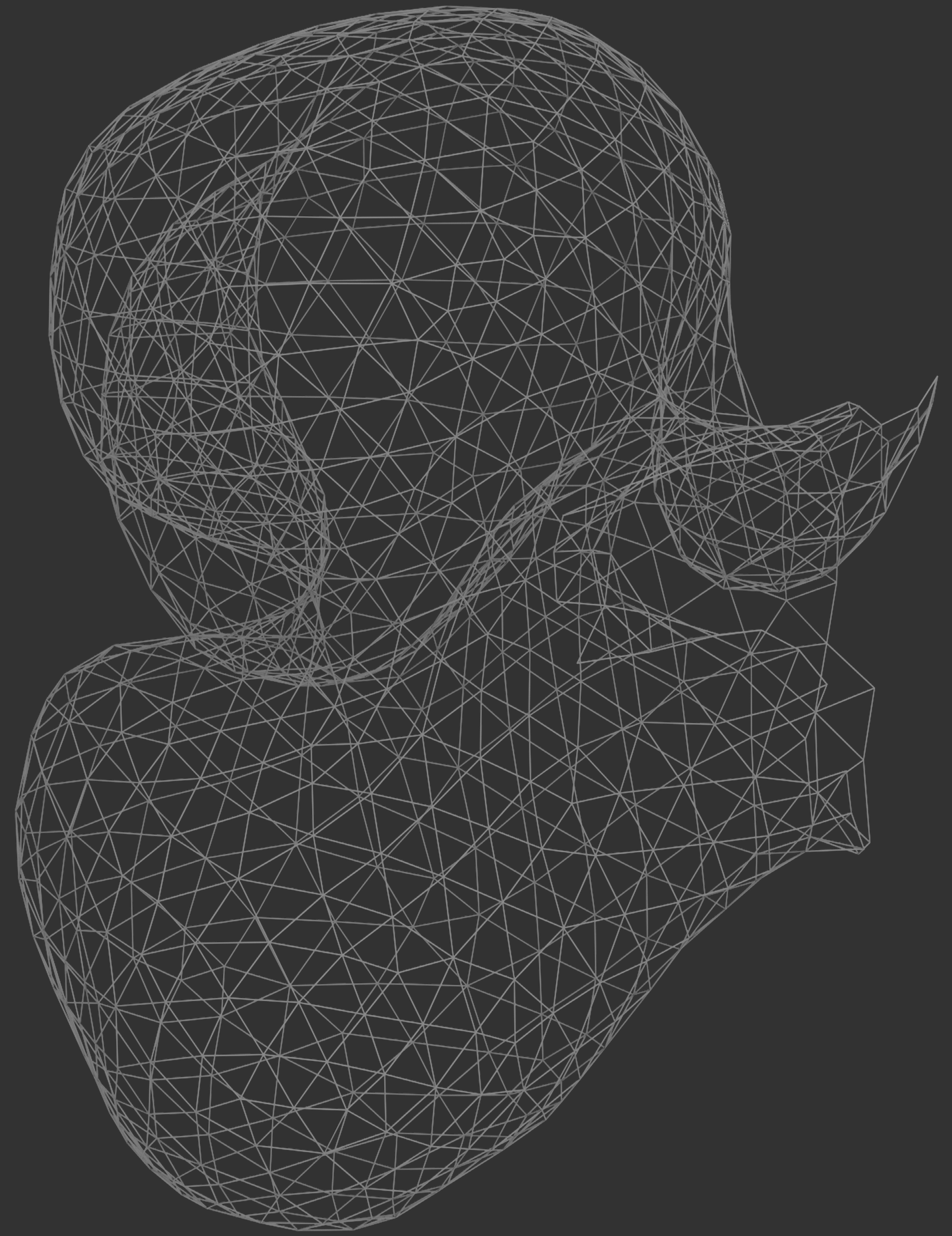
diffusion limited aggregation

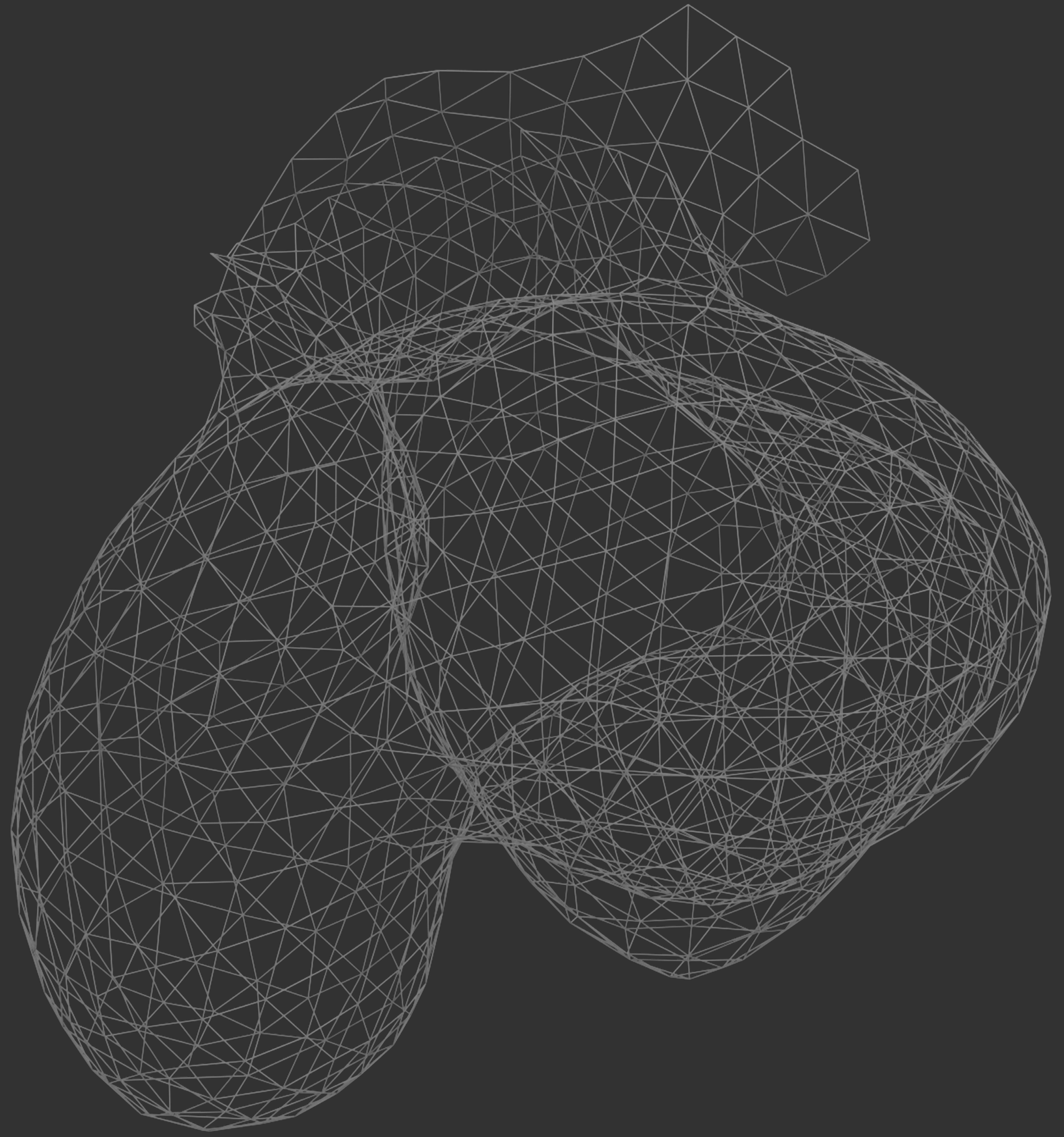
status change + new spawn

macro

scale

2m



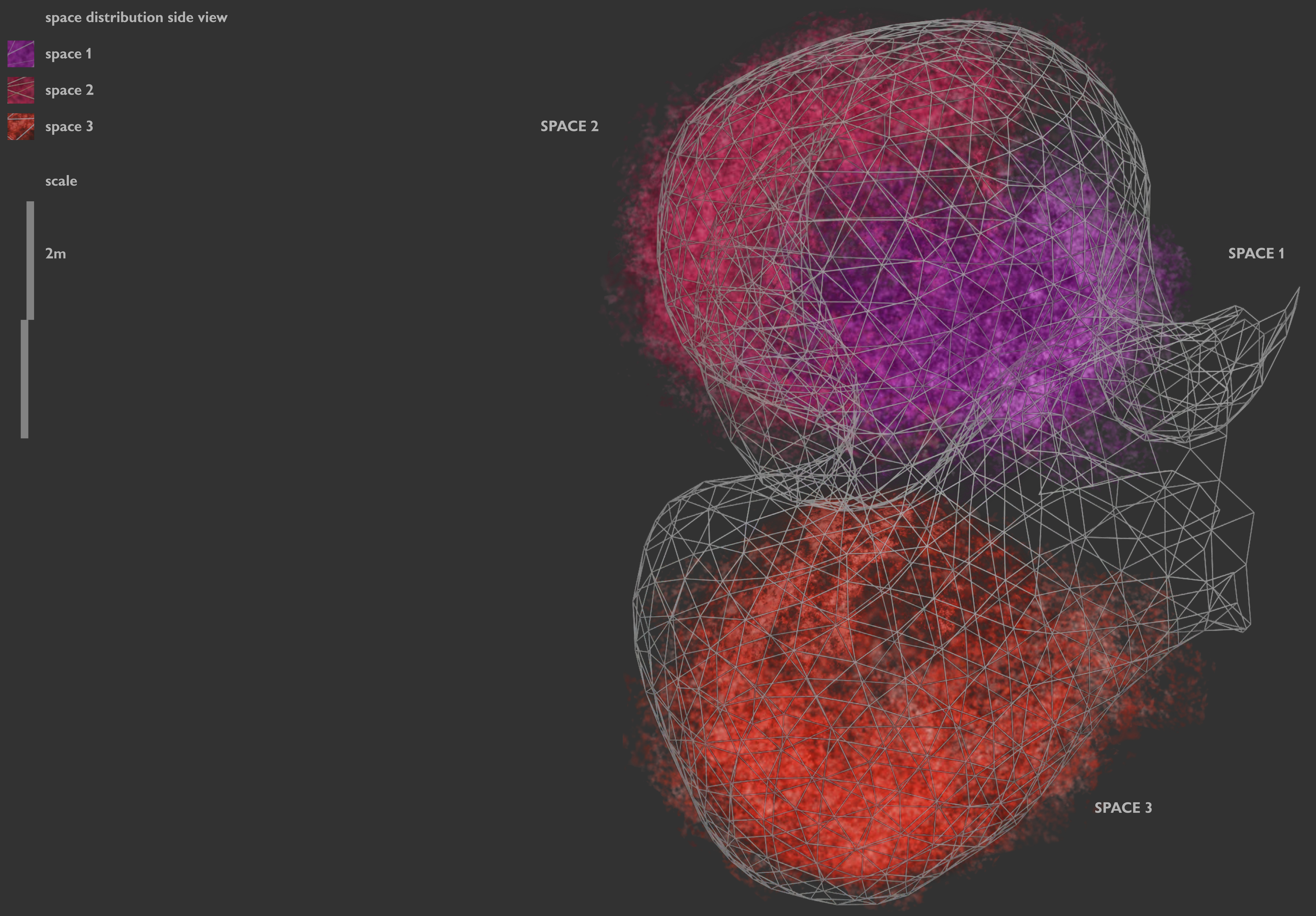


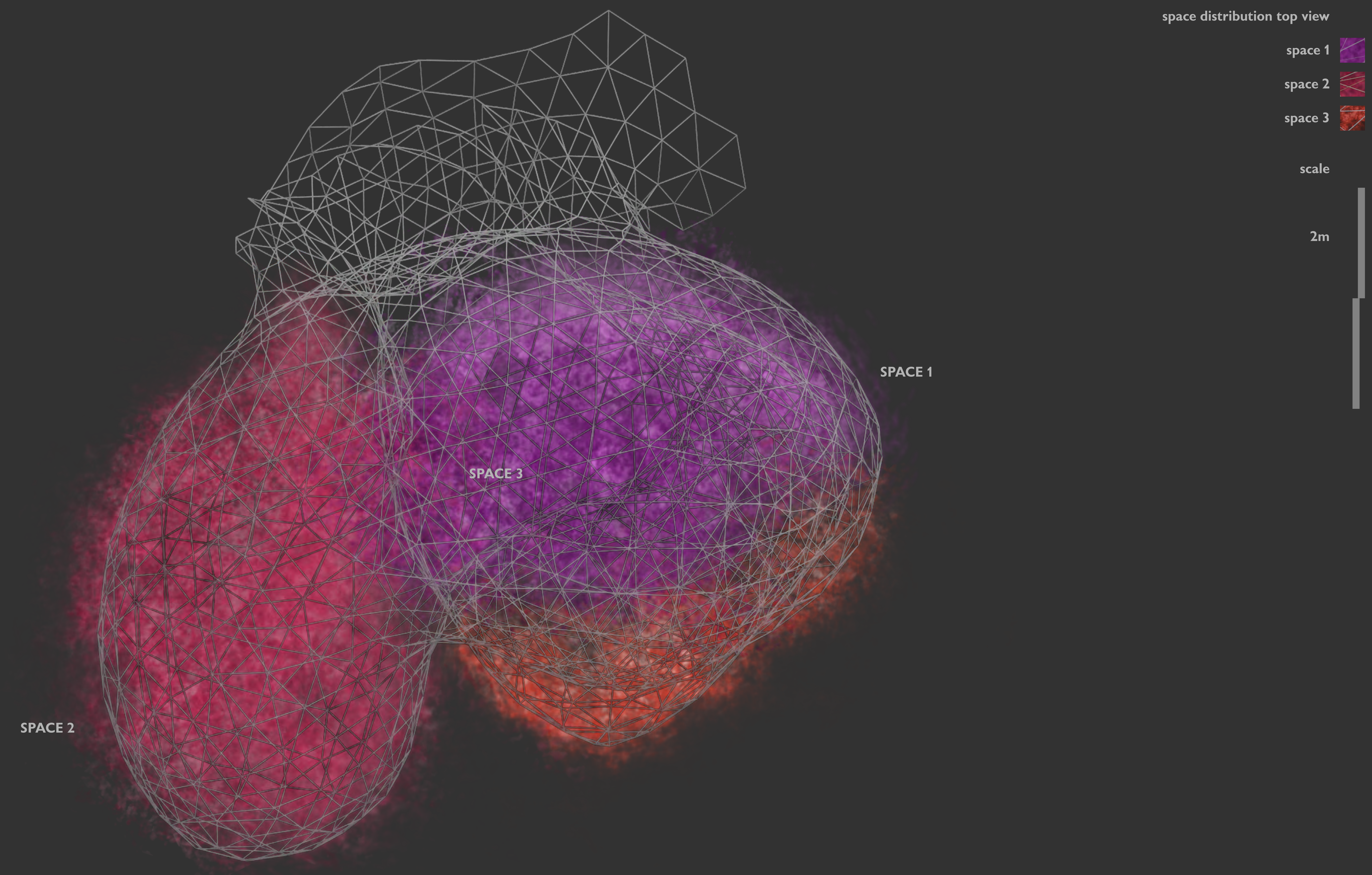
fraction

spaces

10^{0}

macro

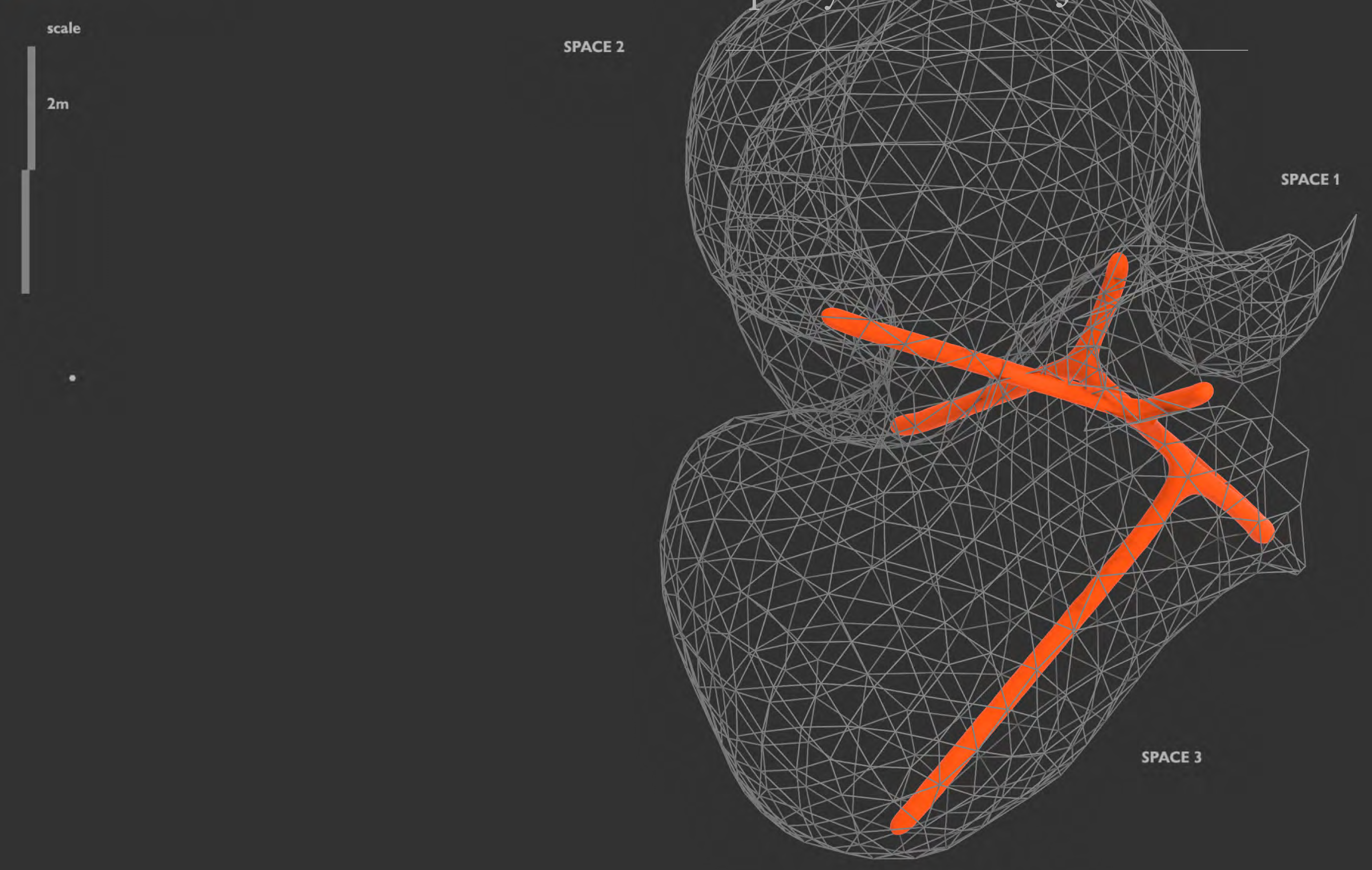




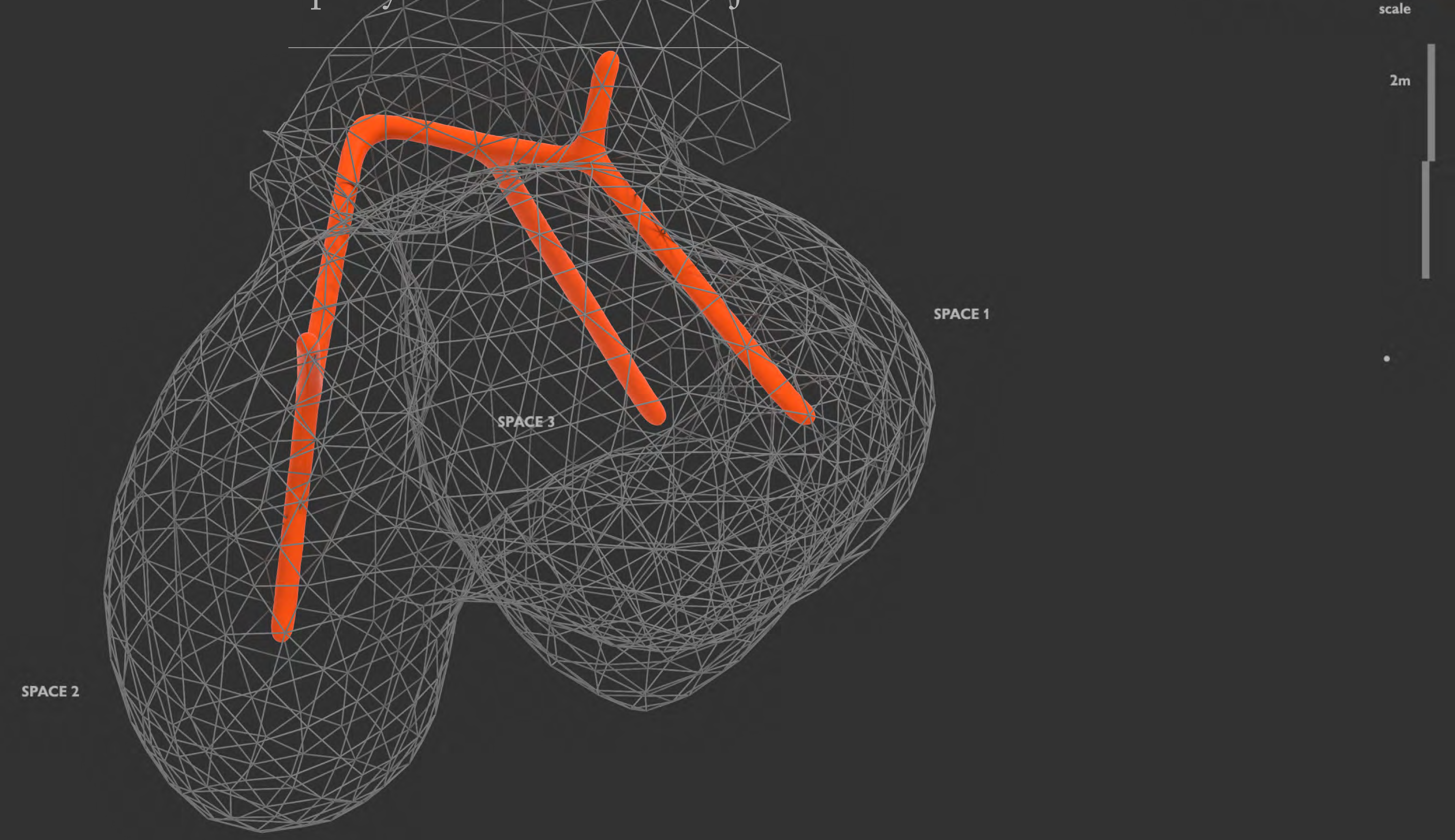
fraction

spaces

https://youtu.be/BDJSCPCbwrI



https://youtu.be/DD-rShn4jtk



fraction

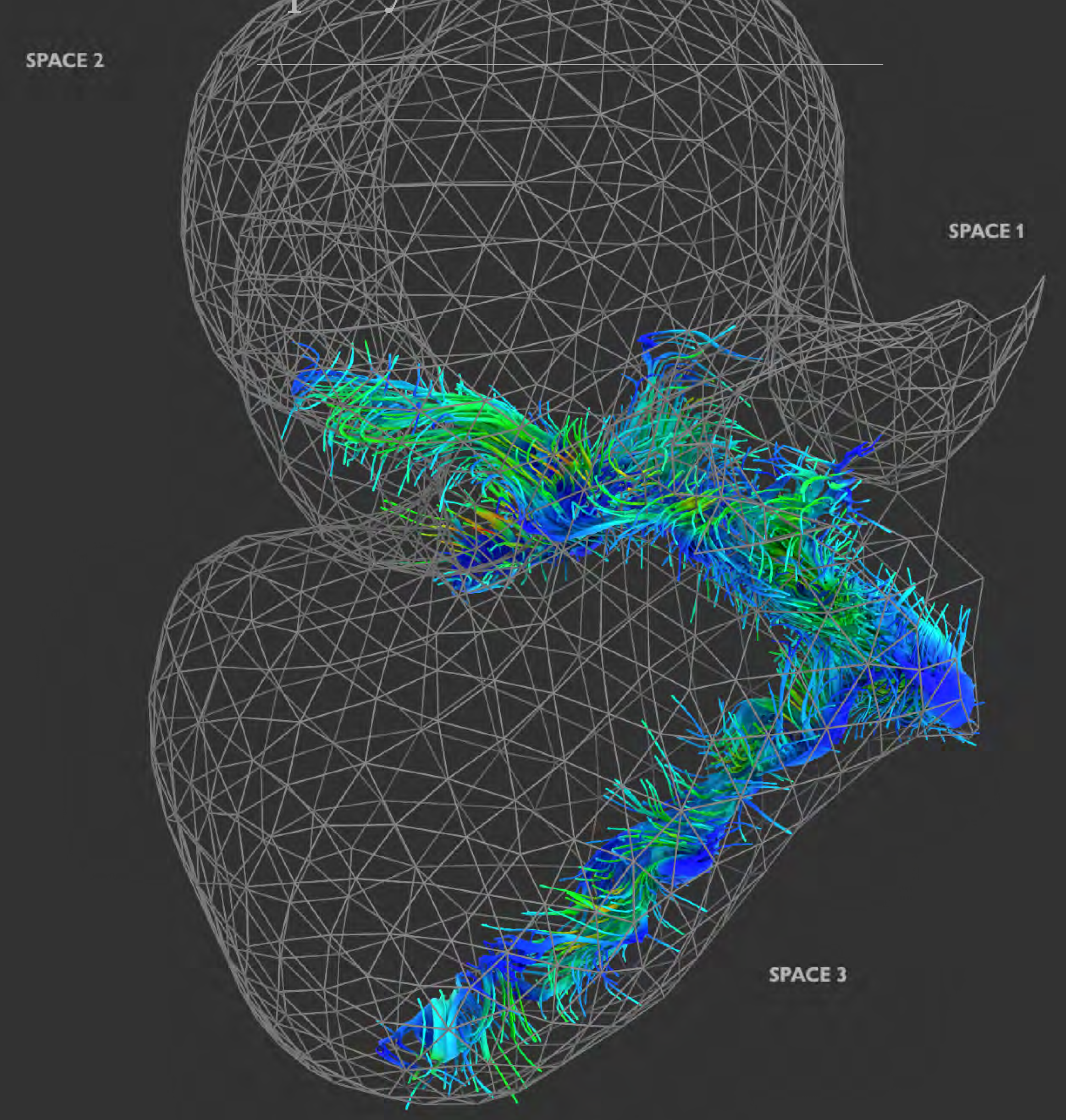
self organized connections

10^0

macro

side view
dynamic volume trail
scale
2m

https://youtu.be/diru1OtsMk4

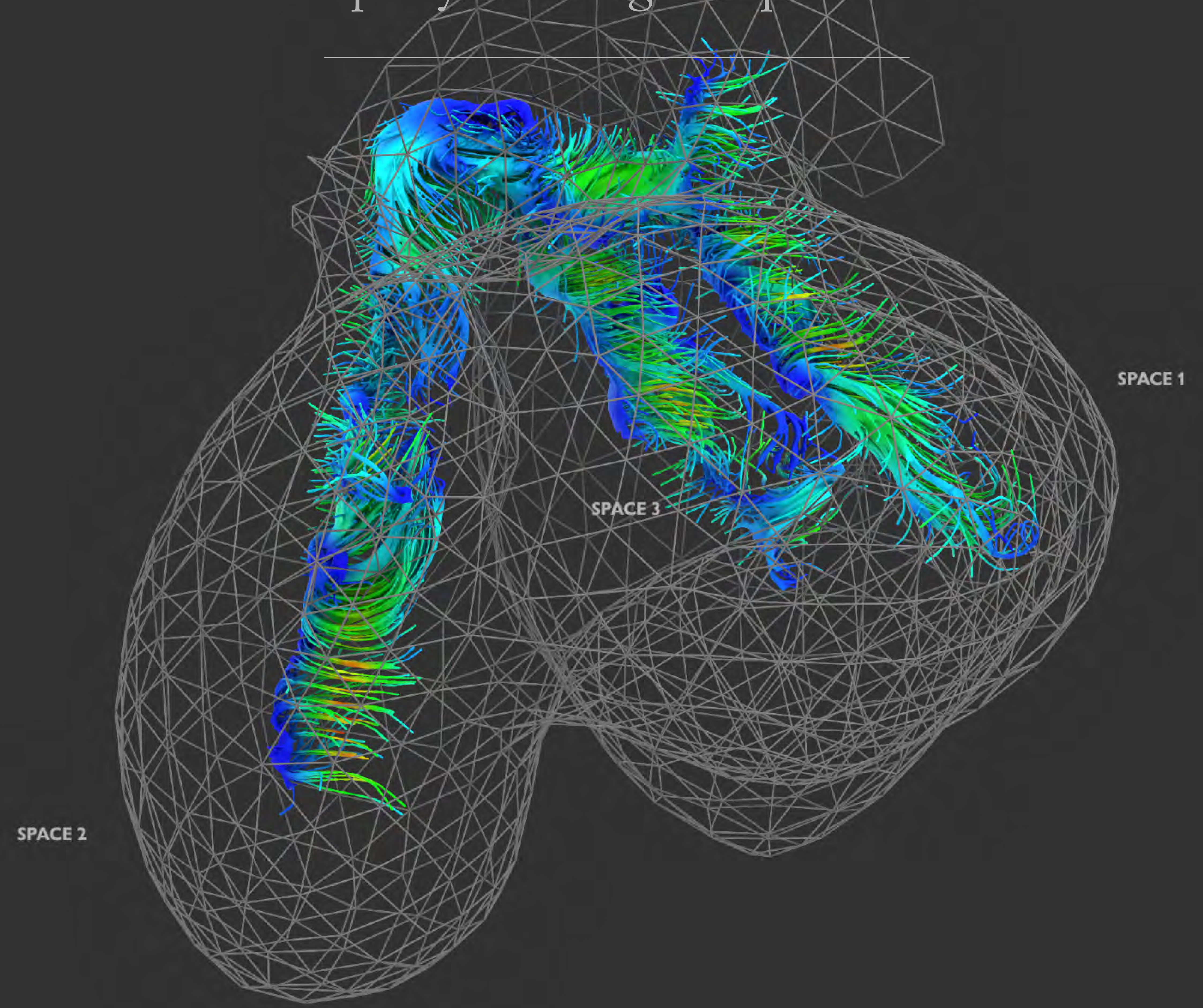


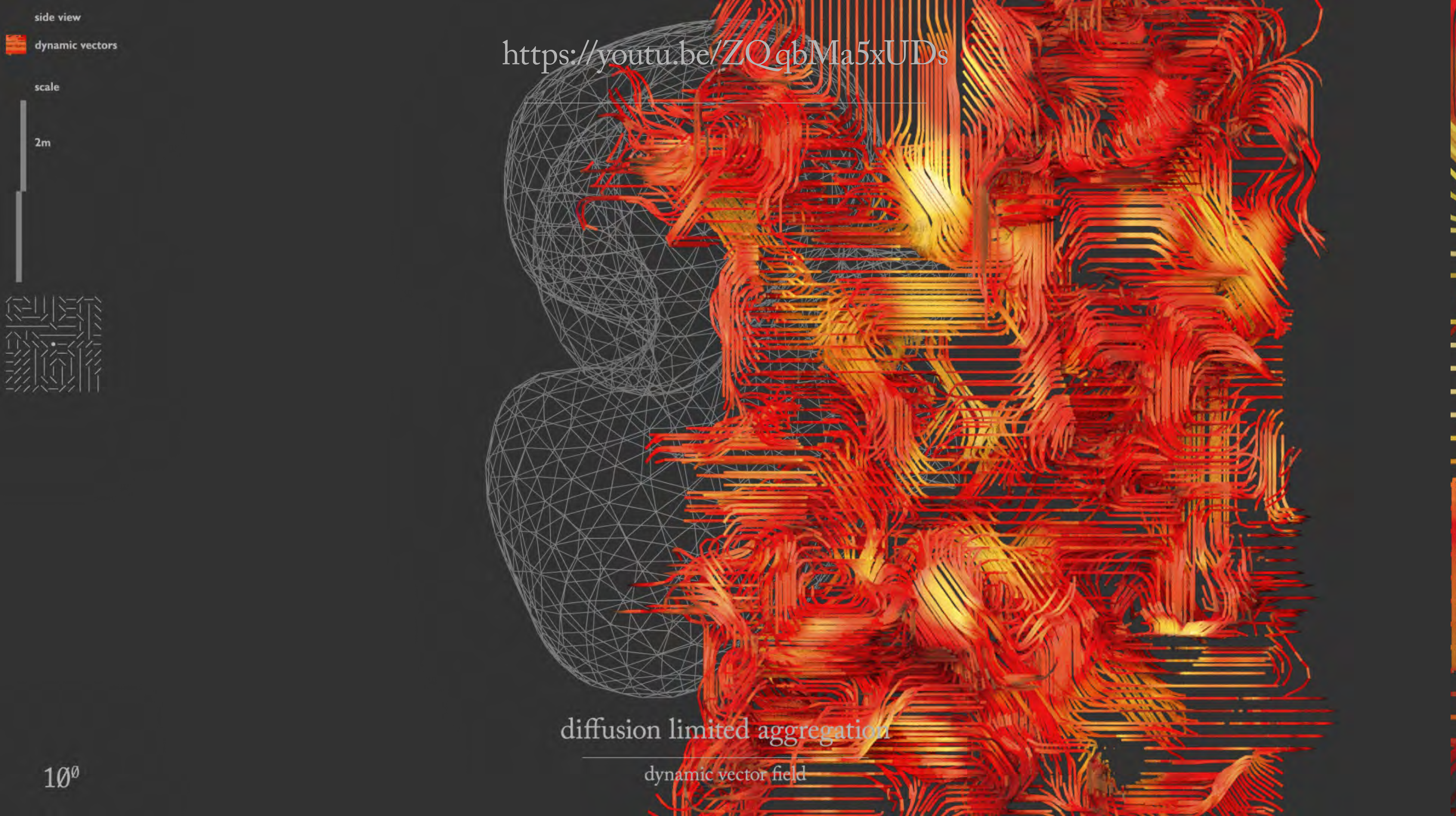
fraction

dynamic connections

https://youtu.be/g5G6qkduaWo

top view
dynamic volume trail
scale
2m

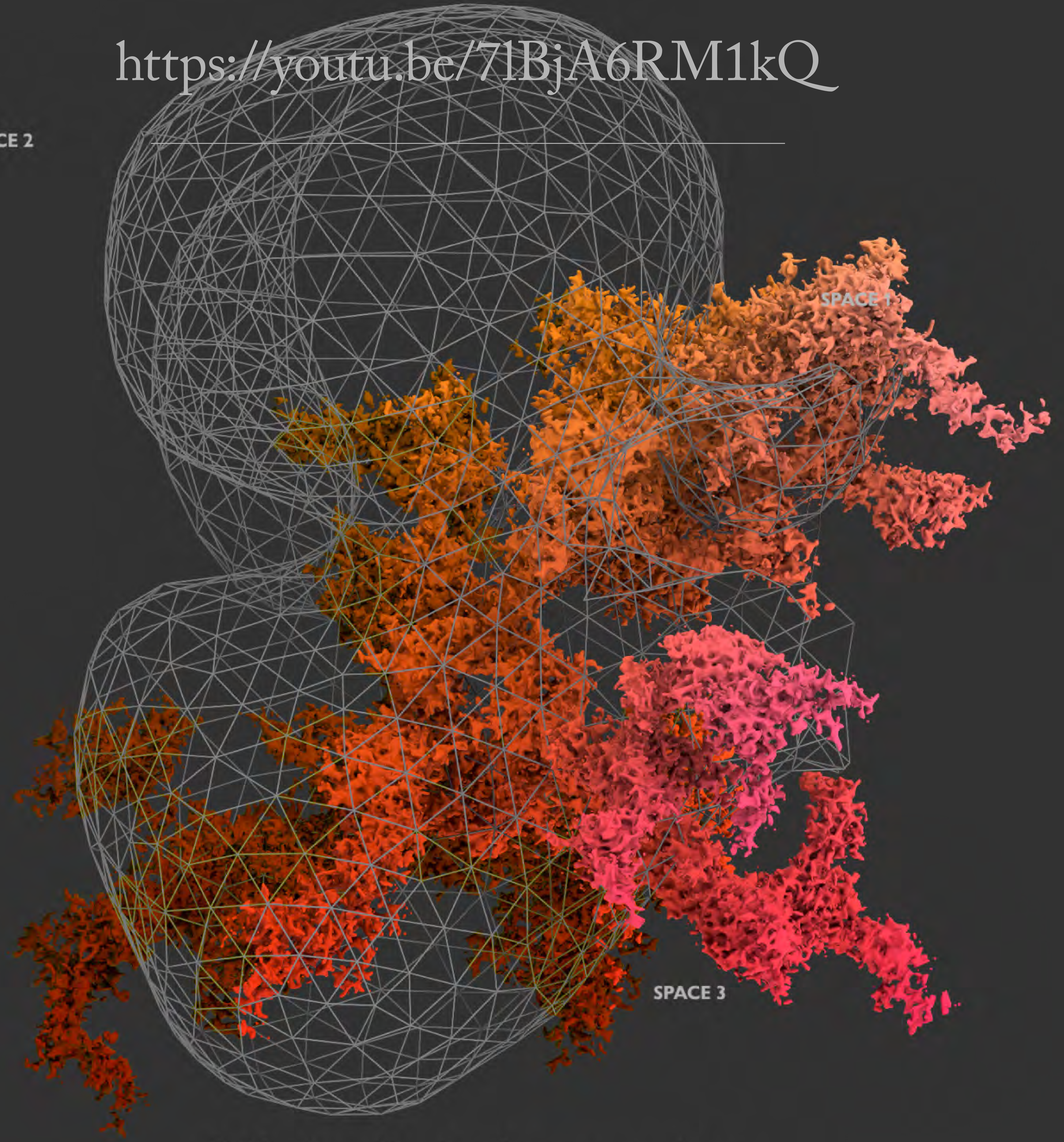



side view
dynamic vectors
scale
2m
https://youtu.be/ZQqbMa5xUDs
diffusion limited aggregation
dynamic vector field
10^0


top view
dynamic vectors
scale
1m
macro

side view
particles
scale
2m

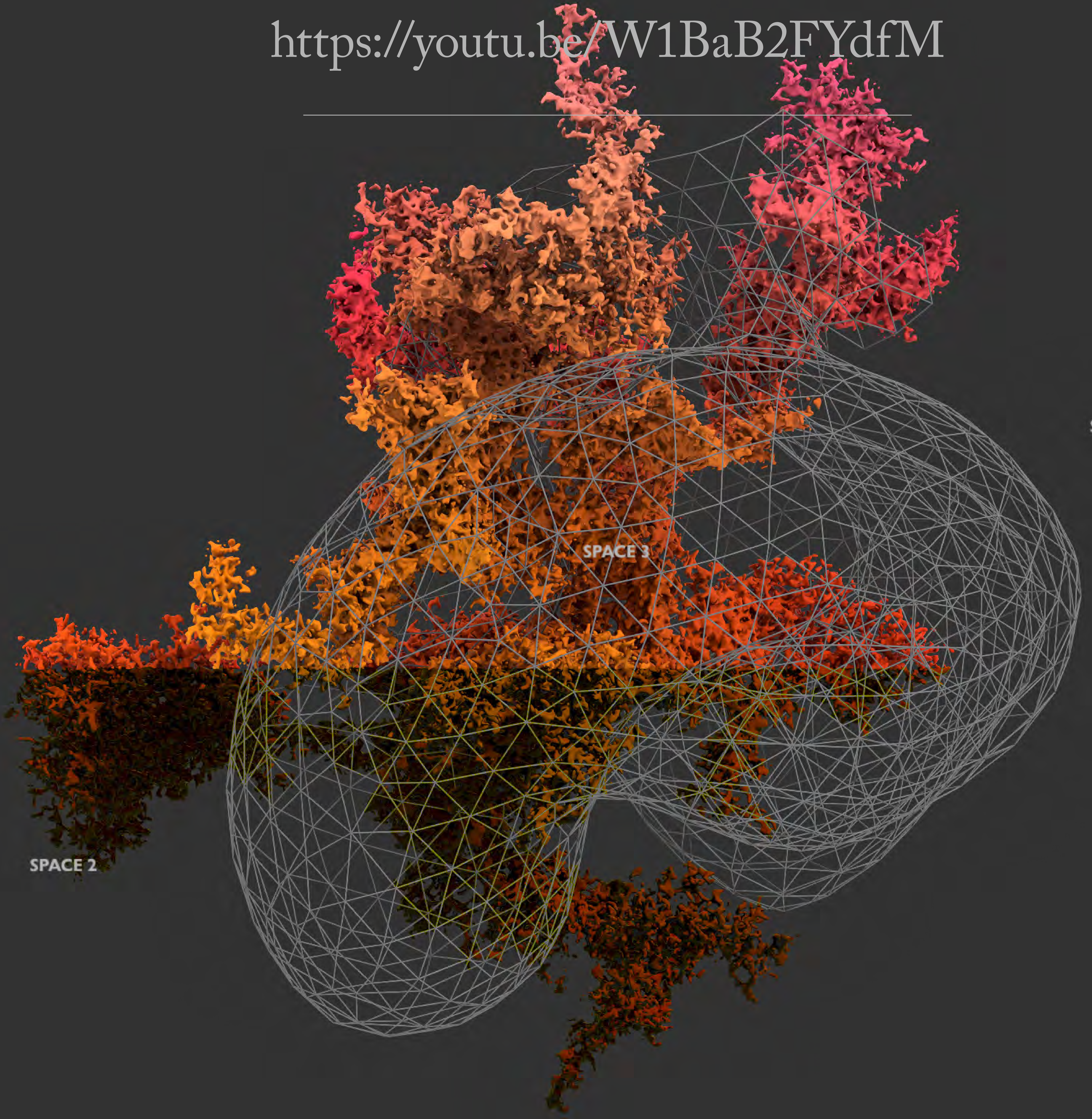
https://youtu.be/7lBjA6RM1kQ



diffusion limited aggregation

particle system

https://youtu.be/W1BaB2FYdfM



top view
particles
scale
2m

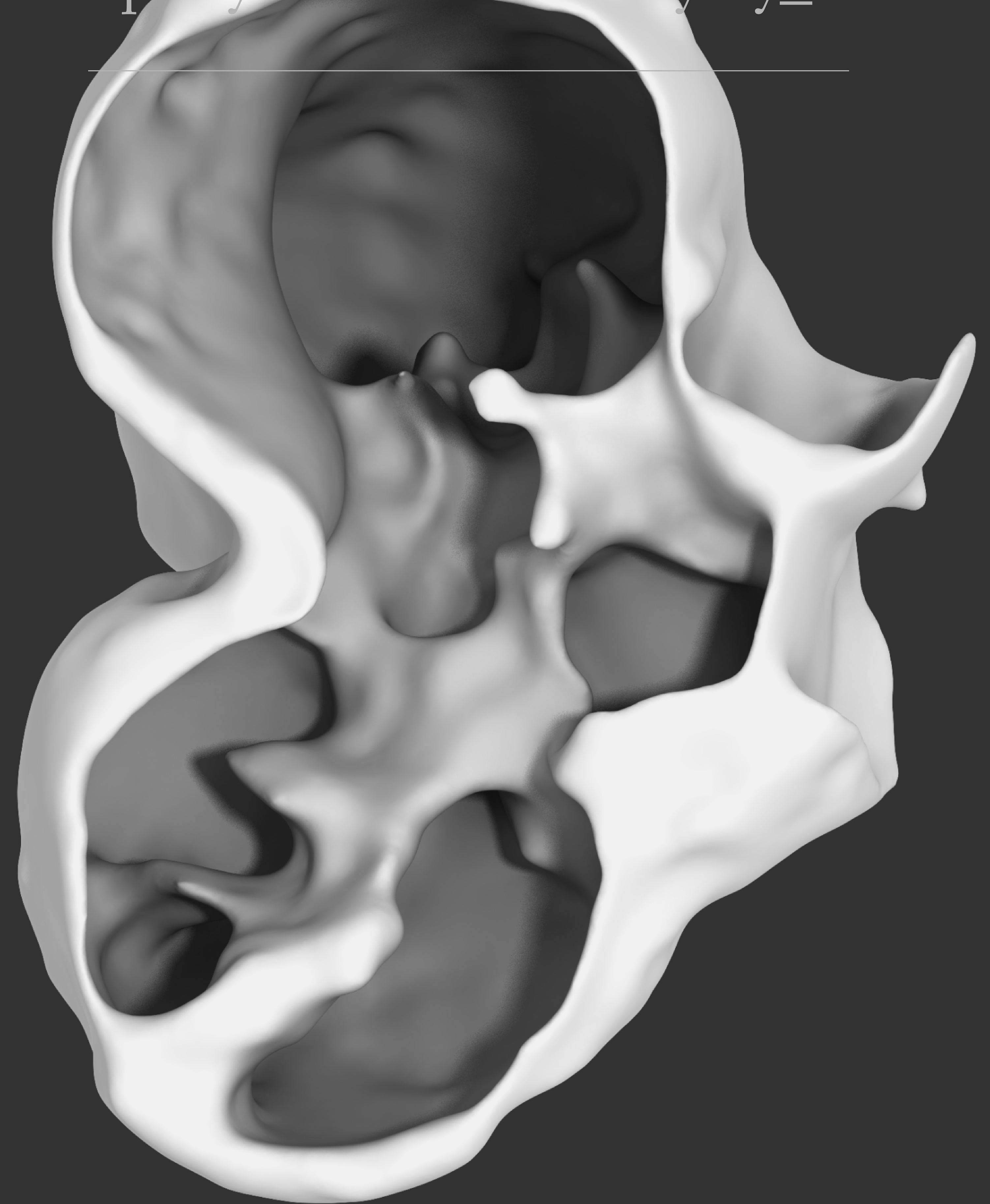
side view

solid geometry

scale

2m

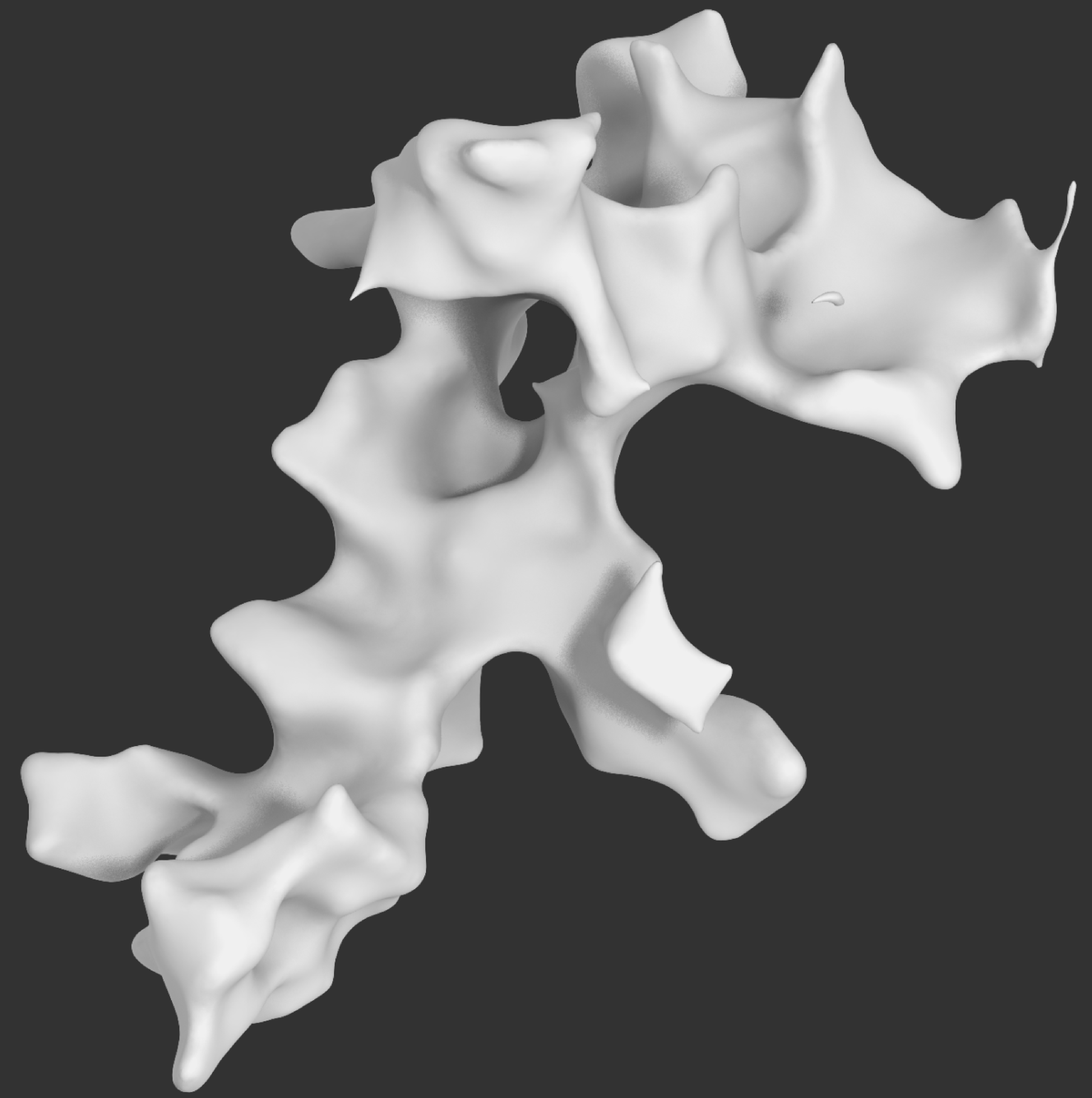
https://youtu.be/SHHCJyHy_Xo



diffusion limited aggregation

core geometry growth

https://youtu.be/4KJbCeiLTD8



side view

core

scale

2m

macro

sources

#1
slow life

© bioquest studios, 2014

#2
coral behavior in time lapse - 4k

© coralpublications, 2016

biomimikry

corals, reefs + ocean creatures

sources

#1
slow life

© bioquest studios, 2014

#2
coral behavior in time lapse - 4k

© coralpublications, 2016

mega

source

© neri oxman
2014, stratasys connex technology, cnc milling
paris, france

in collaboration with prof. w. craig carter (department of materials science and engineering, mit)
created for "vocal vibrations" (tod machover and neri oxman)

march 28, 2014 - september 29, 2014
le laboratoire, paris

neri oxman

gemini / 2Ø14

source

© neri oxman
2014, stratasys connex technology, cnc milling
paris, france

in collaboration with prof. w. craig carter (department of materials science and engineering, mit)
created for "vocal vibrations" (tod machover and neri oxman)

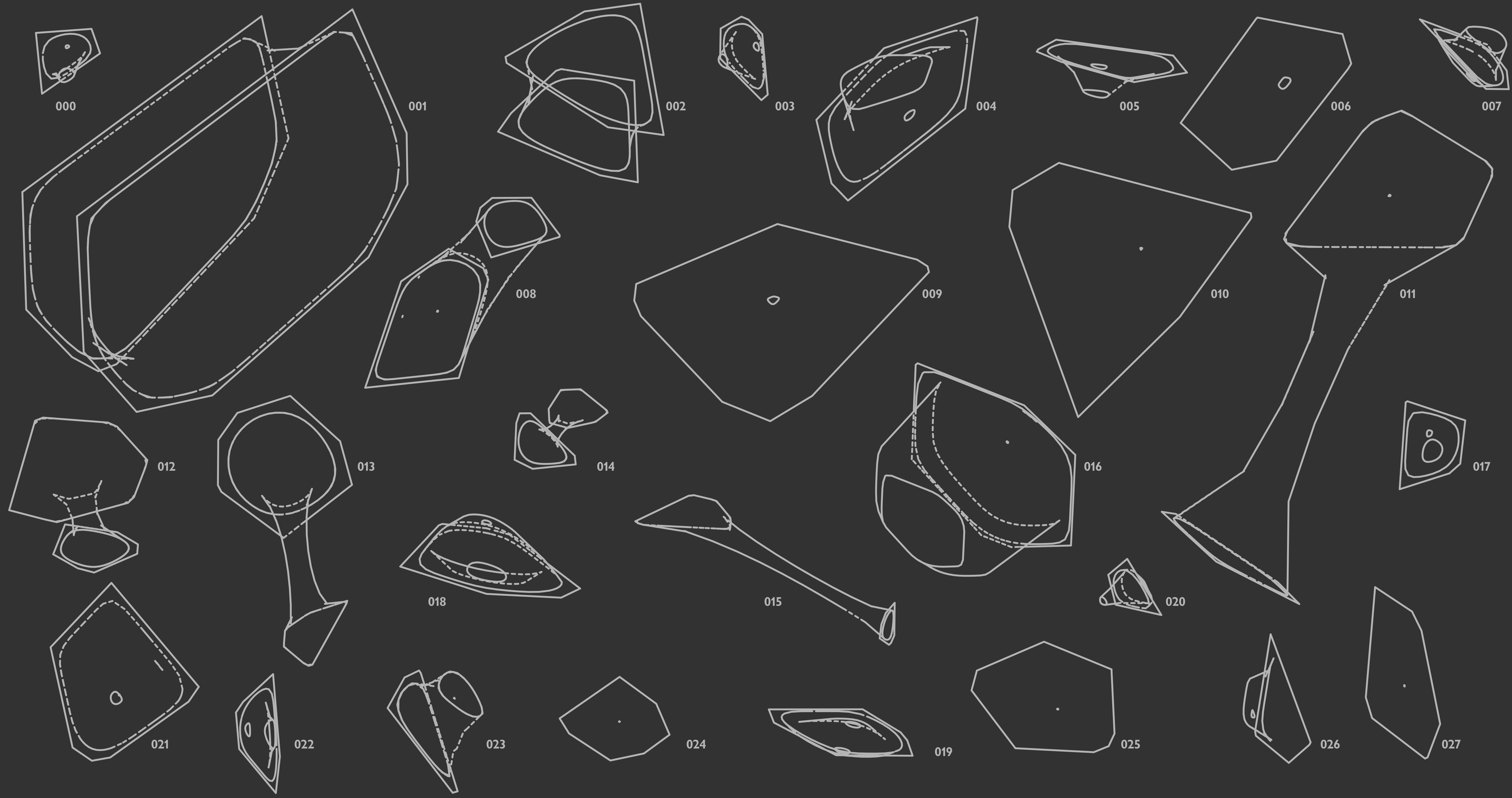
march 28, 2014 - september 29, 2014
le laboratoire, paris

macro

ORDER	FUNCTION	SHELL	PARAMETER 1	PARAMETER 2	PARAMETER 3	PARAMETER 4	PARAMETER 5	PARAMETER 6	PARAMETER 7	PARAMETER 8	PARAMETER 9	PARAMETER 10	MATEIRAL A	MATERIAL B	MATEIRAL C	BEHAVIOR
000	sensors	out	distribution	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	active
001	windows	out	radiation	stress lines	topo opt	views	location	size/scatter	-	-	-	-	EPS	rPU	-	passive
002	roof windows	out	location stairs	stair height	radiation	size/scatter	-	-	-	-	-	-	EPS	rPU	-	passive
003	ventilation	out	intersection core	size	-	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
004	solar energy	out	radiation	angle	vectors |x,y,z|	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	responsive
005	water release	out	vectors -z	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
006	structure	out	stress lines	topo opt	size/scatter	-	-	-	-	-	-	-	EPS	rPU	-	passive
007	vegetation	out	radiation	vectors z	size/scatter	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
008	indirect windows	out	radiation	orientation north	topo opt	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	passive
009	protection	out	vectors z	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
010	wall	out	rest	curvature geo	-	-	-	-	-	-	-	-	EPS	rPU	-	passive
011	windows	in	location out	-	-	-	-	-	-	-	-	-	EPS	rPU	-	passive
012	roof windows	in	location out	-	-	-	-	-	-	-	-	-	EPS	rPU	-	passive
013	indirect windows	in	location out	-	-	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
014	platform a	in	location crv	vectors z	height	planes xy	size/scatter	blend	-	-	-	-	EPS	rPU	-	passive
015	platform b	in	location crv	vectors z	height	planes xy	size/scatter	blend	-	-	-	-	EPS	rPU	-	passive
016	stair a	in	location crv	guide crv	14 ≤ S ≤ 2Ø	26 ≤ A ≤ 32	height	planes xy	curvature geo	vectors z	size/scatter	bend	EPS	rPU	-	passive
017	stair b	in	location crv	guide crv	14 ≤ S ≤ 2Ø	26 ≤ A ≤ 32	height	planes xy	curvature geo	vectors z	size/scatter	bend	EPS	rPU	-	passive
018	bench	in	location crv	guide pts	height platform	curvature geo	size/scatter	bend	blend	-	-	-	EPS	rPU	-	passive
019	shelf	in	location crv	guide crv	xy, xz, yz planes	curvature geo	normal vectors	height	size/scatter	-	-	-	EPS	rPU	silicone	adaptive
020	sensors	in	distribution	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	active
021	bench cushion	in	bench pos	height	curvature geo	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	adaptive
022	passive light stairs	in	stairs walk crvs	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
023	transistion platform a	in	platform a	normal vectors	size/scatter	-	-	-	-	-	-	-	EPS	rPU	-	passive
024	passive light platform	in	platform a + b	location	size/scatter	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
025	extensive walking	in	vectors z	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
026	ventilation/heating	in	core distribution	cp out ventilation	size/scatter	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
027	light top	in	vectors -z	location platform	loaction stairs	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	responsive
028	structure	in	stress lines	topo opt	size/scatter	-	-	-	-	-	-	-	EPS	rPU	-	passive
029	wall	in	rest	curvature geo	-	-	-	-	-	-	-	-	EPS	rPU	-	passive

function mapping

parameters



macro

ORDER	FUNCTION	SHELL	PARAMETER 1	PARAMETER 2	PARAMETER 3	PARAMETER 4	PARAMETER 5	PARAMETER 6	PARAMETER 7	PARAMETER 8	PARAMETER 9	PARAMETER 10	MATEIRAL A	MATERIAL B	MATEIRAL C	BEHAVIOR
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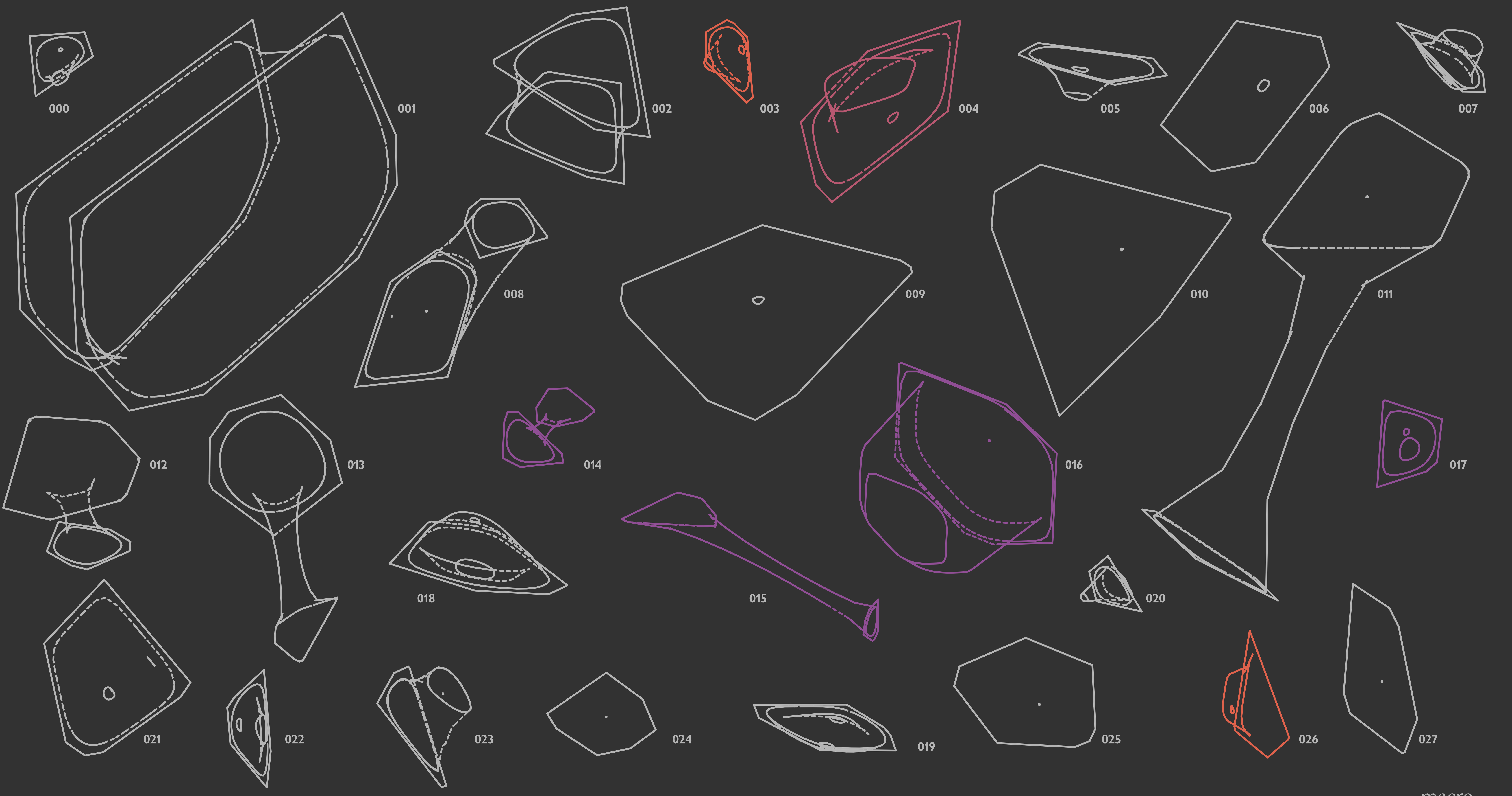
001	windows	out	radiation	stress lines	topo opt	views	location	size/scatter	-	-	-	-	EPS	rPU	-	passive
002	roof windows	out	location stairs	stair height	radiation	size/scatter	-	-	-	-	-	-	EPS	rPU	-	passive
003	ventilation	out	intersection core	size	-	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
004	solar energy	out	radiation	angle	vectors |x,y,z|	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	responsive
005	water release	out	vectors -z	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
006	structure	out	stress lines	topo opt	size/scatter	-	-	-	-	-	-	-	EPS	rPU	-	passive
007	vegetation	out	radiation	vectors z	size/scatter	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
008	indirect windows	out	radiation	orientation north	topo opt	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	passive
009	protection	out	vectors z	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
010	wall	out	rest	curvature geo	-	-	-	-	-	-	-	-	EPS	rPU	-	passive
011	windows	in	location out	-	-	-	-	-	-	-	-	-	EPS	rPU	-	passive
012	roof windows	in	location out	-	-	-	-	-	-	-	-	-	EPS	rPU	-	passive
013	indirect windows	in	location out	-	-	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
014	platform a	in	location crv	vectors z	height	planes xy	size/scatter	blend	-	-	-	-	EPS	rPU	-	passive
015	platform b	in	location crv	vectors z	height	planes xy	size/scatter	blend	-	-	-	-	EPS	rPU	-	passive
016	stair a	in	location crv	guide crv	14 ≤ S ≤ 2Ø	26 ≤ A ≤ 32	height	planes xy	curvature geo	vectors z	size/scatter	bend	EPS	rPU	-	passive
017	stair b	in	location crv	guide crv	14 ≤ S ≤ 2Ø	26 ≤ A ≤ 32	height	planes xy	curvature geo	vectors z	size/scatter	bend	EPS	rPU	-	passive
018	bench	in	location crv	guide pts	height platform	curvature geo	size/scatter	bend	blend	-	-	-	EPS	rPU	-	passive
019	shelf	in	location crv	guide crv	xy, xz, yz planes	curvature geo	normal vectors	height	size/scatter	-	-	-	EPS	rPU	silicone	adaptive
020	sensors	in	distribution	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	active
021	bench cushion	in	bench pos	height	curvature geo	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	adaptive
022	passive light stairs	in	stairs walk crvs	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
023	transistion platform a	in	platform a	normal vectors	size/scatter	-	-	-	-	-	-	-	EPS	rPU	-	passive
024	passive light platform	in	platform a + b	location	size/scatter	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
025	extensive walking	in	vectors z	size/scatter	-	-	-	-	-	-	-	-	EPS	rPU	silicone	passive
026	ventilation/heating	in	core distribution	cp out ventilation	size/scatter	-	-	-	-	-	-	-	EPS	rPU	silicone	responsive
027	light top	in	vectors -z	location platform	loaction stairs	size/scatter	-	-	-	-	-	-	EPS	rPU	silicone	responsive
028	structure	in	stress lines	topo opt	size/scatter	-	-	-	-	-	-	-	EPS	rPU	-	passive
029	wall	in	rest	curvature geo	-	-	-	-	-	-	-	-	EPS	rPU	-	passive

function mapping

parameters



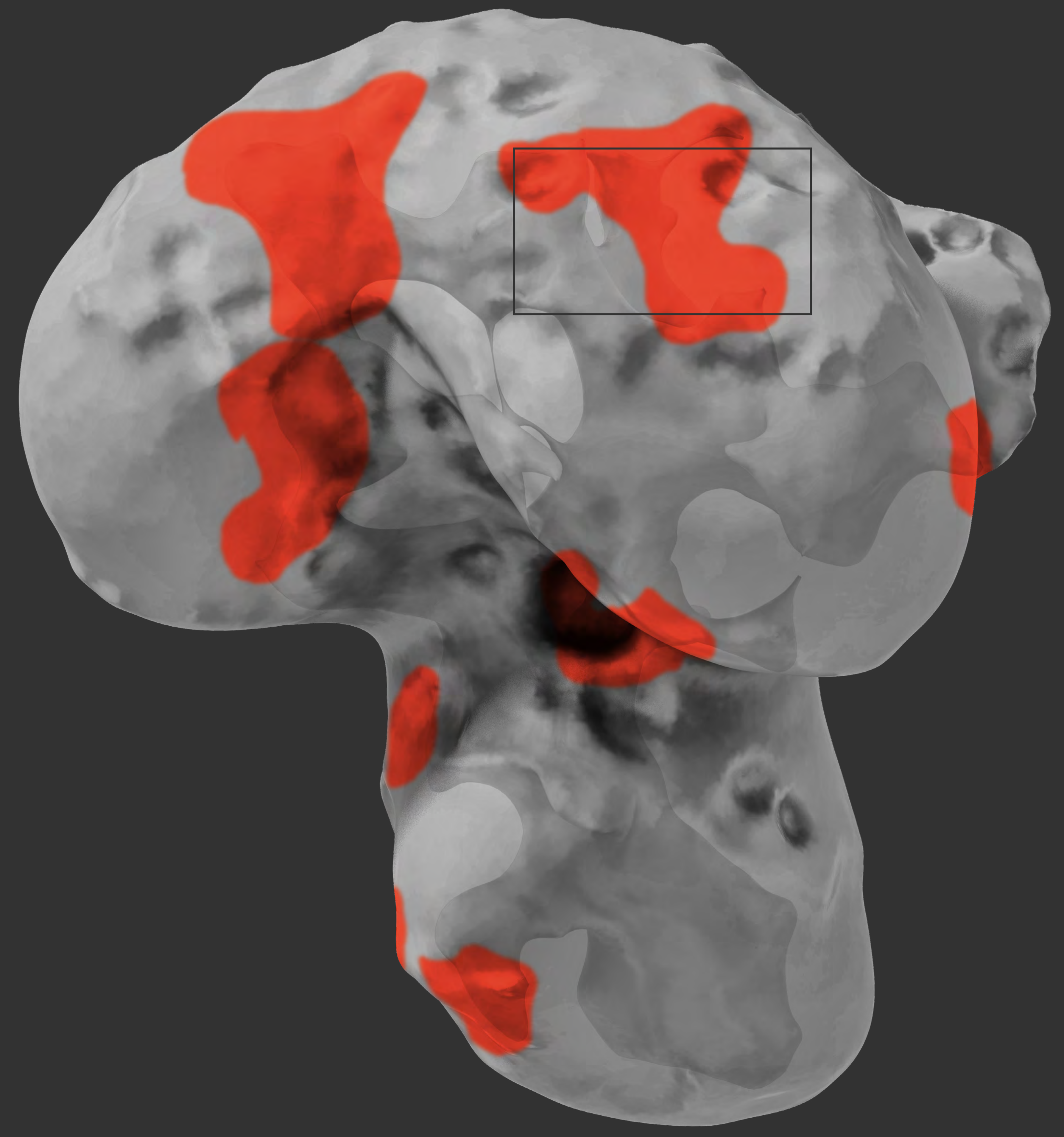
macro

ventilation system

core shell intersection

scale

2m



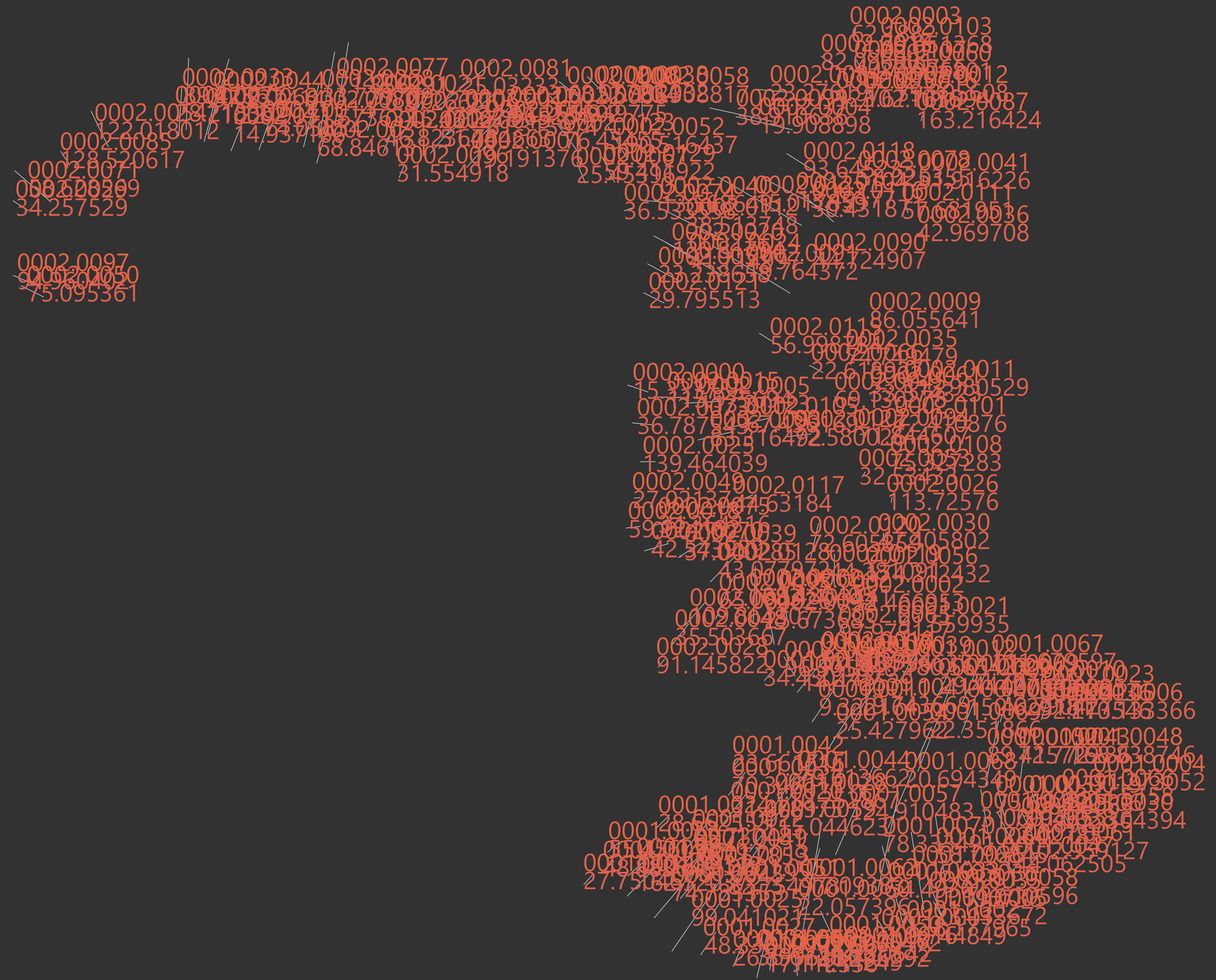
function mapping

ventilation

ventilation data

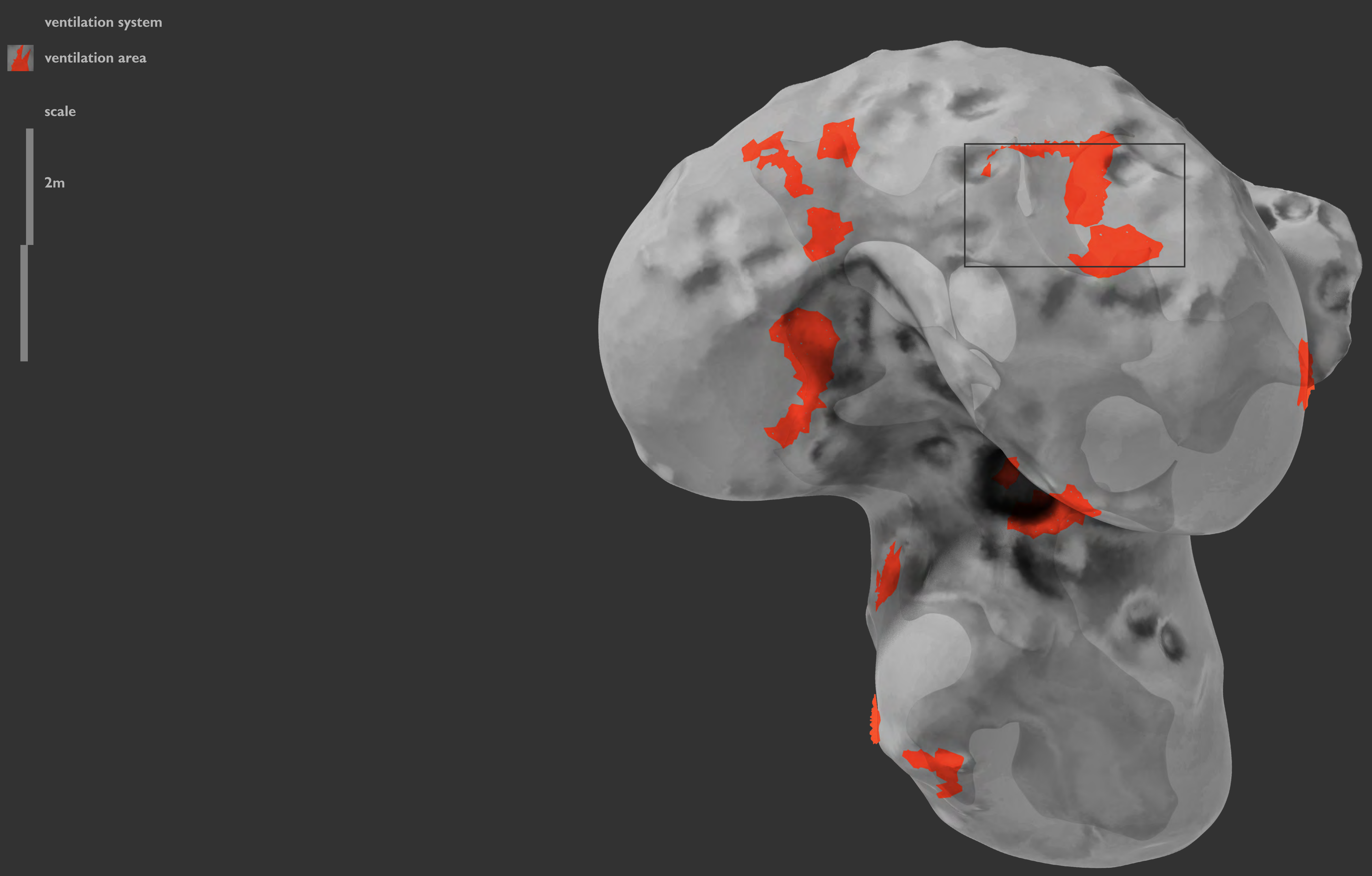
vector

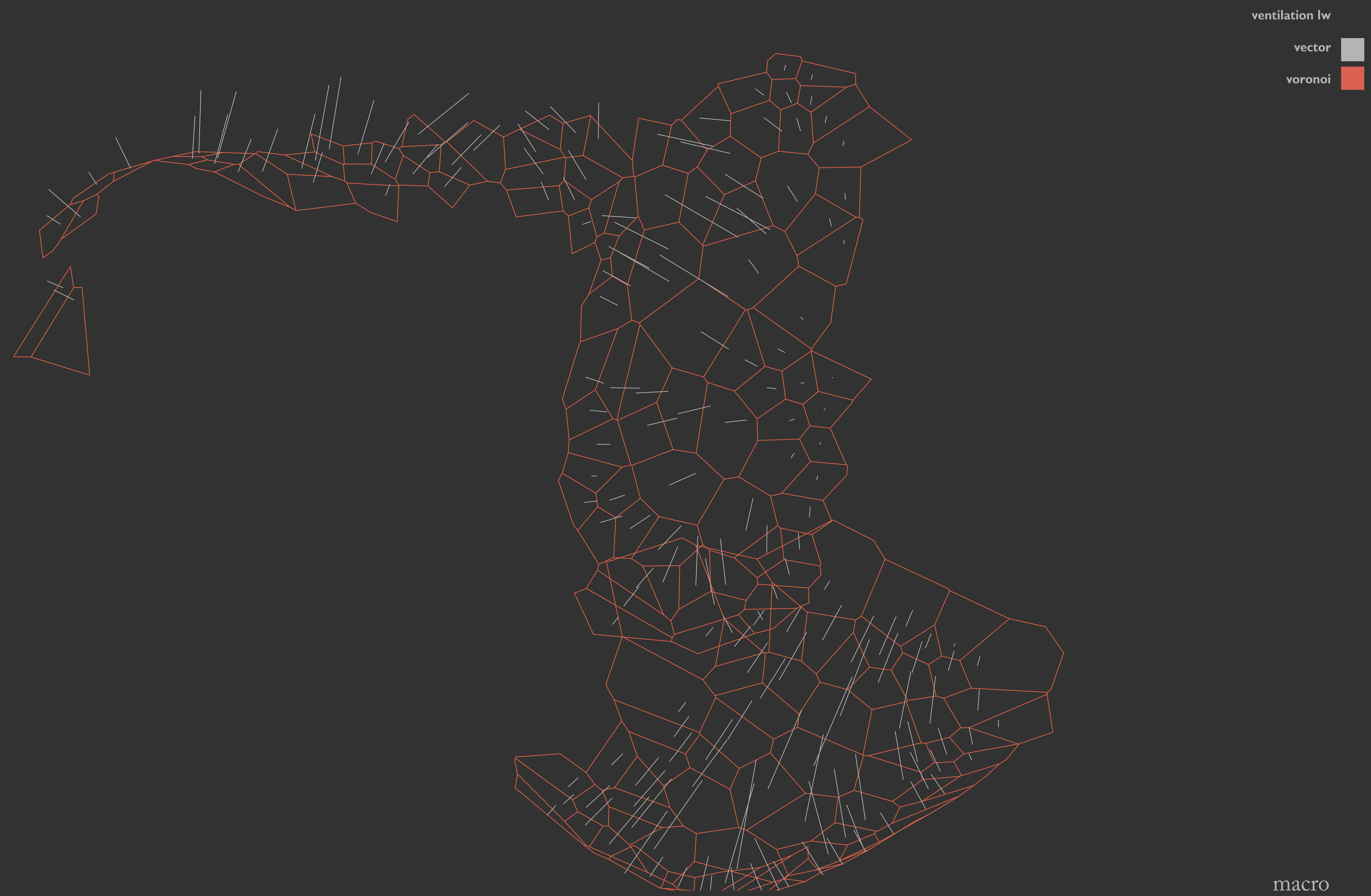
ip + intensity



10^0

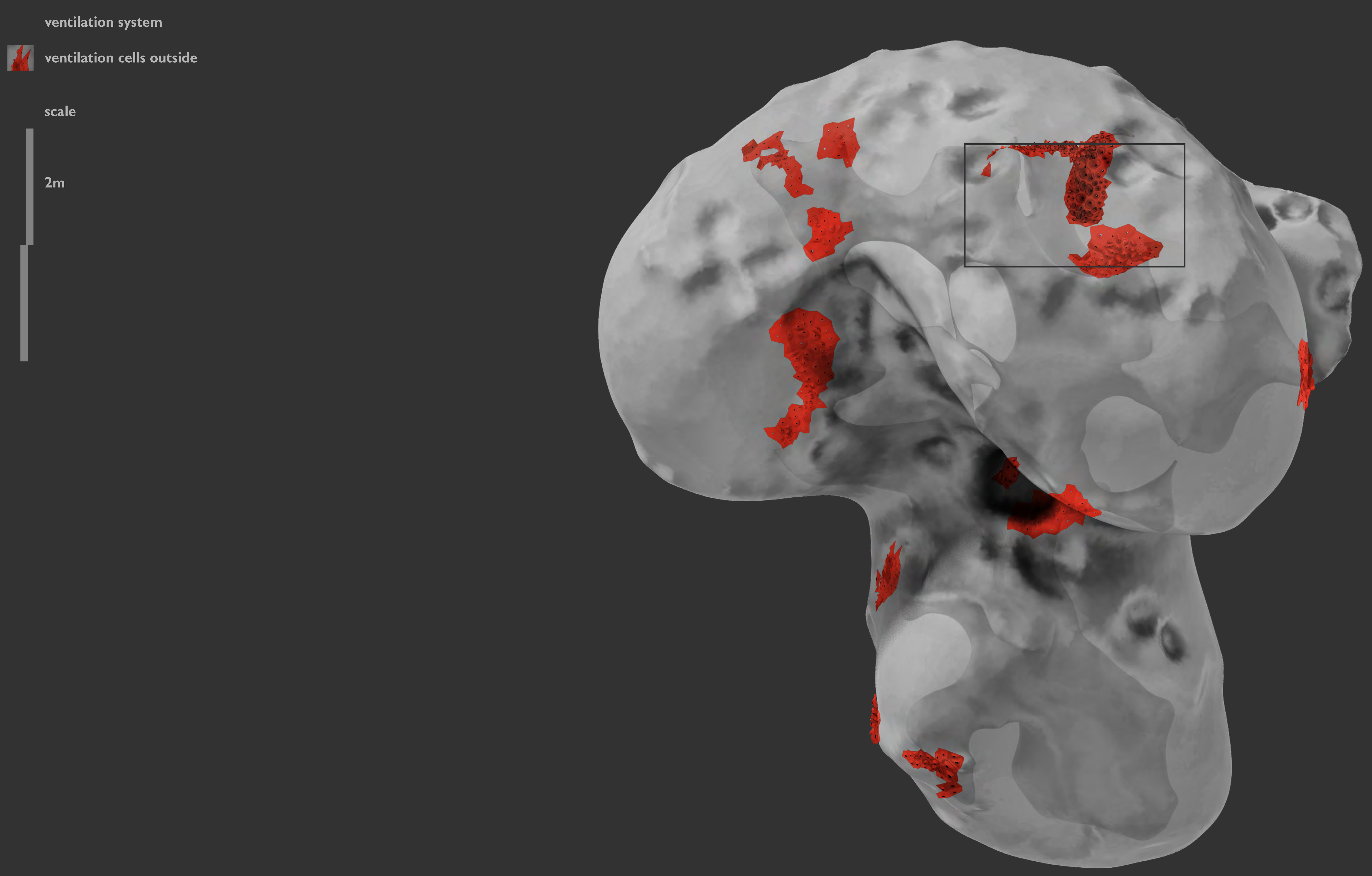
macro

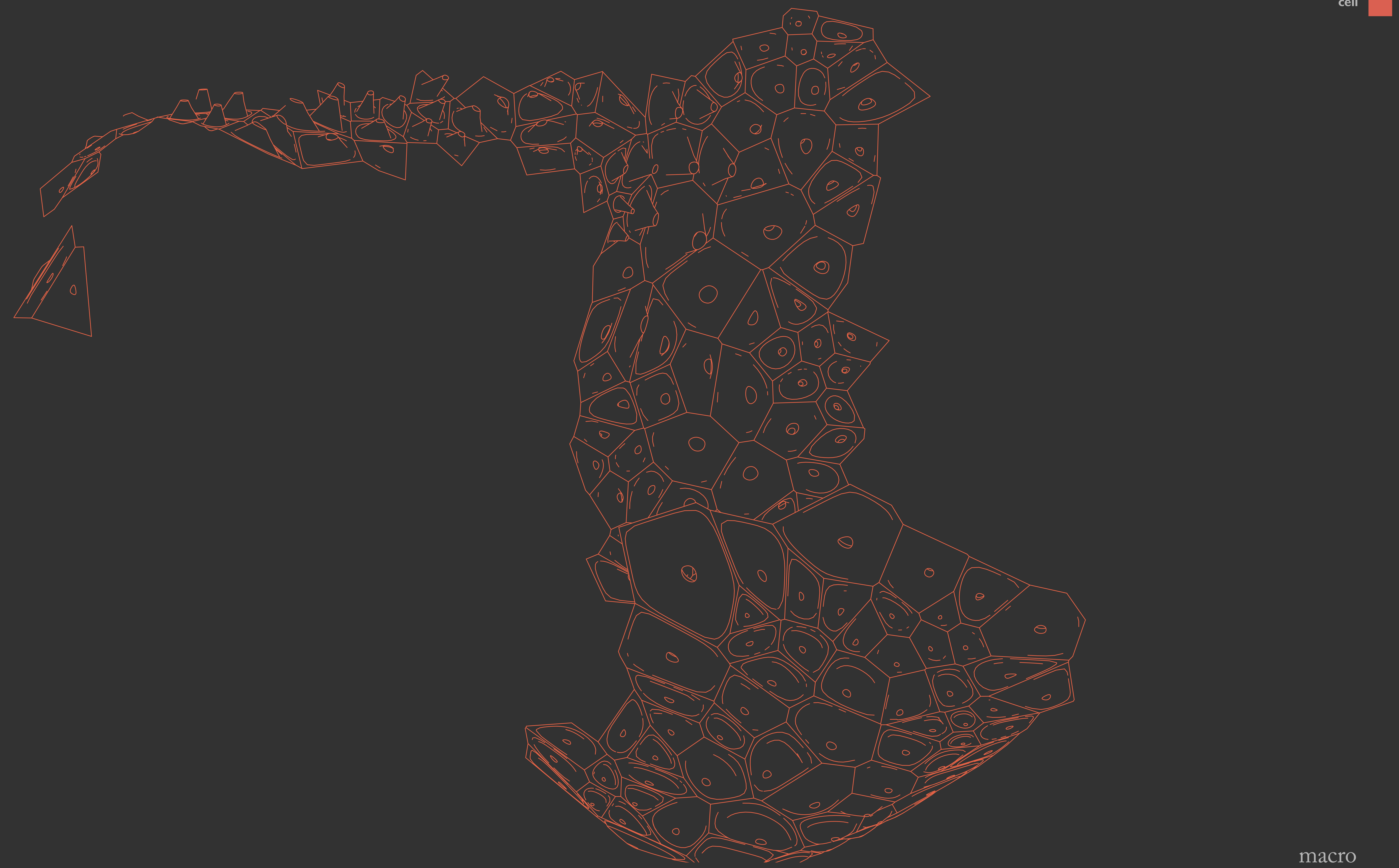




function mapping

ventilation





function mapping

ventilation

macro

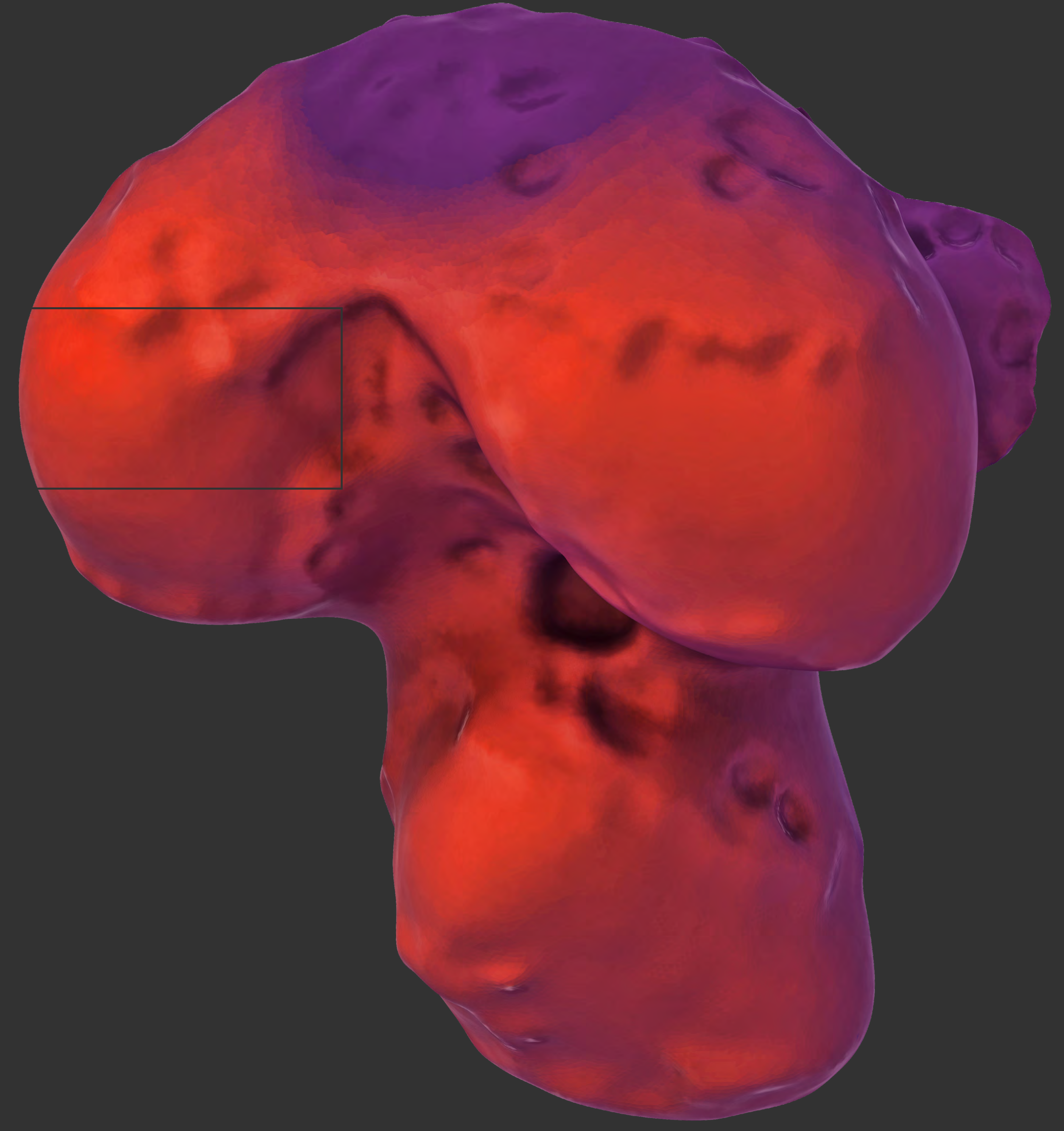
solar radiation

high

low

scale

2m



function mapping

radiation

radiation data

vector

ip + intensity

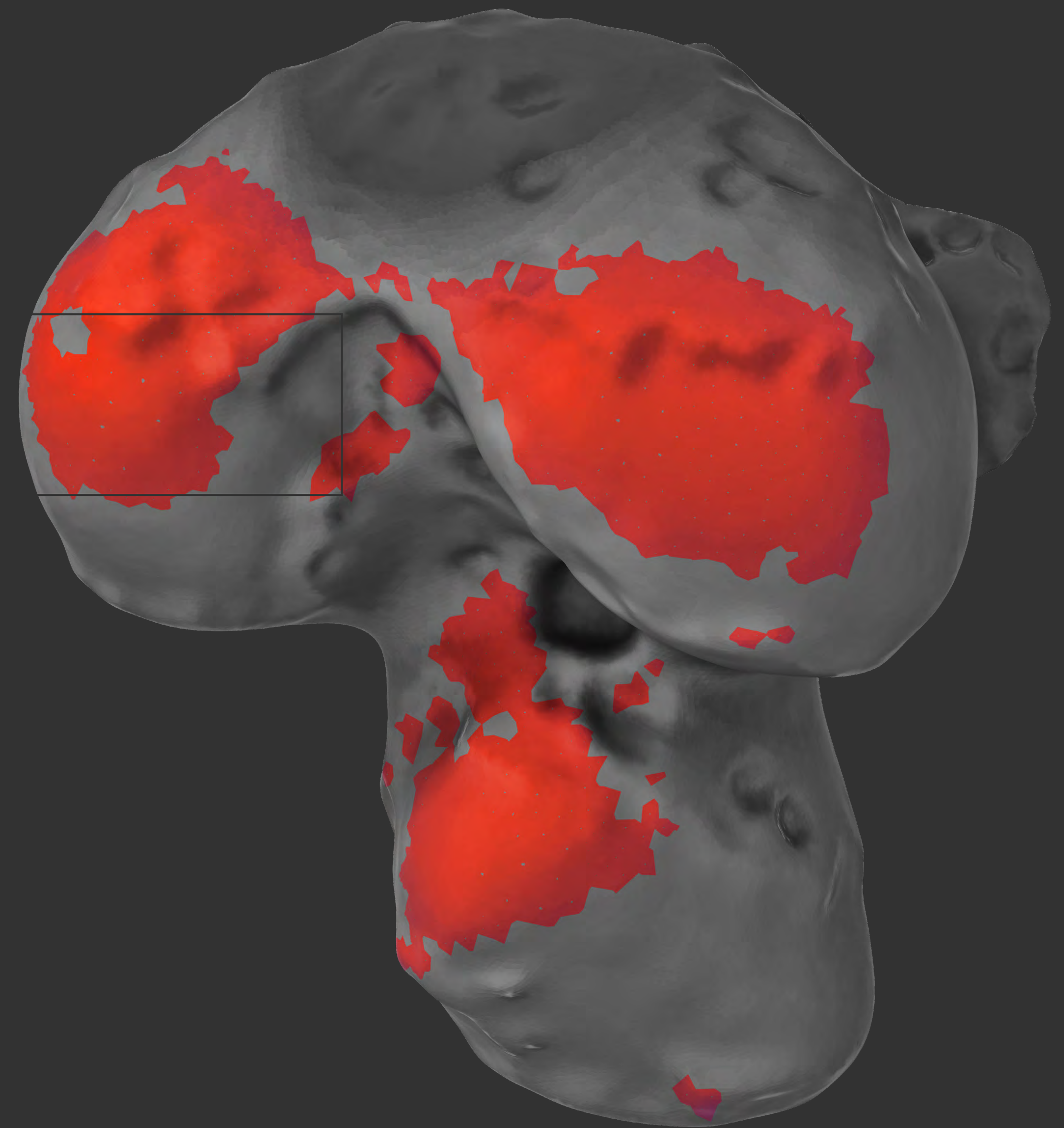
macro

solar radiation

radiation area

scale

2m



function mapping

radiation

radiation lw

vector

voronoi

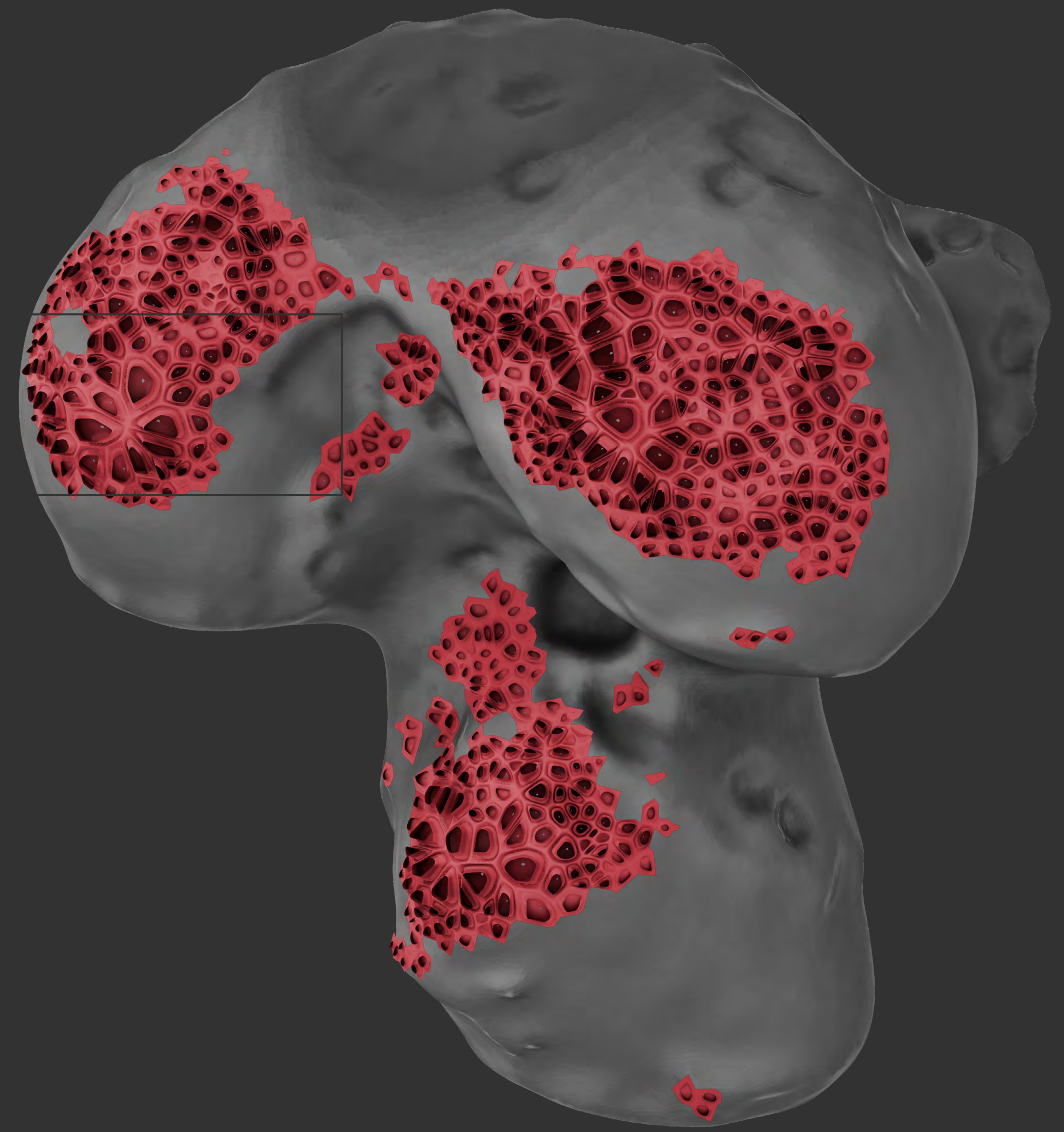
macro

solar radiation

radiation cells

scale

2m



function mapping

radiation

1Ø^{0}

radiation cells

cell

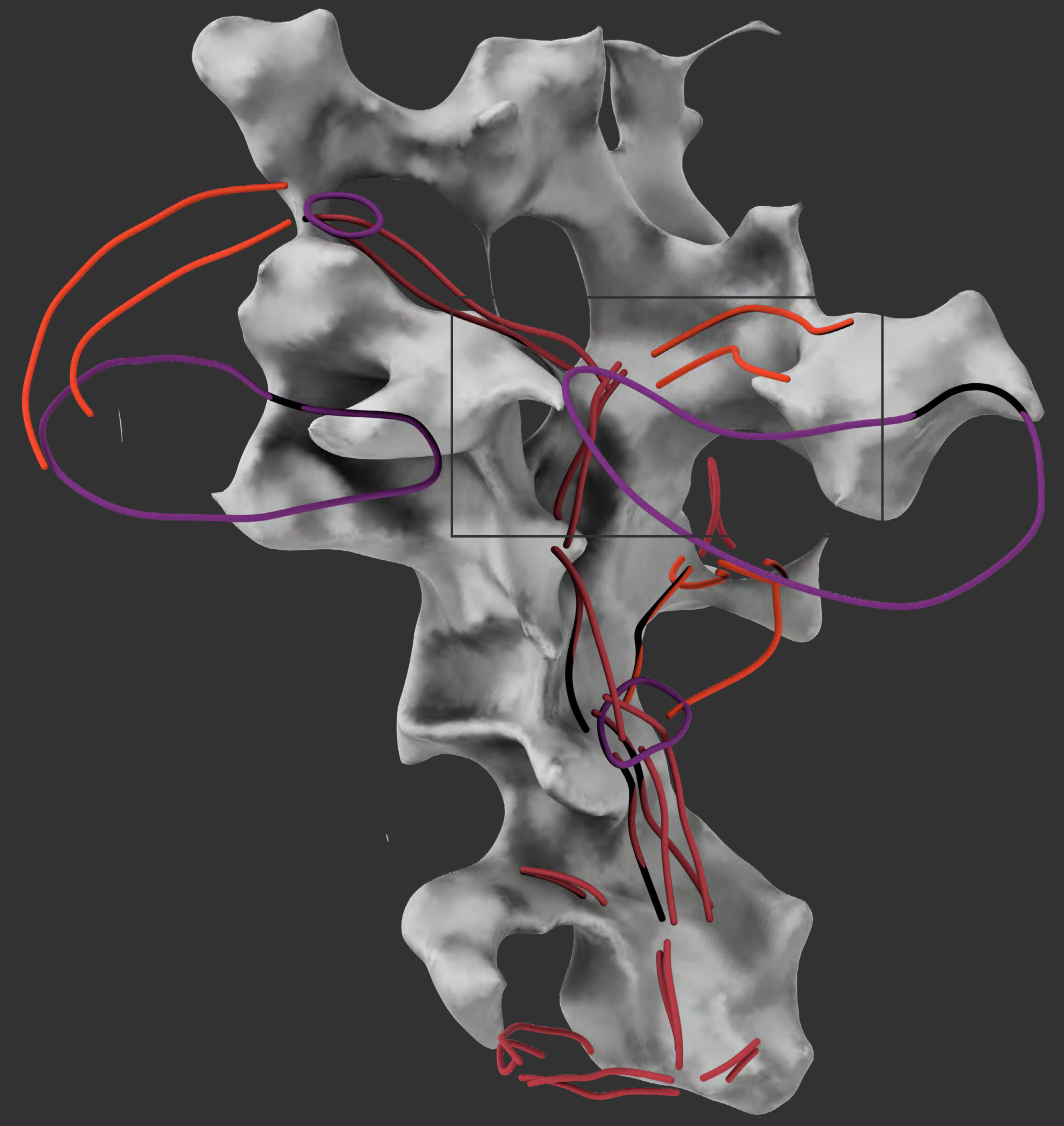
macro

circulation

location curves

scale

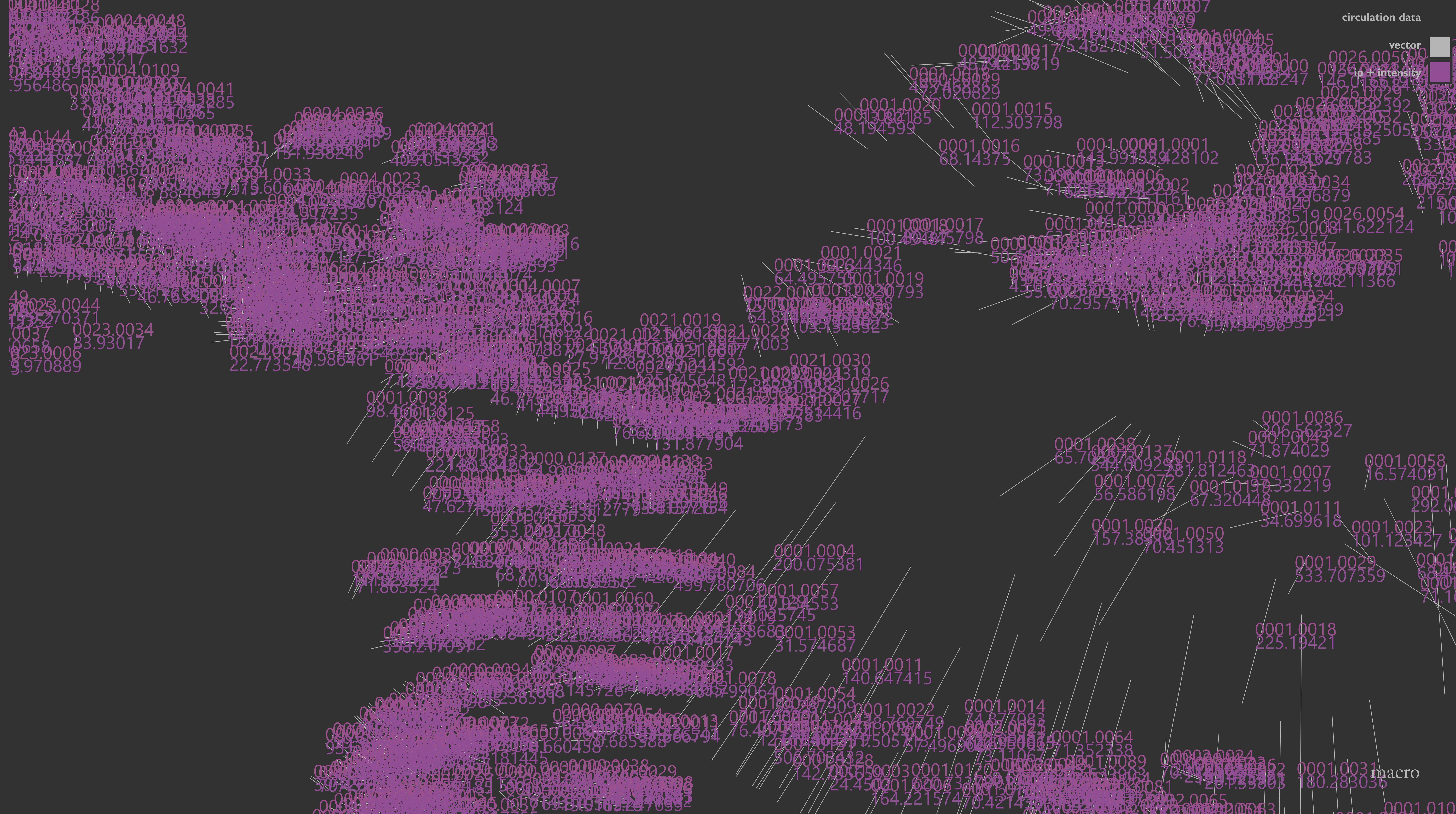
2m



function mapping

circulation

10^{0}



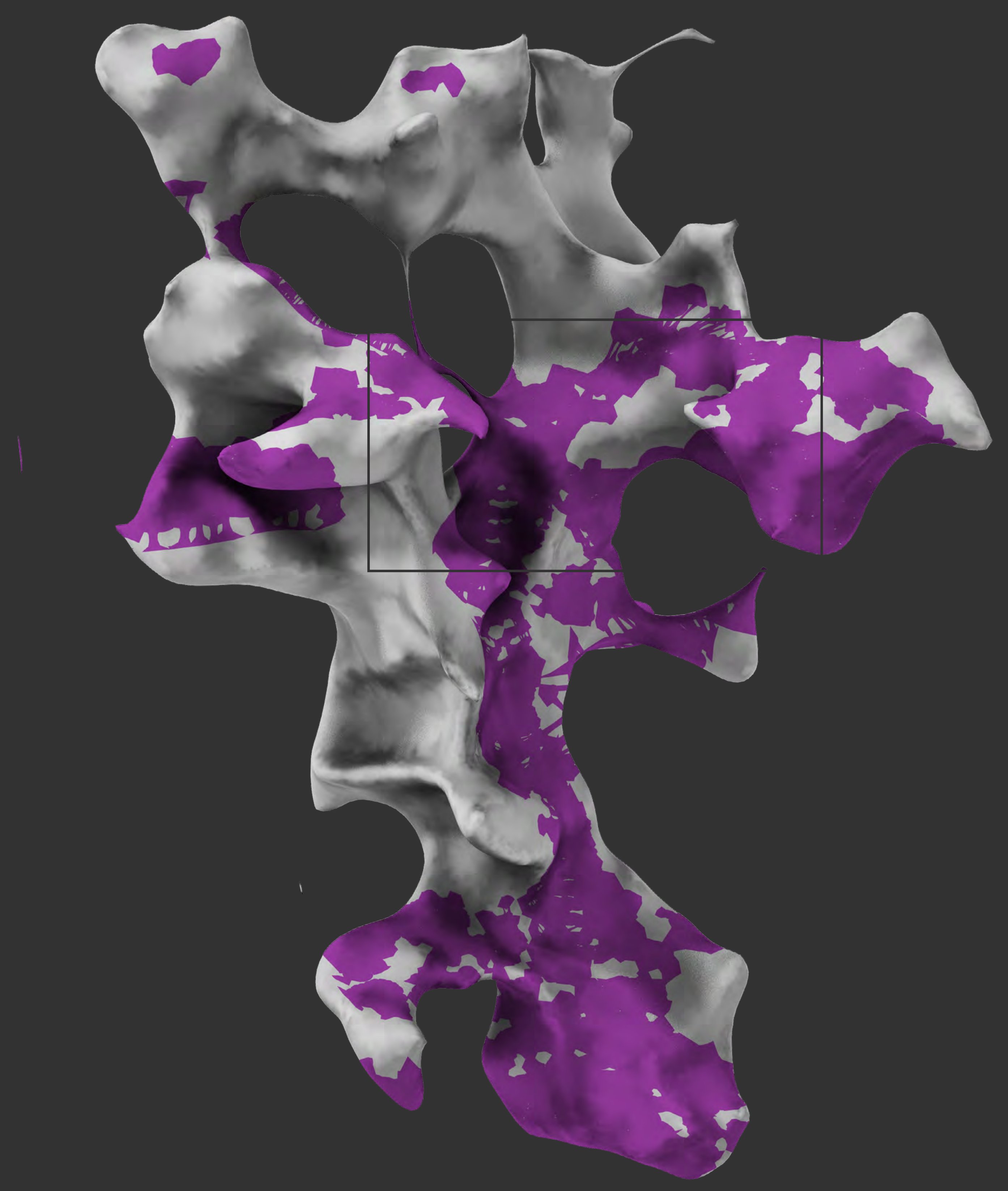
macro

circulation

circulation area

scale

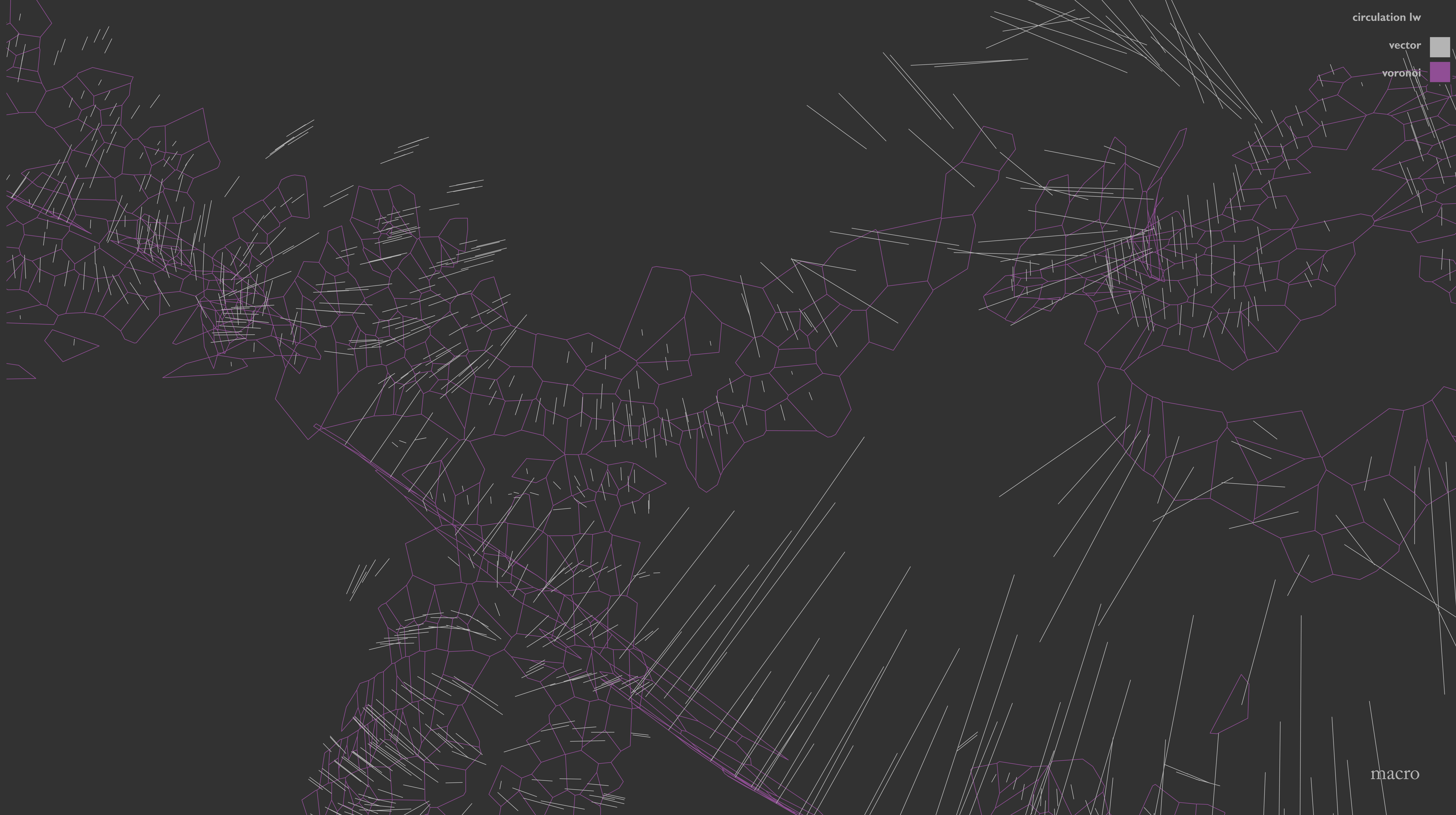
2m



function mapping

circulation

$1Ø^{0}$



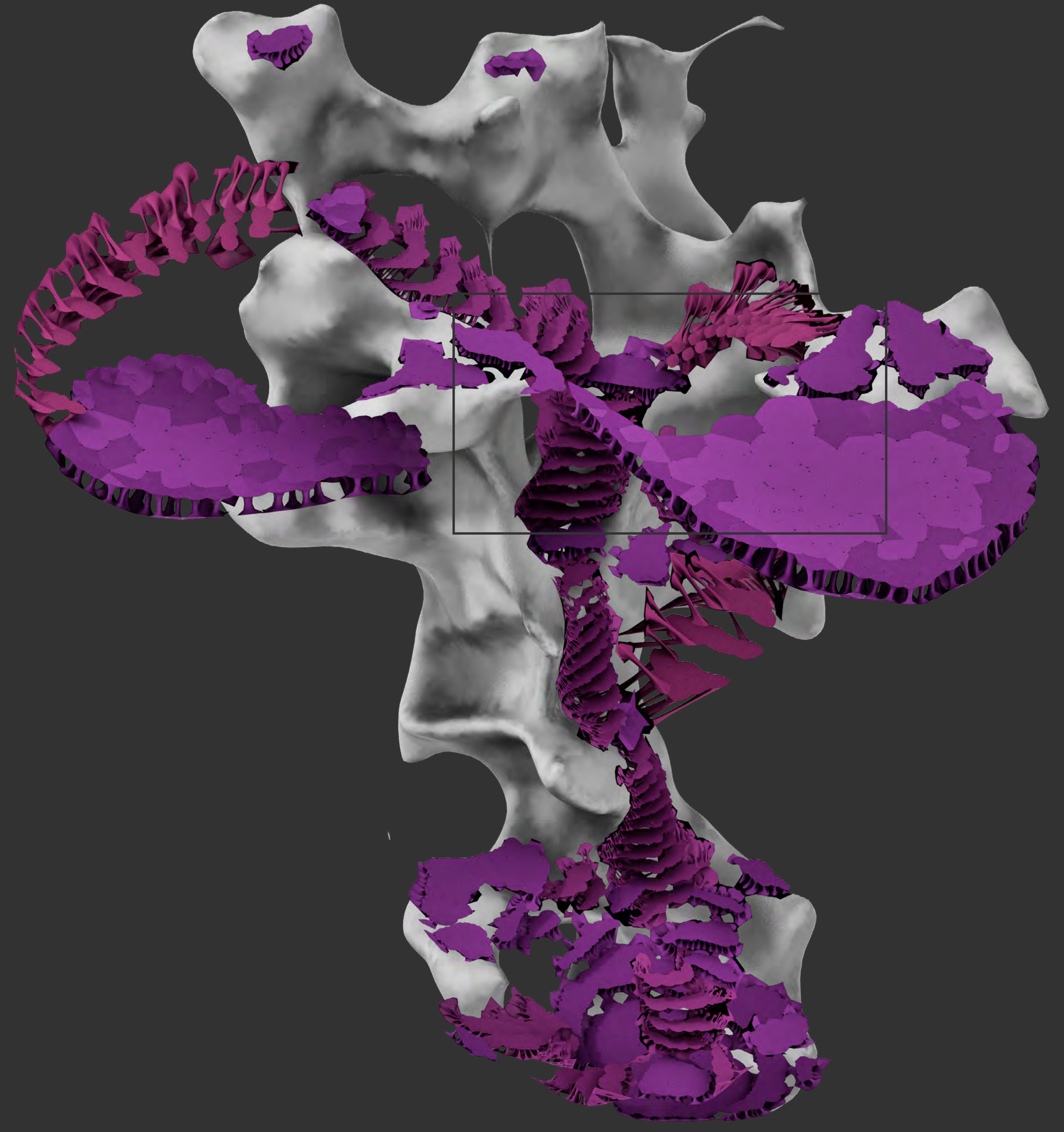
macro

circulation

circulation cells

scale

2m



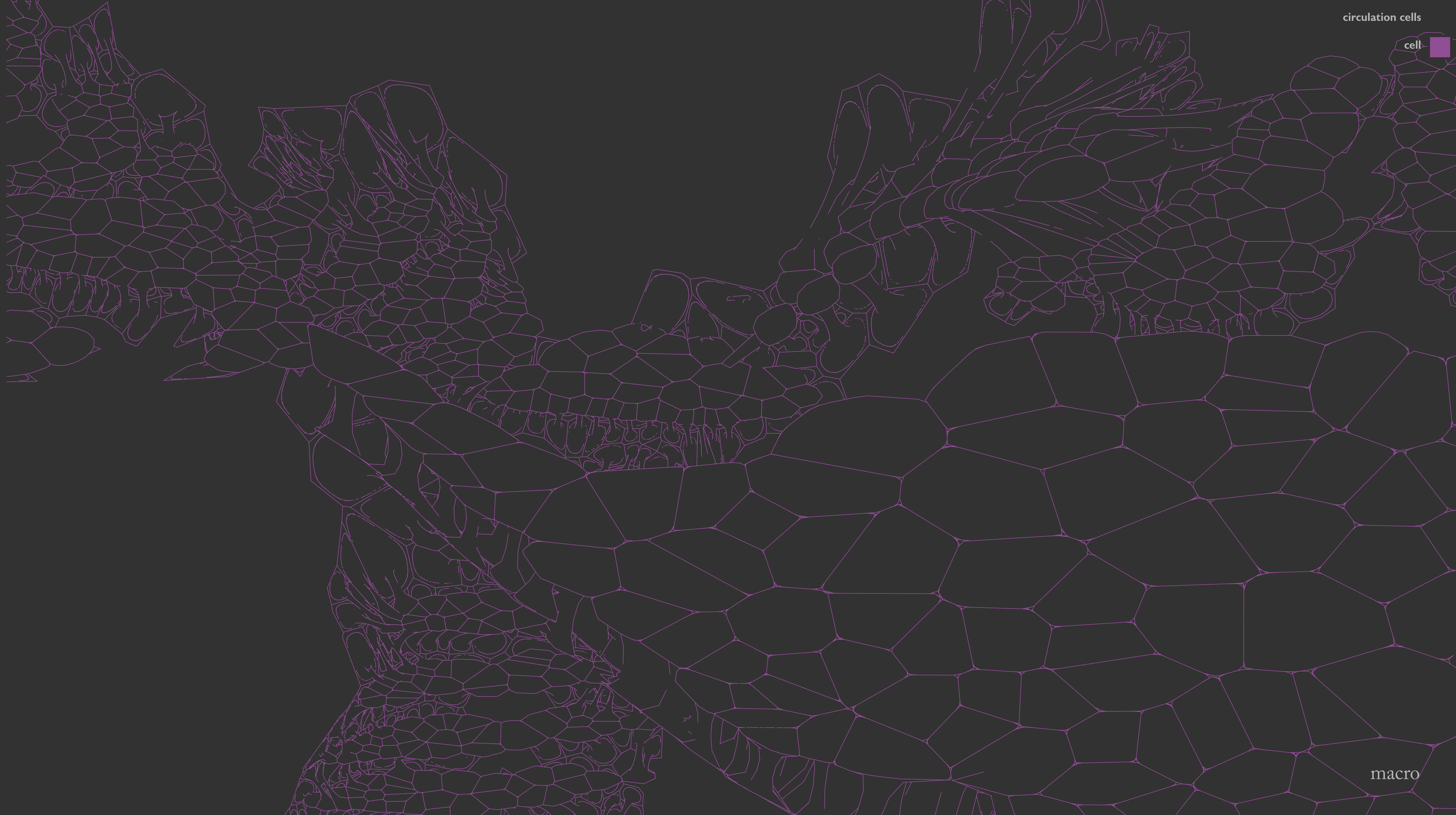
function mapping

circulation

10^{0}

circulation cells

cell



macro

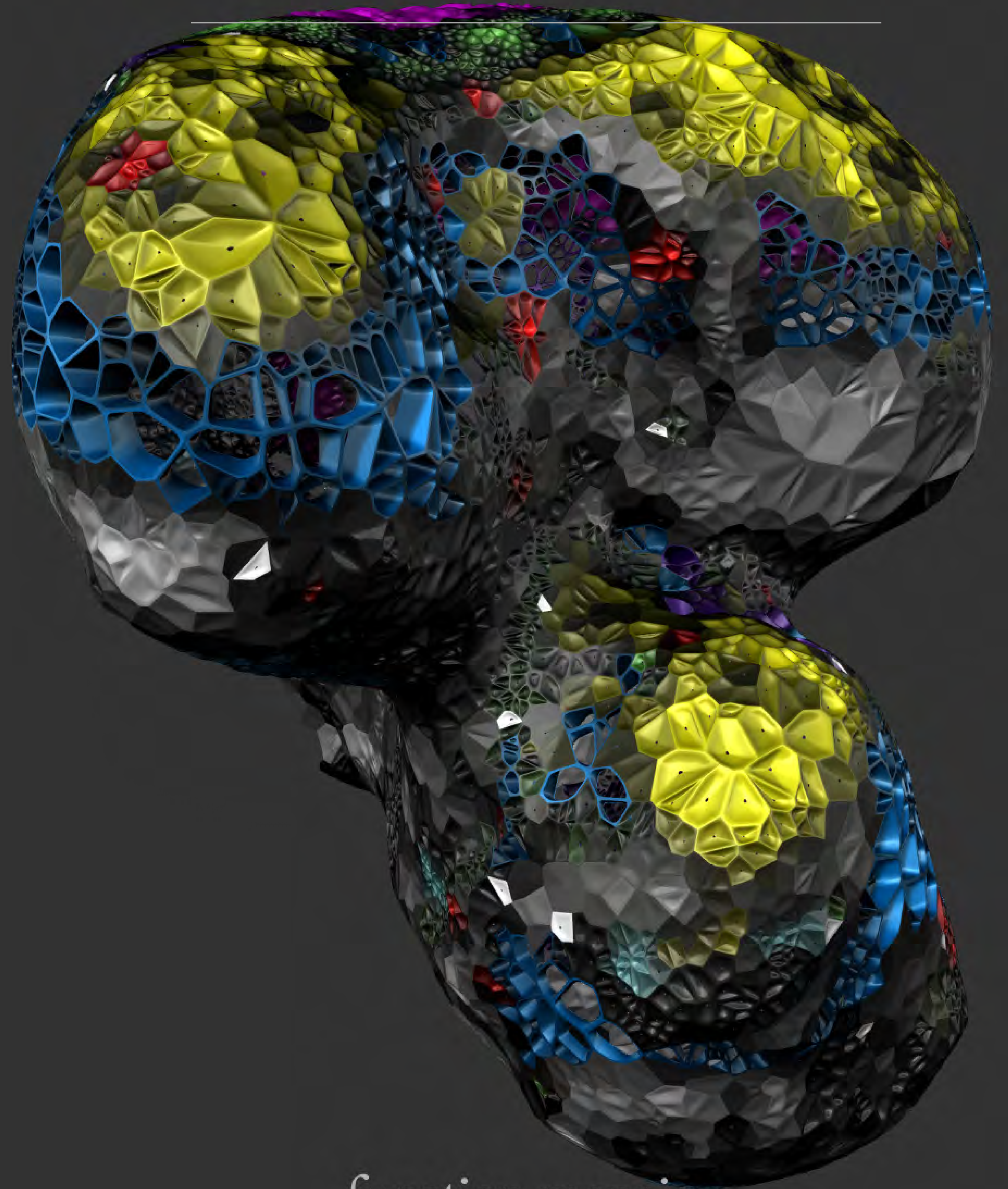
functions out

cones

scale

2m

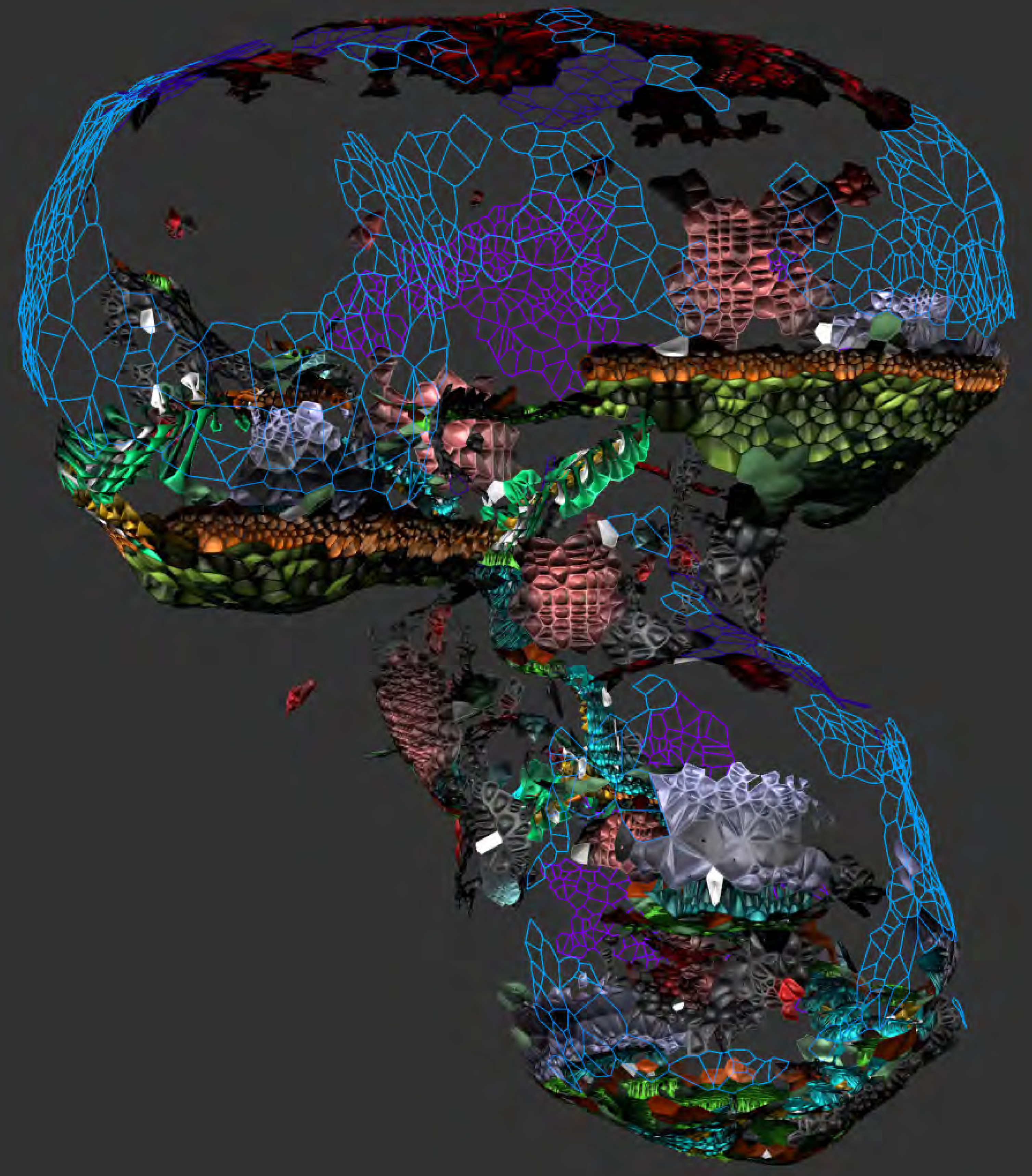
https://youtu.be/0Vj49RA7q1Y



function mapping

cells

https://youtu.be/TkphV8DCRa8



functions in

cones

scale

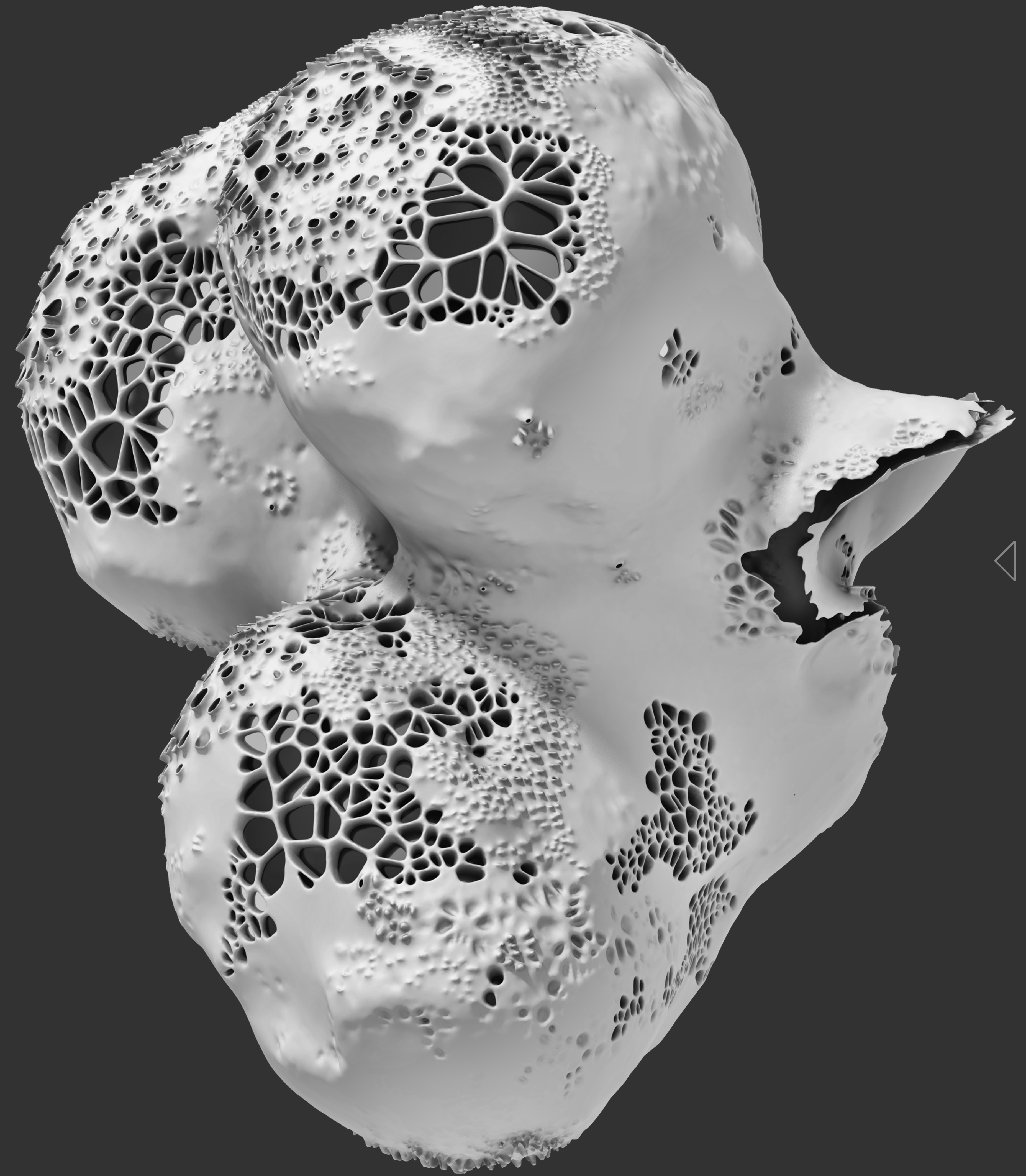
2m

macro

elevation

scale

2m

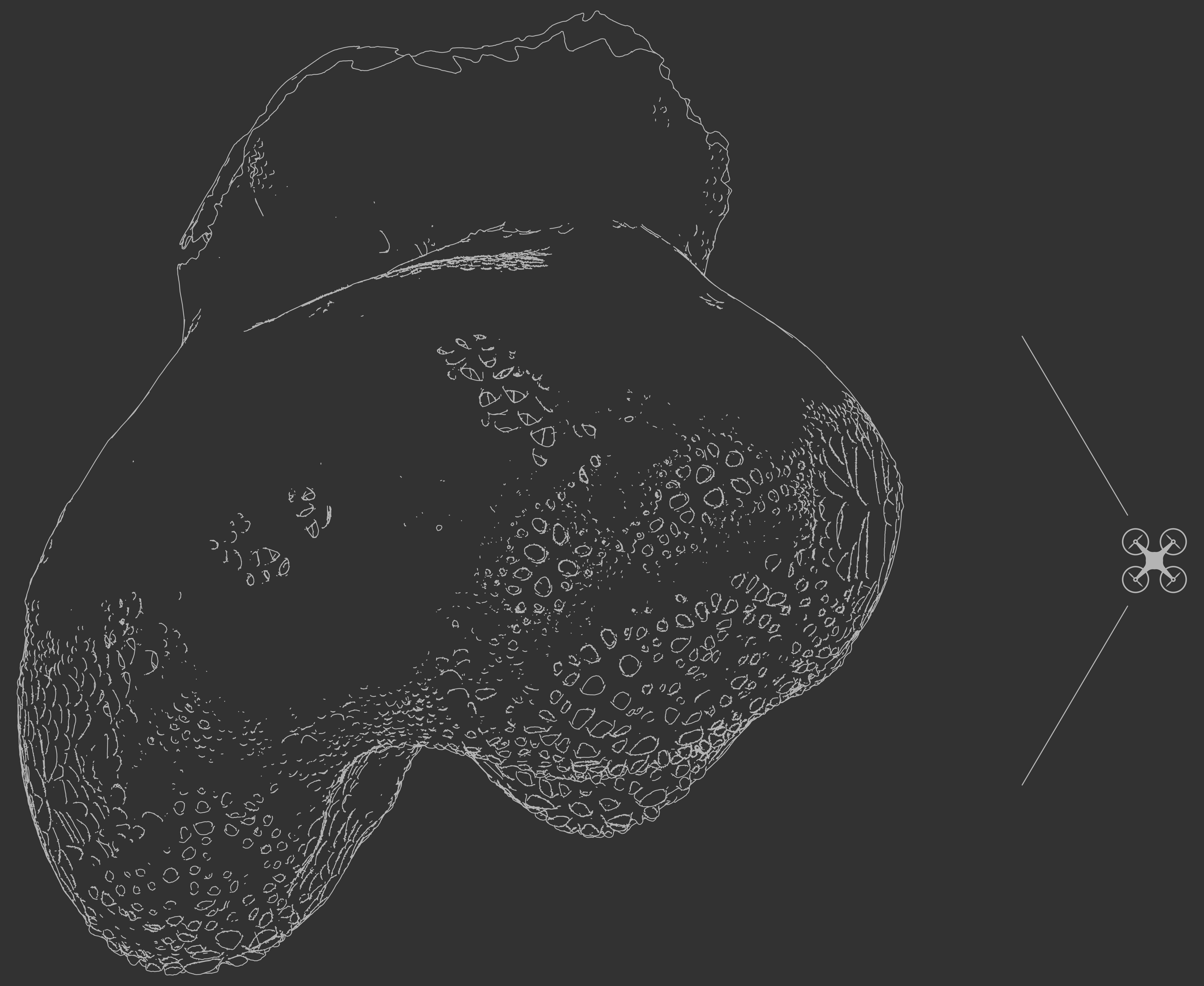


elevation

view position

scale

2m



10^{0}

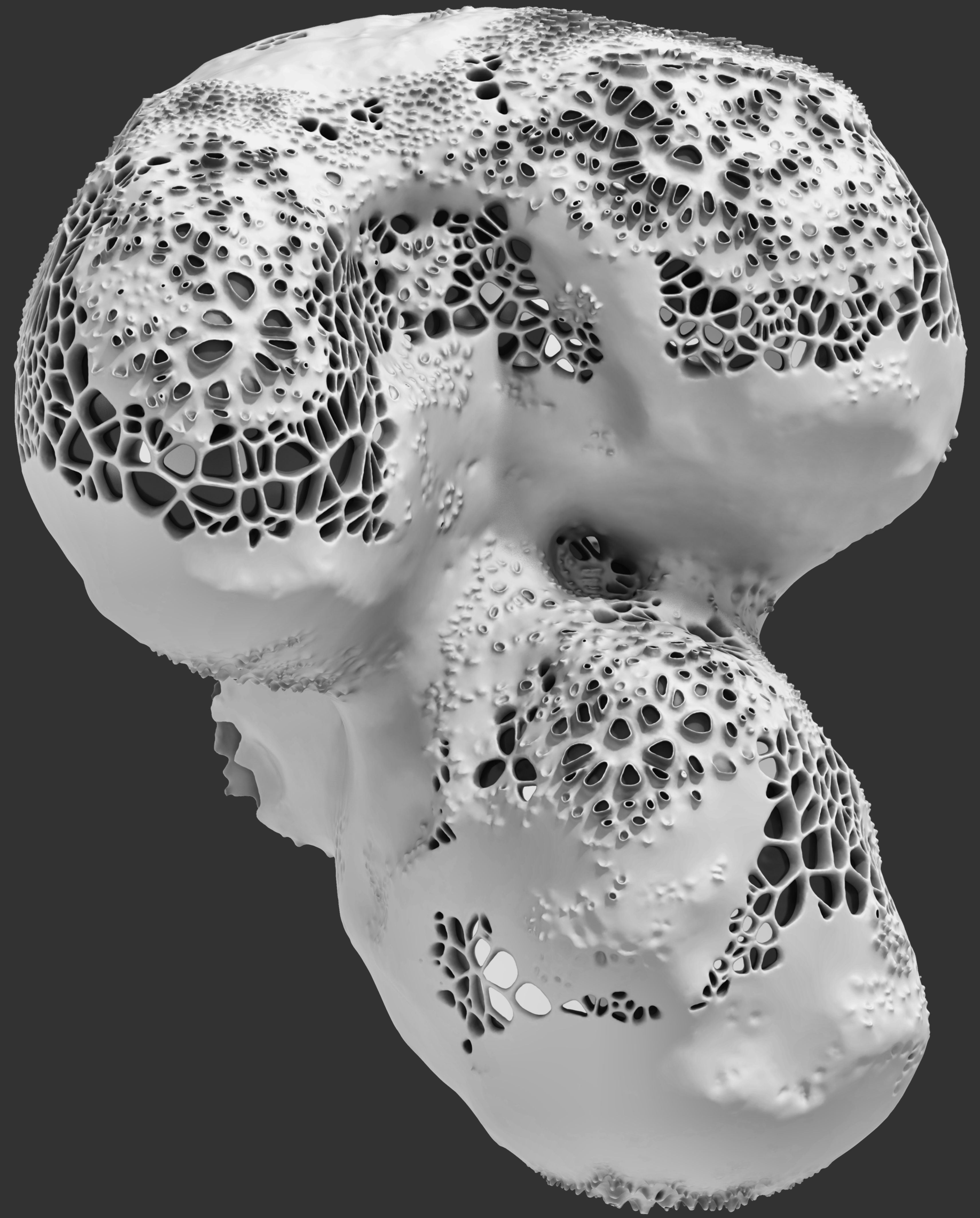
elevation

macro

elevation

scale

2m



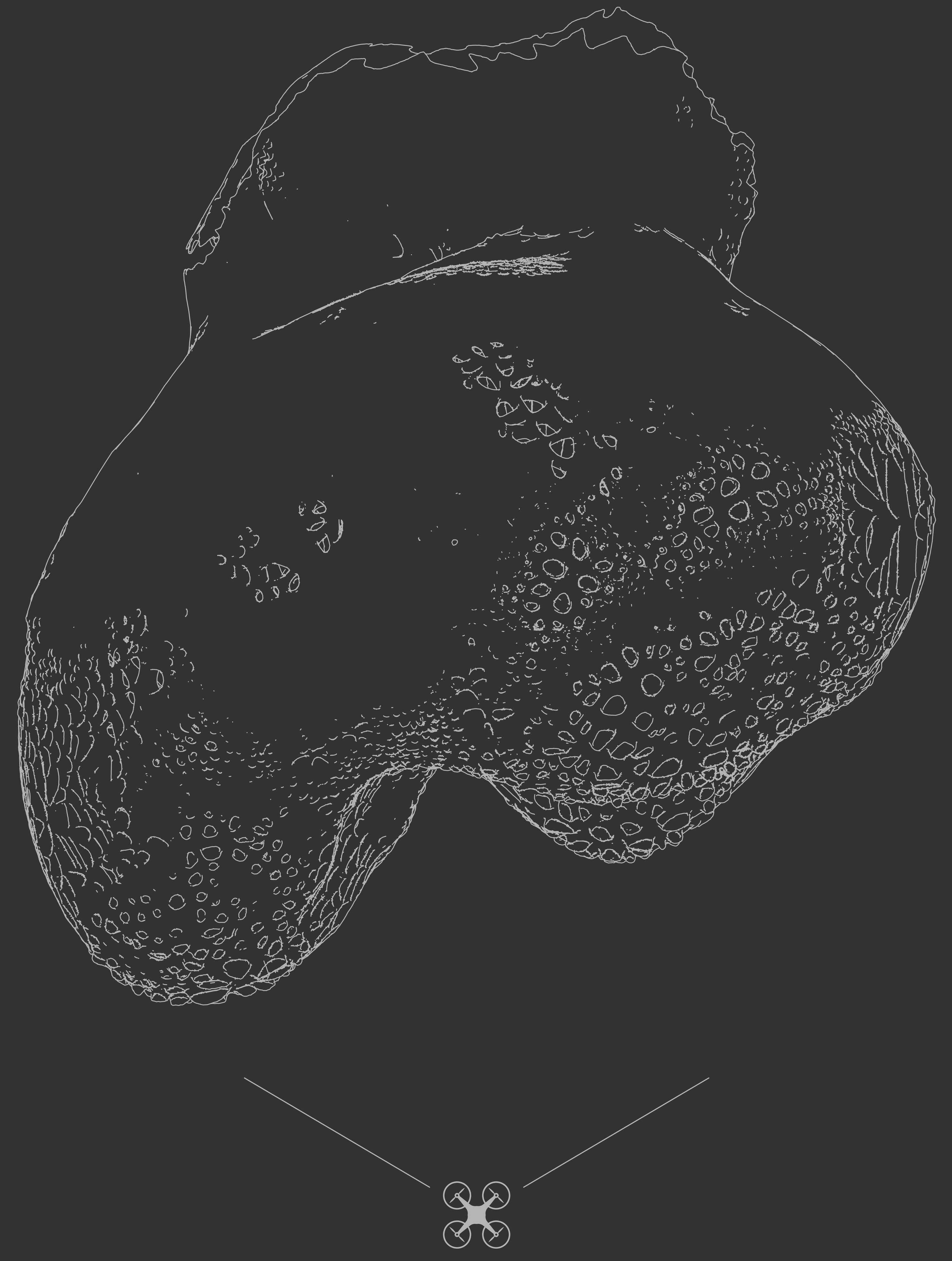
elevation

elevation

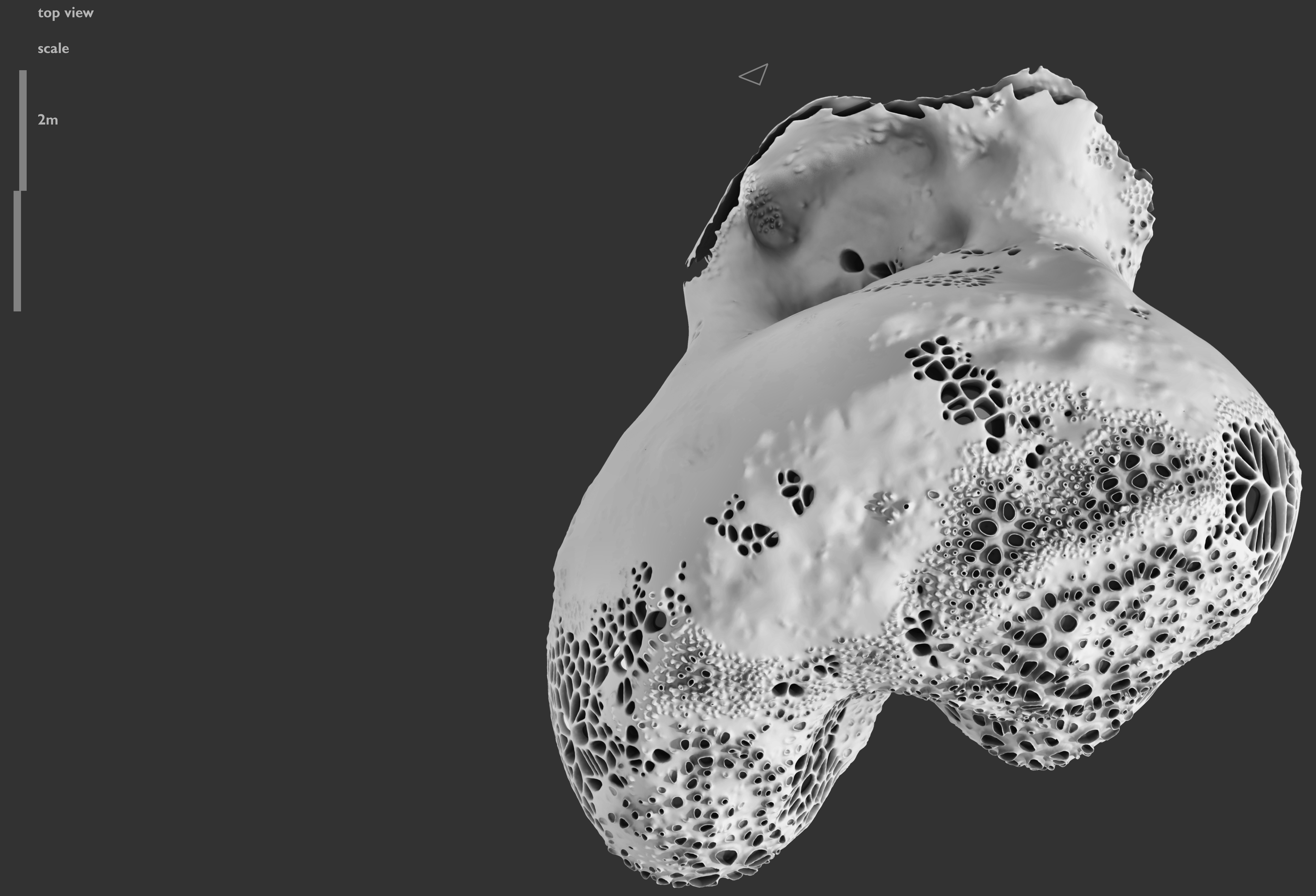
view position

scale

2m



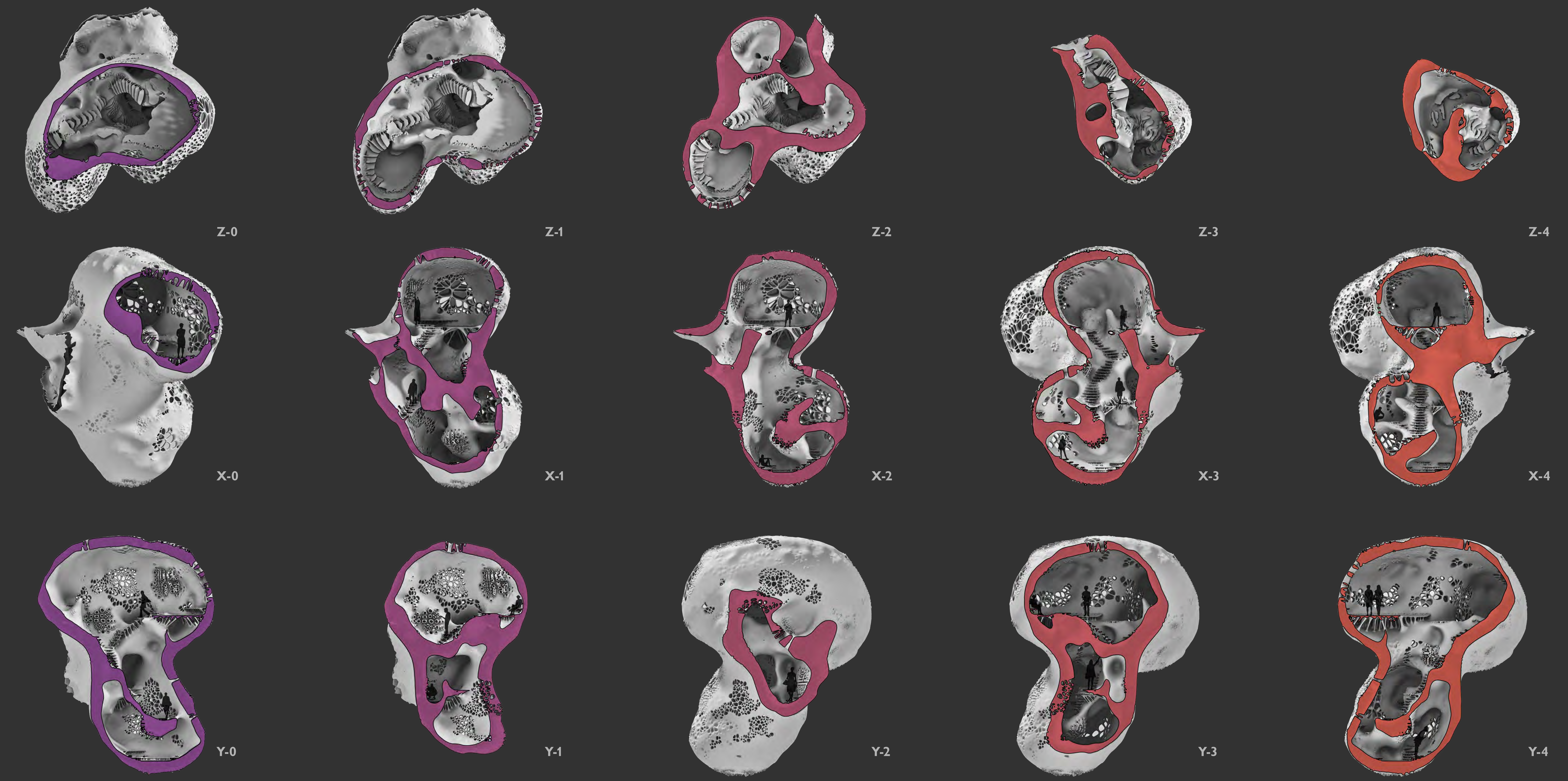
macro



top view

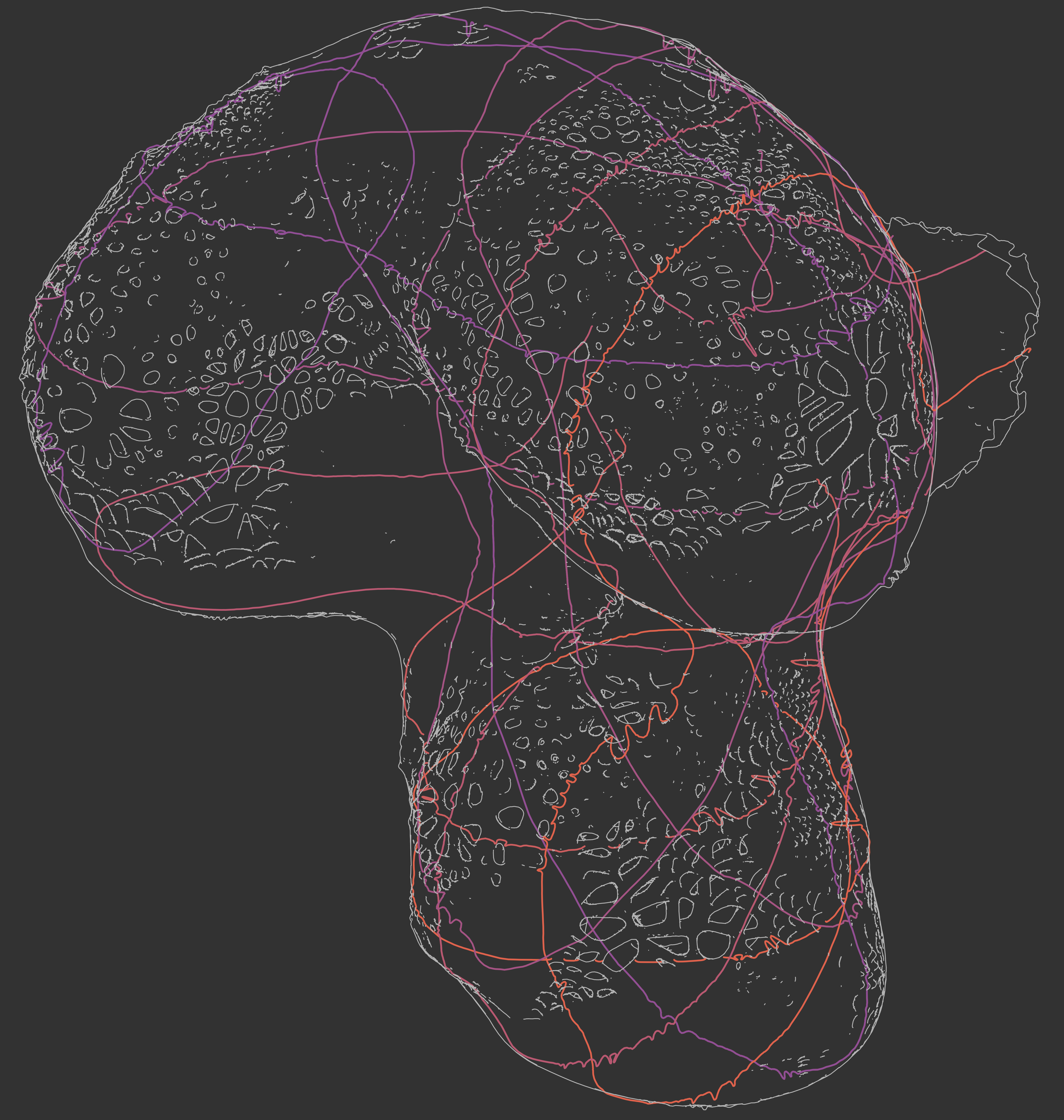
1-100

macro



section matrix

1-1ØØ



section matrix

Z-0
Z-1
Z-2
Z-3
Z-4
X-0
X-1
X-2
X-3
X-4
Y-0
Y-1
Y-2
Y-3
Y-4

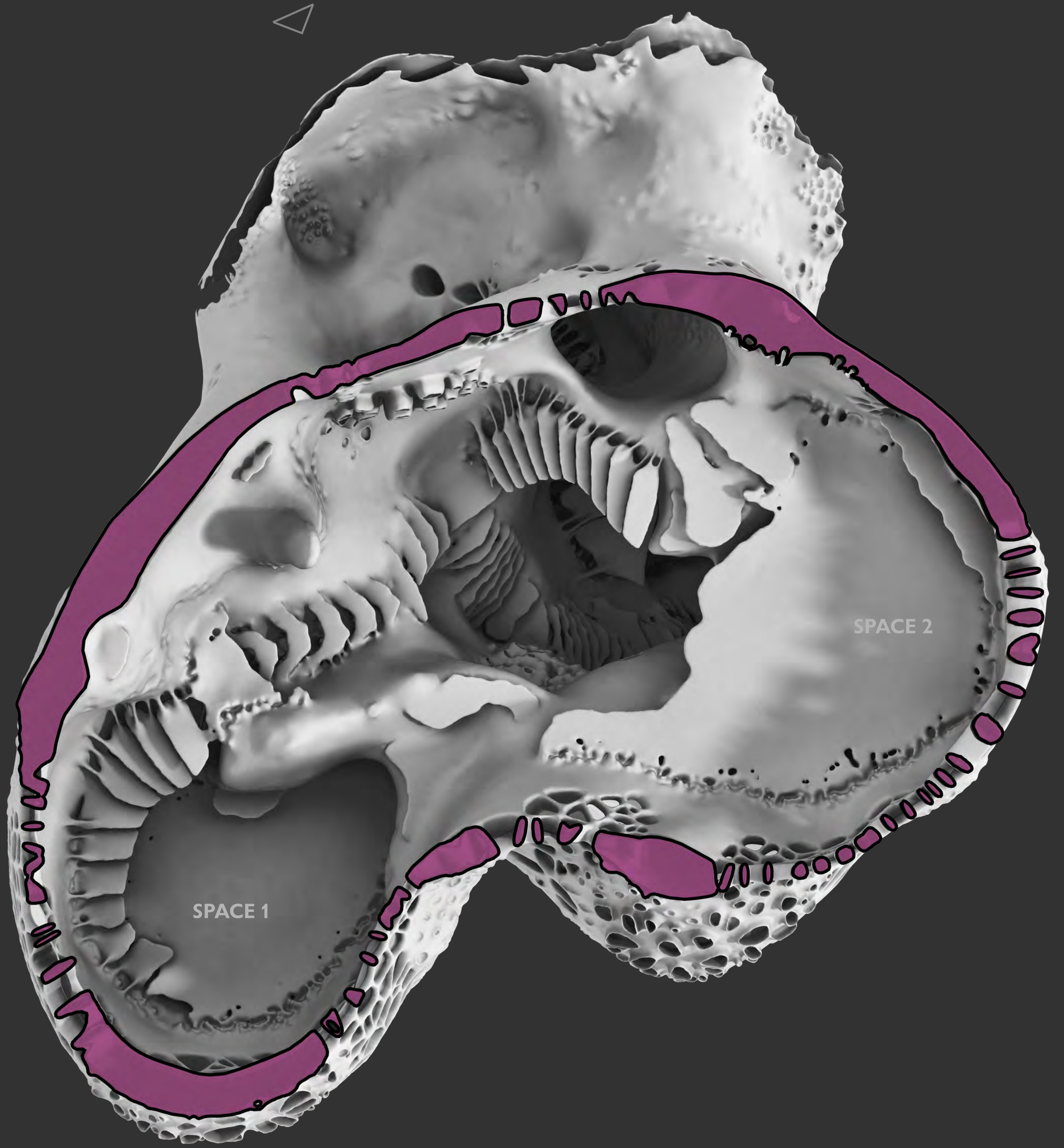
scale

2m

$1Ø^{Ø}$

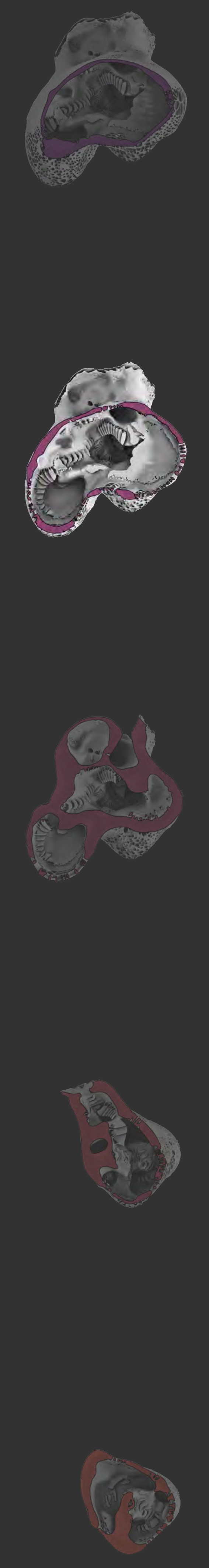
macro

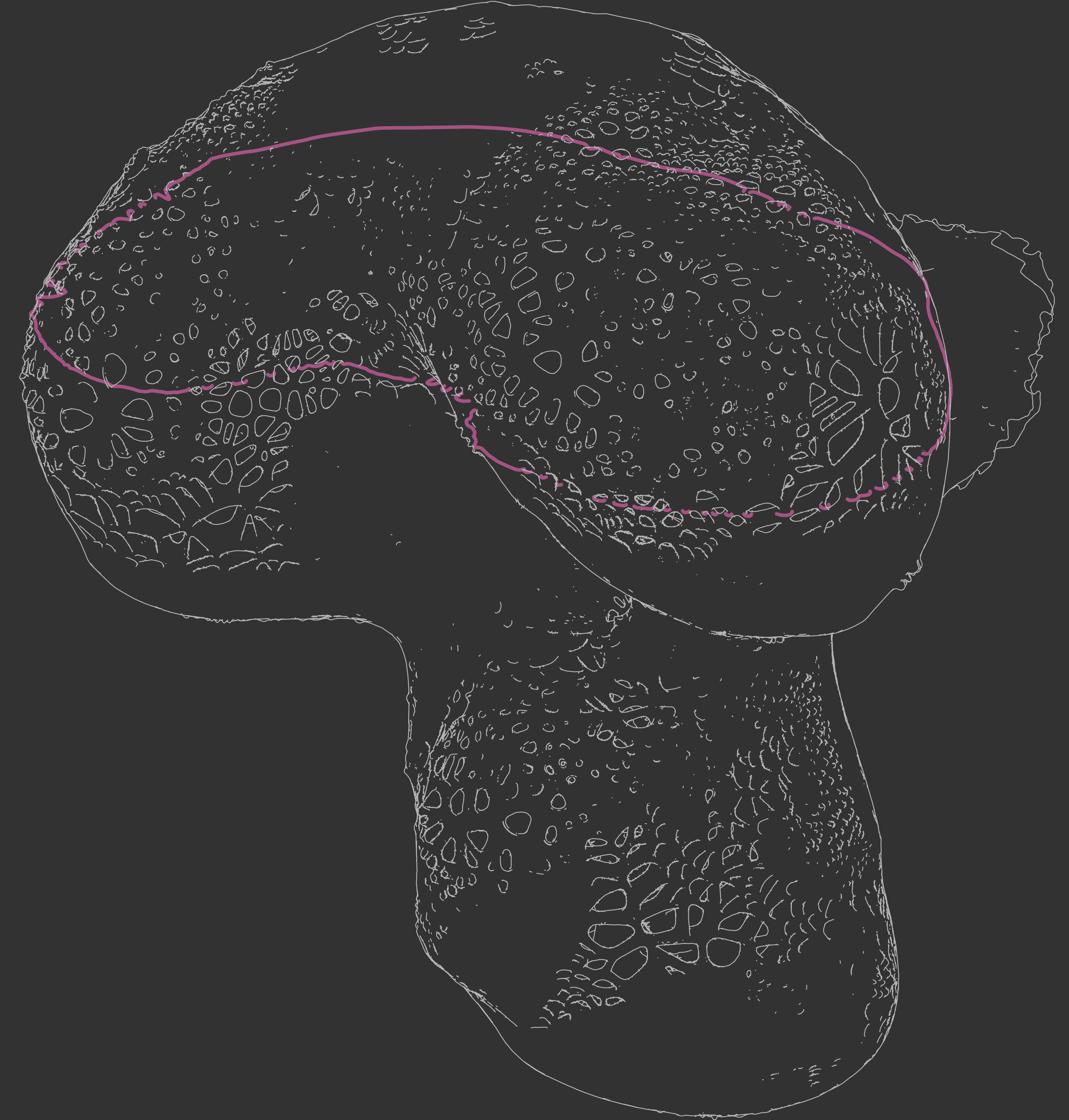
section
Z-1
scale
2m



section z

1-100



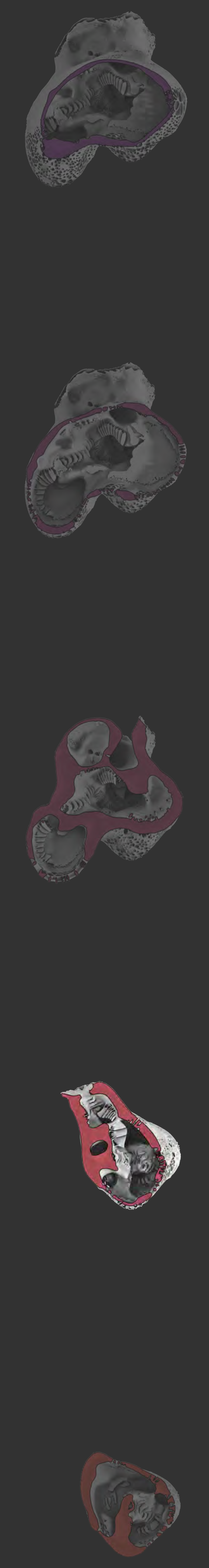


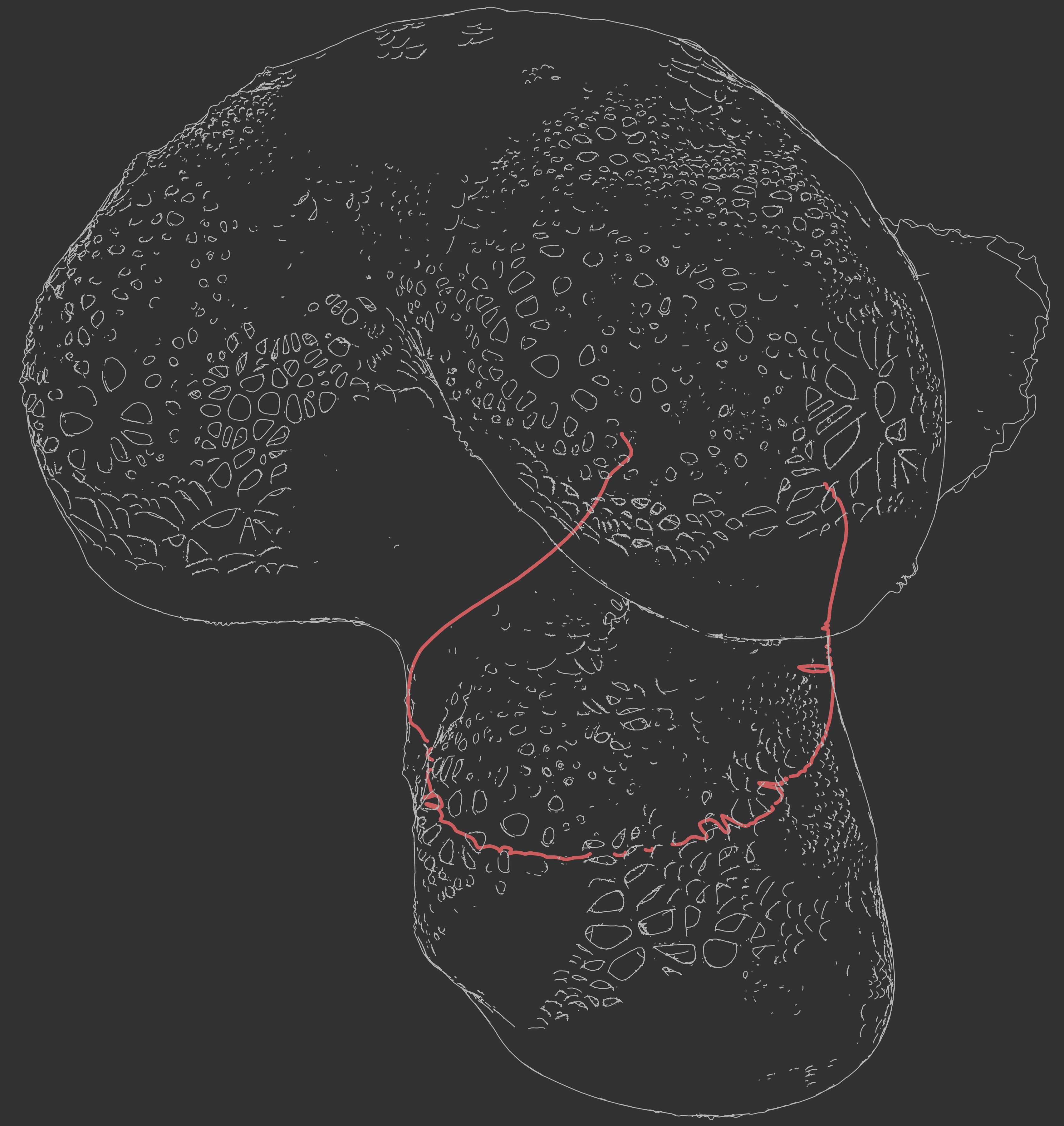
section
Z-1
scale
2m

$1\emptyset^{\emptyset}$

macro

section
Z-3
scale
2m





section
Z-3
scale
2m

section z

1-1ØØ

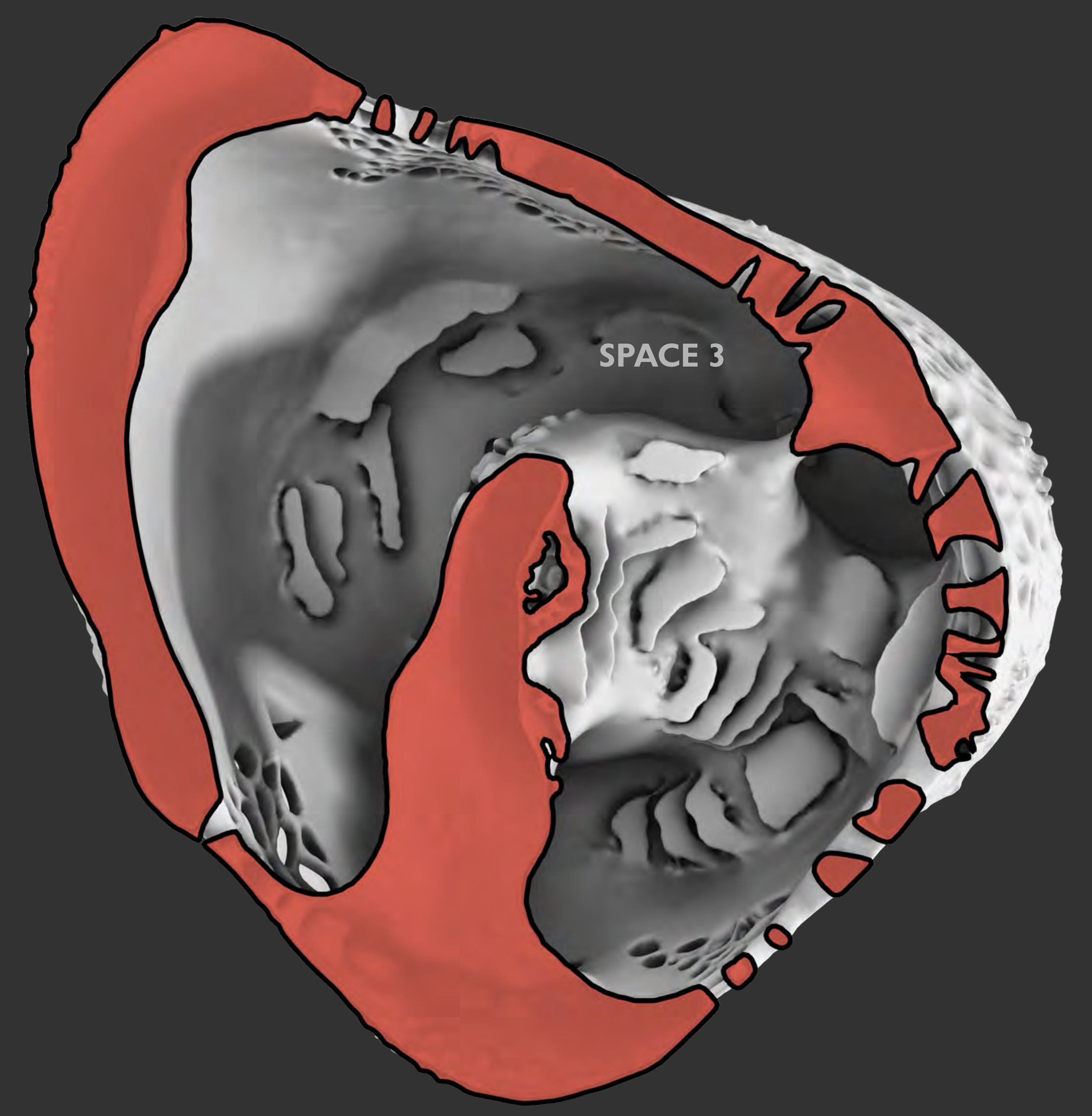
macro

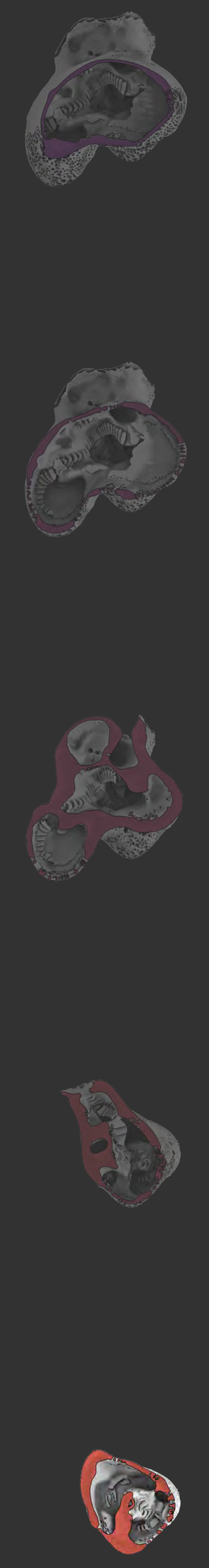
section

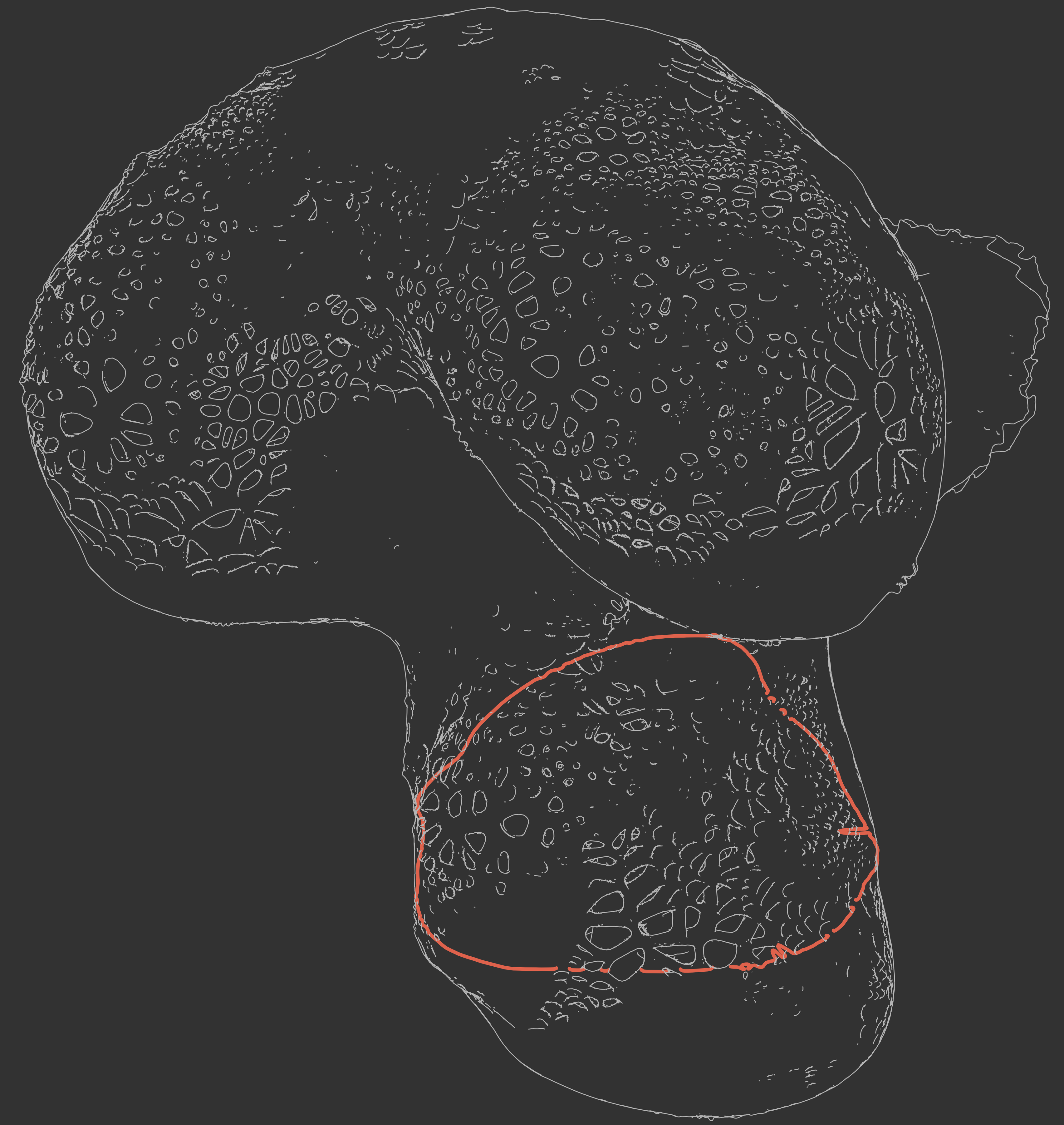
Z-4

scale

2m







section

Z-4

scale

2m

section z

1-1ØØ

$1\text{Ø}^{\text{Ø}}$

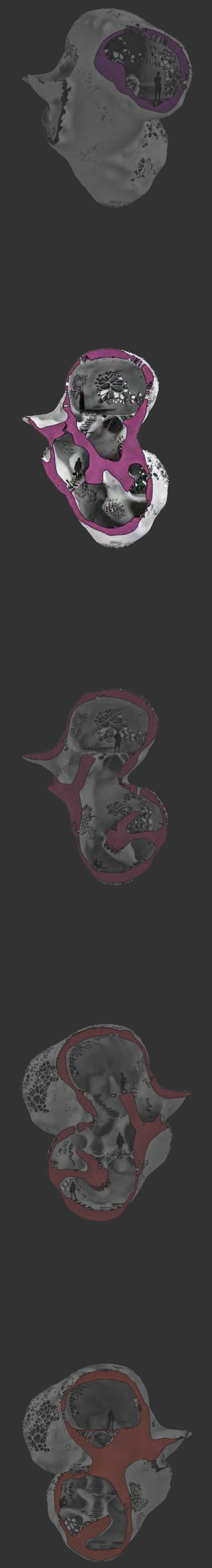
macro

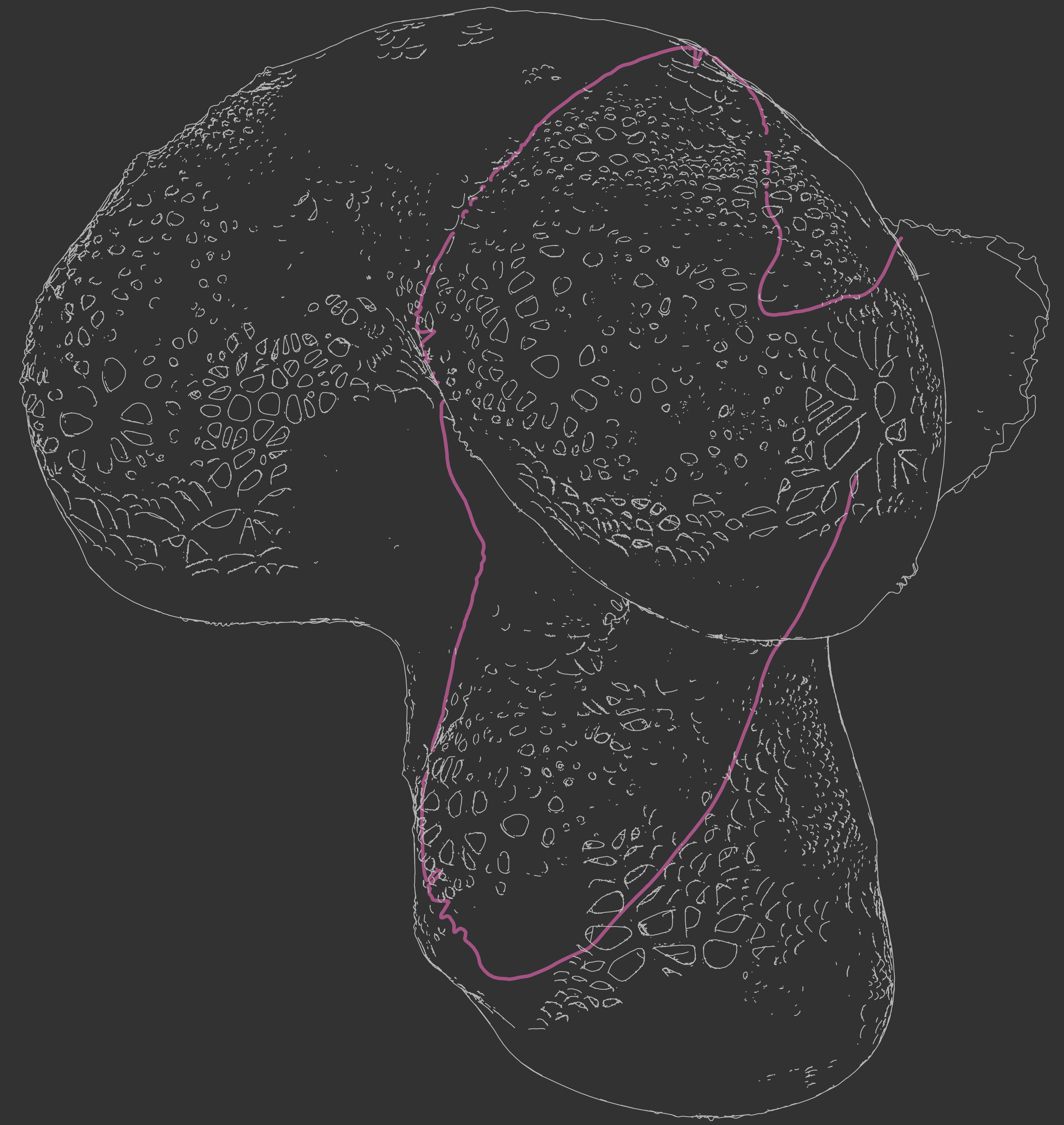
section

X-1

scale

2m





section

X-1

scale

2m

10^0

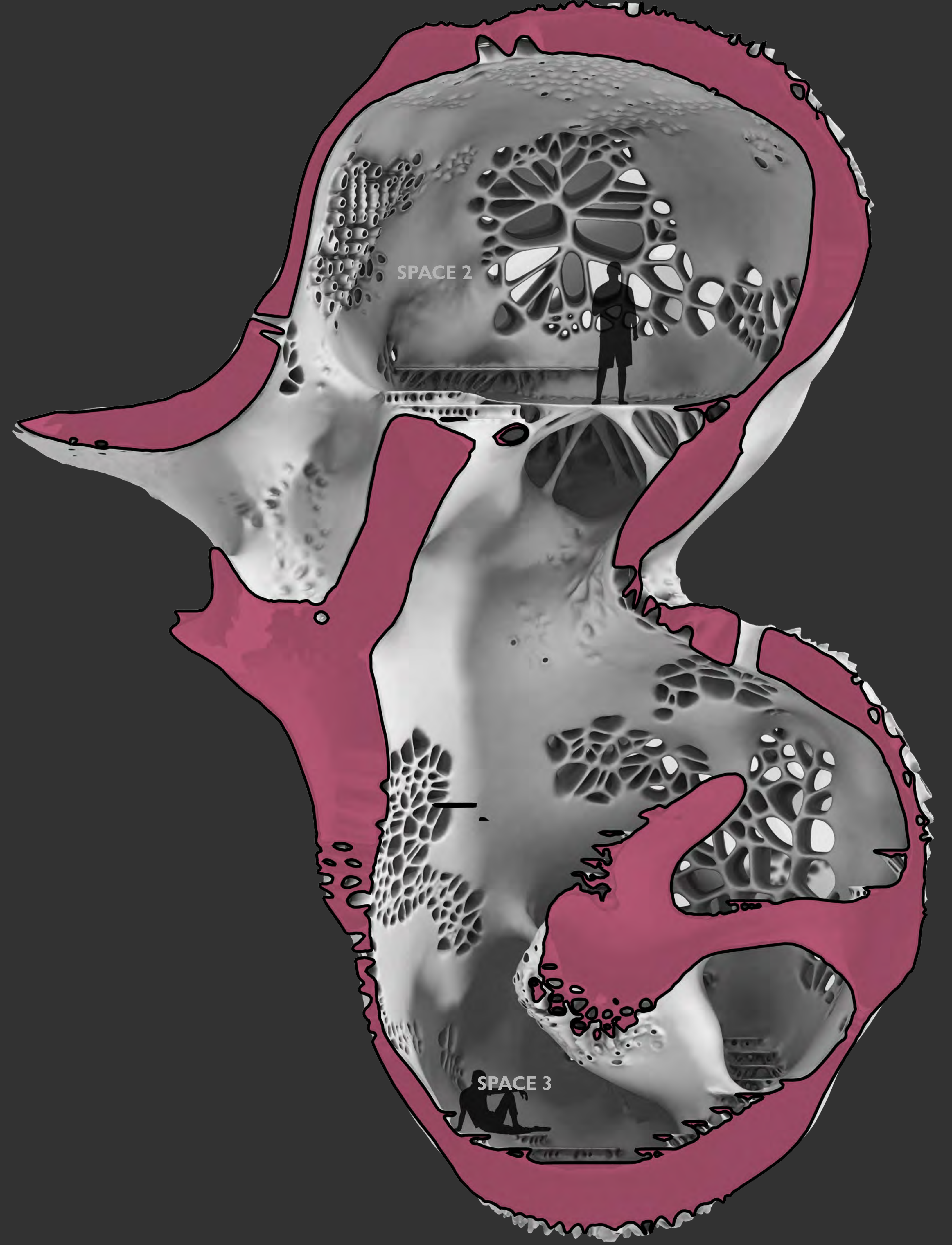
macro

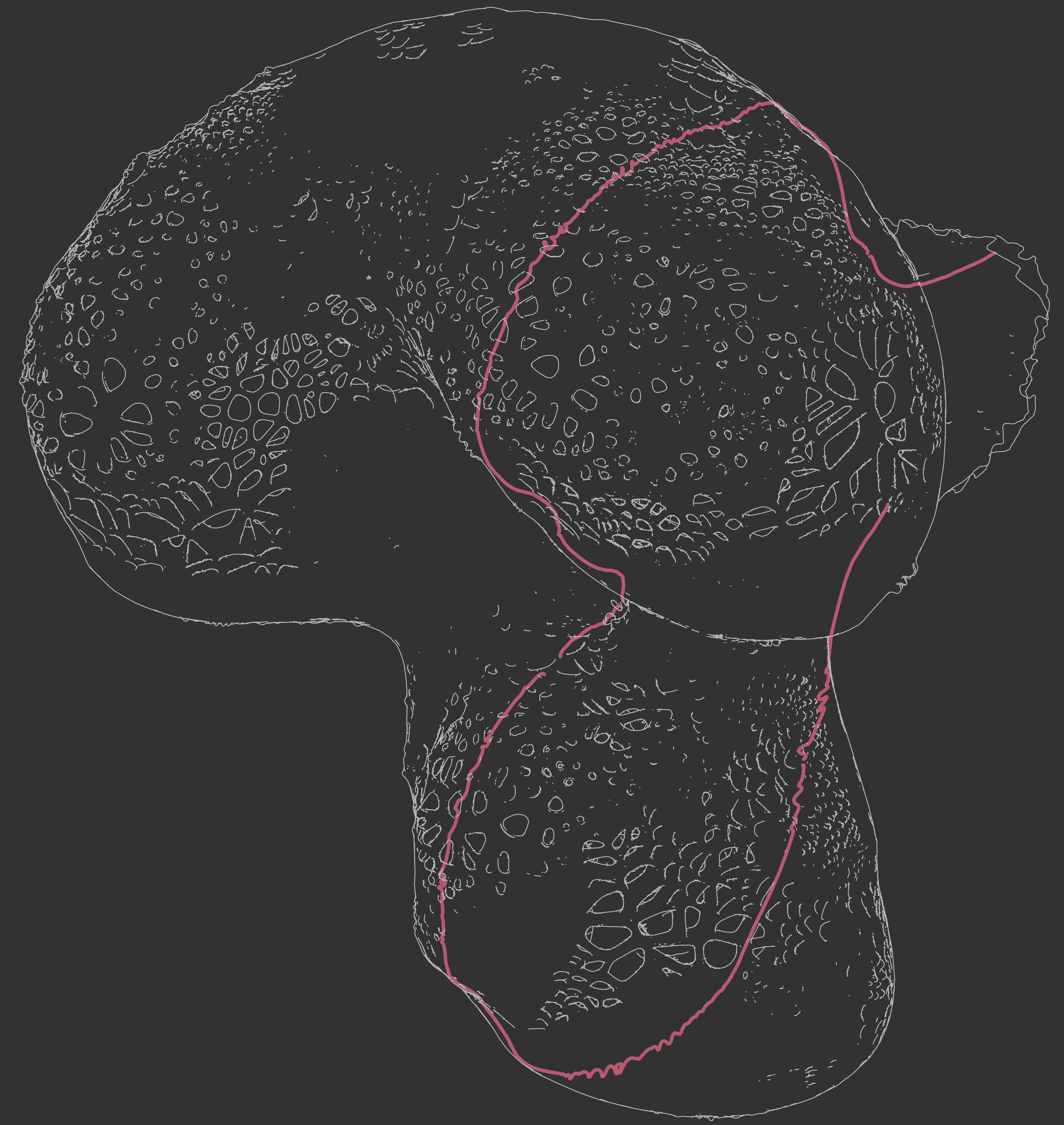
section

X-2

scale

2m





section

X-2

scale

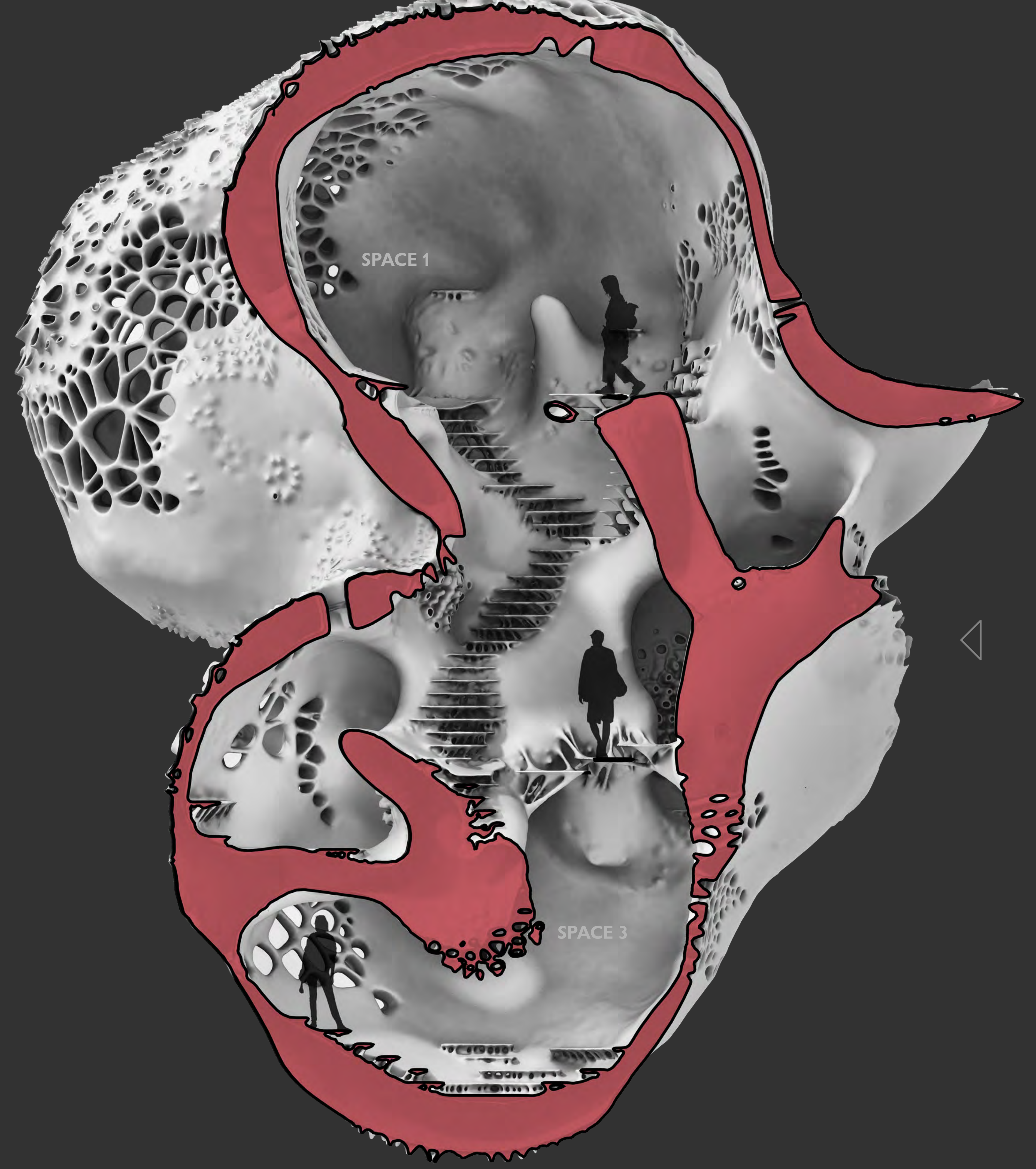
2m

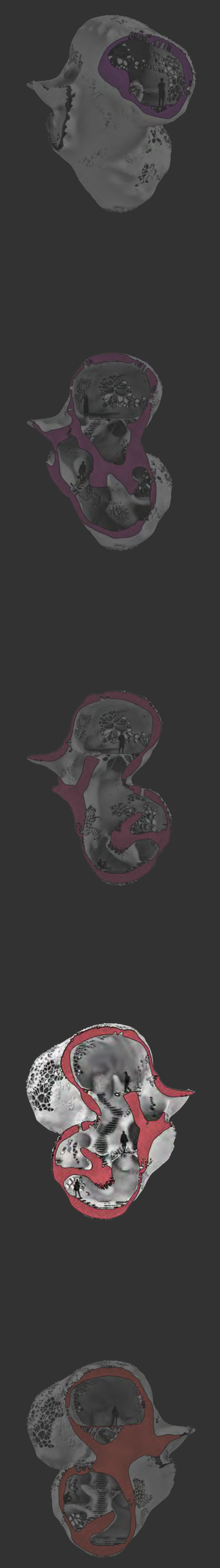
section

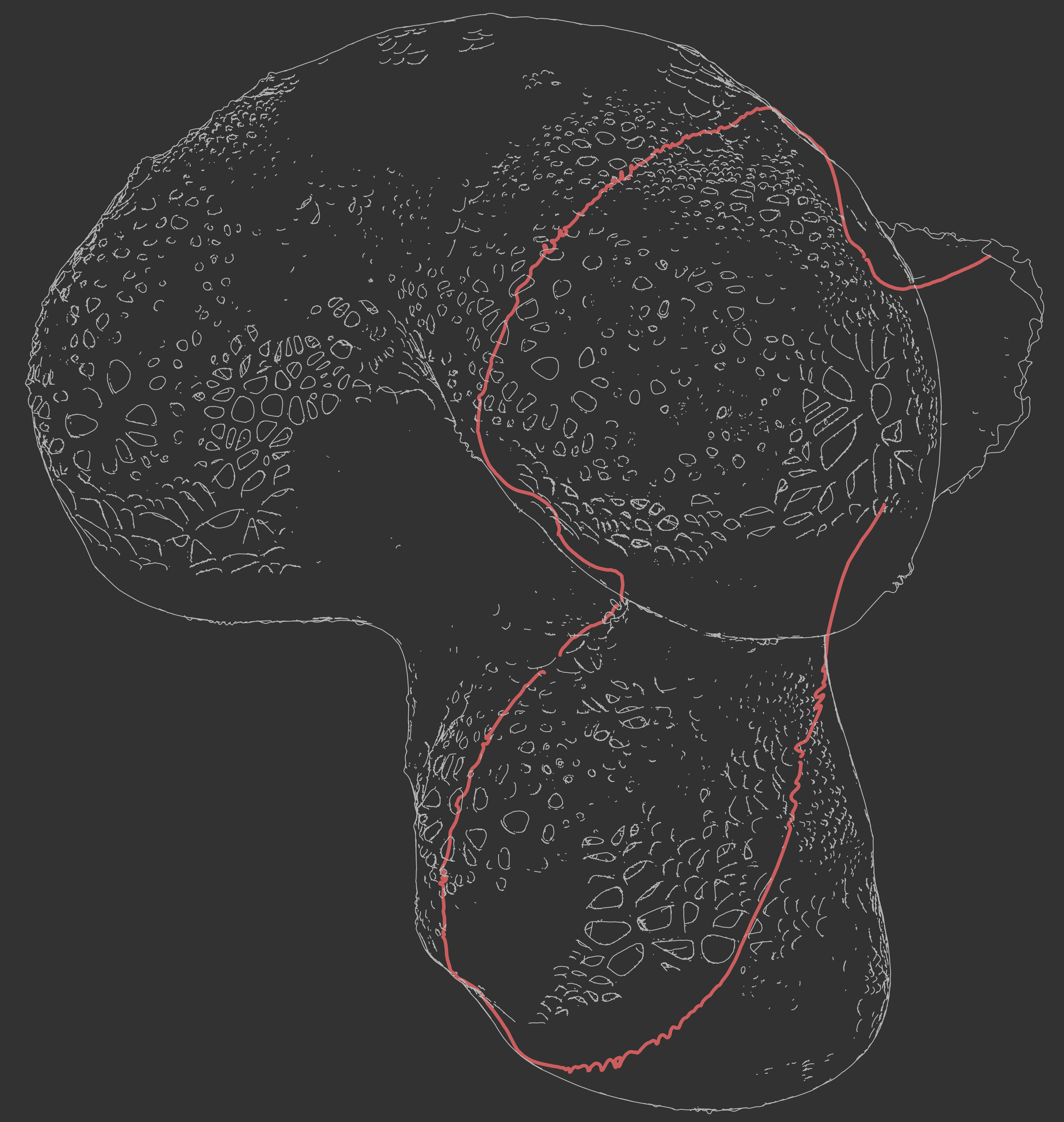
X-3

scale

2m







section

X-3

scale

2m

10^0

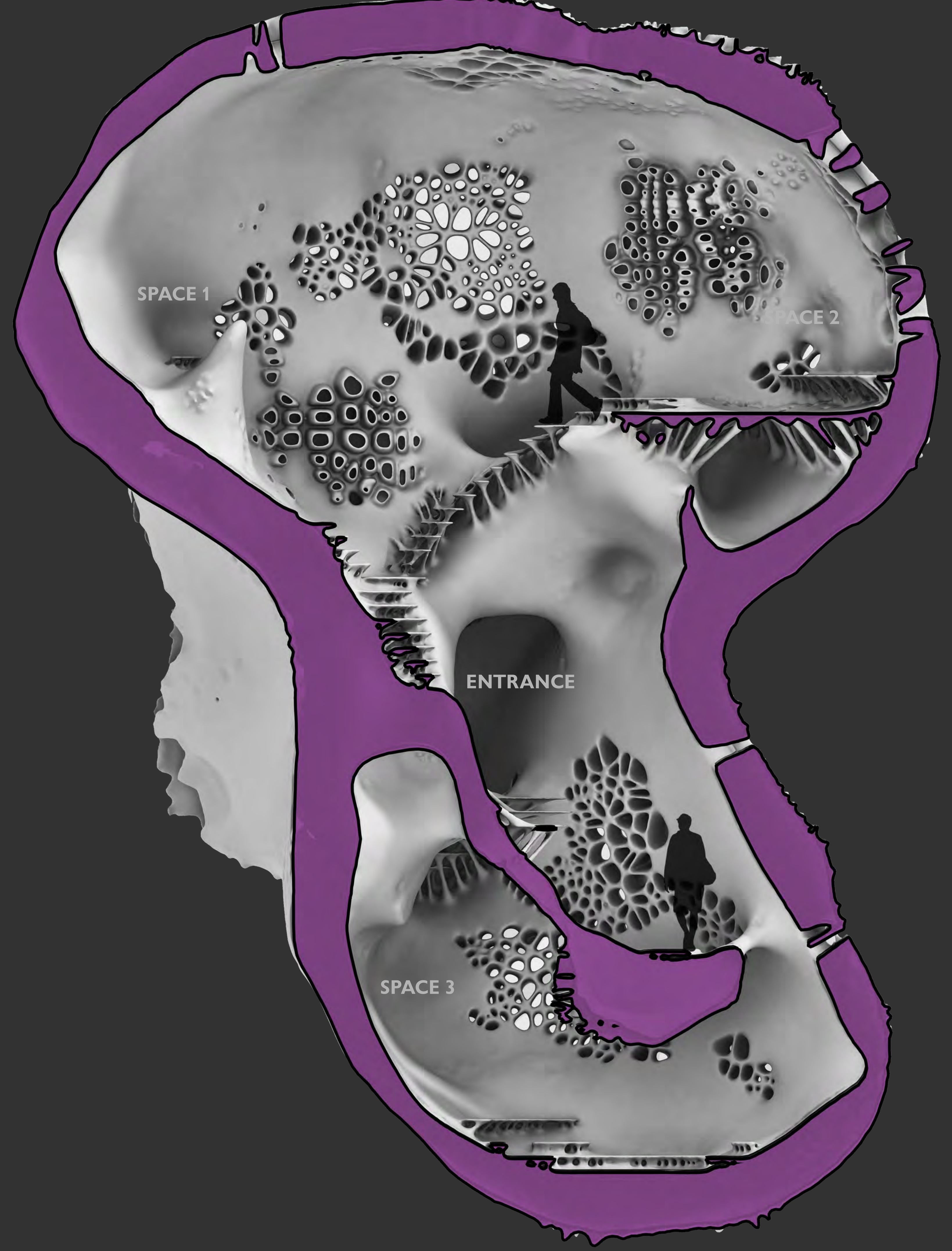
macro

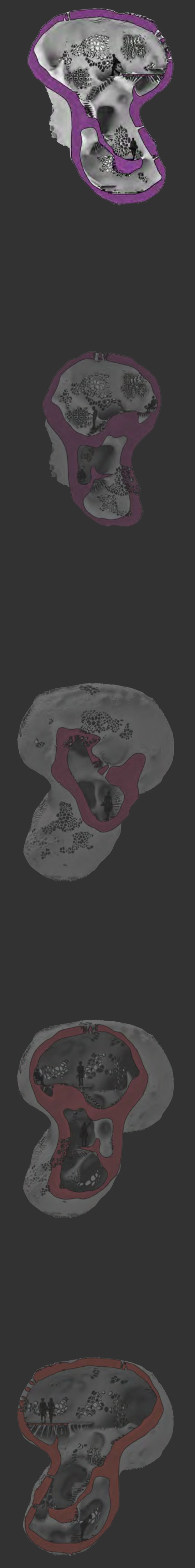
section

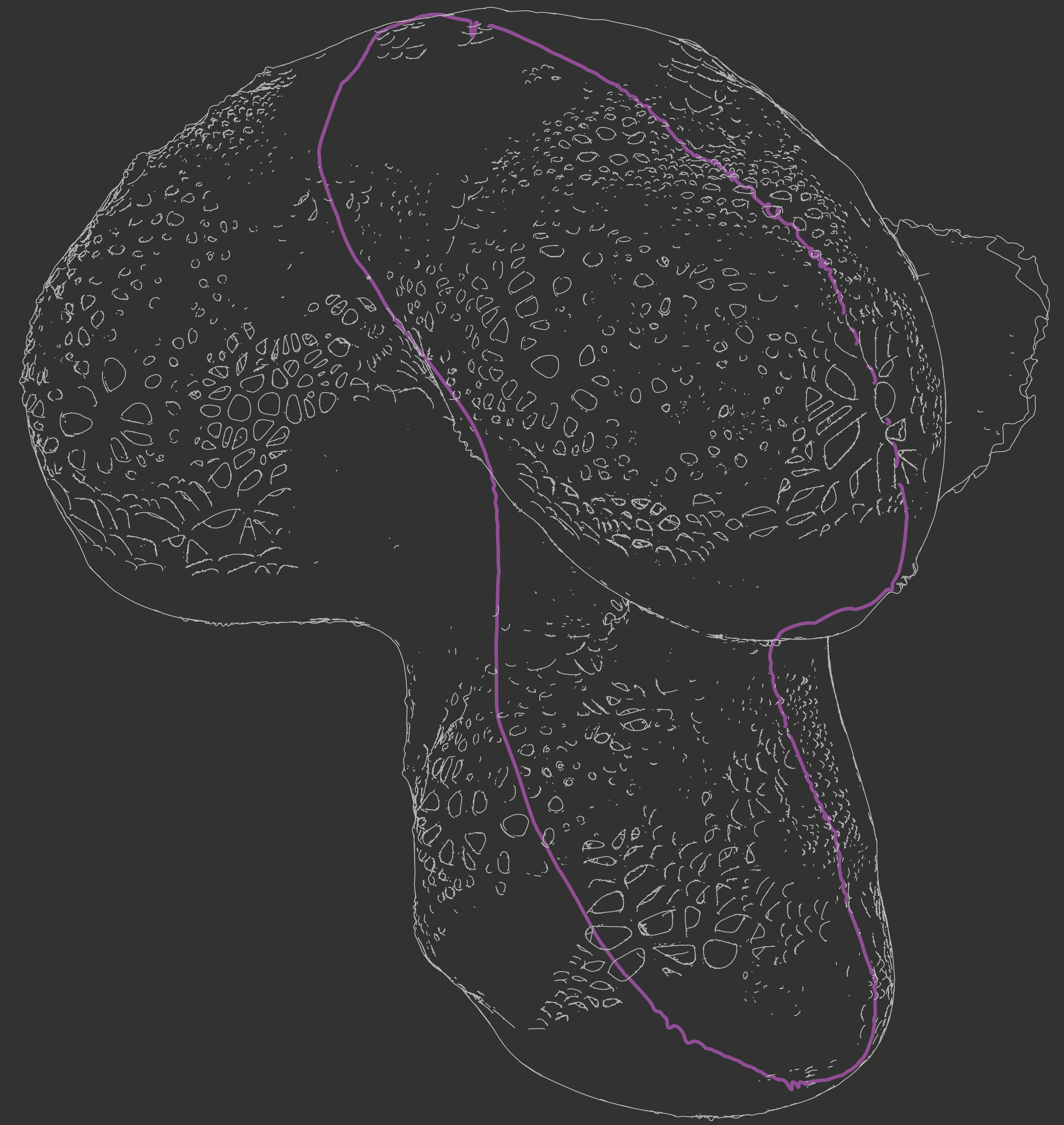
Y-0

scale

2m







section

Y-0

scale

2m

10^0

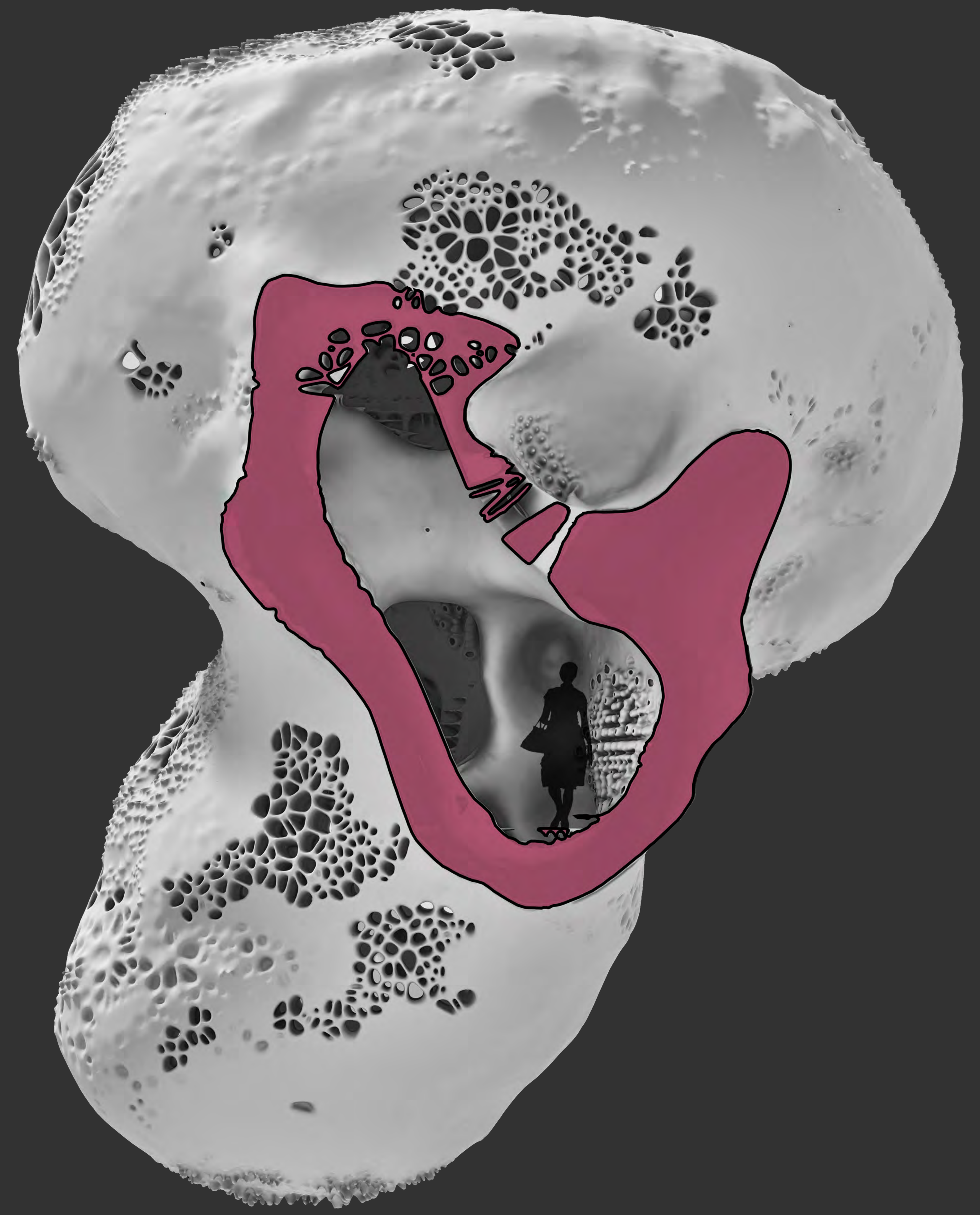
macro

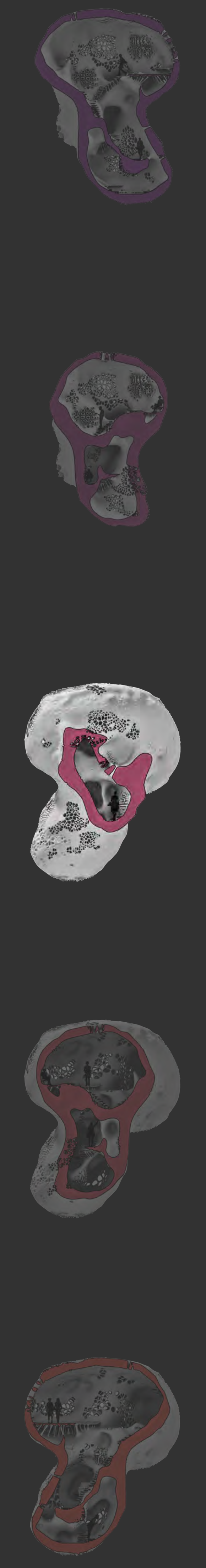
section

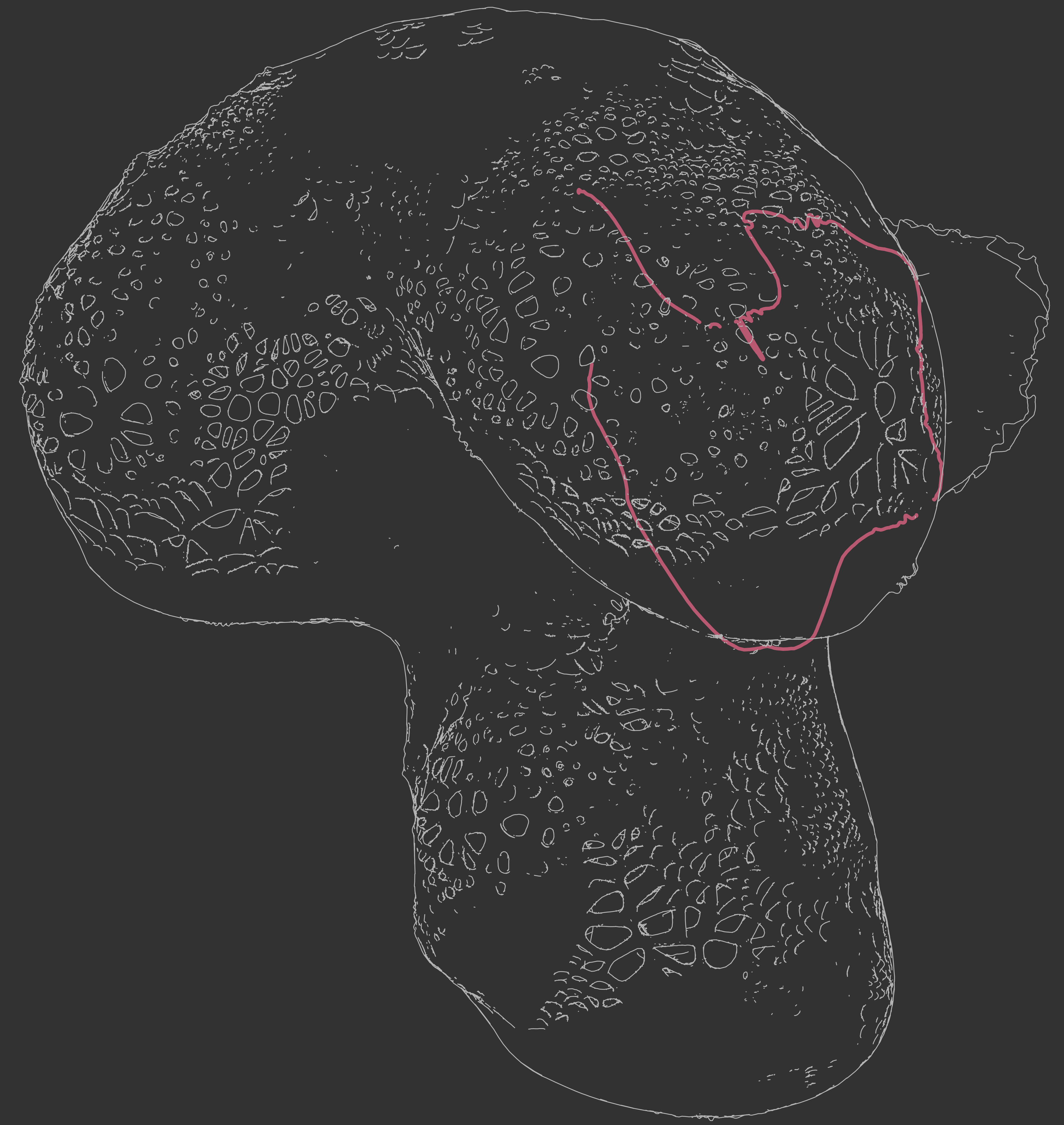
Y-2

scale

2m







section

Y-2

scale

2m

10^{0}

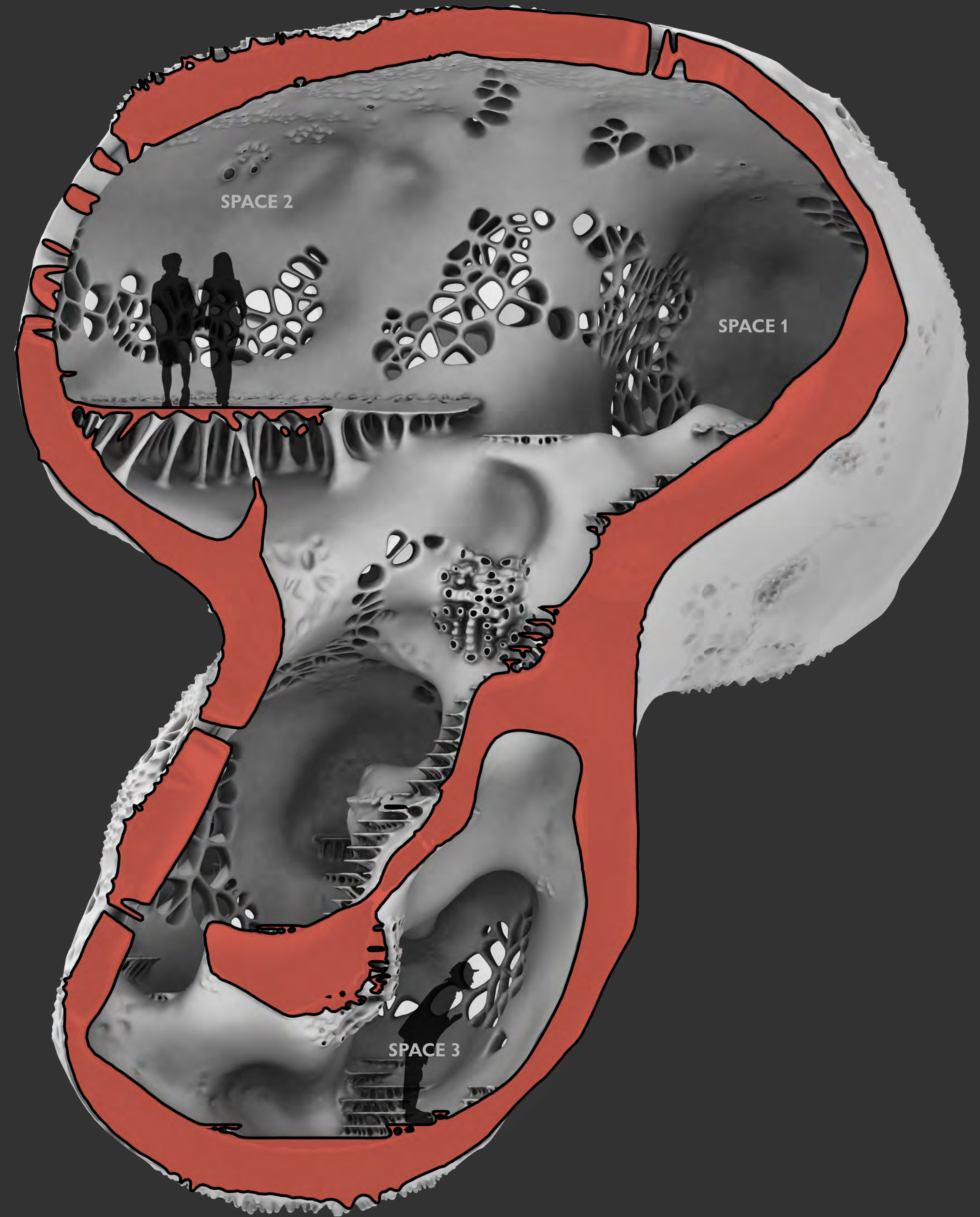
macro

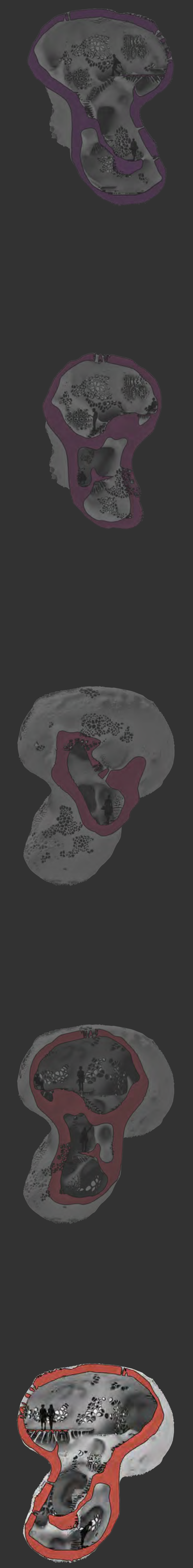
section

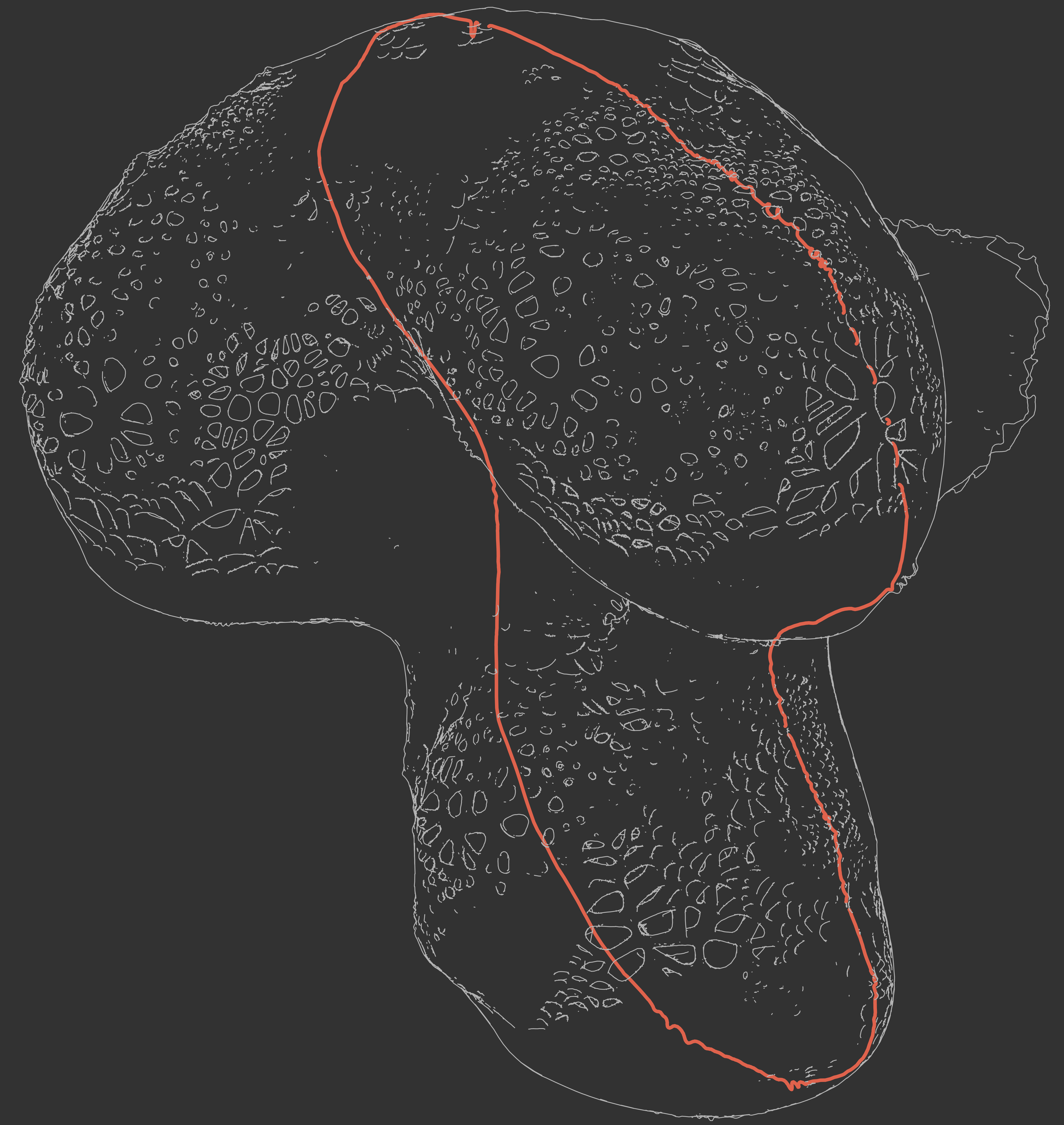
Y-4

scale

2m







section

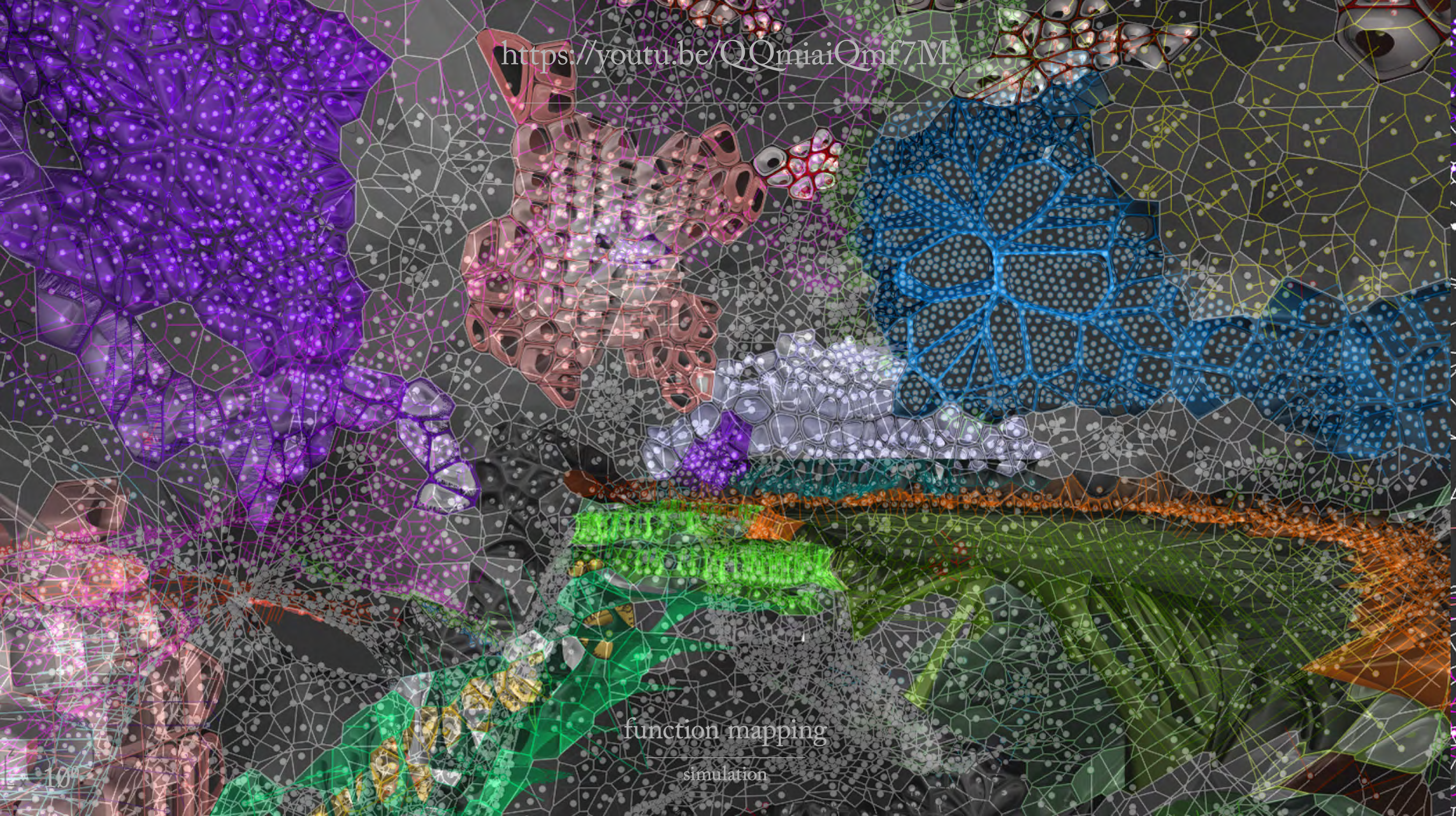
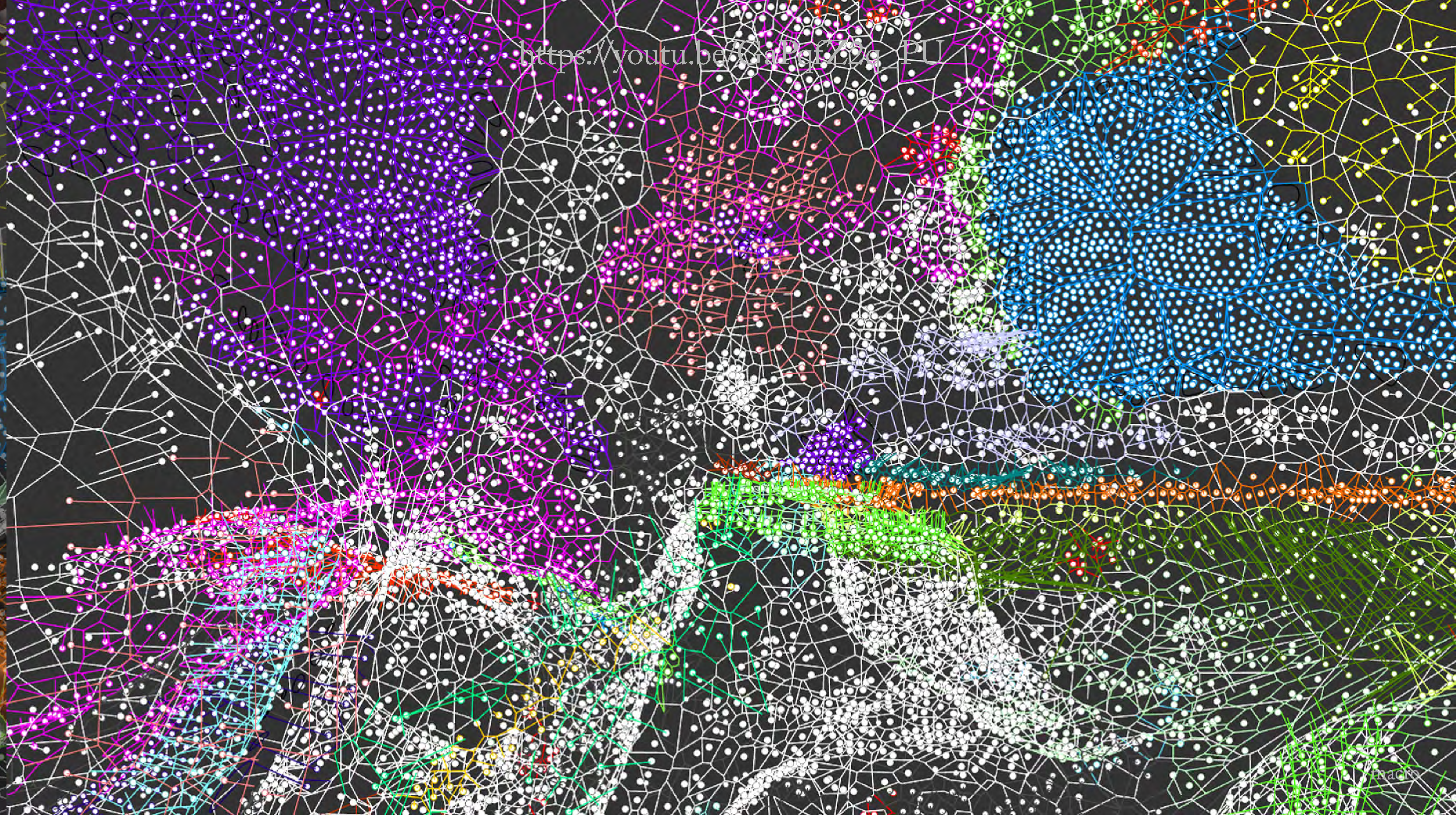
Y-1

scale

2m

1Ø^{0}

macro


https://youtu.be/QQmiaiQmf7M
function mapping
simulation

https://youtu.be/GaPqfZ2q_PU

source

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incidental space / swiss pavilion at venice architecture biennale 2016

venice, italy

june 30, 2016

christian kerez

incidental space / 2016

source

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incidental space / swiss pavilion at venice architecture biennale 2016

venice, italy

june 30, 2016

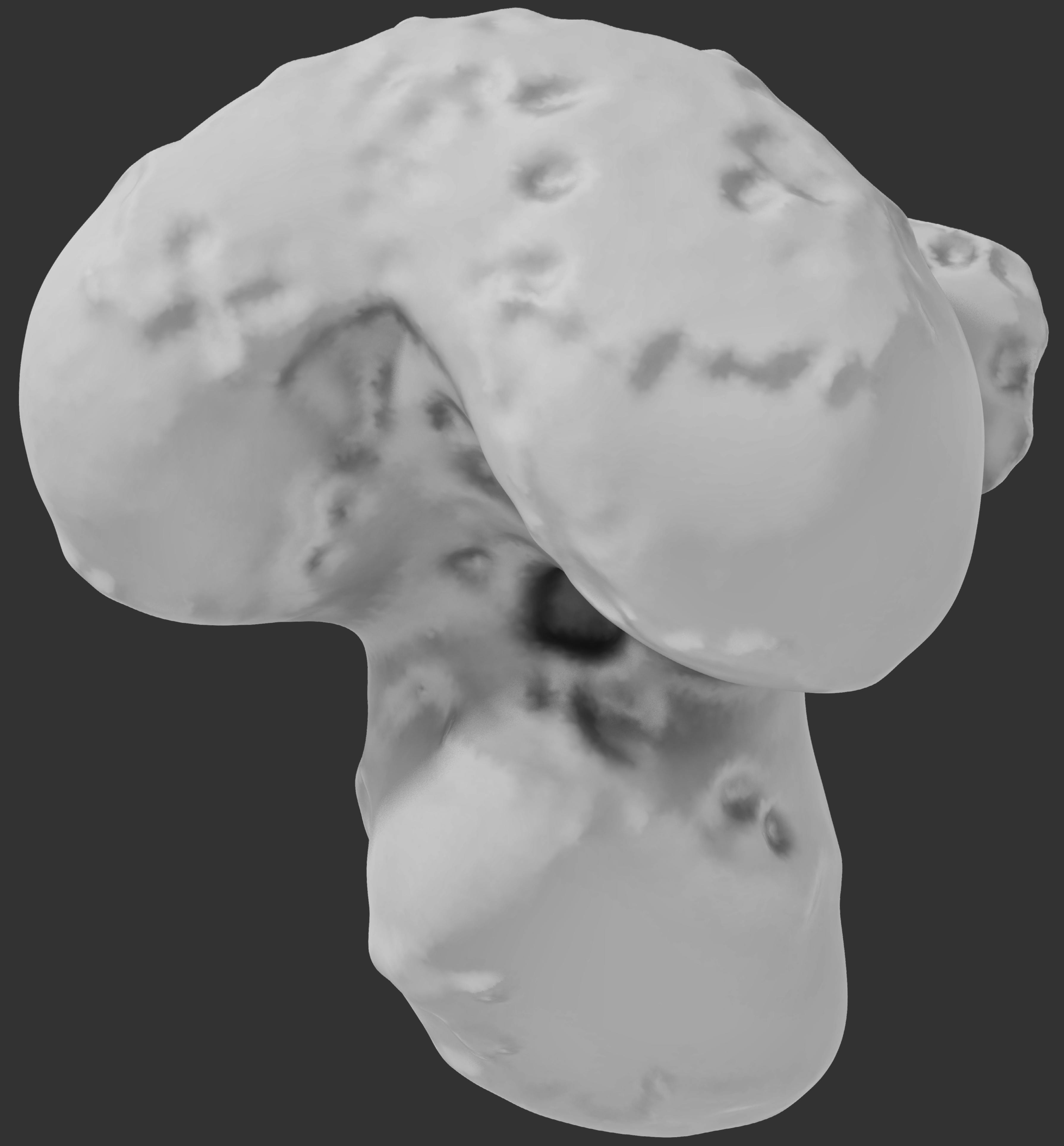
$1Ø^{-3}$

milli

$1Ø^{-3} = Ø{,}ØØ1$

scale

2m



fraction

selection

1Ø$^{-3}$

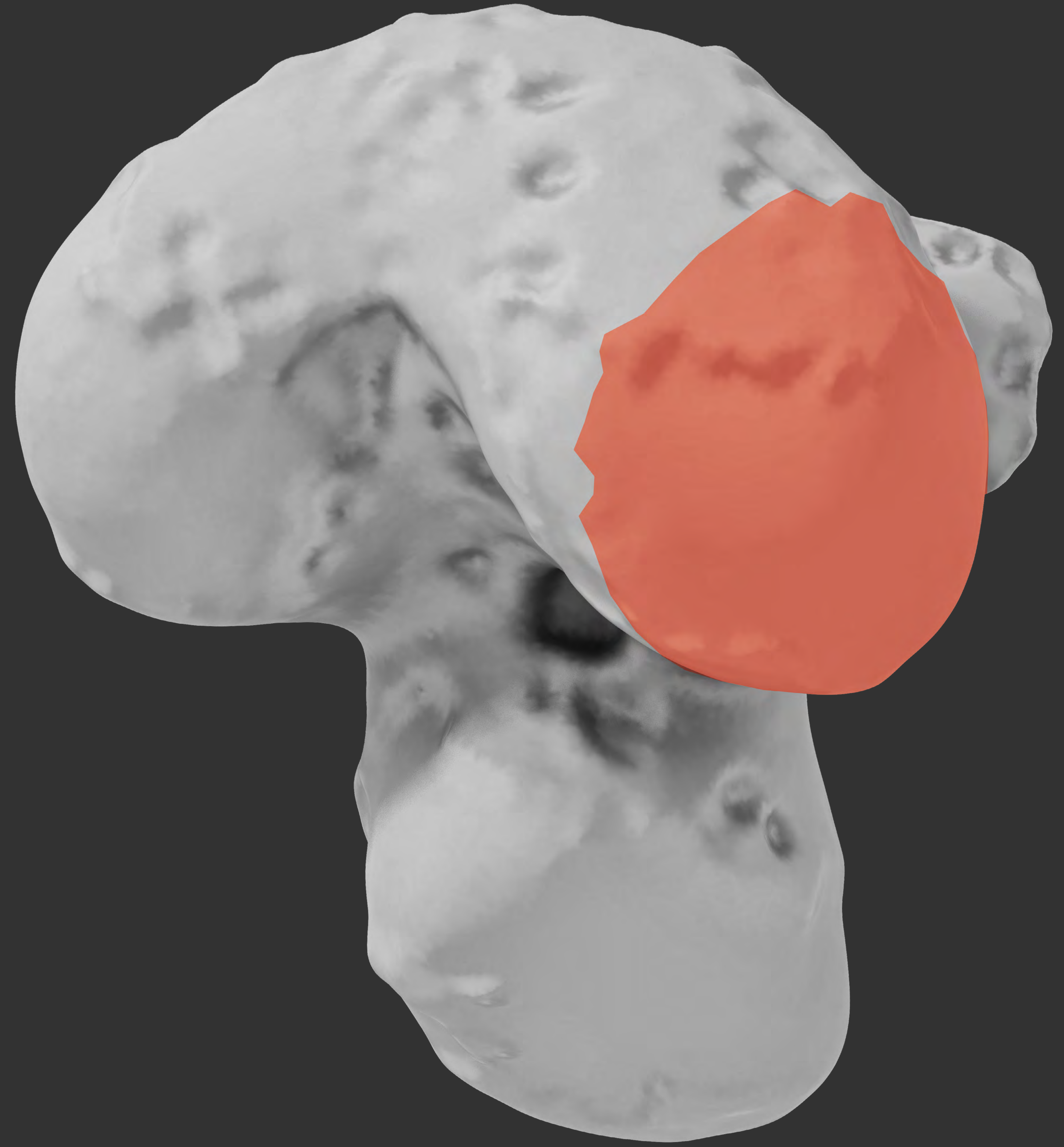
milli

1-20

selection

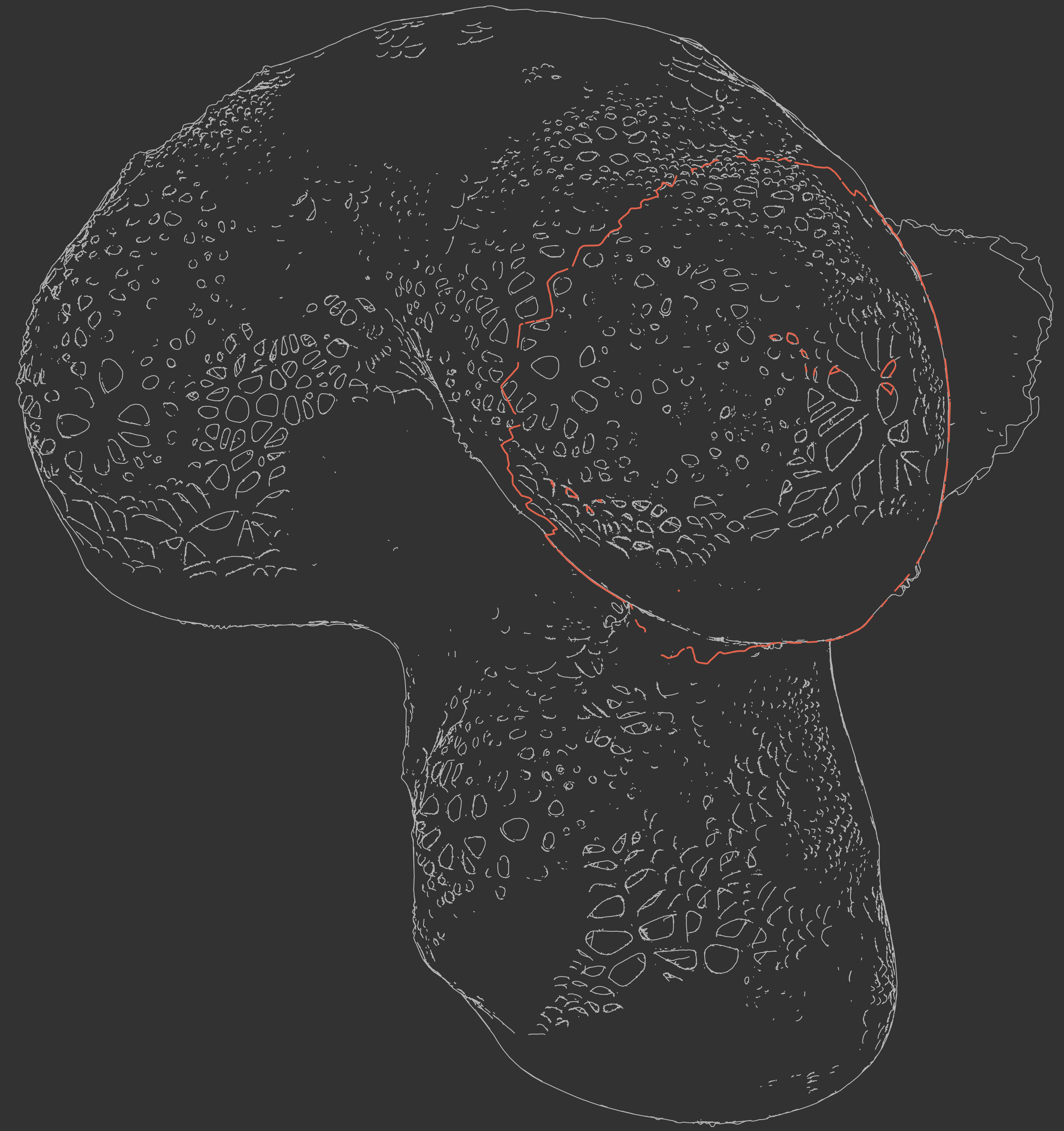
scale

2m



fraction

selection



1-20

selection

scale

2m

10-3

milli

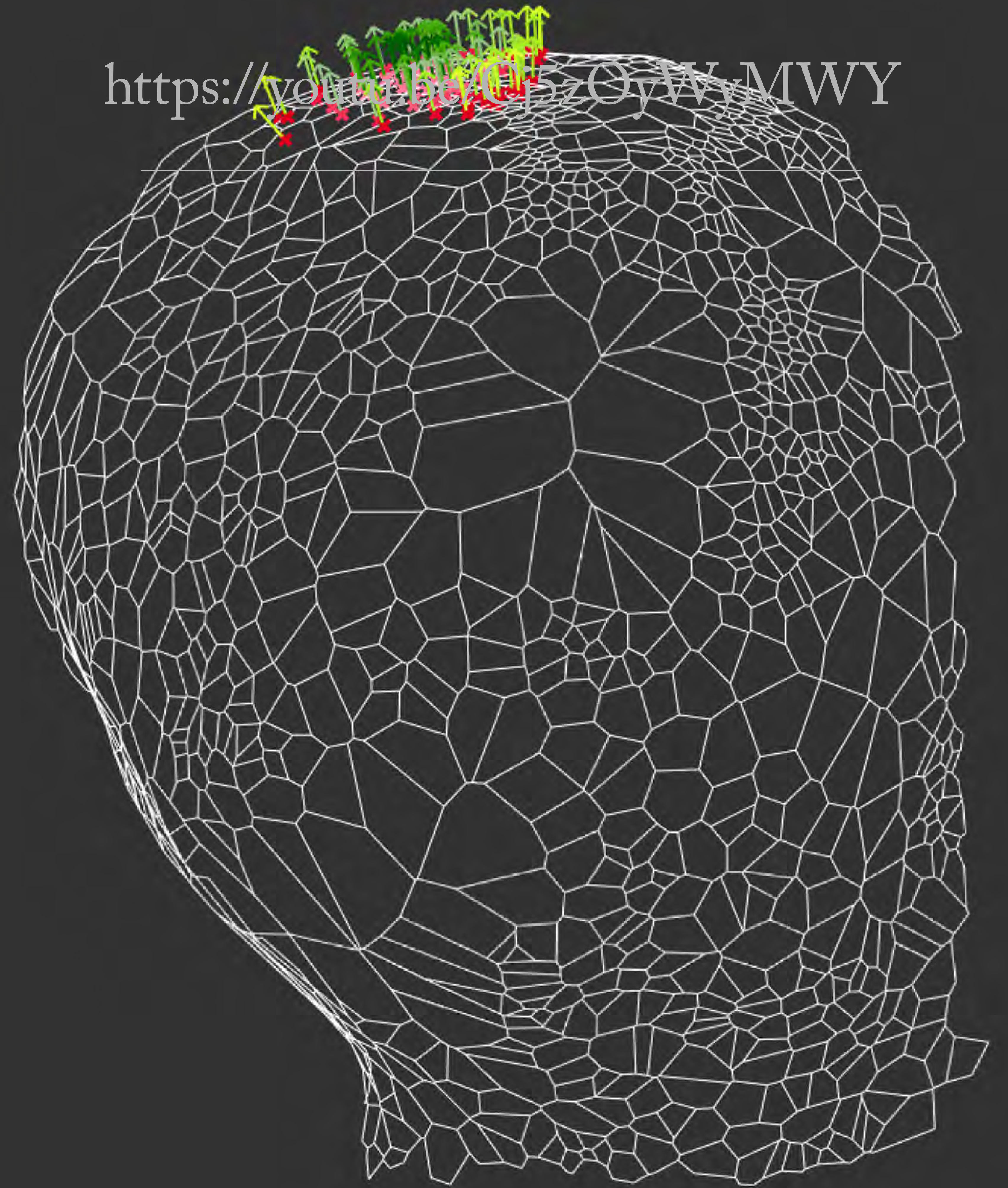
nesting out

scale

1m

nesting_shellOutside

mainLoop_3/666
subLoop_75/222
vectorNeighbour_-0.0609,0.1091,0.9922
vectorDiff_0.3257,0.2659,0.0407
cellsProcessed_0/1051
minArea_0.175m2
maxArea_0.733m2
testAreaTotal_0.645283m2
tolerance_10
mismatches_4
index0_13102
index1_13117
index2_13111
index3_13058
index4_13043
index5_13119
index6_13176
index7_13117
index8_13021
index9_13103
index10_13012
index11_13094
index12_13016
index13_13004
index14_13027
index15_13002
index16_13181
index17_12994
index18_13003
index19_13182
index20_13216
index21_13047
index22_12982
index23_12979
index24_13120
index25_13211
index26_12958
index27_13240
index28_13258
index29_13038
index30_12984
index31_13237
index32_12939



index33_13183
index34_12937
index35_13263
index36_13271
index37_13109
index38_13176
index39_12930
index40_13108
index41_12922
index42_12932
index43_13286
index44_13288
index45_13013
index46_12915
index47_13156
index48_12947
index49_13258
index50_13296
index51_12957
index52_13188
index53_12979
index54_13341
index55_12941
index56_13331
index57_13282
index58_13216
index59_13038
index60_13194
index61_13060
index62_13262
index63_13284
index64_13355
index65_13337
index66_12928
index67_13040
index68_12969
index69_13334
index70_13152
index71_12937
index72_13378
index73_13307
index74_13359

processing...

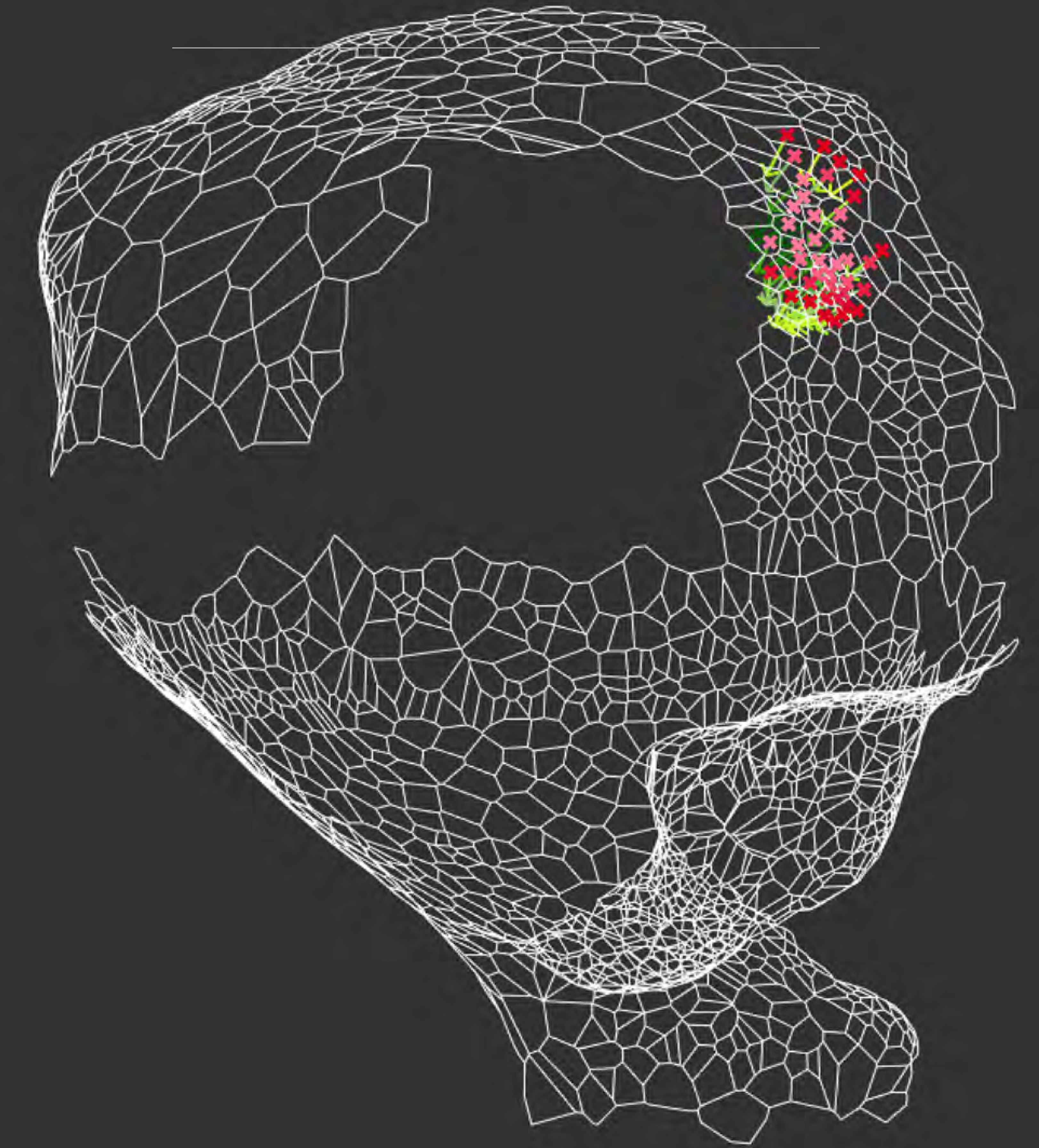
nesting cells

components

nesting_shellInside

mainLoop_42/1666
subLoop_41/333
vectorNeighbour_-0.7659,-0.4144,-0.4849
vectorDiff_0.1857,0.2579,0.0368
cellsProcessed_64/1635
minArea_0.1m2
maxArea_0.4252m2
testAreaTotal_0.328571m2
tolerance_13
mismatches_8
index0_13221
index1_13152
index2_13158
index3_13271
index4_13190
index5_13274
index6_13098
index7_13128
index8_13213
index9_13146
index10_13334
index11_13103
index12_13051
index13_13287
index14_13187
index15_13247
index16_13128
index17_13103
index18_13204
index19_13037
index20_13153
index21_13025
index22_13329
index23_13289
index24_13072
index25_13187
index26_13357
index27_13240
index28_12981
index29_13154
index30_13107
index31_12955
index32_13172

https://youtu.be/tS1duyn235o



index33_13068
index34_13303
index35_12992
index36_13344
index37_13208
index38_13010
index39_13256
index40_12954

processing...

nesting in

scale

1m

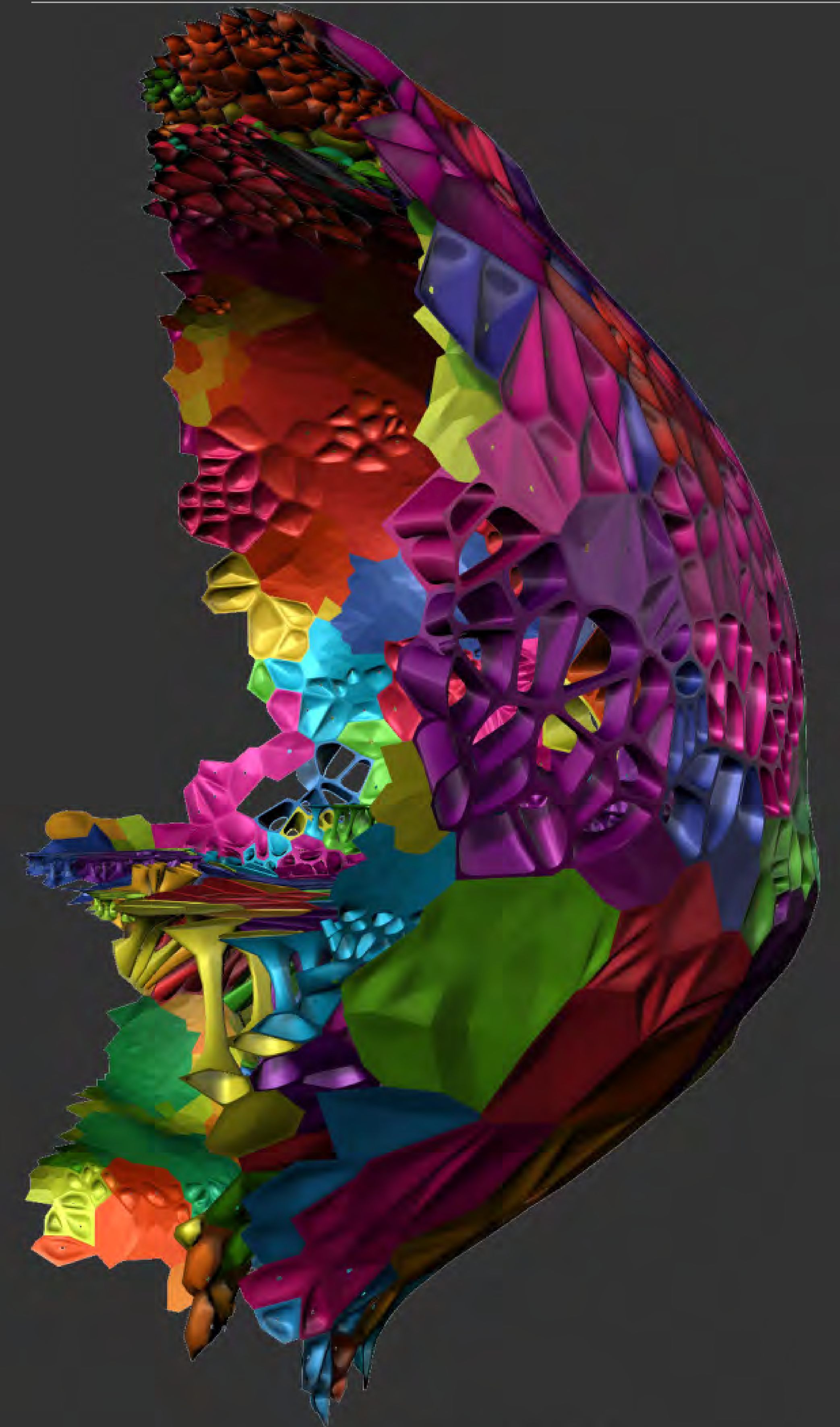
10^{-3}

milli

scale

1m

https://youtu.be/tff3zxOBMFg



components

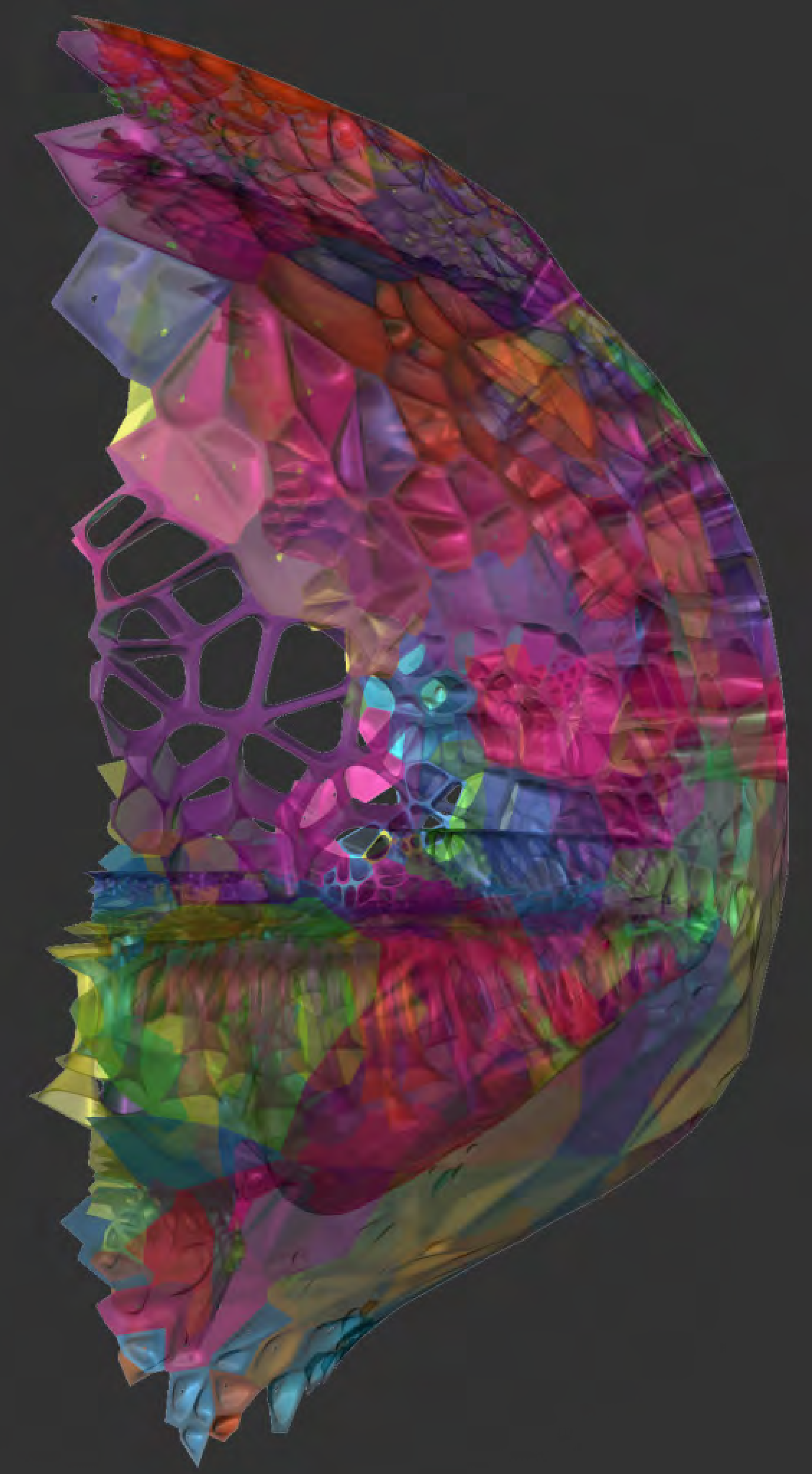
cluster

10^{-3}

scale

1m

https://youtu.be/qqnl6yeI58E



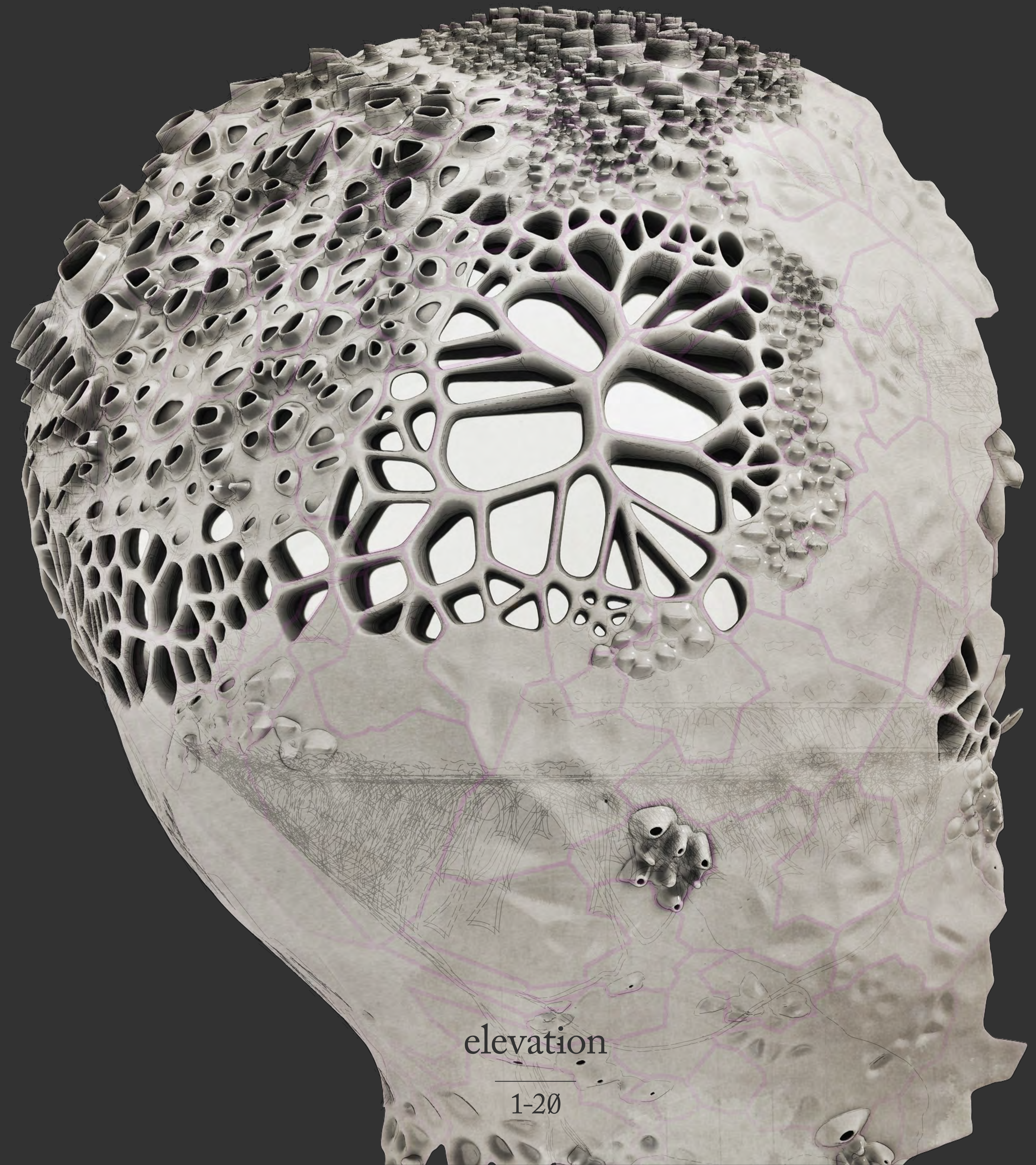
milli

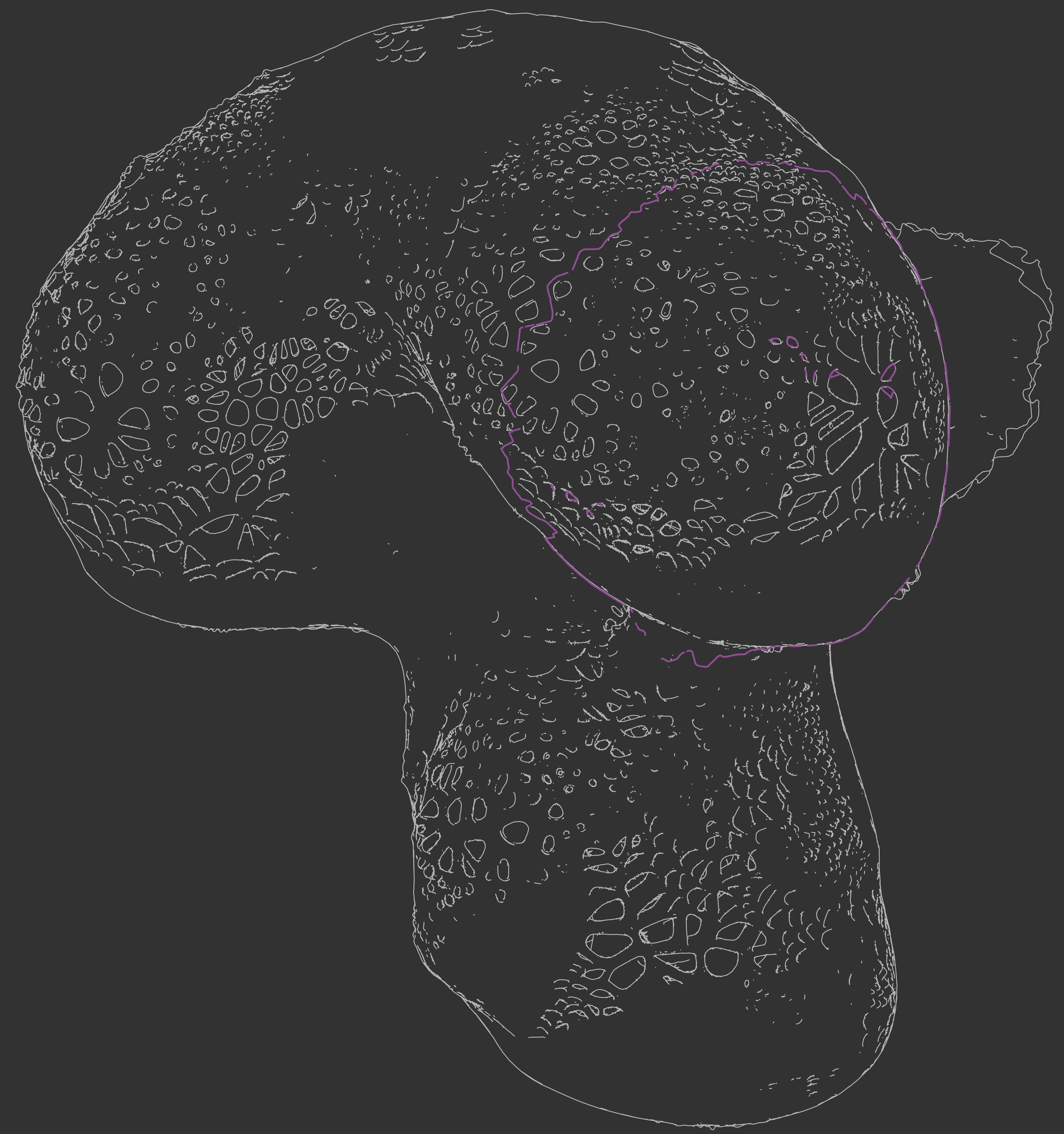
elevation

components

scale

1m





elevation

selection

scale

2m

1Ø-3

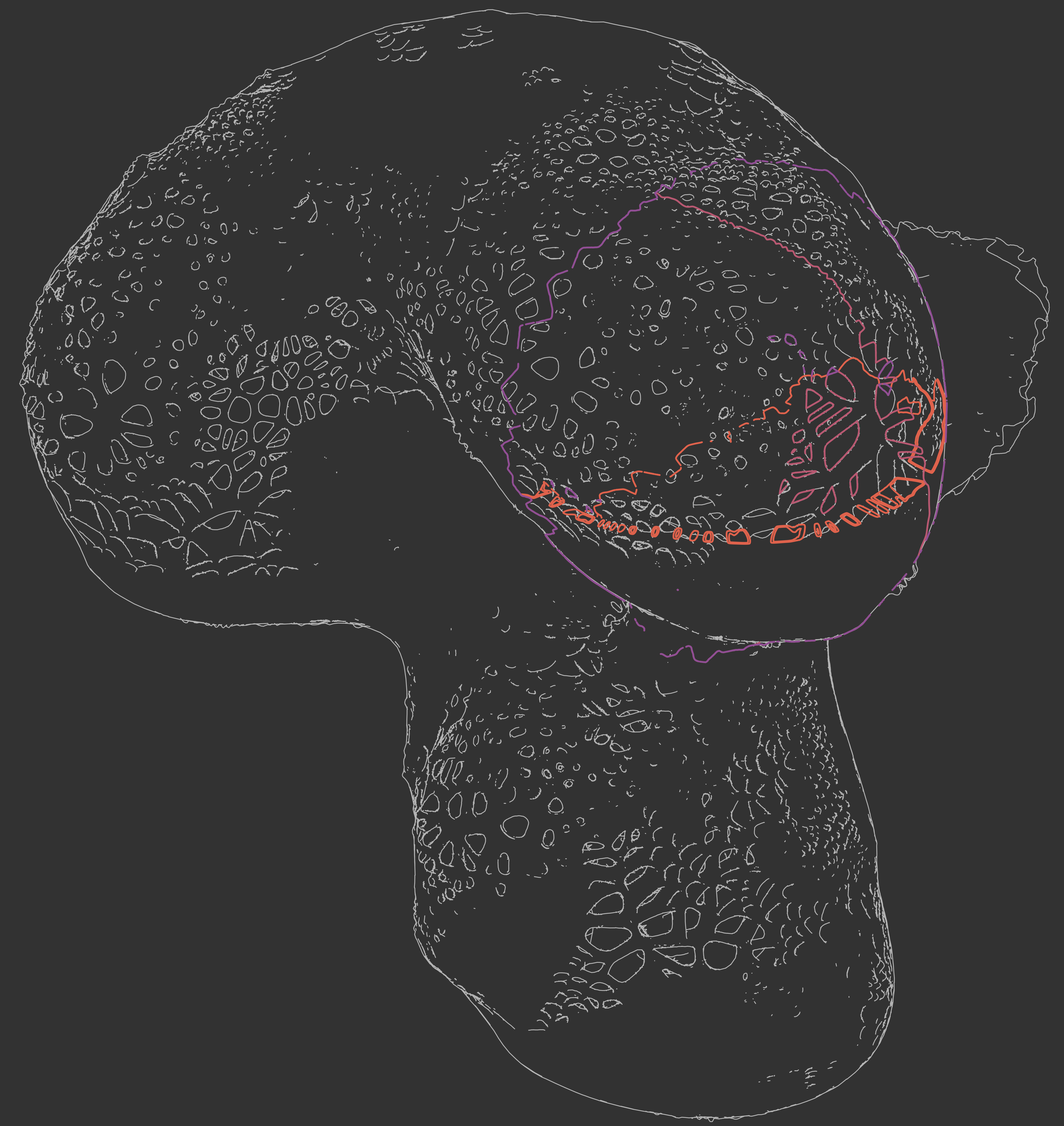
milli

elevation

components

scale

1m



1-20

elevation

section x

section z

scale

2m

10^{-3}

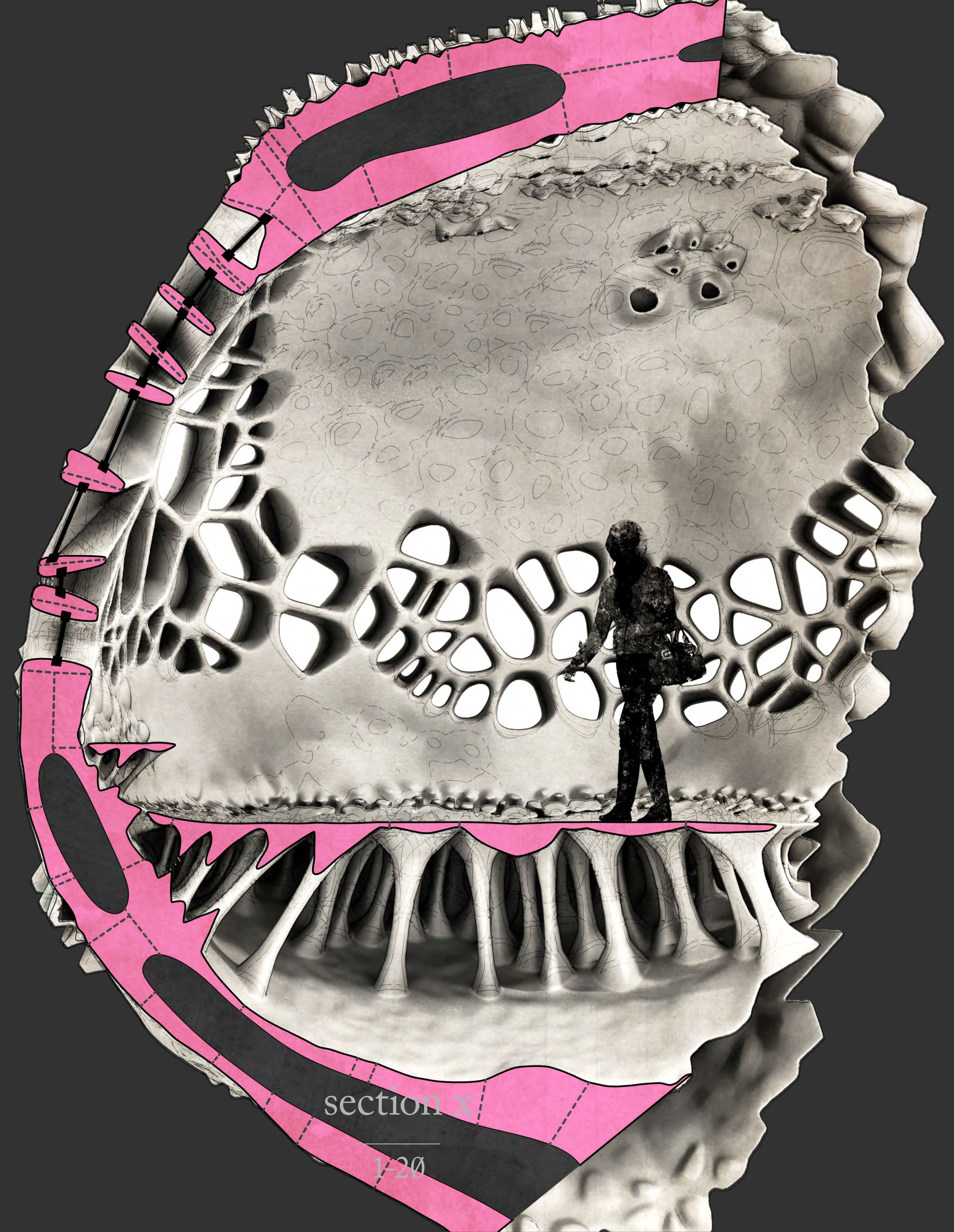
milli

section

cut

scale

1m

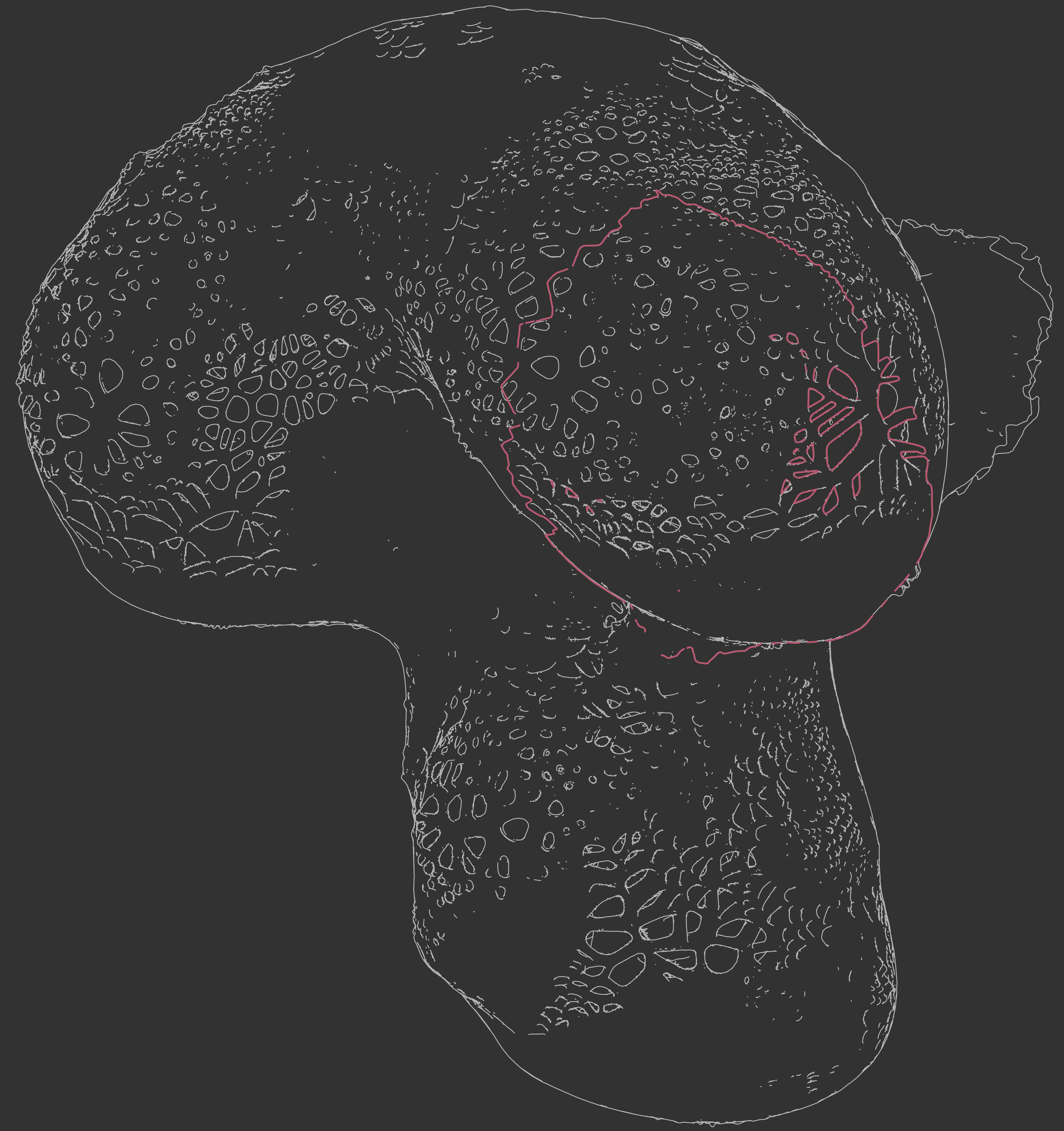


1-20

section x

scale

2m



1Ø-3

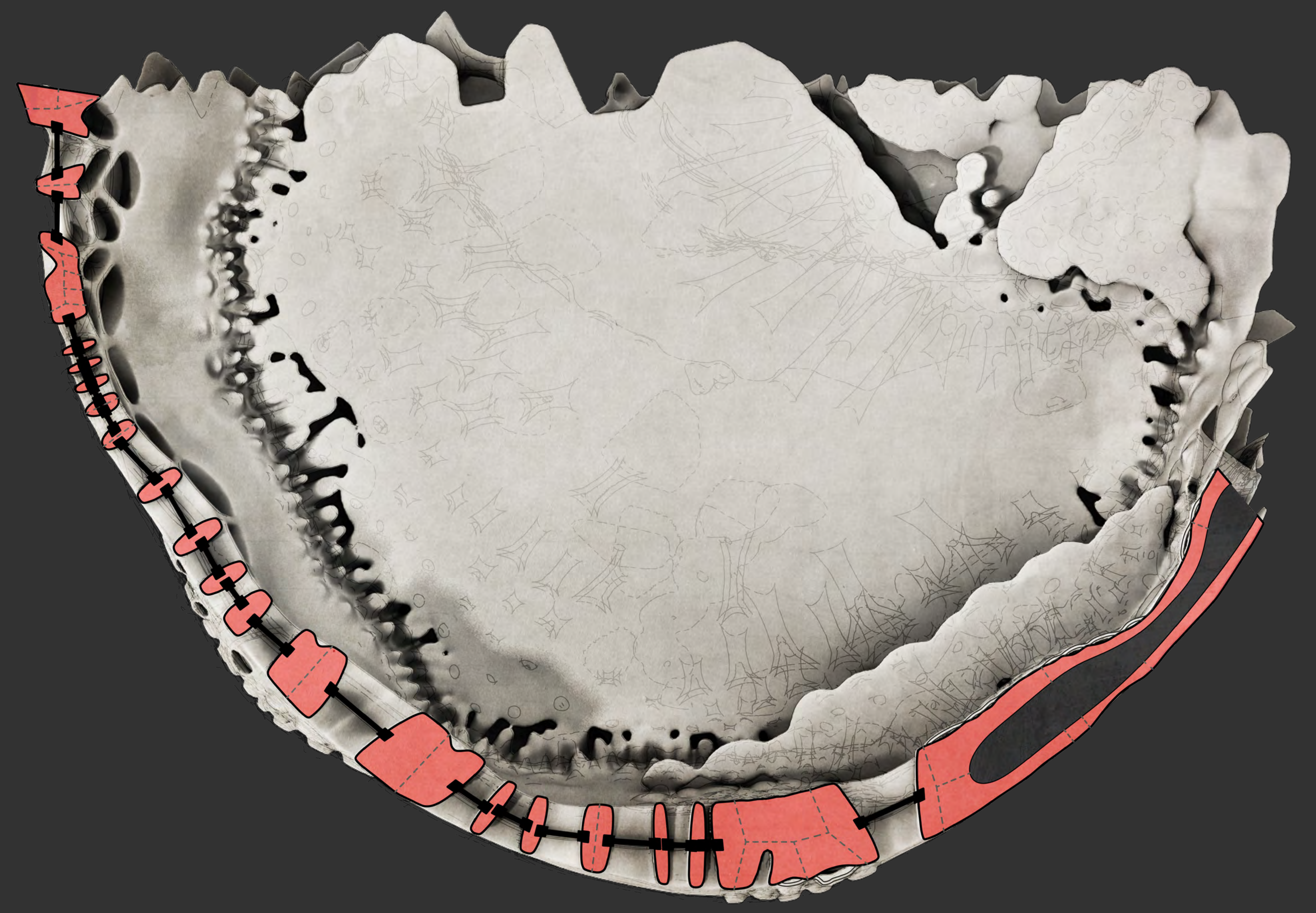
milli

floor plan

cut

scale

1m



section z

1-20

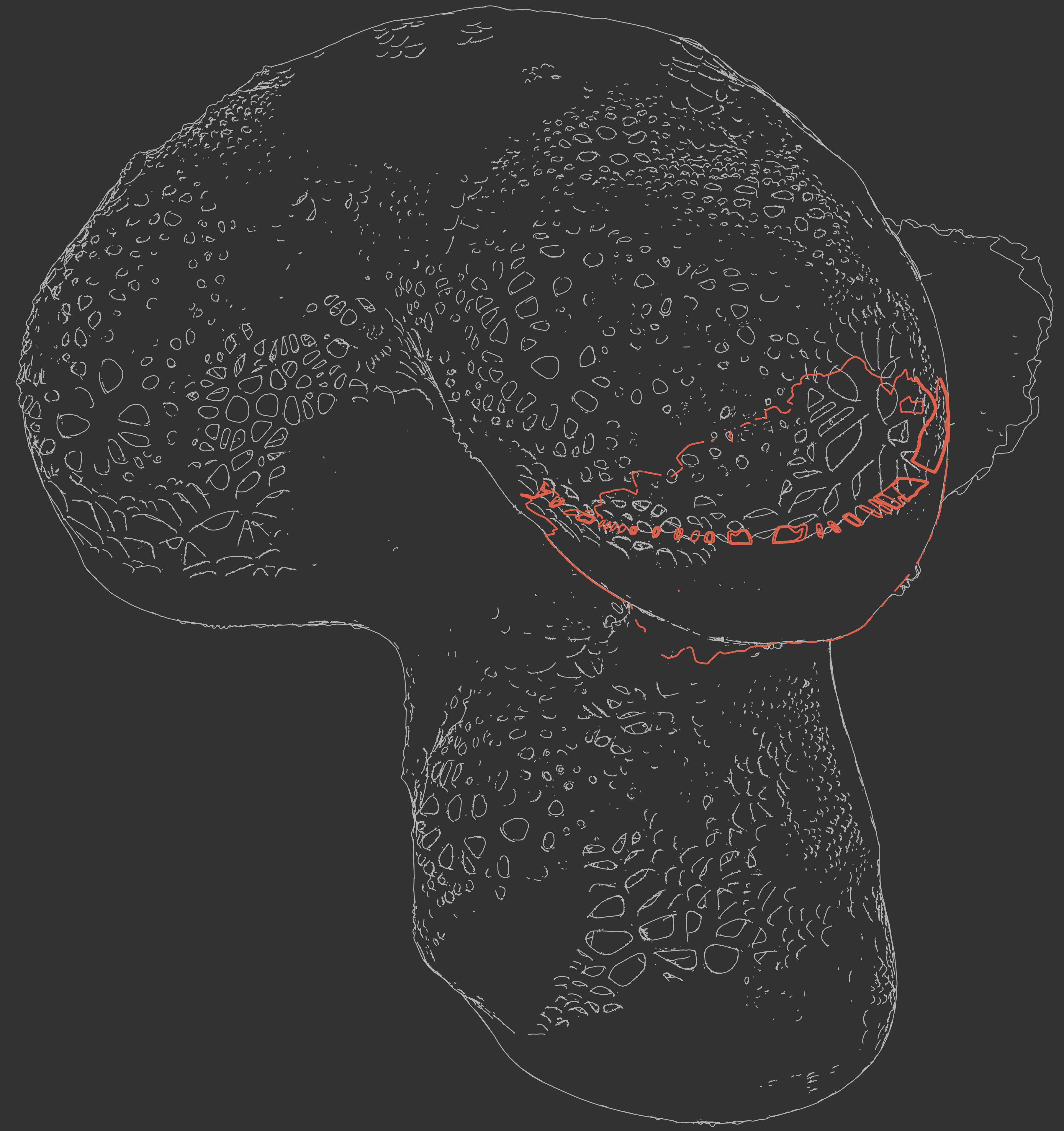
10^{-3}

1-20

section z

scale

2m



color study

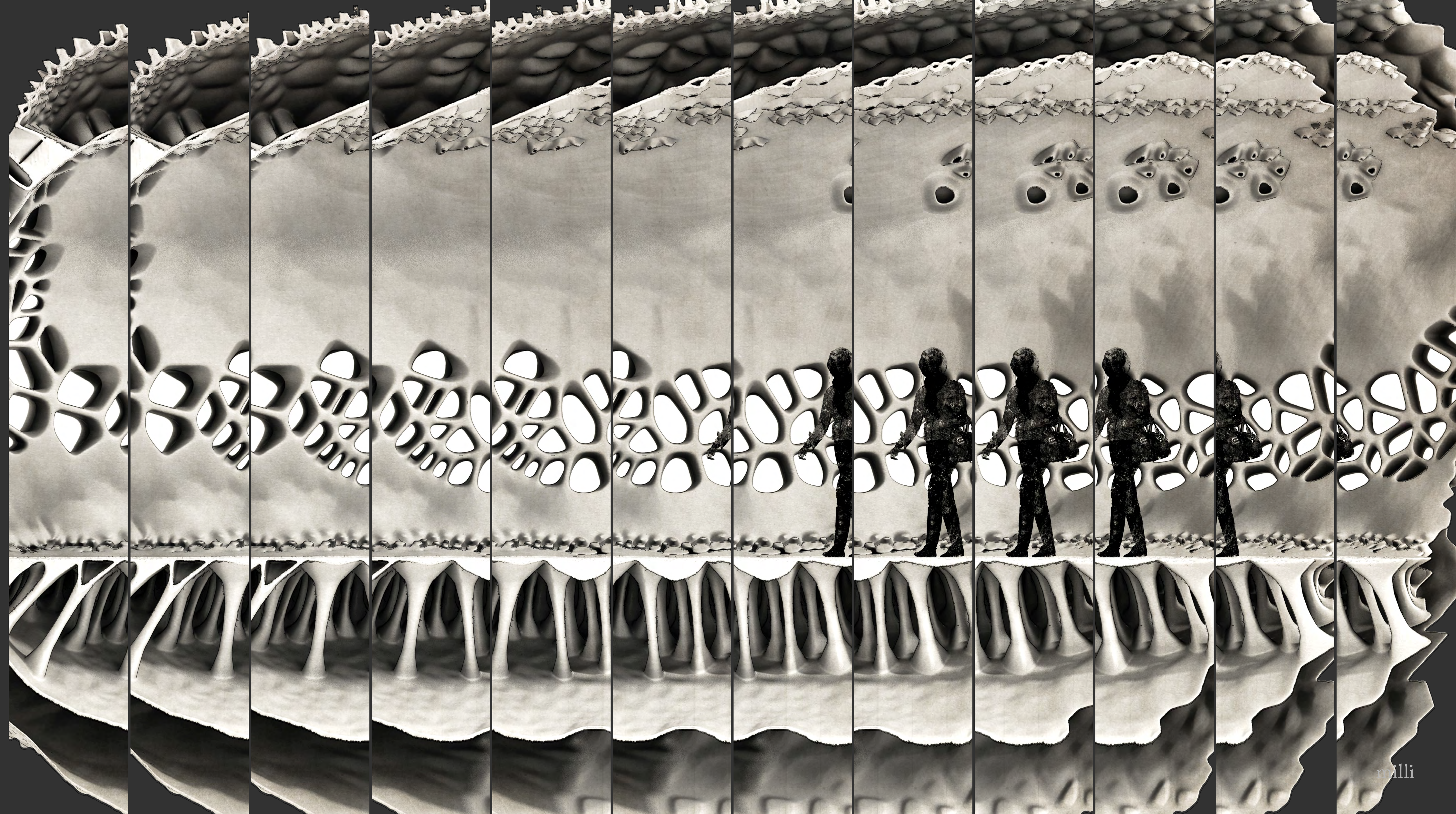
neutral

scale

1m

color inside

case study

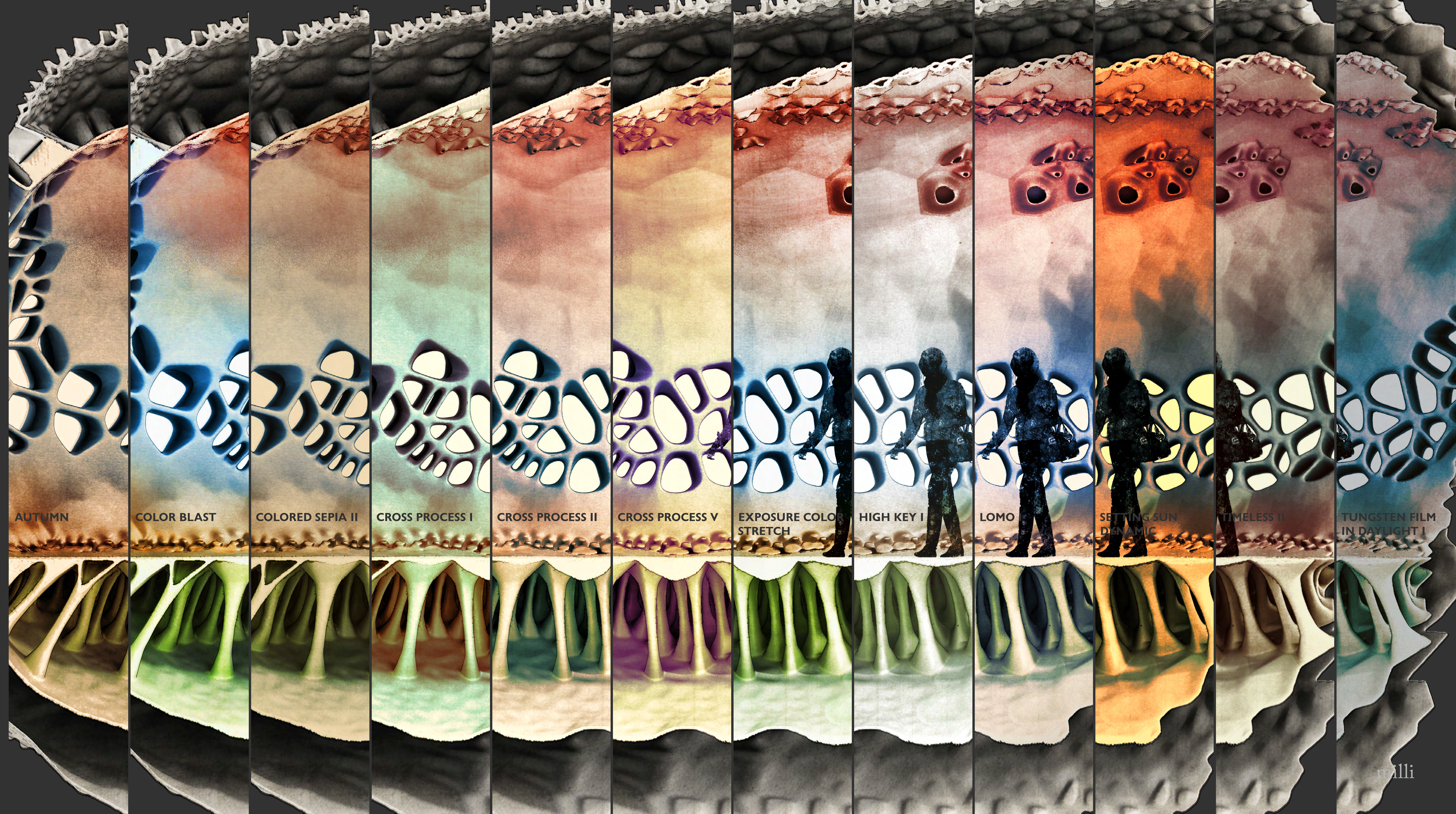


color study

cross process V

scale

1m



color inside

case study

$1Ø^{-3}$

https://youtu.be/1sU2V5ri-zc

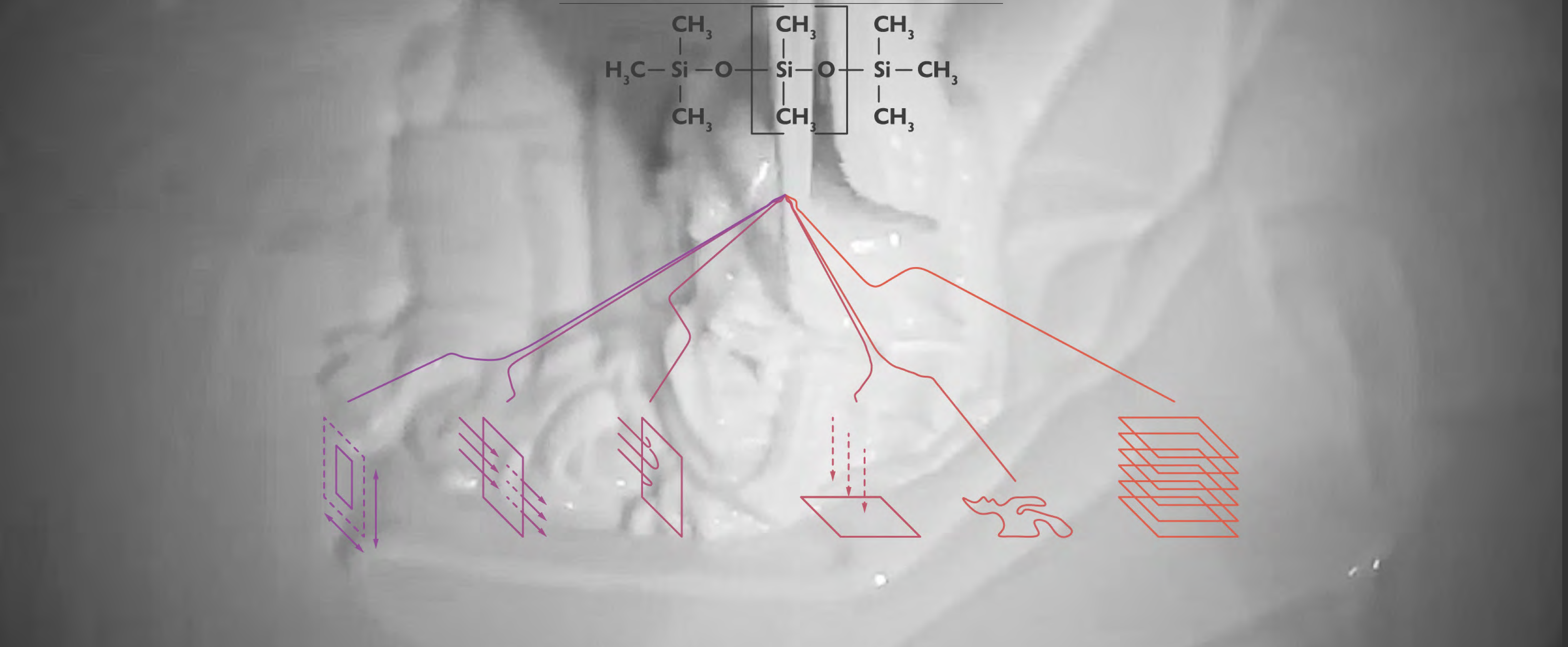
https://youtu.be/q88Xz84gIOg

$1\emptyset^{-6}$

micro

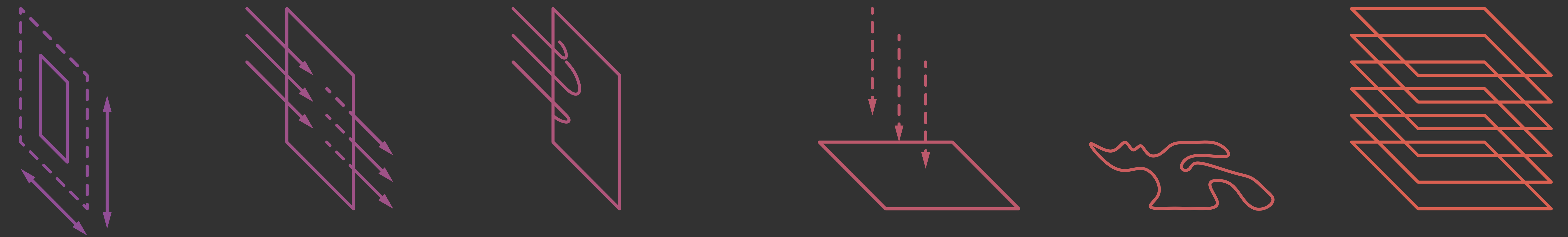
$1\emptyset^{-6} = \emptyset{,}\emptyset\emptyset\emptyset.\emptyset\emptyset1$

https://youtu.be/M2S18pDyEMY



robotic production

material



HIGH FLEXIBILITY

FLEX FATIGUE RESISTANCE

TEAR STRENGTH

TENSILE STRENGTH

TRANSLUCENCY

GAS PERMABILITY

TRANSPARENCY

COLORING PROPERTIES

HEAT RESISTANCE

THERMAL CONDUCTIVITY

FLAME RETARDANCY

COLD RESISTAANCE

GOOD WEATH-ERABILITY

RADIATION RESISTANCE

WATER REPELLENCY

MOISTURE + STEAM RESISTANCE

RESISTANCE TO OILS, SOLVENTS, CHEMICALS

ELECTRICAL INSULATION

GOOD COM-PRESSION CHAR-ACTERISTICS

VIBRATION ABSORPTION

FREEFROM-ABILITY

RELEASABILITY

NON-COR-ROSIVITY

PHYSIOLOGI-CALLY INERT

COMBINABILITY

HIGH VISCOSITY

MODIFIABILITY OF MATERIAL PROPERTIES

silicone 3d print

1st iteration


kuka agilus 1100
silicone cartridges
2 linear actuators
nozzle diameter 3mm
nozzle supported by ball bearings
white silicone
transparent silicone
7 basic cell types
transition cells
method test
2nd iteration
front view
https://youtu.be/yh7EUQJTL-w
silicone extruder
2nd iteration
10^{-6}


https://youtu.be/VTheJy-54N8
kuka agilus 1100
silicone cartridges
2 linear actuators
nozzle diameter 3mm
nozzle supported by ball bearings
white silicone
transparent silicone
7 basic cell types
transition cells
method test
2nd iteration
close up
micro

silicone printing

kuka agilus 1100
silicone cartridges
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transparent silicone
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transition cells
method test
2nd iteration

silicone printing

kuka agilus 1100
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white silicone
transparent silicone
7 basic cell types
transition cells
method test
2nd iteration

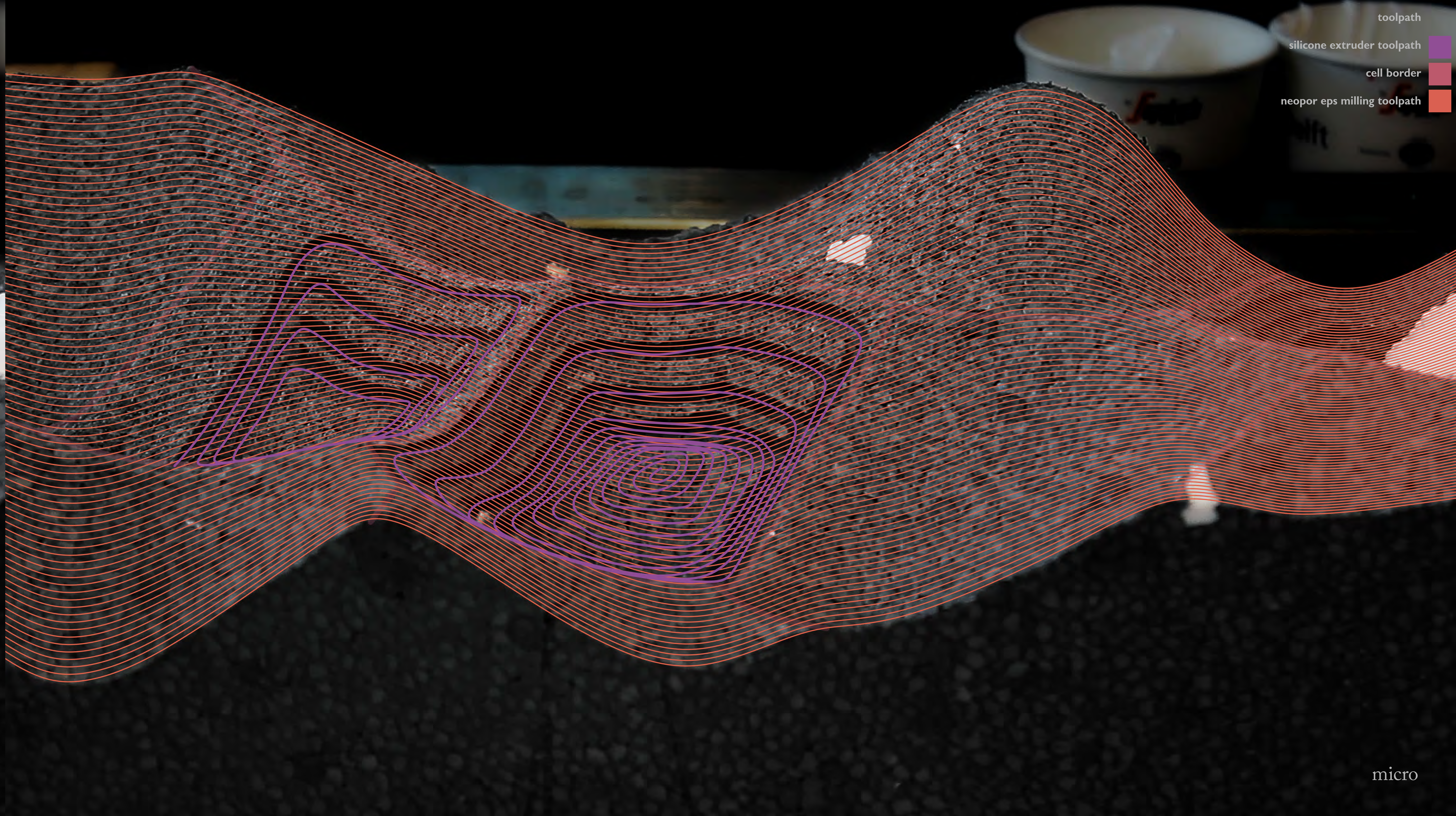
silicone 3d print

2nd iteration

https://youtu.be/Yh9WUK2KJ3o

neopor eps + silicone

hybridity



silicone printing

kuka agilus 1100
silicone cartridges
2 linear actuators
nozzle diameter 3mm
nozzle supported by ball bearings

white silicone
neopor eps (milled)
hybridity
workshop
3rd iteration

neopor eps + silicone

hybridity

silicone printing

kuka agilus 1100
silicone cartridges
2 linear actuators
nozzle diameter 3mm
nozzle supported by ball bearings

white silicone
neopor eps (milled)
hybridity
workshop
3rd iteration

silicone printing

kuka agilus 1100
silicone cartridges
2 linear actuators
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white silicone
neopor eps (milled)
hybridity
workshop
3rd iteration

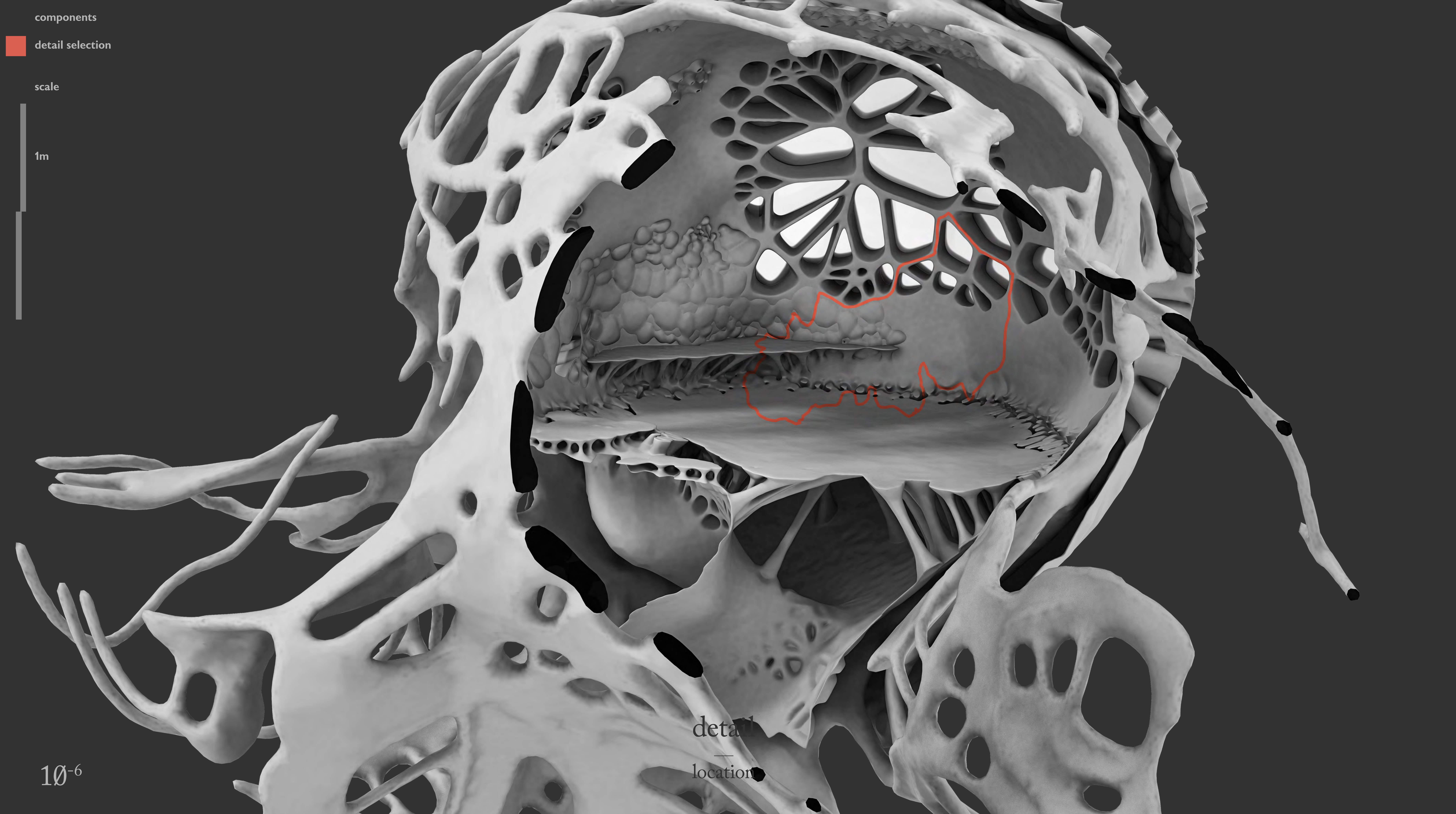
neopor eps + silicone

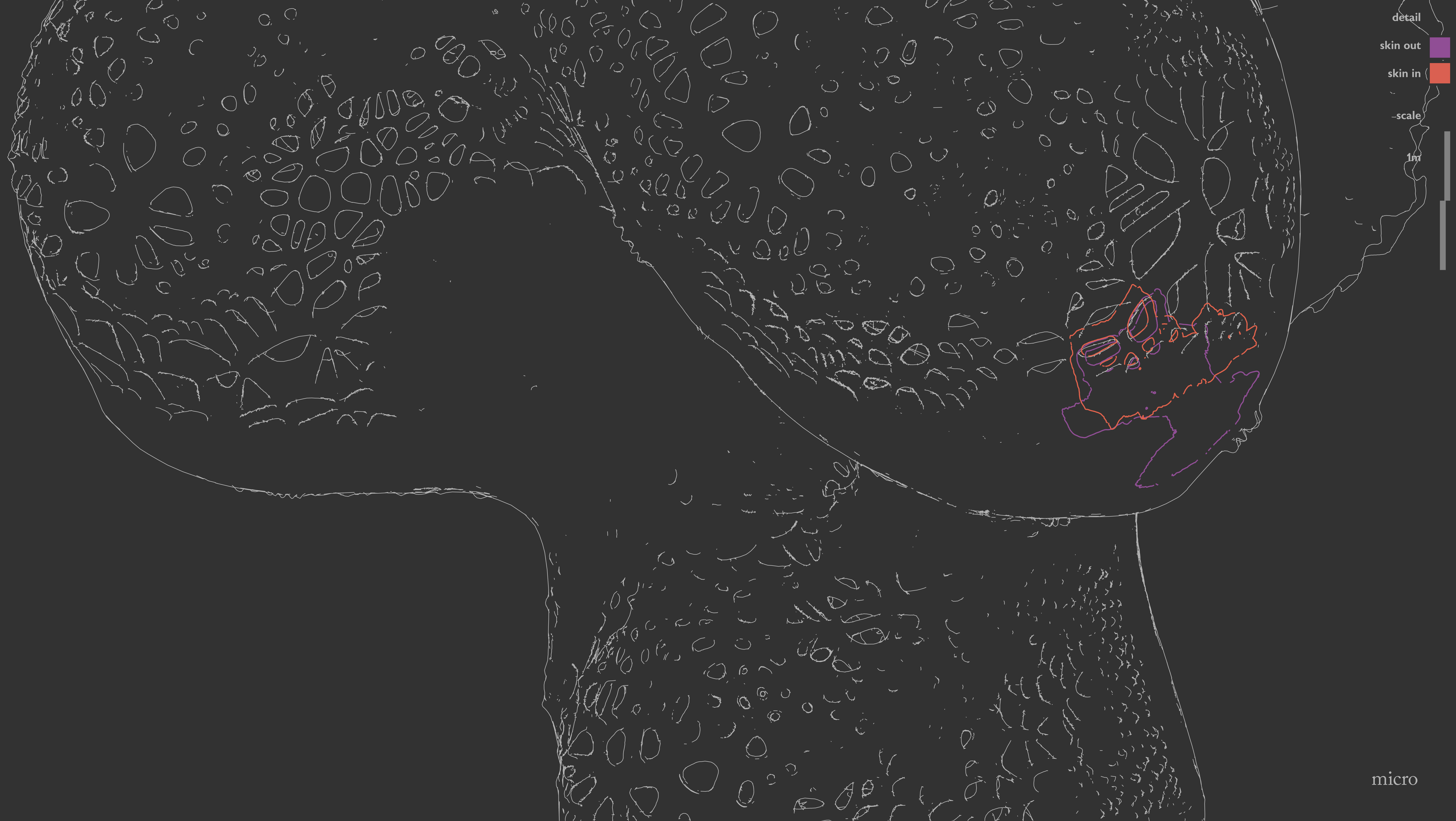
hybridity

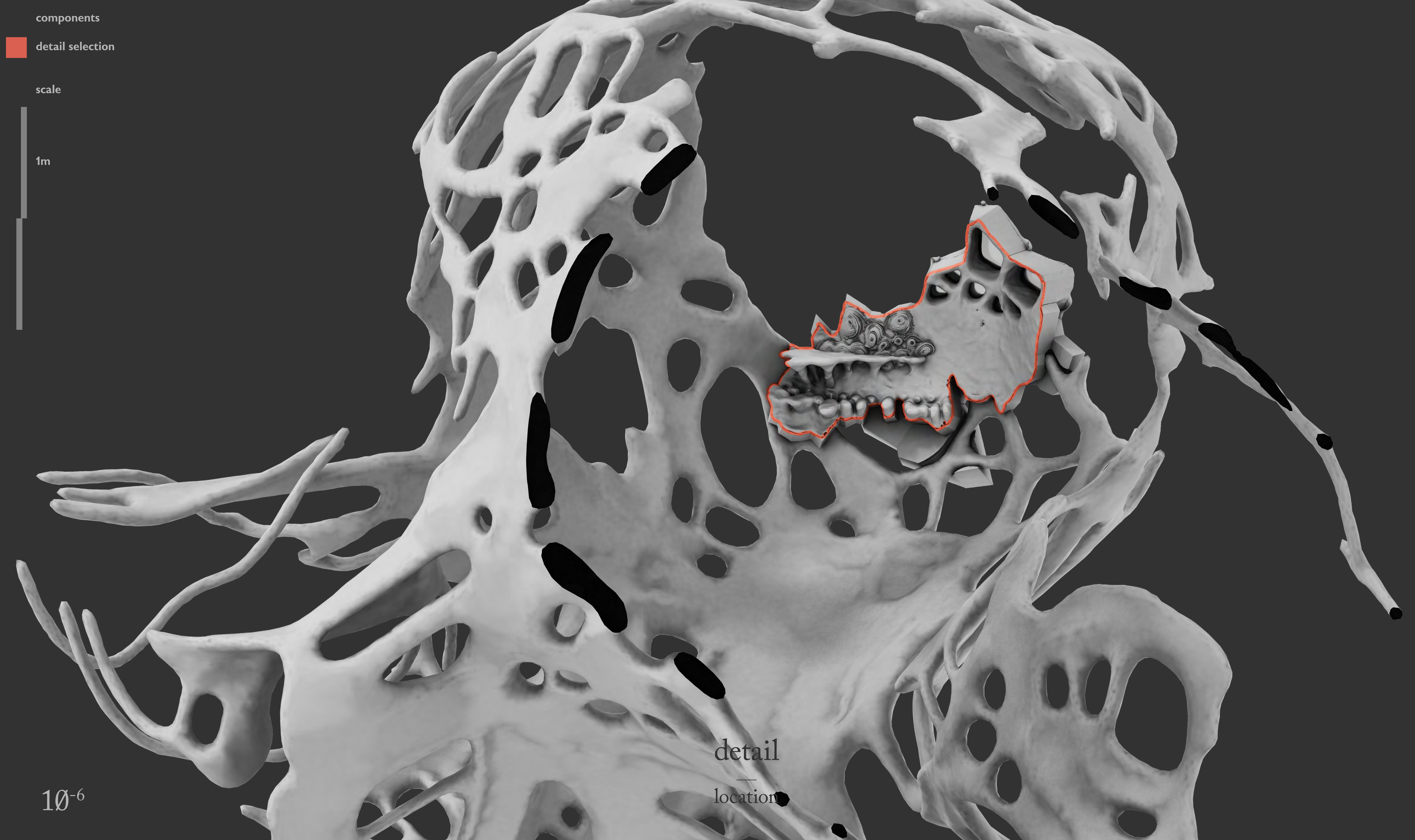
silicone printing

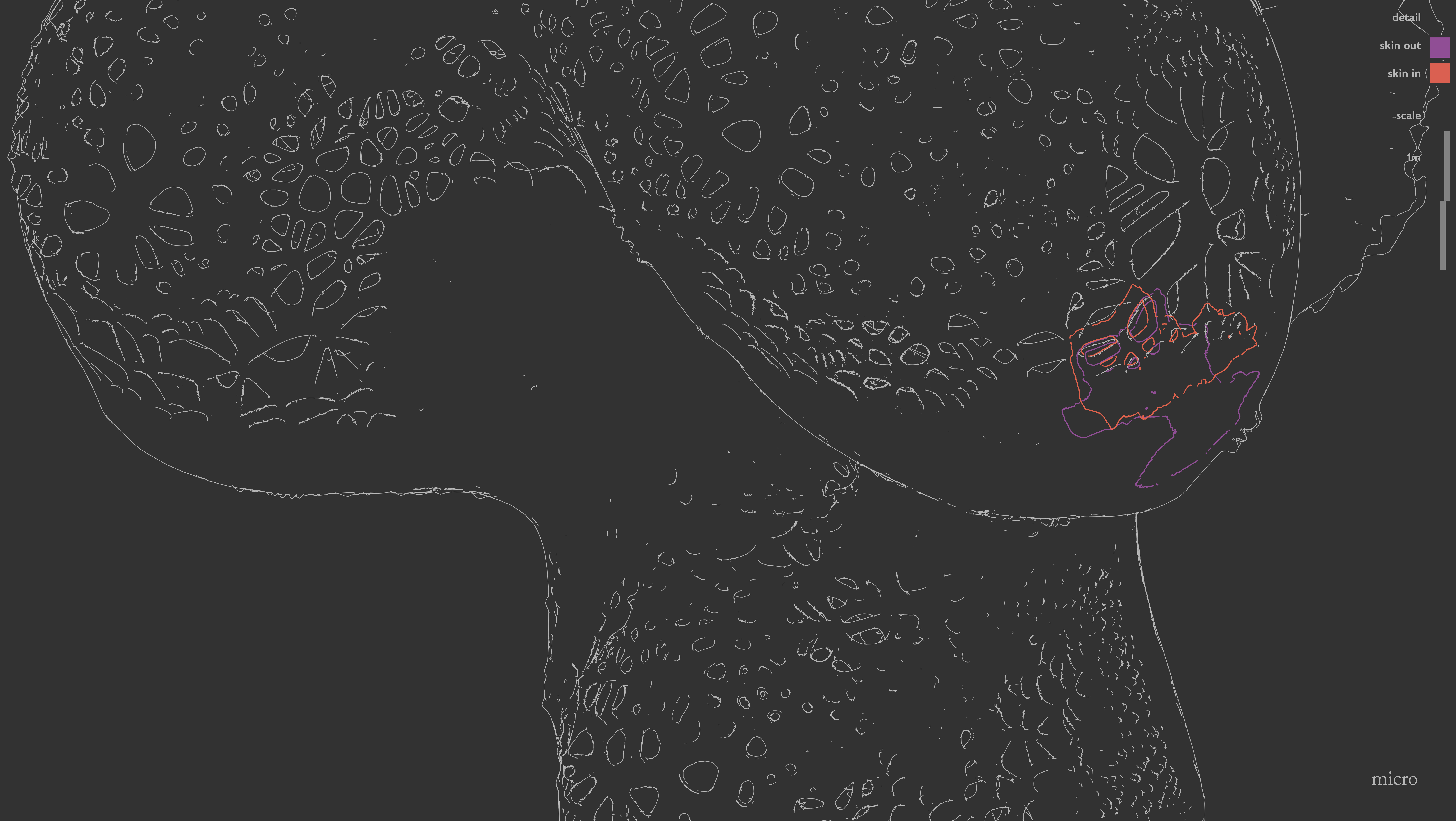
kuka agilus 1100
silicone cartridges
2 linear actuators
nozzle diameter 3mm
nozzle supported by ball bearings

white silicone
neopor eps (milled)
hybridity
workshop
3rd iteration


components
detail selection
scale
1m
10⁻⁶
location


detail
skin out
skin in
scale
1m
micro


components
detail selection
scale
1m
detail
location
10⁻⁶

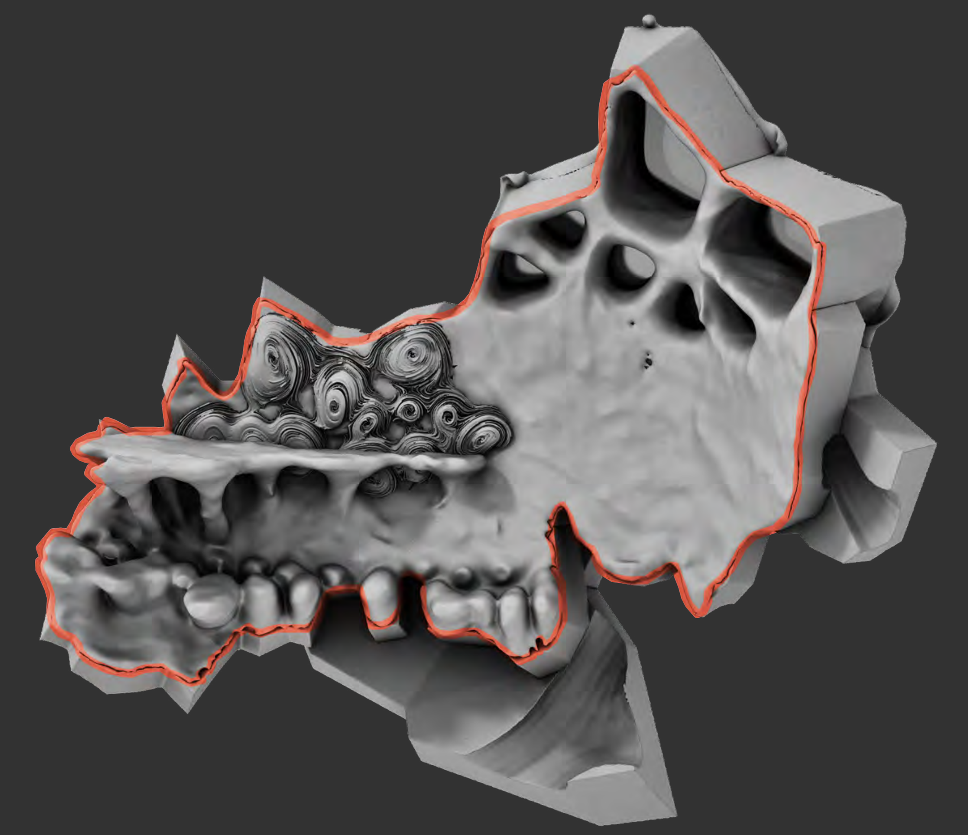

detail
skin out
skin in
scale
1m
micro

components

detail selection

scale

1m



detail

location

10^{-6}

detail

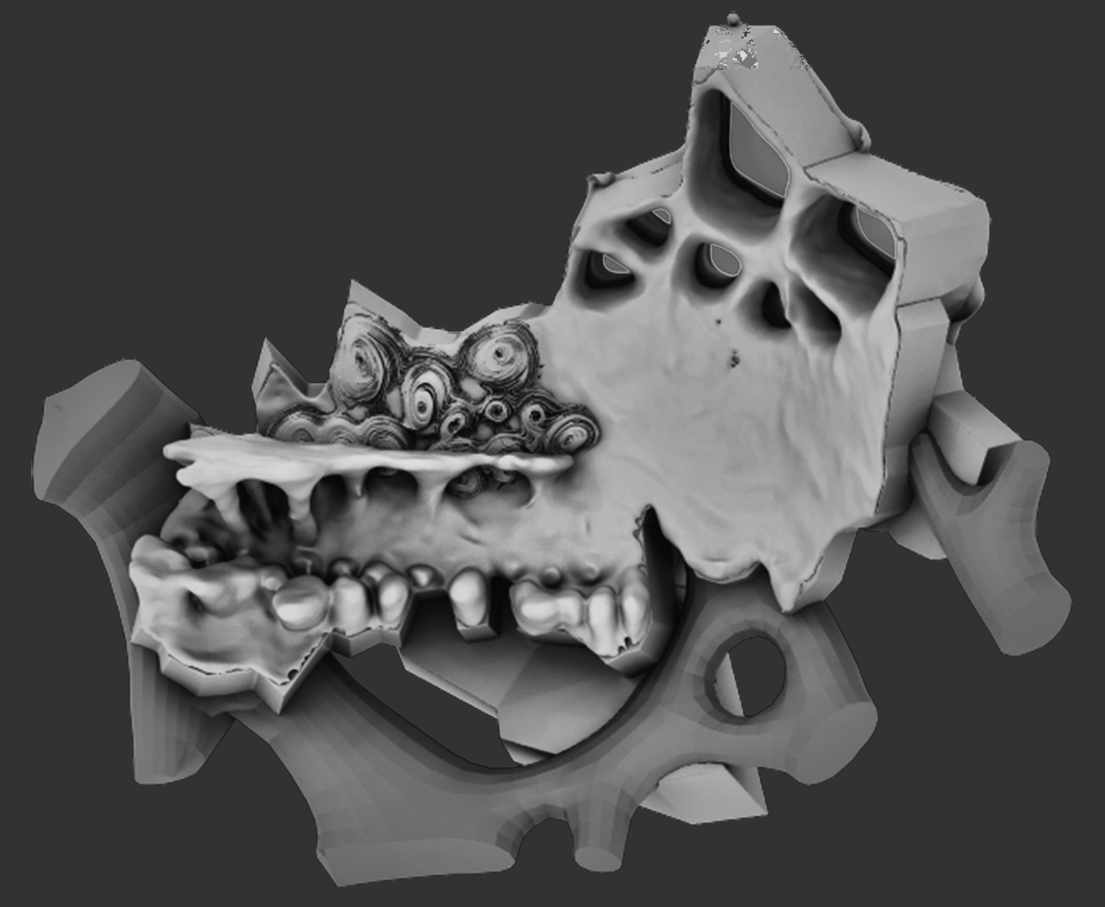
skin out

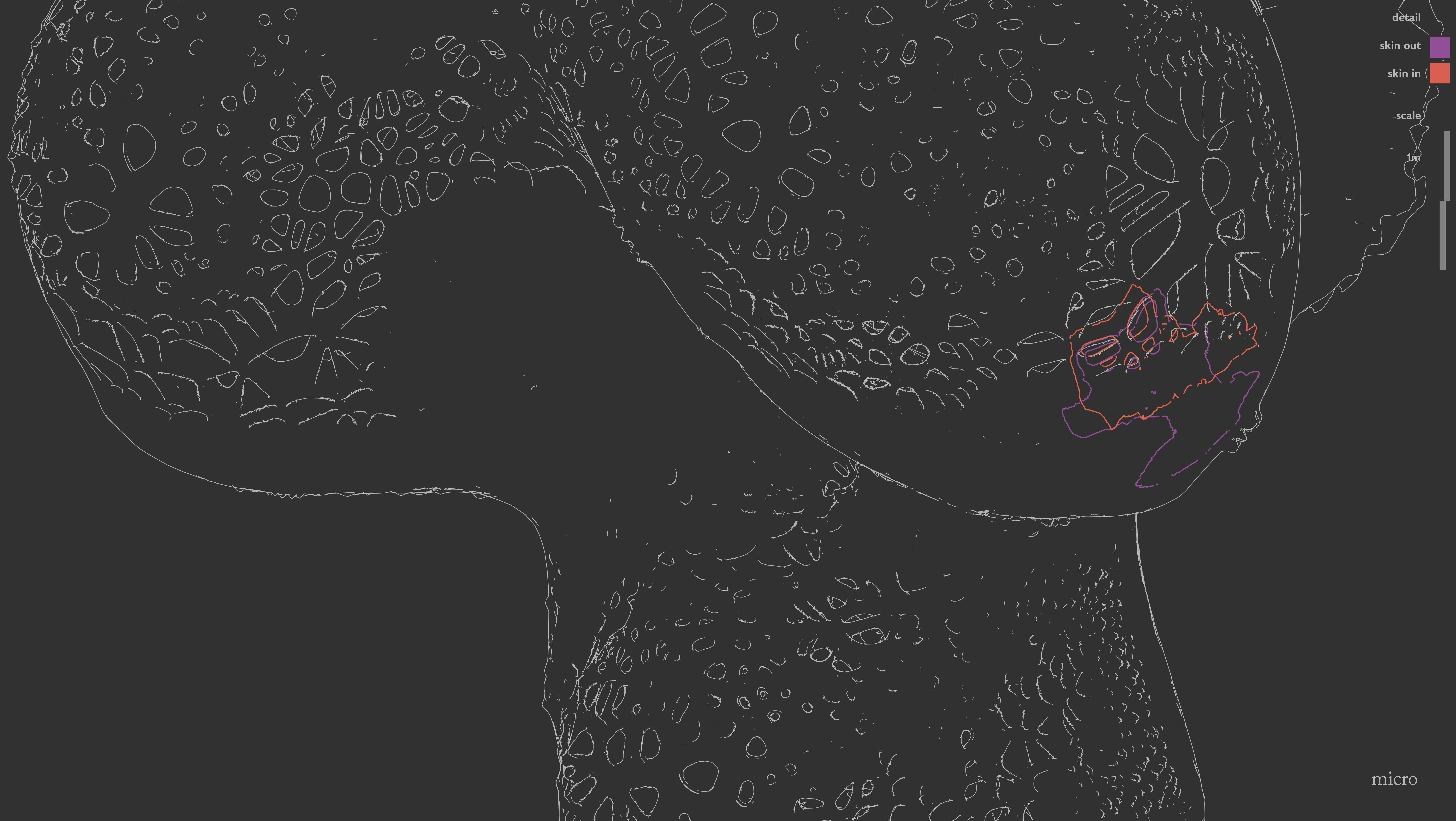
skin in

scale

1m

micro



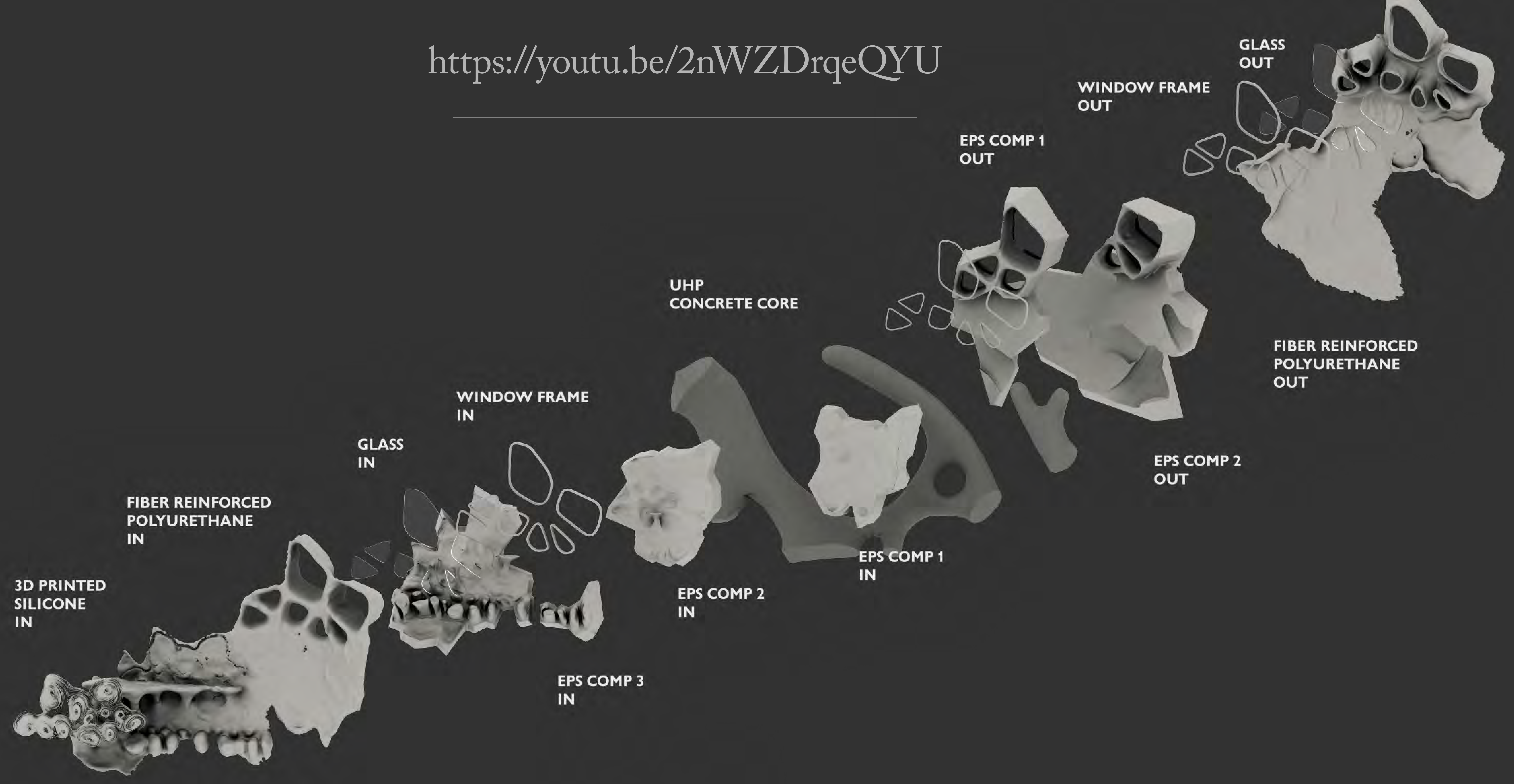


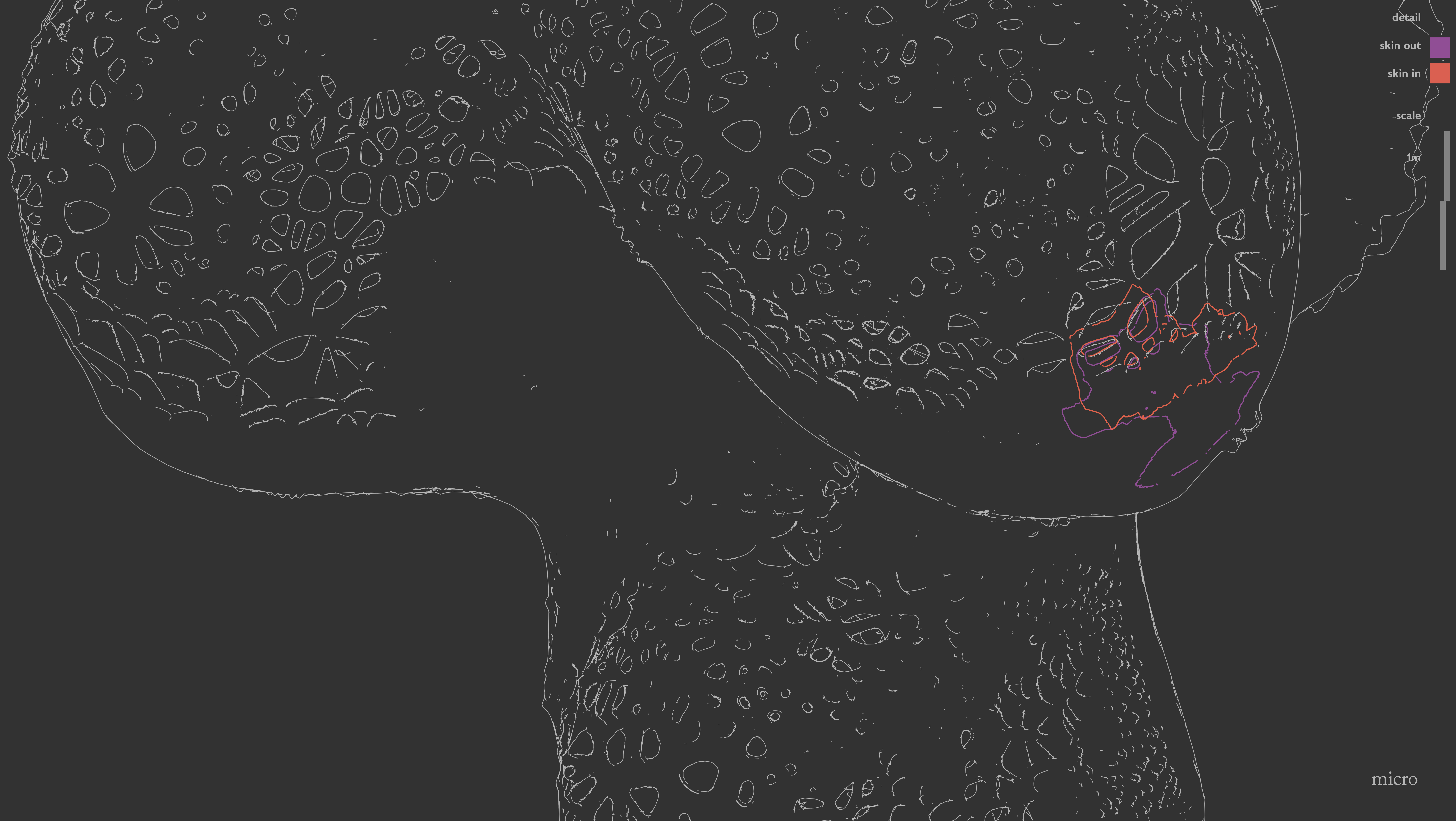
detail

—

explosion

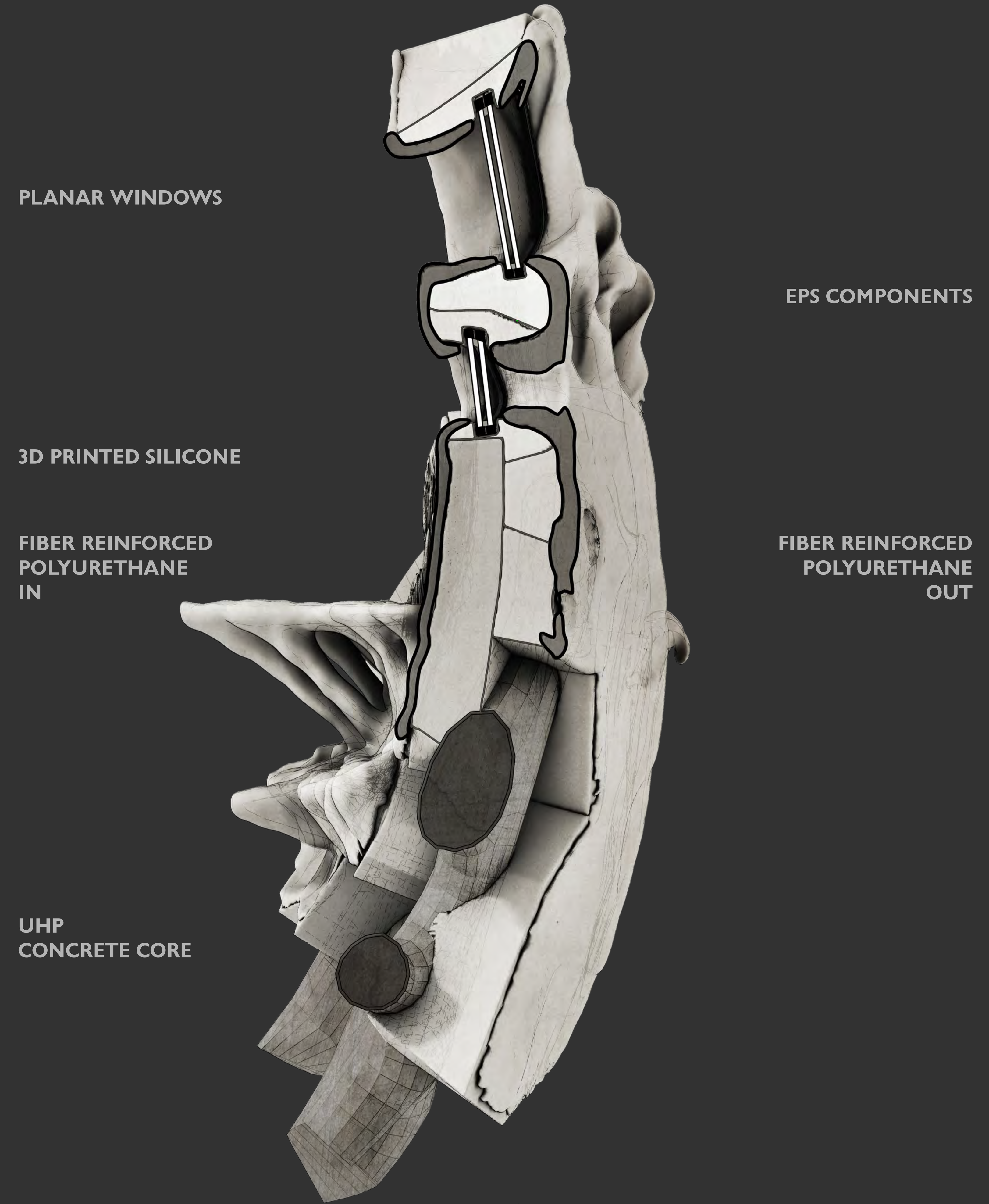
https://youtu.be/2nWZDrqeQYU





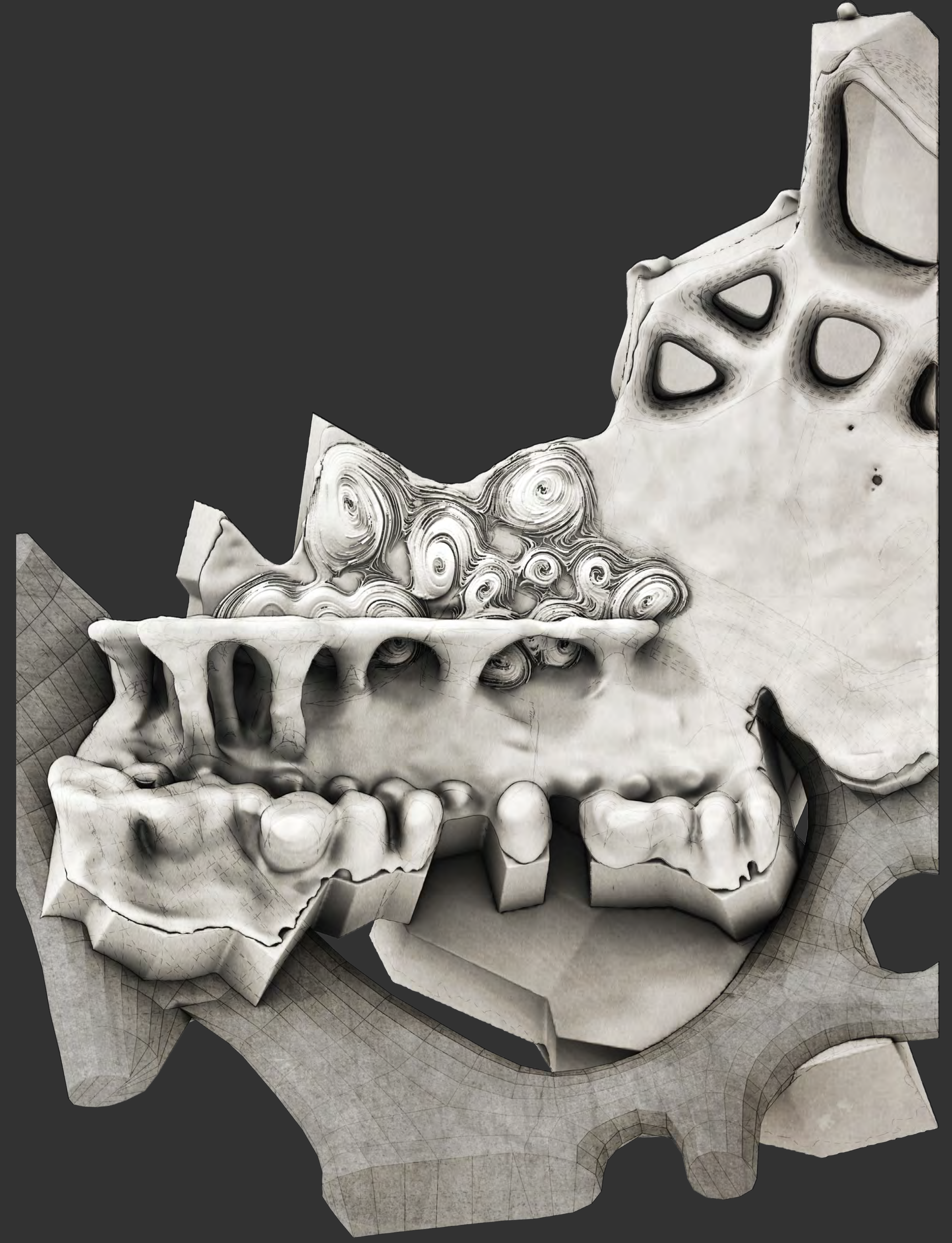
detail

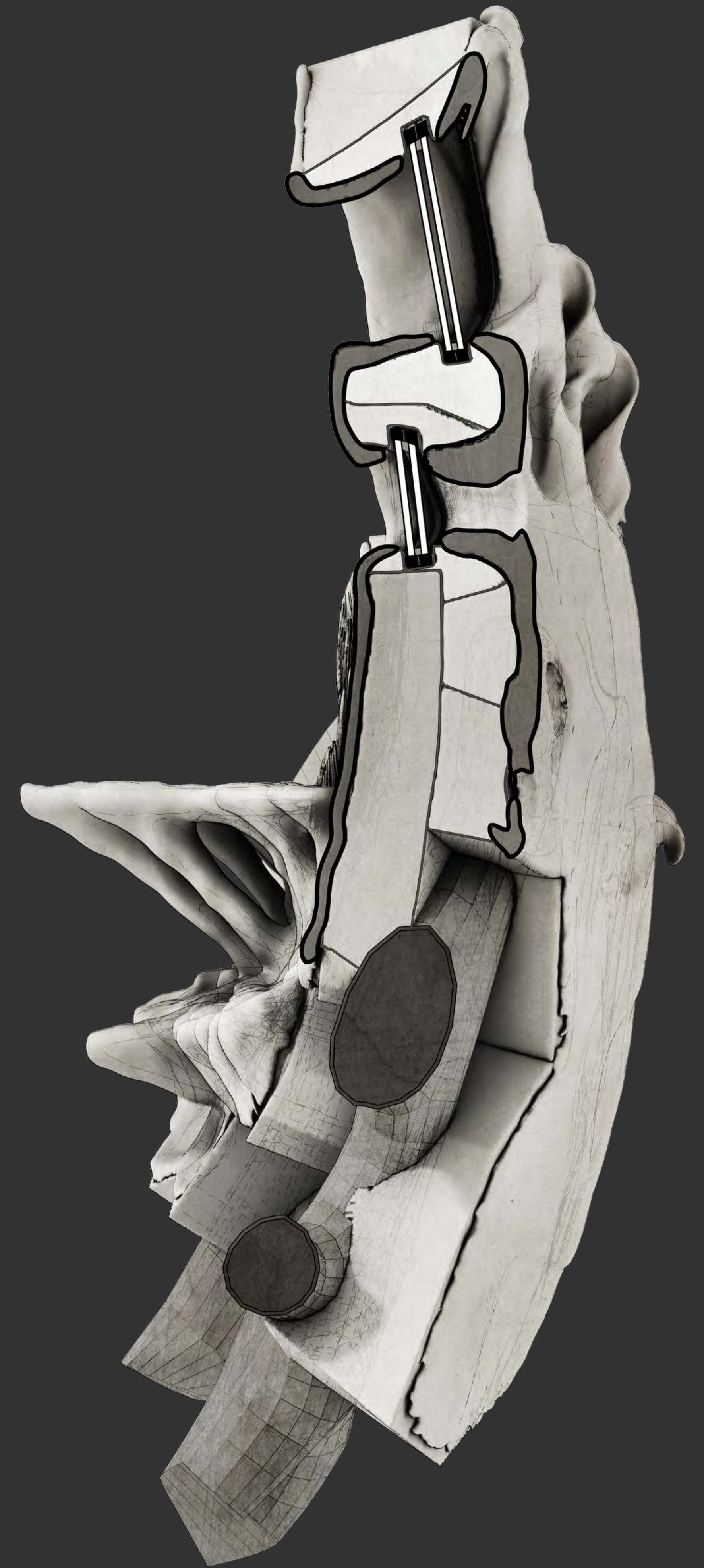
explosion



detail

1-5





detail section

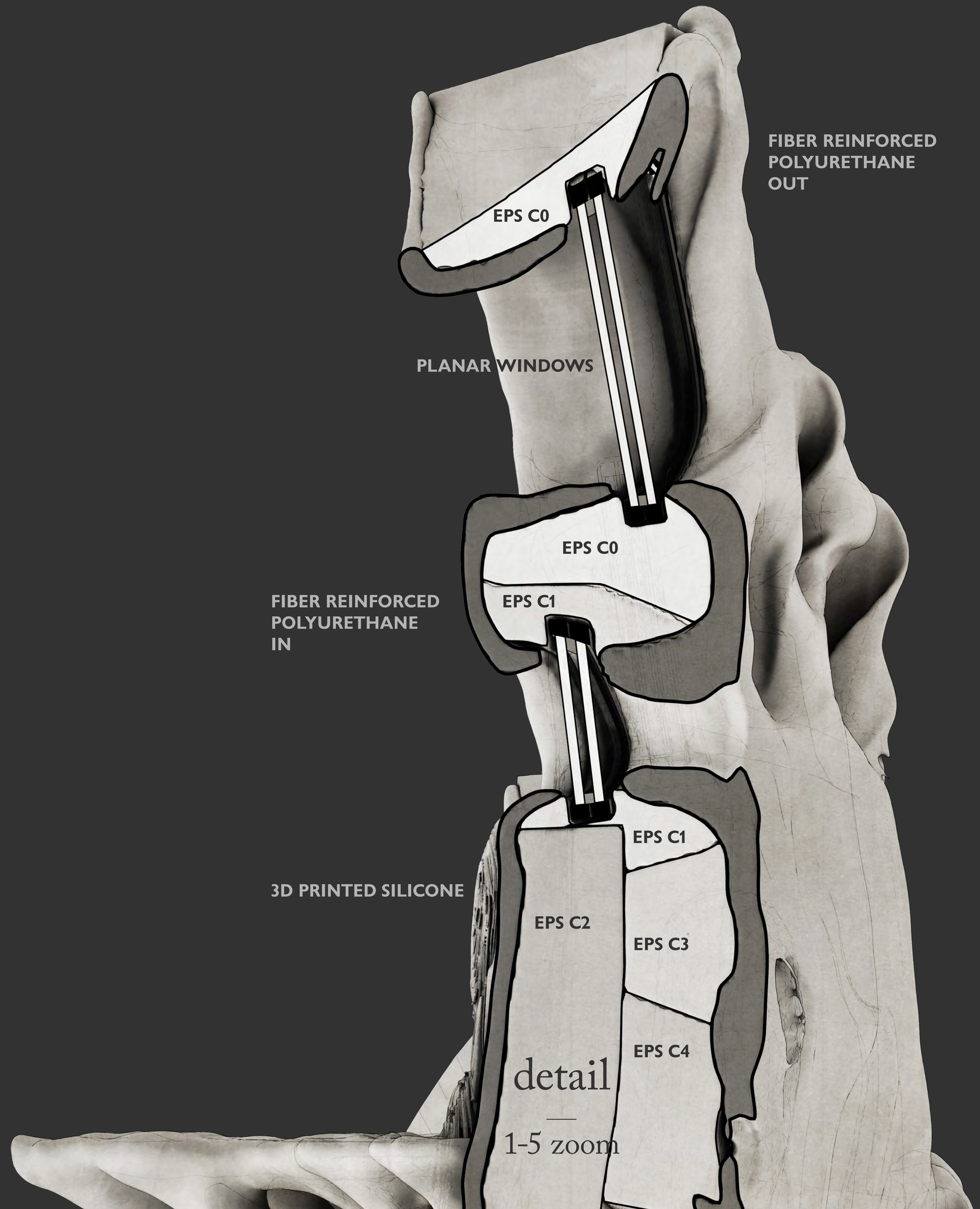
scale

25cm

detail section

scale

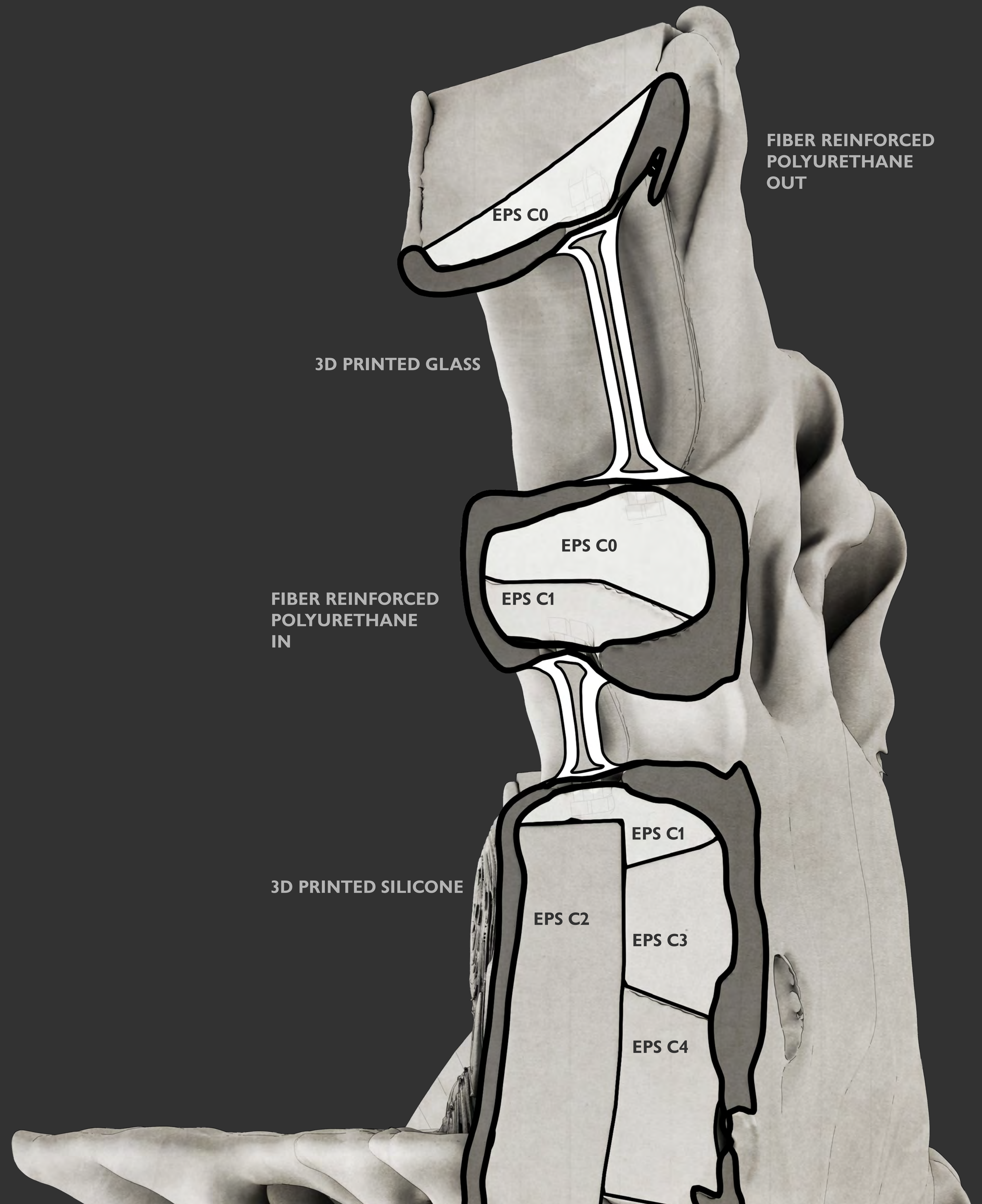
5cm



3d printed glass variation

scale

5cm



$1Ø^{-6}$

micro

$1\emptyset^{-9}$

nano

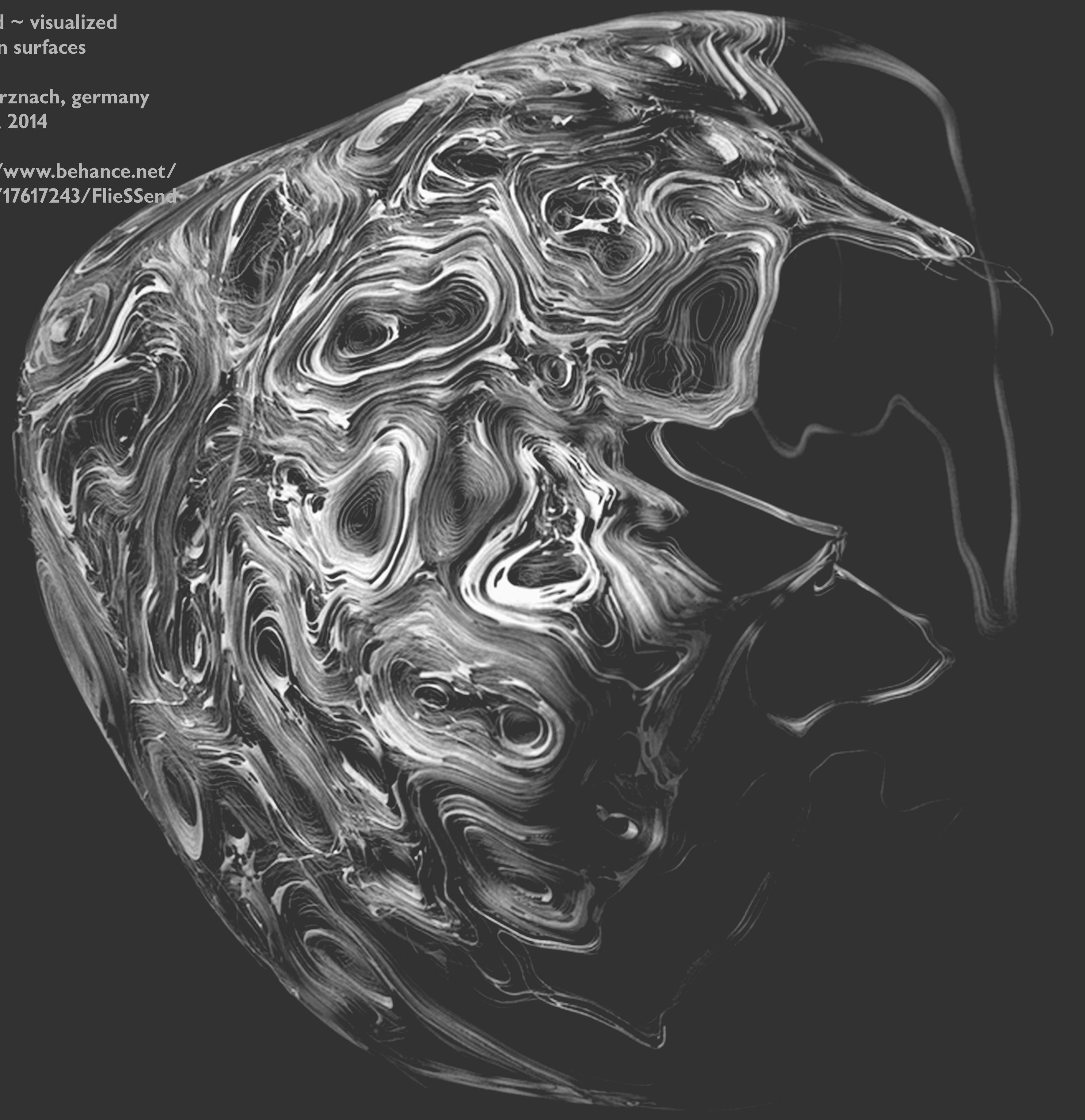
$1\emptyset^{-6} = \emptyset{,}\emptyset\emptyset\emptyset.\emptyset\emptyset\emptyset.\emptyset\emptyset1$

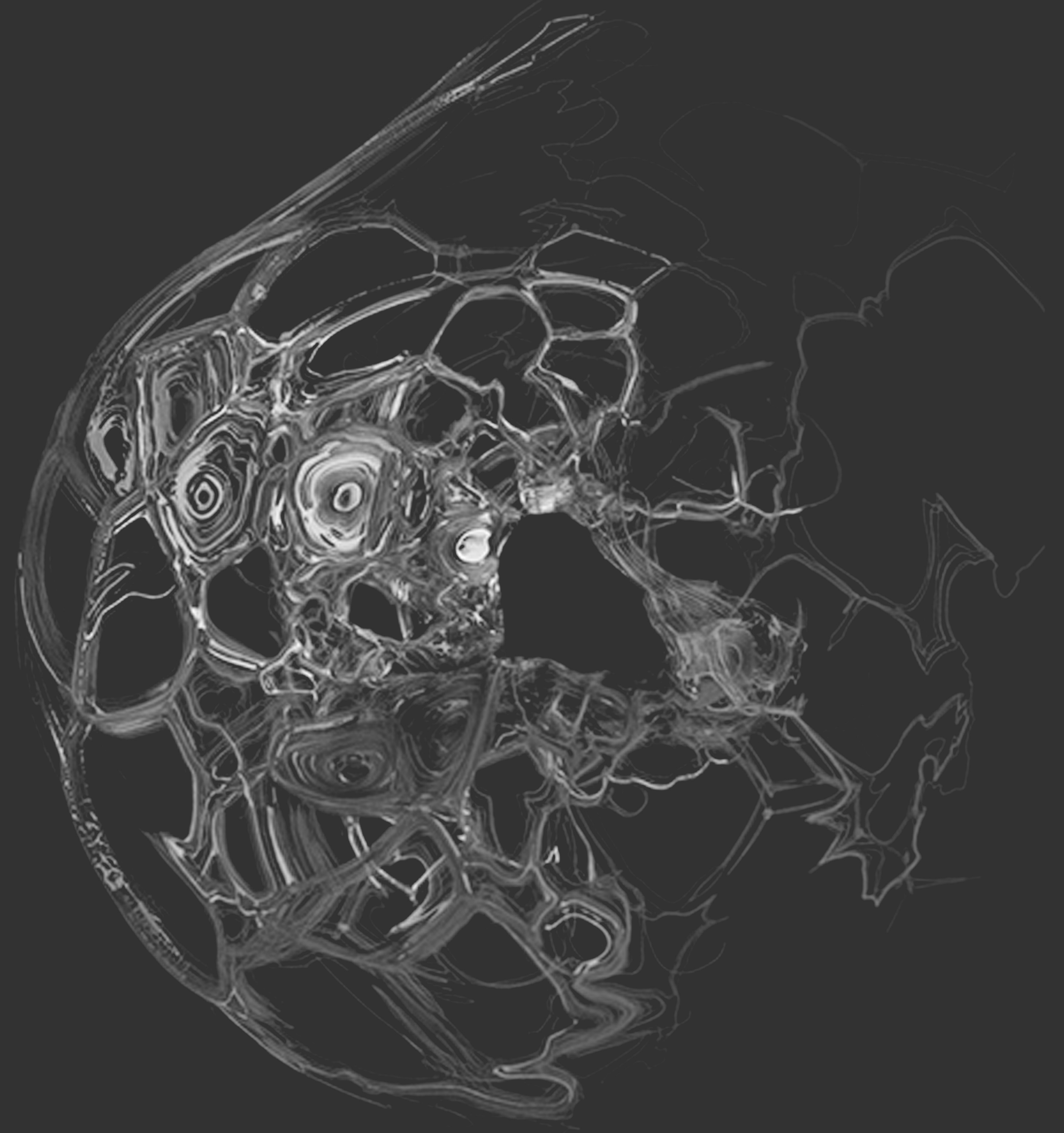
source

fließend ~ visualized
flieds on surfaces

bad wurznach, germany
june 12, 2014

https://www.behance.net/gallery/17617243/FlieSSend

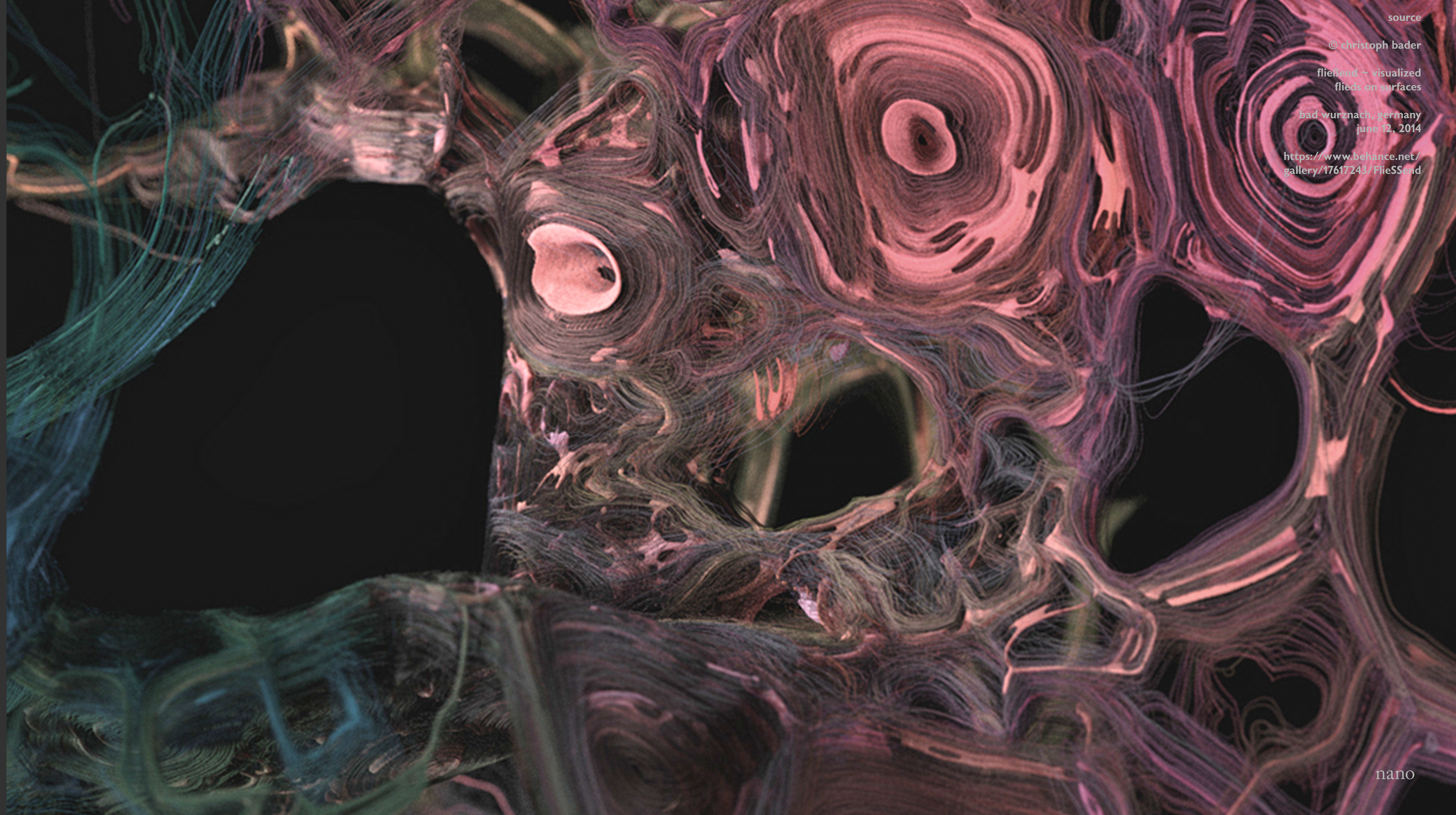




christoph bader

fließend

10^{-9}



source

© christoph bader

fließend ~ visualized
flieds on surfaces

bad wurznach, germany
june 12, 2014

https://www.behance.net/gallery/17617243/FlieSSend

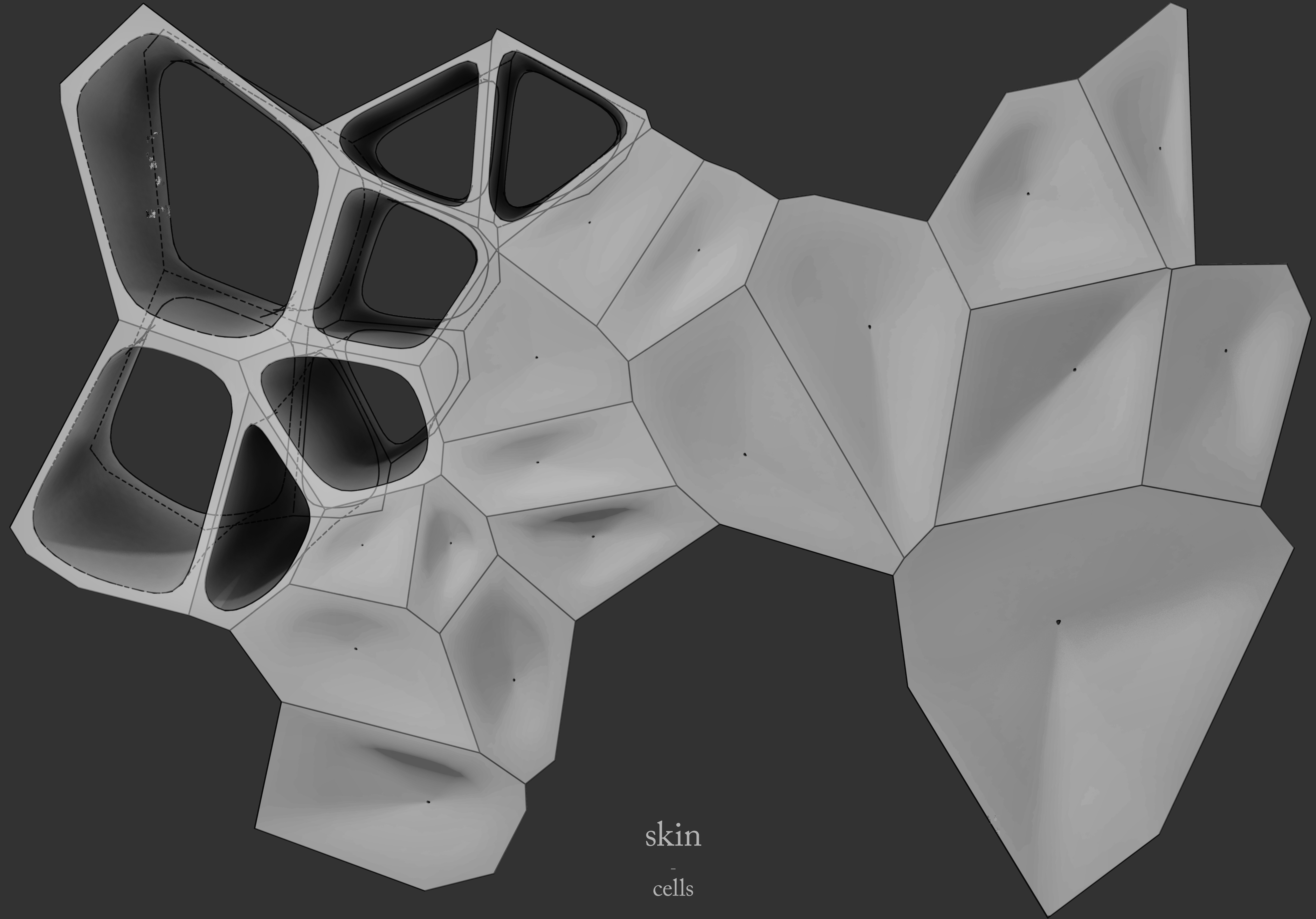
nano

skin detail

basic cell geometry

scale

25cm



skin

-

cells

10^{-9}

detail

skin out

scale

1m

nano

skin detail

low velocity

high velocity

scale

25cm

https://youtu.be/f4DQMzz_maI

skin

-

vortex curves

$1\emptyset^{-9}$

detail

skin out

scale

1m

nano

skin detail

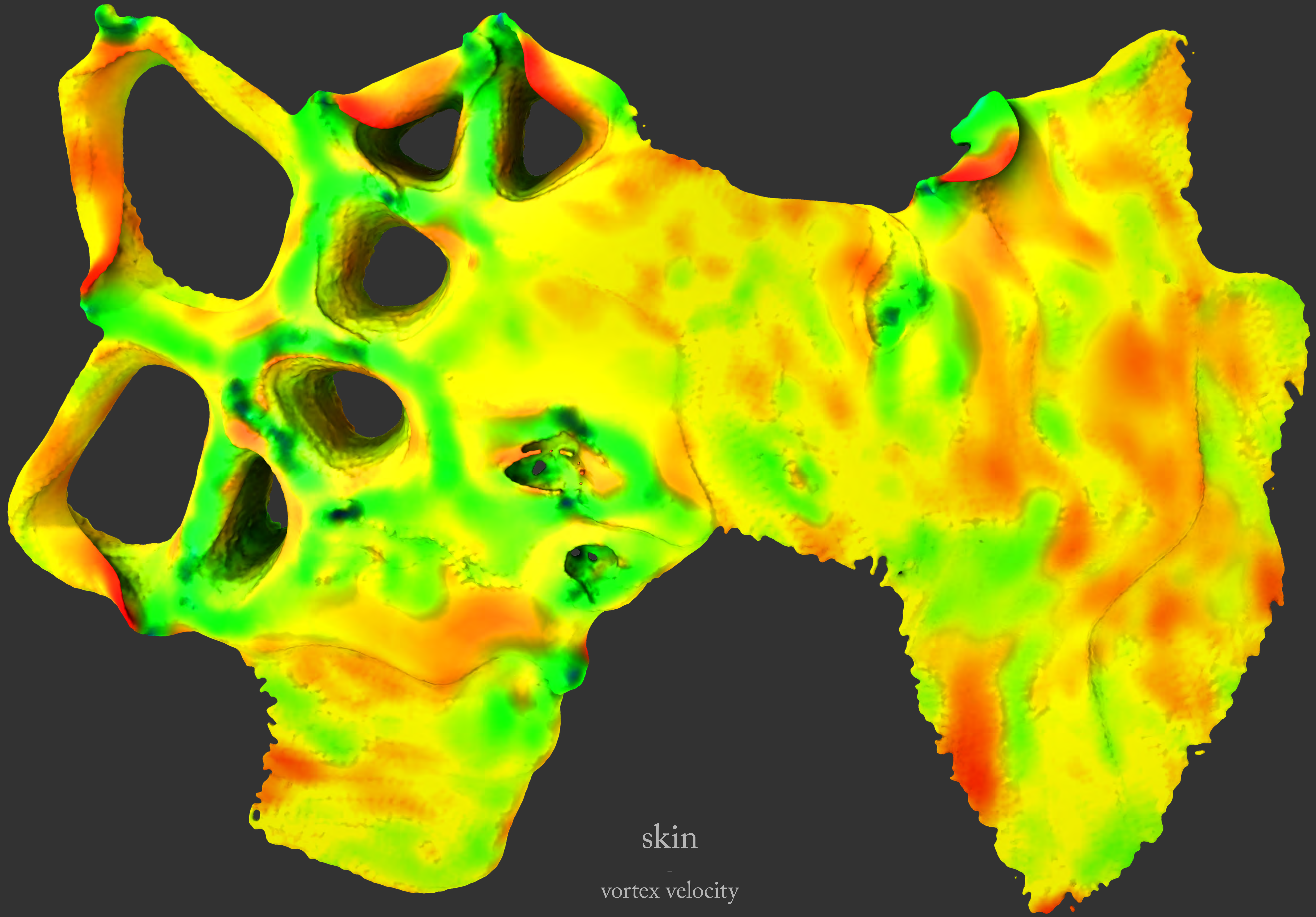
velocity

high

low

scale

25cm



skin

-

vortex velocity

10^{-9}

nano

skin detail

fiber reinforced polyurethane

scale

25cm

skin

-

vortex fluid

$1Ø^{-9}$

detail

skin out

scale

1m

nano


https://youtu.be/GgJ9-kKBhbE
running out of gas on the fast lane
benjamin norbert kemper