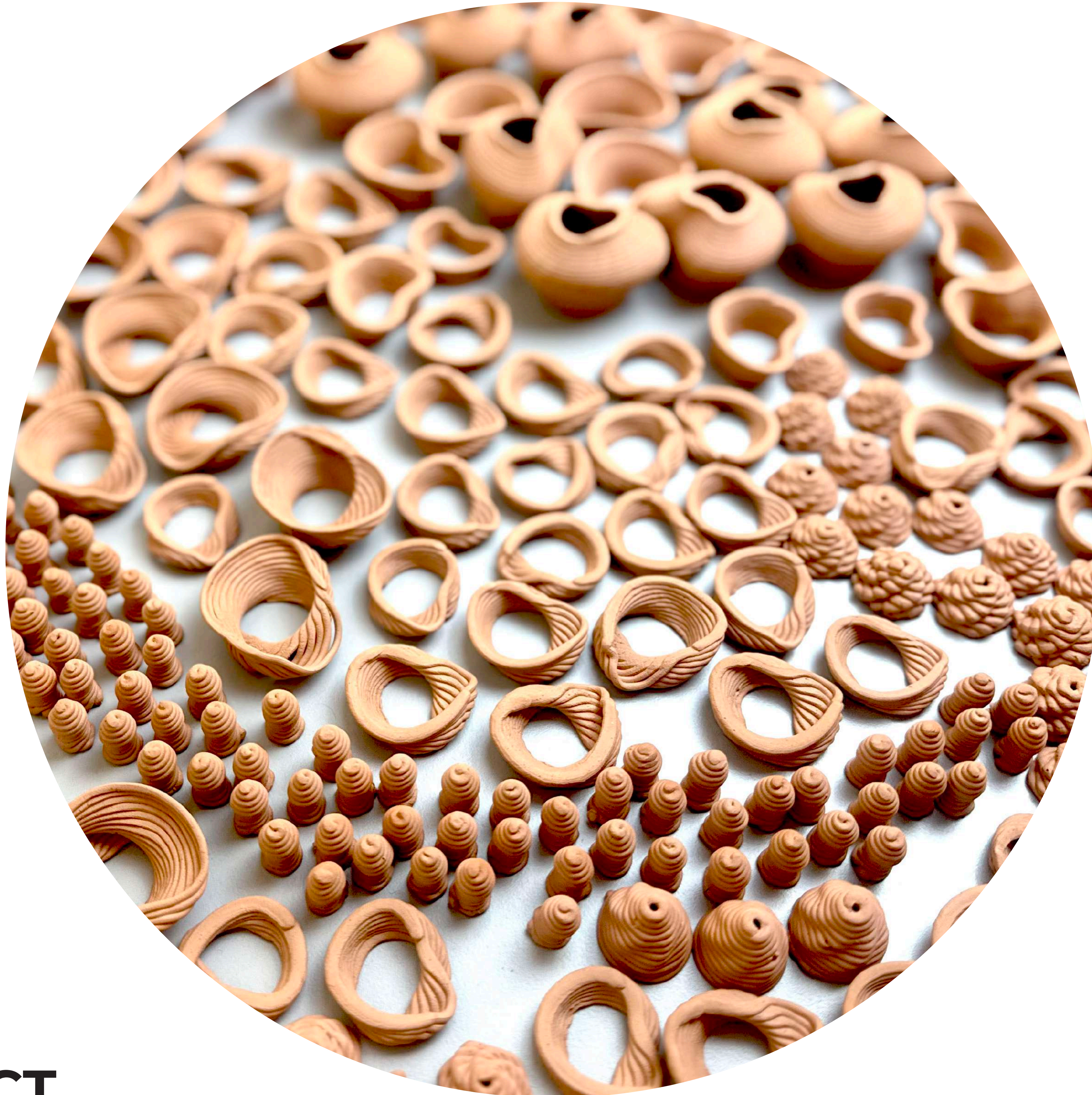


Simone Kiswani



RESURRECT

Worn. Then Inhabited.



“The end of use is not the end of life.”

A non-linear lifecycle



A multi-life design



More than human

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001 | Self-Intro | Simone Kiswani

Resurrect is closely connected to my background and the work I've been developing over the past few years. Much of my practice has focused on sustainable materials, fabrication processes, and designing with a long-term perspective on how objects are made, used, and eventually discarded. Through this, I became increasingly interested in earth-based materials, modular systems, and digital manufacturing, which naturally led me to working with clay. Beyond its environmental qualities, clay fascinated me because of its deep connection to both people and place. The project grew from my interest in creating objects that can exist beyond a single lifecycle, exploring alternative relationships between fashion, material consumption, and nature.



002 | Abstract

Contemporary fashion, particularly within ornamental practices, is characterized by short lifecycles and material excess, prompting an urgent shift toward sustainable and regenerative approaches. Additive manufacturing has emerged as a tool for rethinking fabrication in fashion, enabling customization and material efficiency, however, most applications remain dependent on synthetic, polymer-based materials and linear production systems.

Resurrect investigates how fashion can extend beyond the human body into ecological function. Developed through clay additive manufacturing, the project proposes garments not as final objects but as transitional states within an extended environmental lifecycle. The system is embedded with small-scale 3D printed terracotta modules (1–3 cm), fabricated through clay extrusion to control porosity and surface texture.

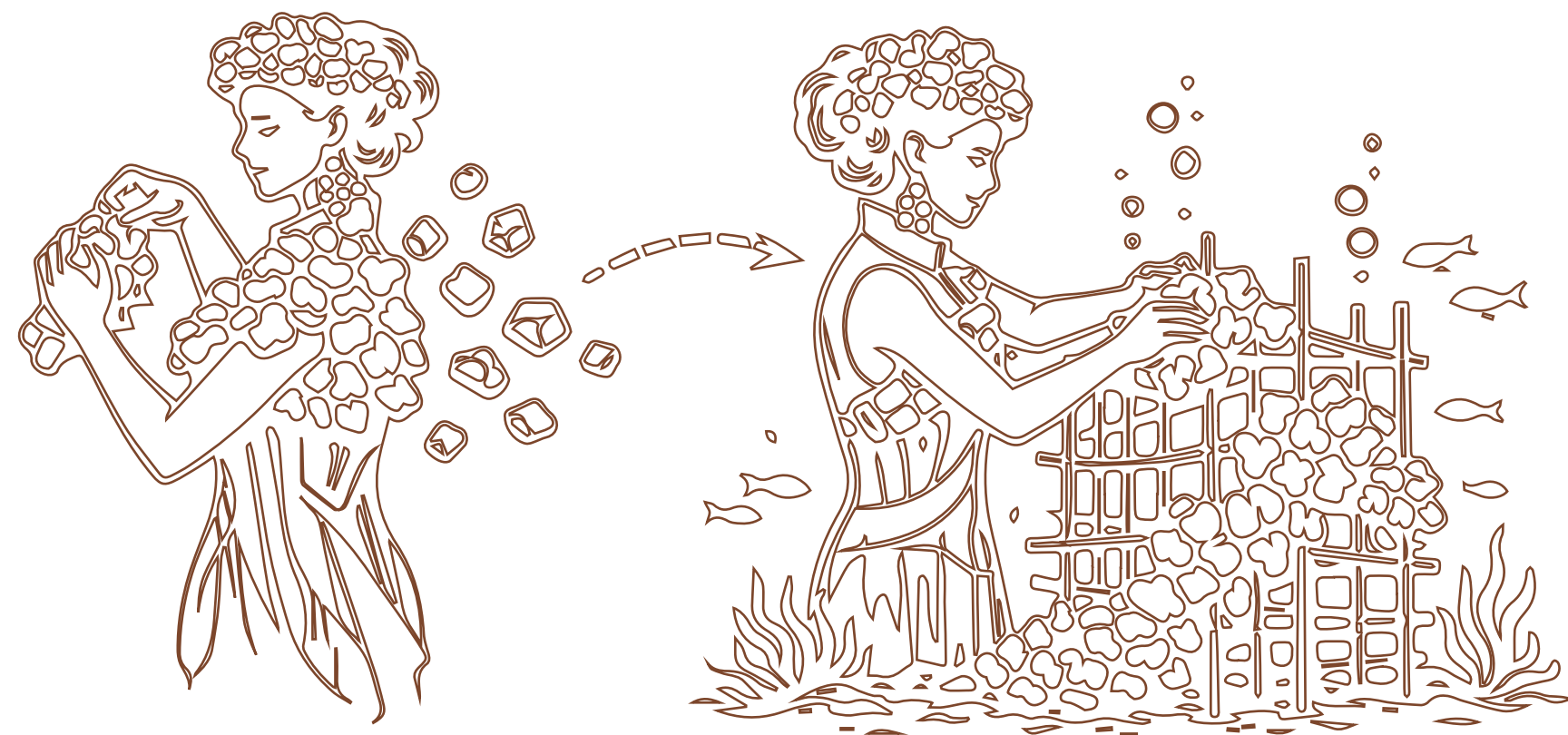
The modules are mechanically attached to the textile, enabling full disassembly. Following its wearable phase, the system transitions into a second life, where the terracotta elements are reassembled underwater onto a treated steel structure, with the intention of forming a porous substrate capable of supporting marine microhabitats and potential coral attachment. Through this transformation, the material shifts from ornament to ecological infrastructure.



003 | Introduction

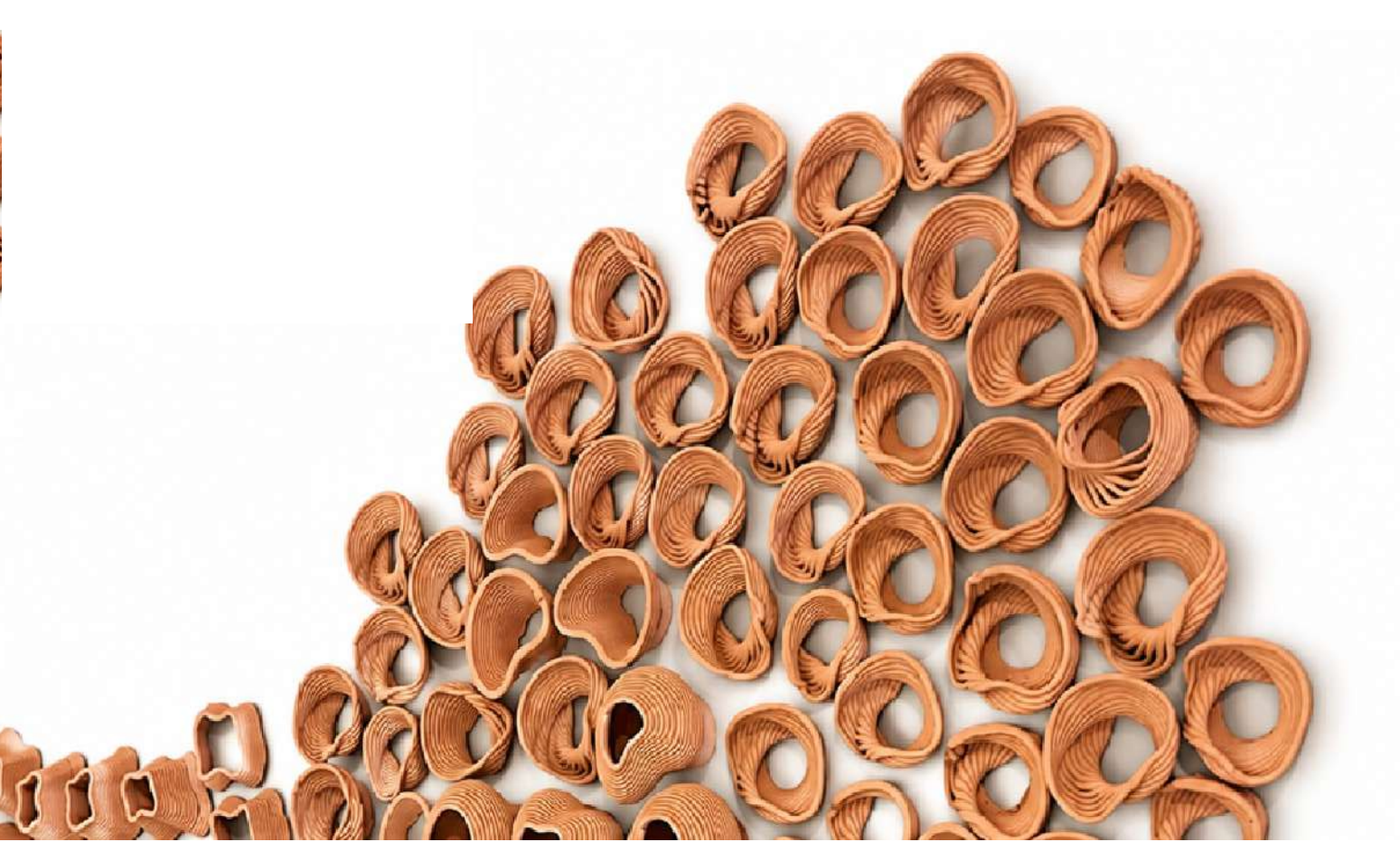
Resurrect

A ritual-based wearable project that questions the human hierarchy over nature.



Exploring a Multi-life Design Strategy Through

Terracotta modules that reinterpret ornamental fashion through a sustainable lens, which transition into a second life as marine habitat.



004 | The Ritual | Symbolic Act of Disassembly

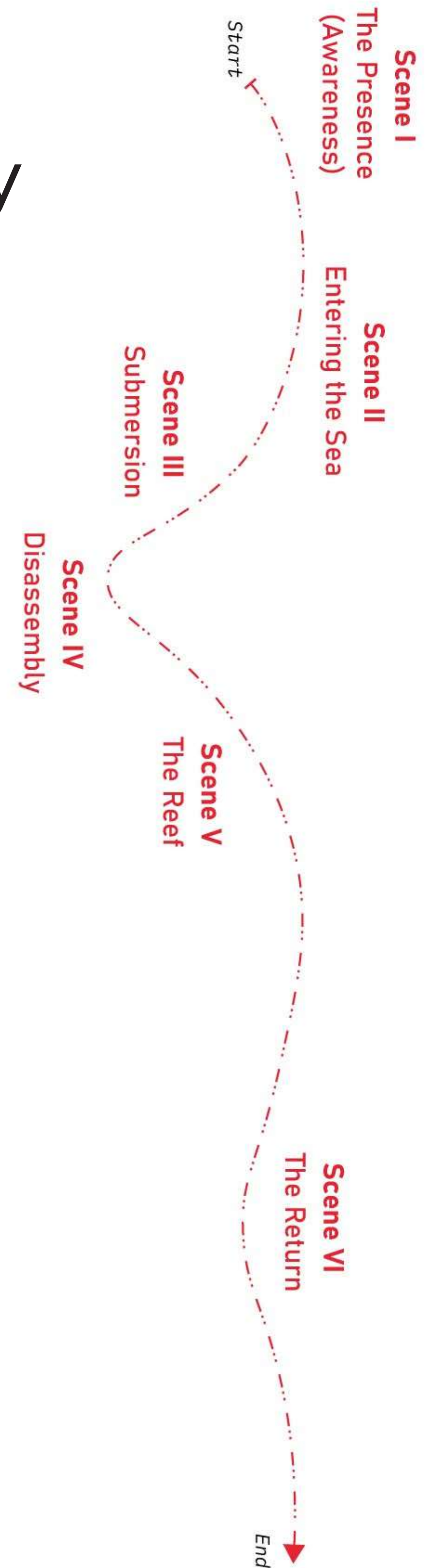
The Conception

Resurrect unfolds as a ritual designed to evoke reflection on humanity's relationship with the natural world. The journey begins with a moment of awareness, confronting the consequences of human consumption and its impact on fragile marine ecosystems.

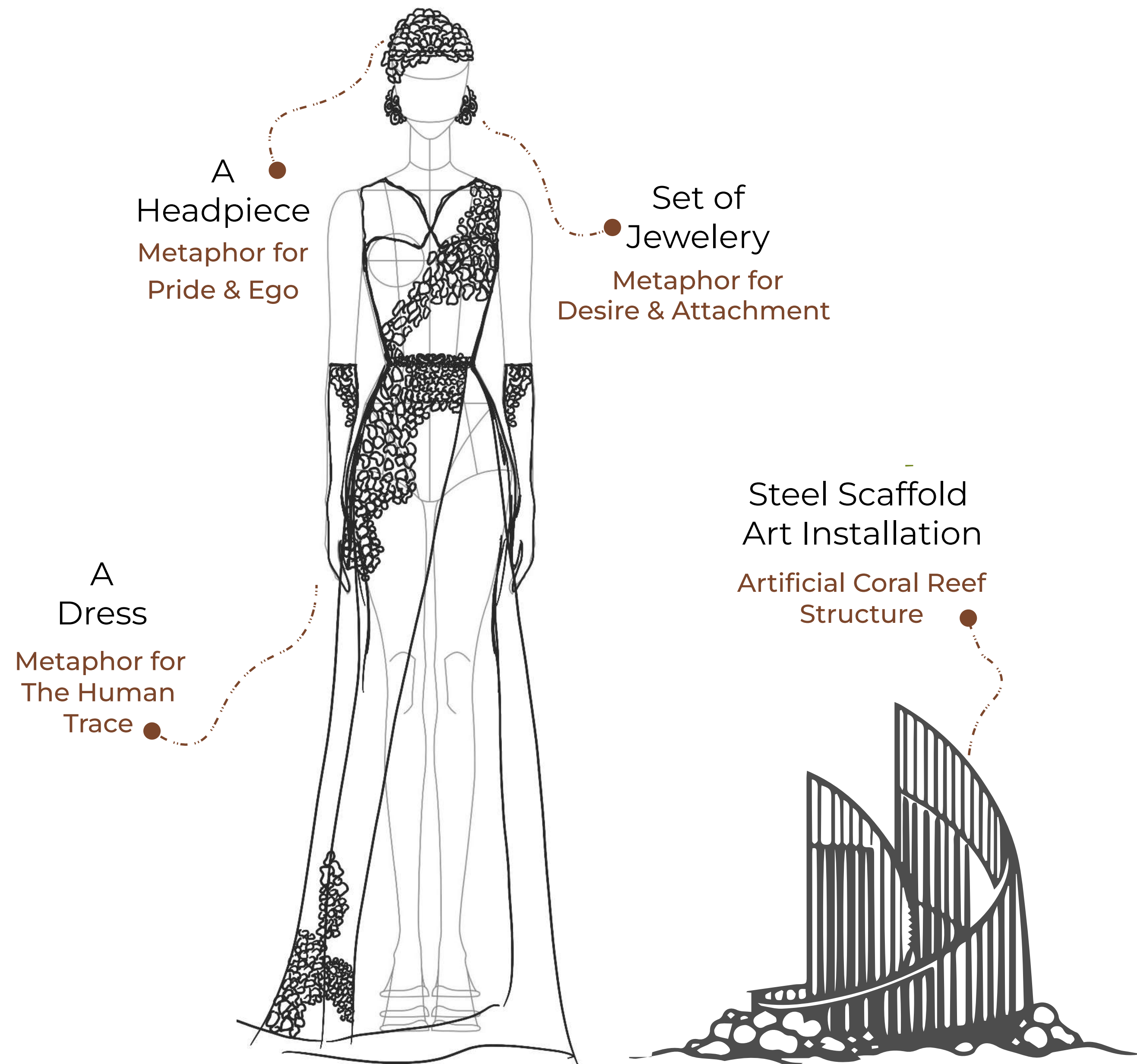
This is followed by a gradual act of surrender in which the terracotta elements composing the wearable are removed according to a symbolic hierarchy: the lower garment, representing the human trace, the jewelry, embodying desire and attachment, and the headpiece, symbolizing pride and ego. As each layer is relinquished, the wearer is invited to let go not only of a material object but also of the values it represents.

The surrendered elements are then reassembled beneath the sea as an artificial reef habitat, allowing what once served the human body to become a refuge for marine life. Through this transformation, the ritual seeks to evoke humility, vulnerability, and renewal, shifting the narrative from ownership to stewardship.

Returning to land stripped of ornament and hierarchy, the participant leaves behind the symbols of possession and superiority, suggesting that true coexistence with nature begins when humanity steps away from the center of the story and makes space for life beyond itself.



004 | The Ritual | Symbolic Act of Disassembly



005 | The Motive

The motivation behind Resurrect stems from the growing environmental burden that human consumption places on marine ecosystems.

Every year, more than 8 million tons of plastic enter the oceans, with up to 35% linked to the textile and ornamental fashion industries through synthetic fibers, waste, and discarded products. At the same time, plastic pollution has been shown to increase the risk of coral disease by up to 20 times, further threatening reef ecosystems already under pressure from climate change and coral bleaching.

These statistics raise an important question: What would it take for us to shift from the center? Rather than designing products that end their lives as waste, Resurrect explores a regenerative alternative in which wearable artifacts are transformed into artificial reef habitats.

The project challenges the human-centered lifecycle of fashion and proposes a model where design extends beyond personal use to support ecological systems, encouraging a transition from consumption and ownership toward stewardship and reciprocity.





“Everything continues, whether we design it to or not.”

006 | Research Synthesis

Aqaba | An Introduction

Located at the northern tip of the Red Sea, Aqaba hosts Jordan's only coastline, extending approximately 27 km along the Gulf of Aqaba. Despite its limited length, this coastline supports a diverse and ecologically significant coral reef system that forms part of one of the world's northernmost tropical reef environments. The reefs of Aqaba are characterized by a variety of coral morphologies, including branching, massive, plate, and soft corals, which provide habitat for hundreds of species of fish, invertebrates, and other marine organisms.

The Gulf of Aqaba has attracted significant scientific interest due to the remarkable thermal tolerance of its coral reefs. Unlike many reef systems worldwide that have experienced severe bleaching events, Aqaba's corals have demonstrated an exceptional capacity to withstand elevated water temperatures, making them an important site for studying coral resilience in the face of climate change.

Nevertheless, these ecosystems remain vulnerable to local pressures such as coastal development, tourism activities, pollution, and marine debris. As a result, the conservation and restoration of Aqaba's coral reefs have become increasingly important, both for maintaining local biodiversity and for preserving a globally significant example of coral ecosystem resilience.

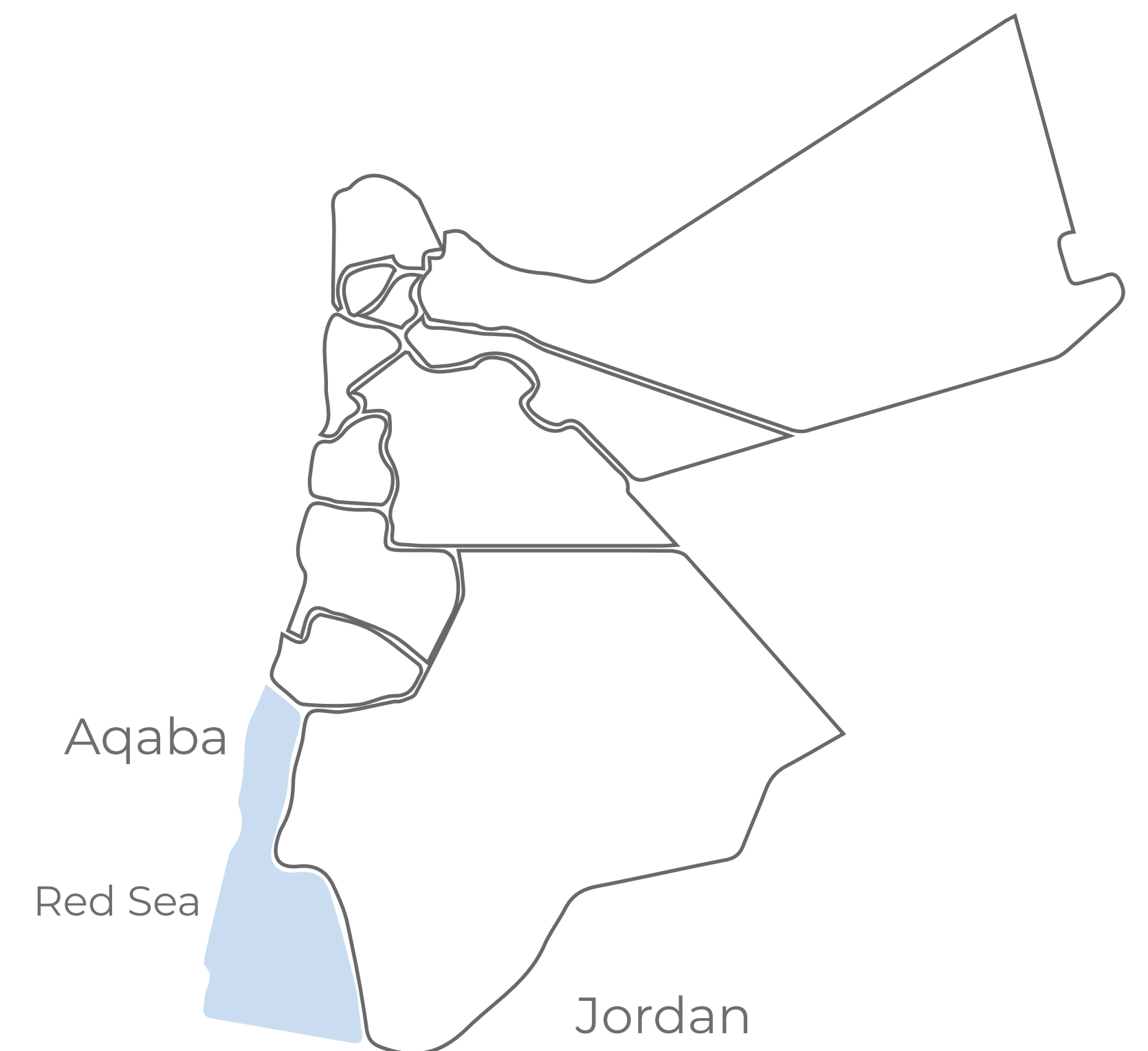
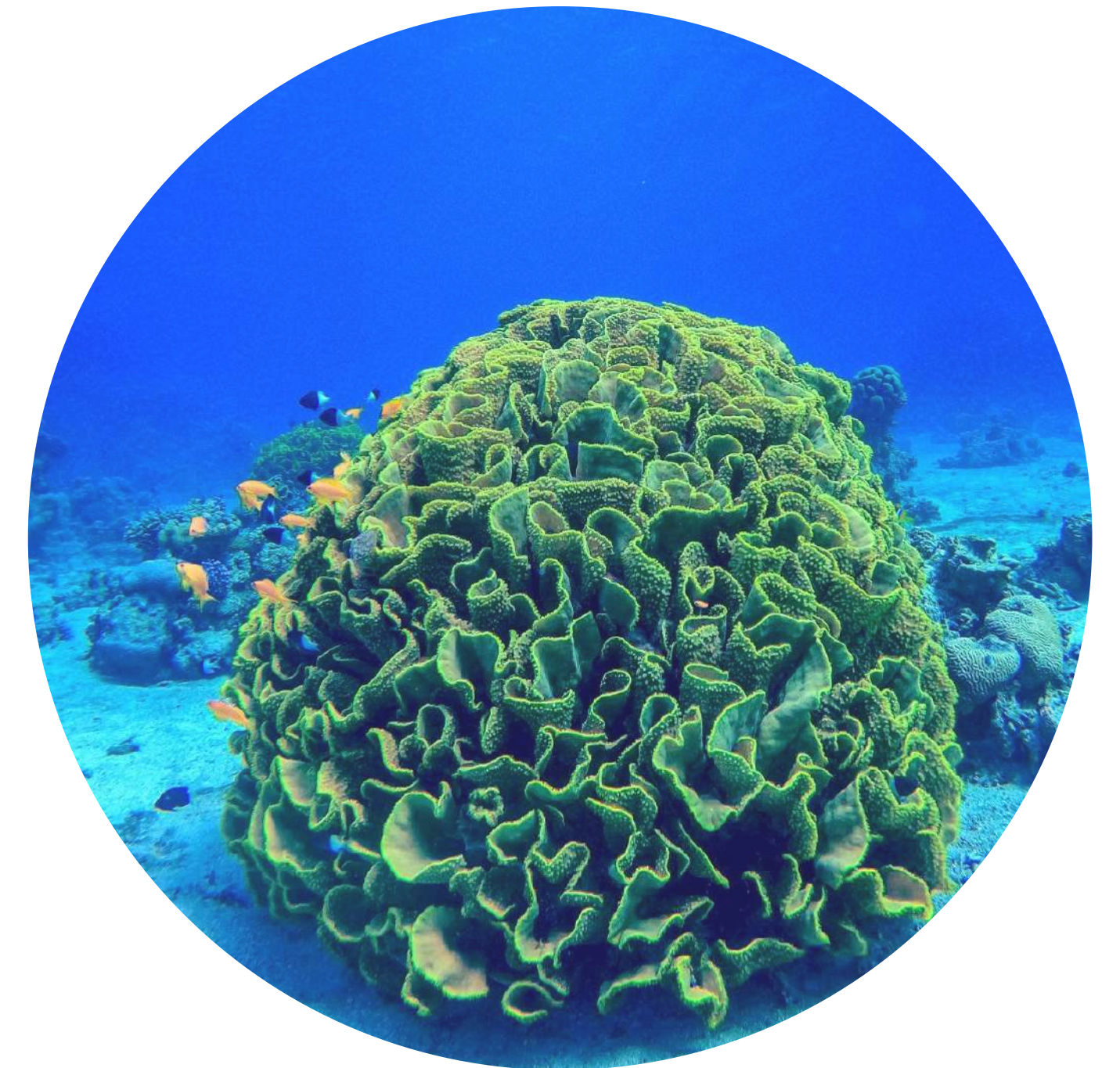




Plate coral on a reef in Aqaba



Coral reefs in Aqaba Red Sea



Soft coral on a reef in Aqaba

006 | Research Synthesis

Aqaba | Main Reef Types

Fringing Reefs (dominant reef type)

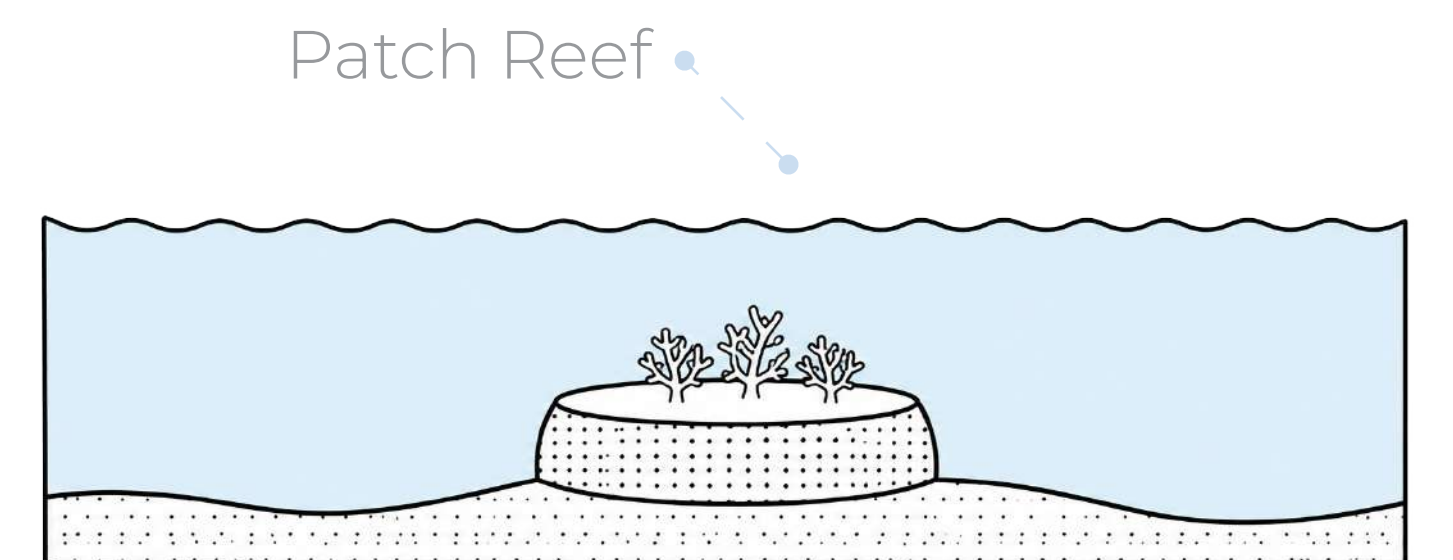
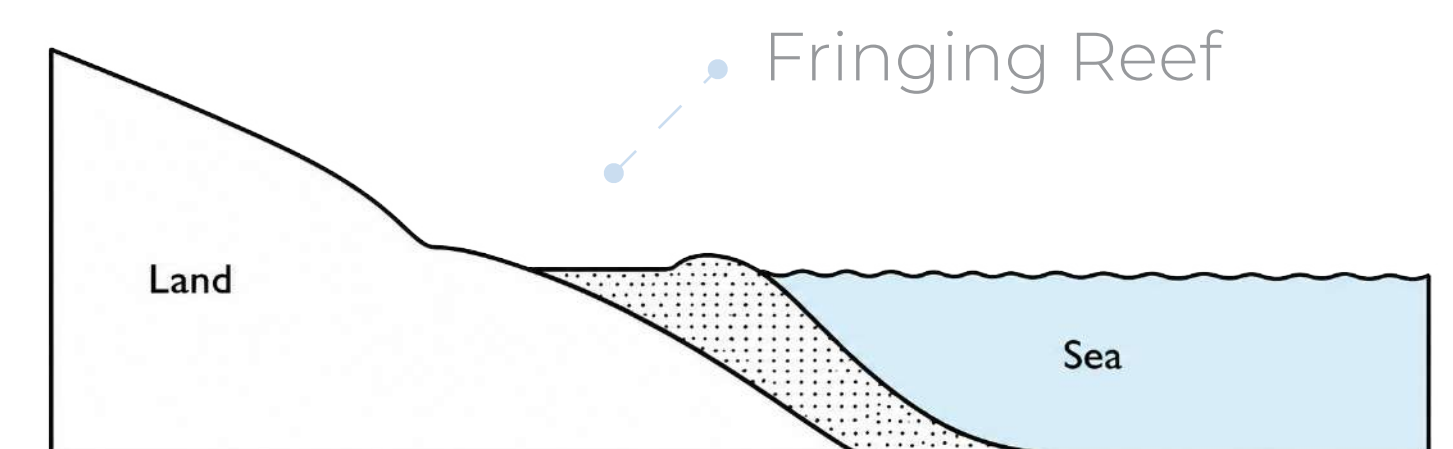
These occur directly along the shoreline and make up the vast majority of Aqaba's coral reef system. Most scientific descriptions of the Gulf of Aqaba refer to it as a fringing reef coastline.

Patch Reefs (localized and smaller)

Small isolated reef formations occur in certain areas, but they are not the dominant reef structure along Jordan's coast.

Reef Slopes / Fore-Reef Drop-offs

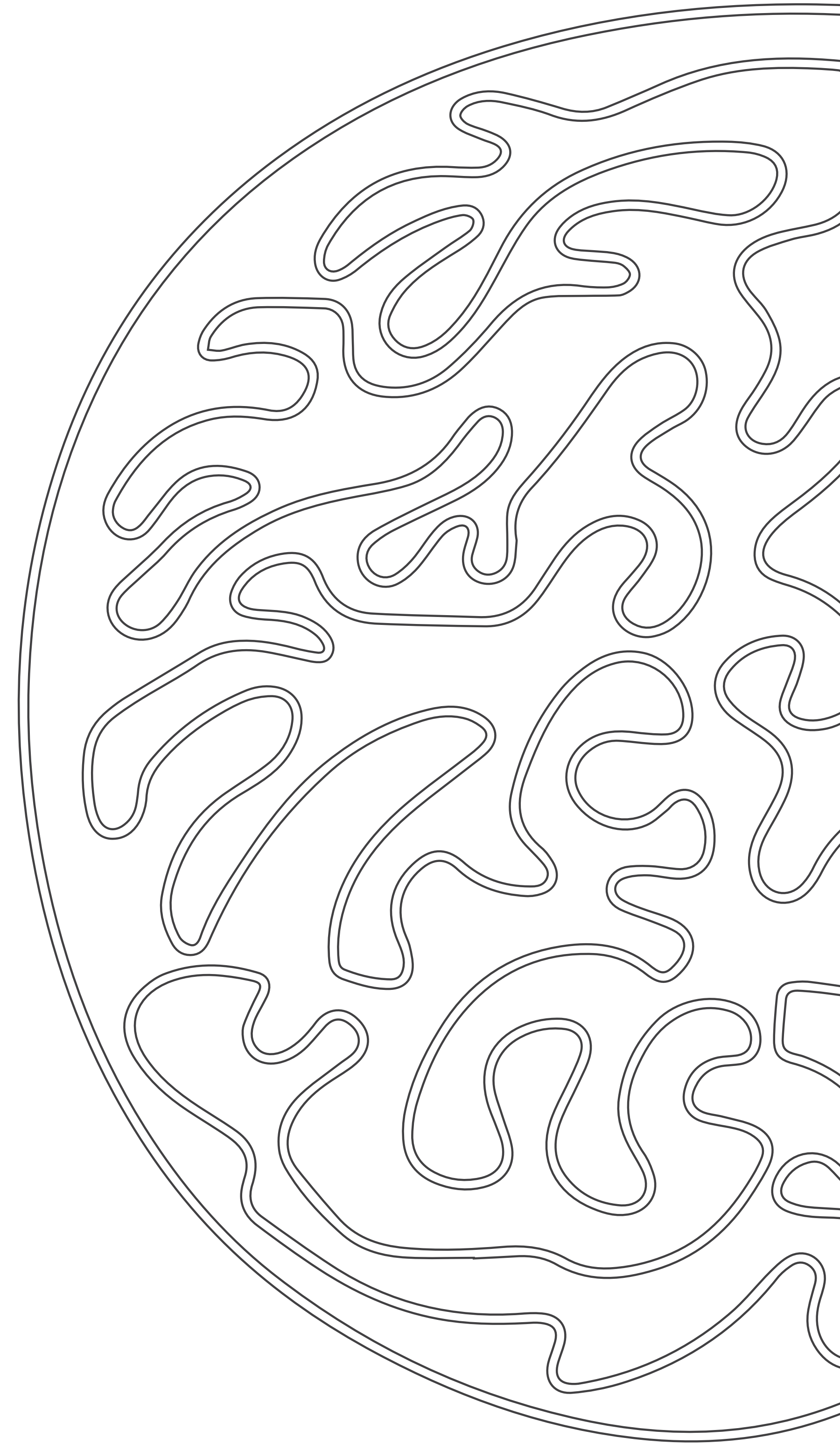
Due to the Gulf of Aqaba's deep rift-valley geology, many fringing reefs transition rapidly into steep reef slopes and deep-water drop-offs. This is a defining characteristic of the Gulf.



006 | Research Synthesis

Aqaba | Variety of Coral Reef Types

A wide variety of coral reefs in the Red Sea and the Gulf of Aqaba includes the families like Cyphastrea, Millepora, Sarcophyton, Caulastrea, Goniopora, Montipora, Stylophora, Galaxea, Favites, Capnella, Amphiprion, Goniastrea, Leptastrea, Lobophyllia, Favia, Phymastrea, Acropora, Dipsastraea, Fungia, Pocillopora, Pavona, Porites, Platygyra, Leptoseris, Echinopora and numerous species of crustaceans, molluscs, echinoderms, sponges, and other invertebrates.



006 | Research Synthesis

Aqaba | Coral Growth Morphologies

The main coral growth forms found in Aqaba's reefs are:

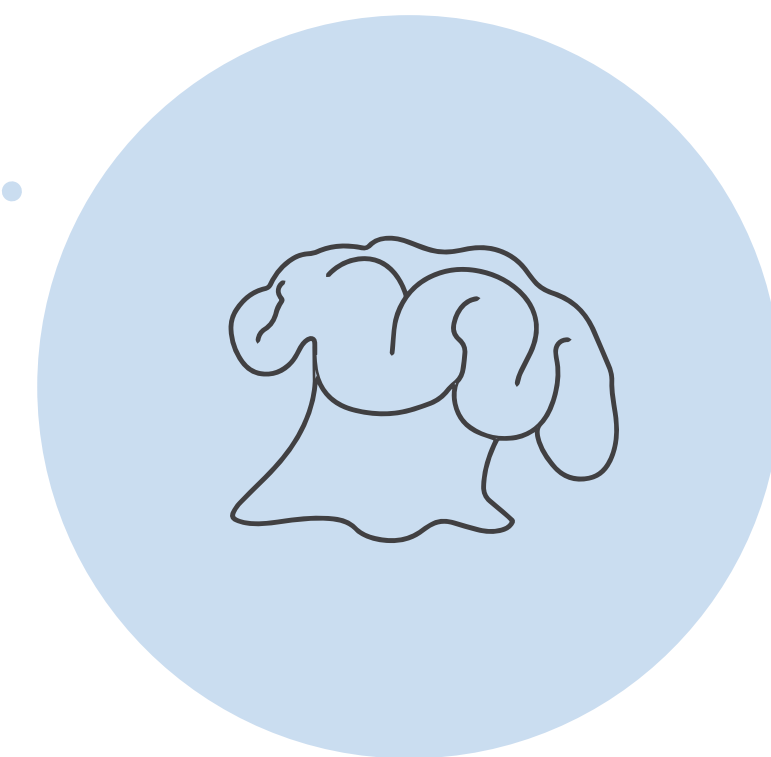
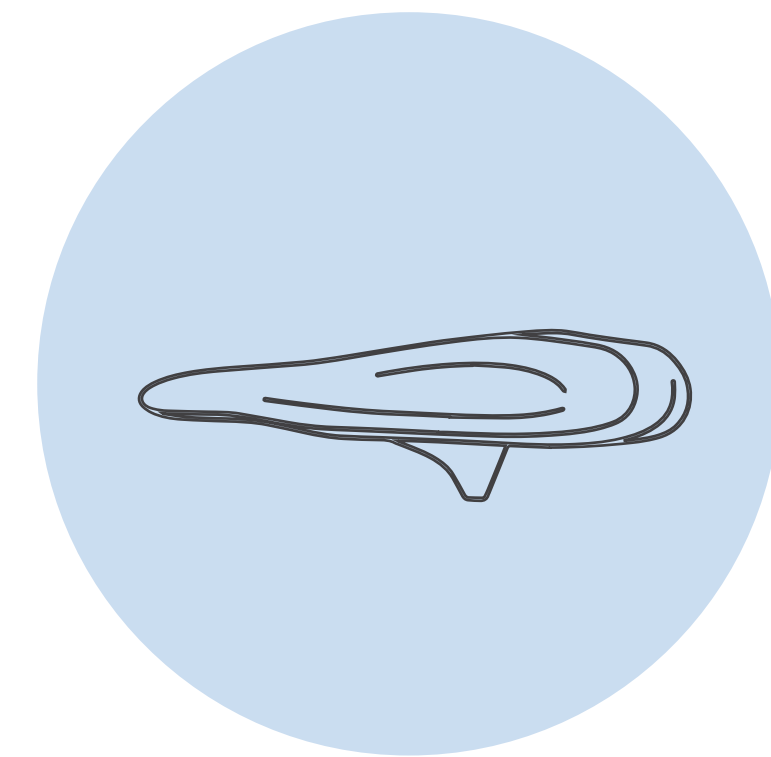
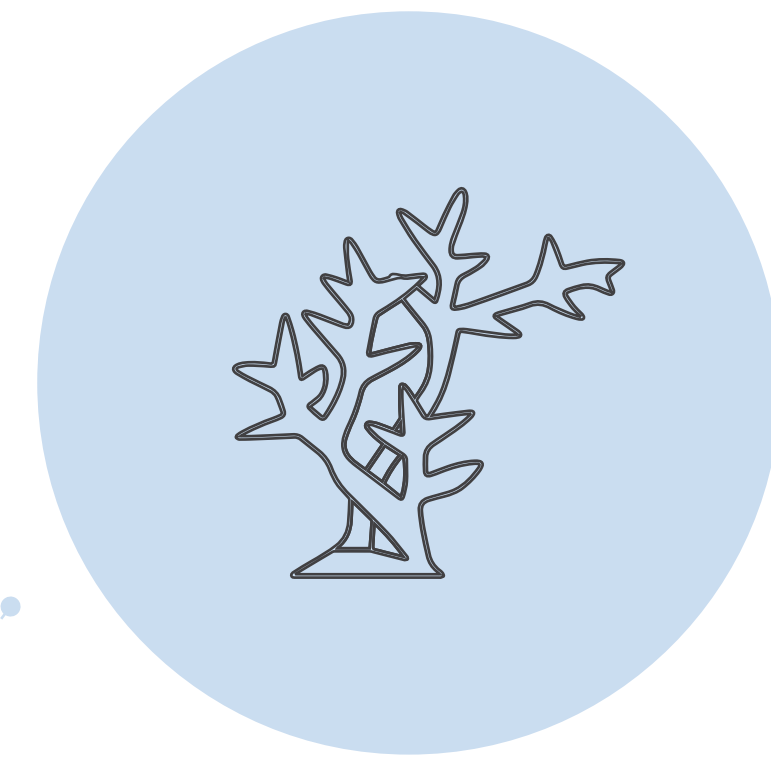
Branching Corals: Tree-like structures that grow rapidly and provide shelter for fish and small marine organisms.

Massive (Boulder) Corals: Large, dome-shaped corals that grow slowly and can live for centuries.

Plate Corals: Flat, layered, or table-like formations that maximize light capture in deeper waters.

Soft Corals: Flexible corals lacking a hard calcium carbonate skeleton, adding biodiversity and habitat complexity.

Encrusting Corals: Corals that spread across rock surfaces, forming thin layers that stabilize reef structures.





Boulder Coral



Plate Coral



Soft Coral



Branching Coral

006 | Research Synthesis

Aqaba | Initiatives and Campaigns

Blue Economy
and
Sustainable
Coastal
Development
Initiative

Aqaba Marine
Reserve (AMR)

JREDS
Coral Reef
Monitoring
Programs
Coral Watch

Mooring Buoy
Installation
Program

Coral Restoration
and
Rehabilitation
Research

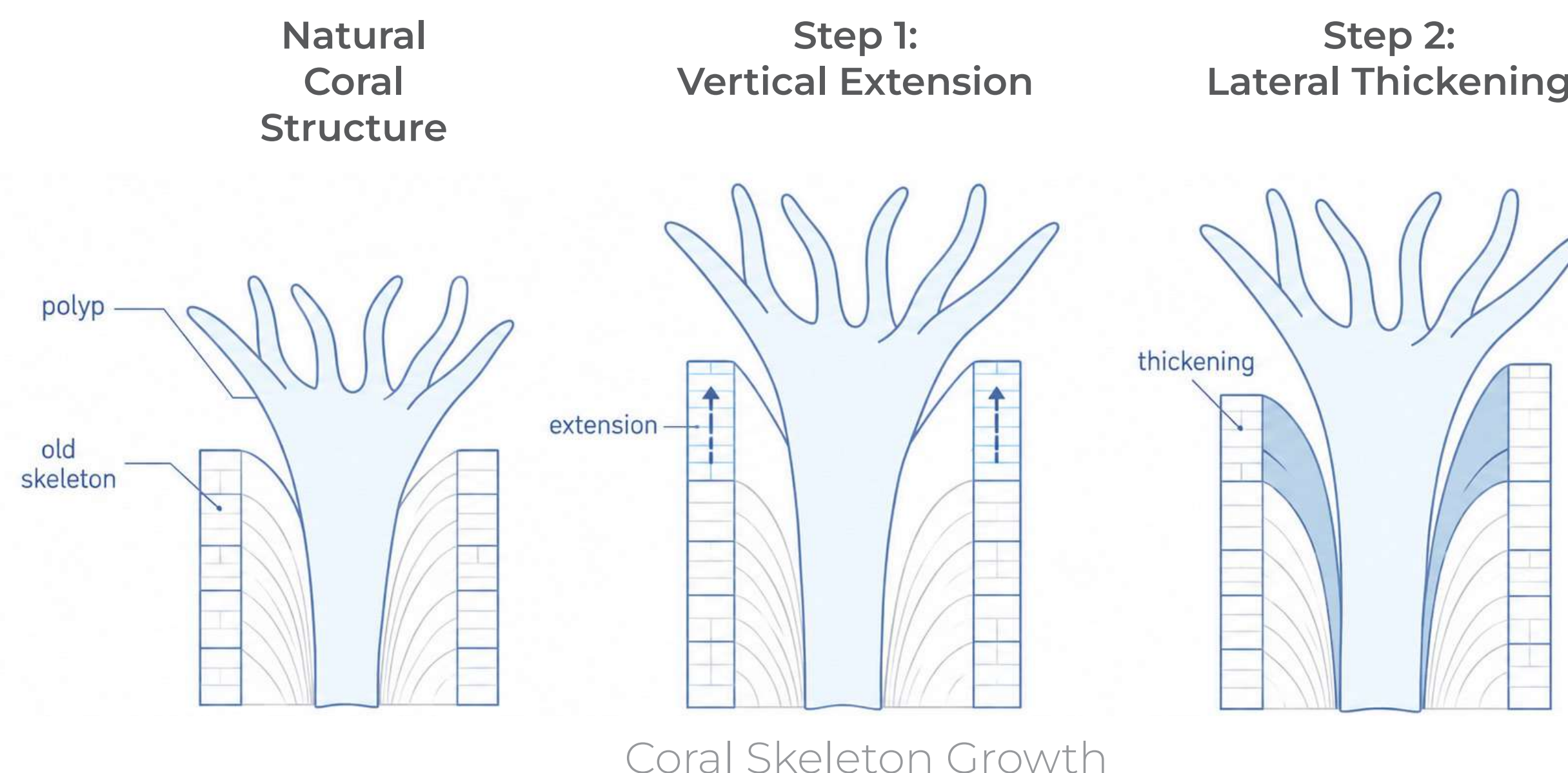
Red Sea Coral
Resilience
Research

006 | Research Synthesis

Artificial Reef

Artificial reefs are human-made underwater structures designed to mimic selected functions of natural reefs by providing hard substrate, vertical relief, and habitat complexity. Their ecological performance depends on factors such as material stability, rugosity, void space, surface texture, spatial arrangement, and suitability to local environmental conditions.

Research shows that artificial reefs can alter local marine habitats by introducing hard surfaces and complex vertical structures that support colonization by marine organisms. Features such as voids, holes, crevices, rugosity, and vertical relief can increase habitat value by offering refuge, feeding areas, settlement surfaces, and breeding spaces. However, artificial reefs are not universal solutions; their success depends on site-specific ecological conditions, appropriate material selection, careful design, monitoring, and integration with local conservation goals.



006 | Research Synthesis

Material Research

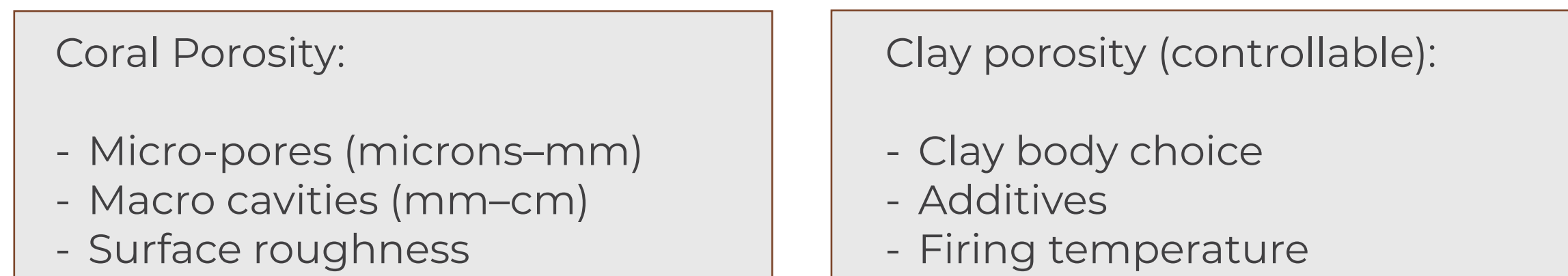
Unglazed fired clay is a promising material for artificial reef applications due to its chemical inertness, non-toxicity, durability, and capacity to support marine colonization. Studies have demonstrated that ceramic substrates can achieve high rates of coral larval settlement while providing long-term structural stability in marine environments. Furthermore, the compatibility of ceramic materials with additive manufacturing enables the creation of complex surface textures and habitat geometries that enhance biological recruitment and ecological functionality.



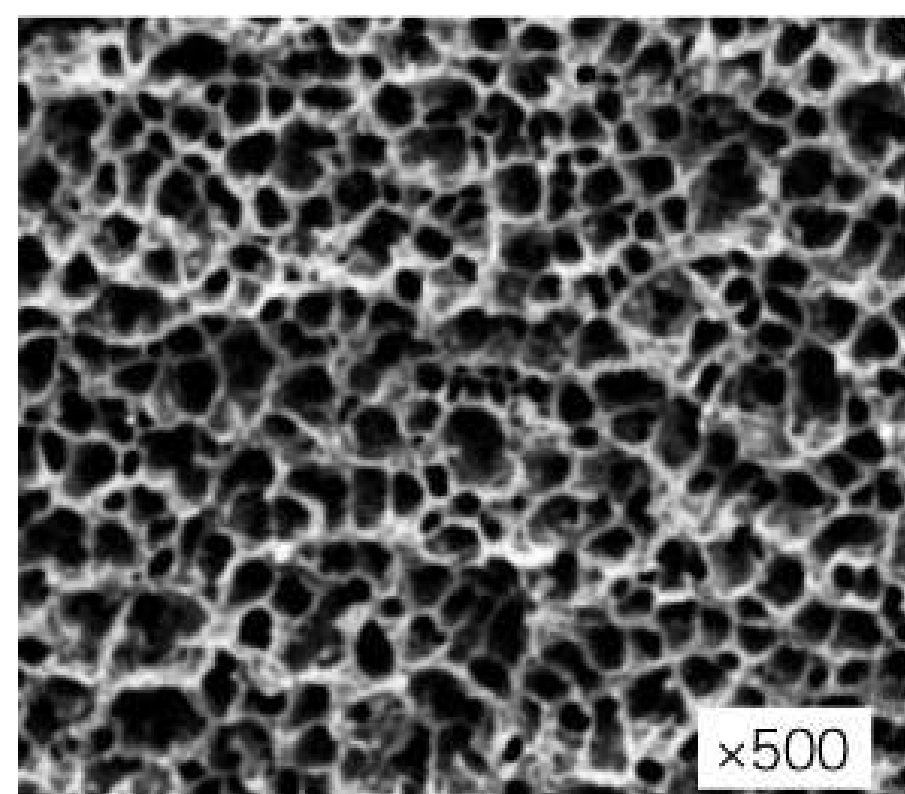
006 | Research Synthesis

Material Research

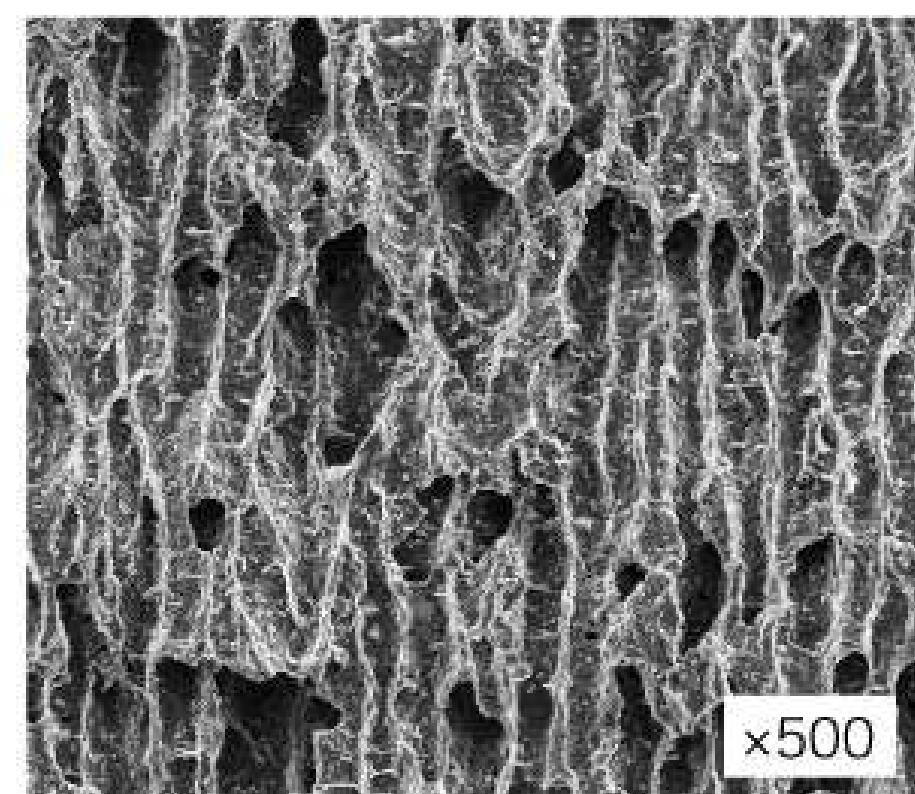
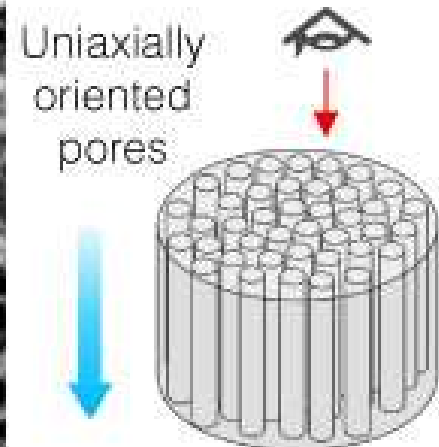
Clay can host life the way coral does



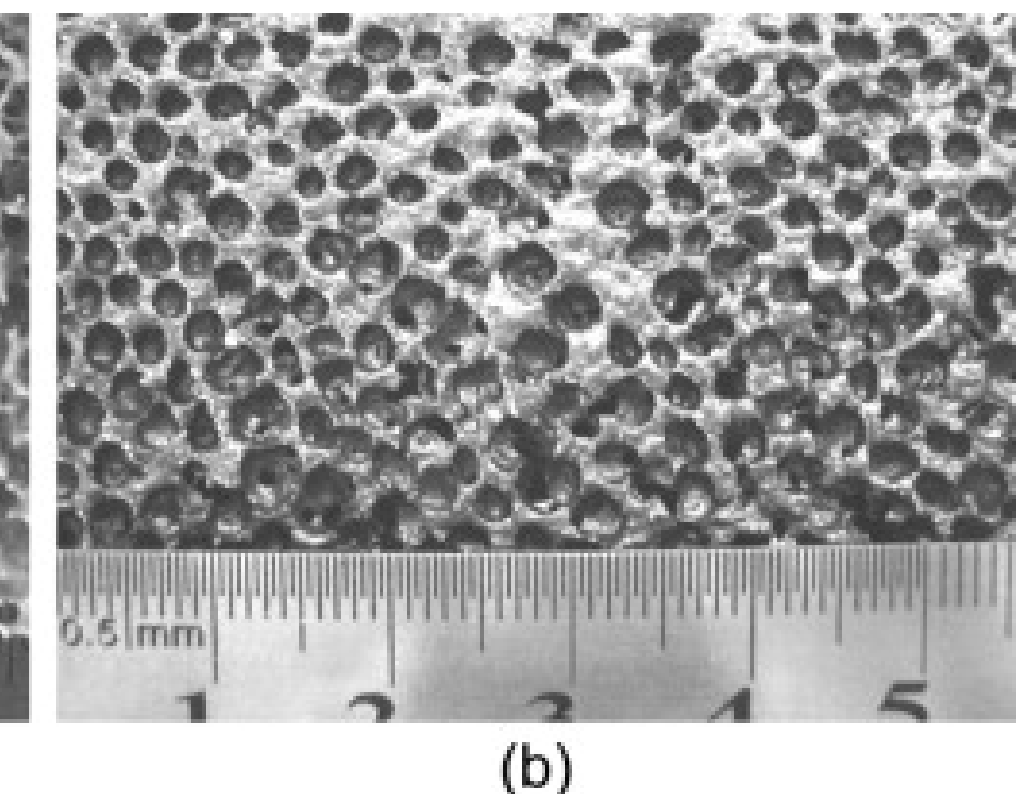
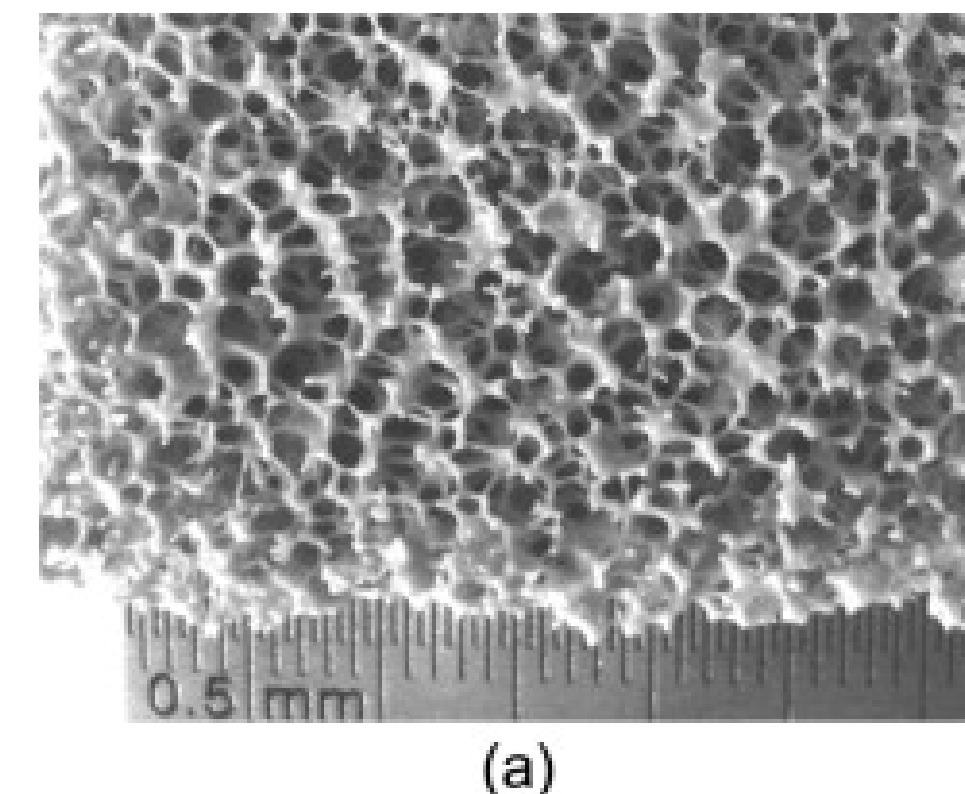
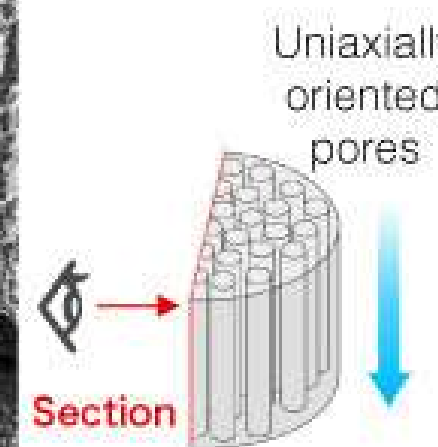
- This allows:
- Water flow
 - Algae attachment
 - Micro-organism shelter
 - Larval settlement



SEM image: planar structural view



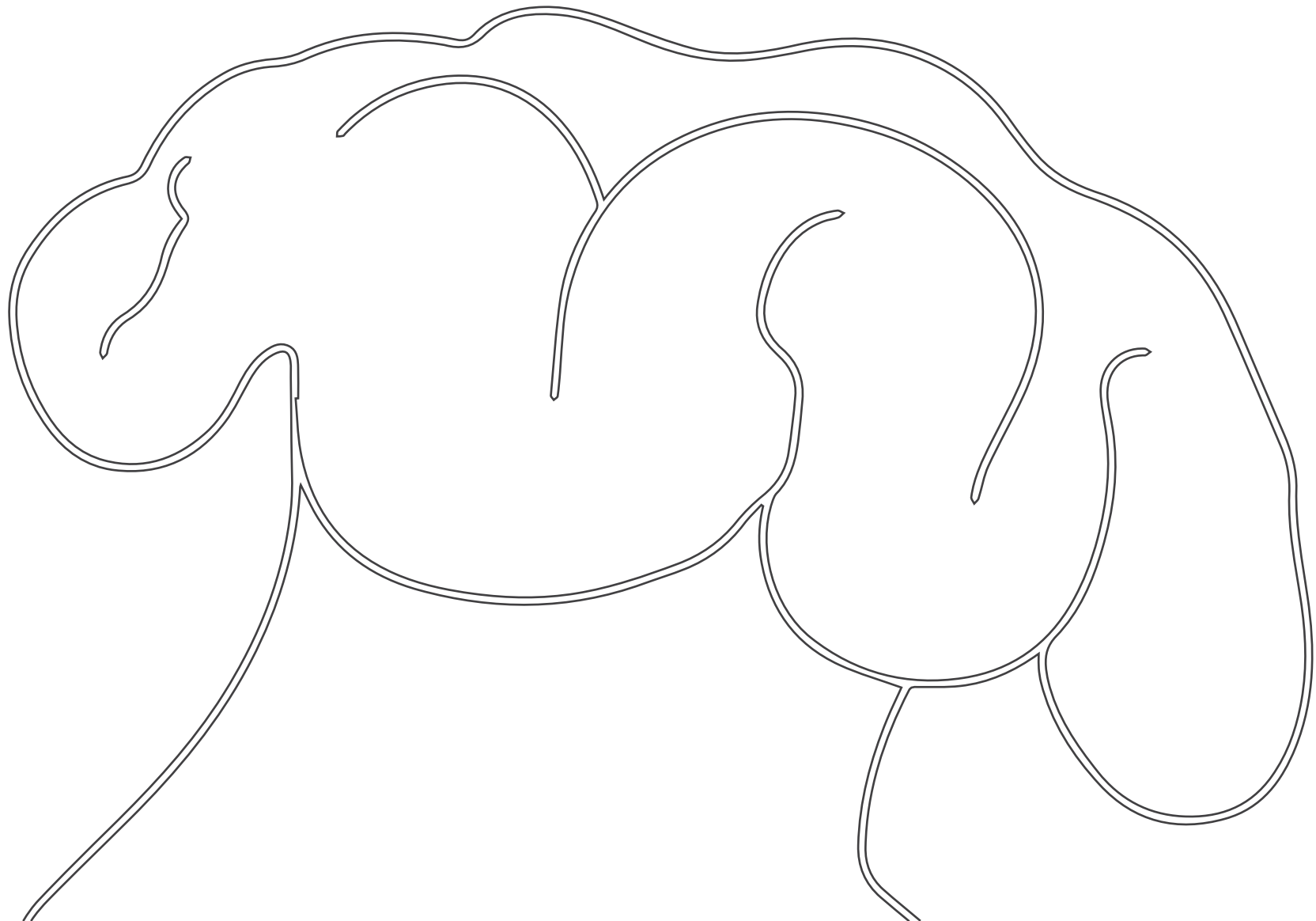
SEM image: vertical structural view



Full article: Macro-porous processing and properties

006 | Research Synthesis

Geometric Design Principles for Clay-Based Artificial Reefs



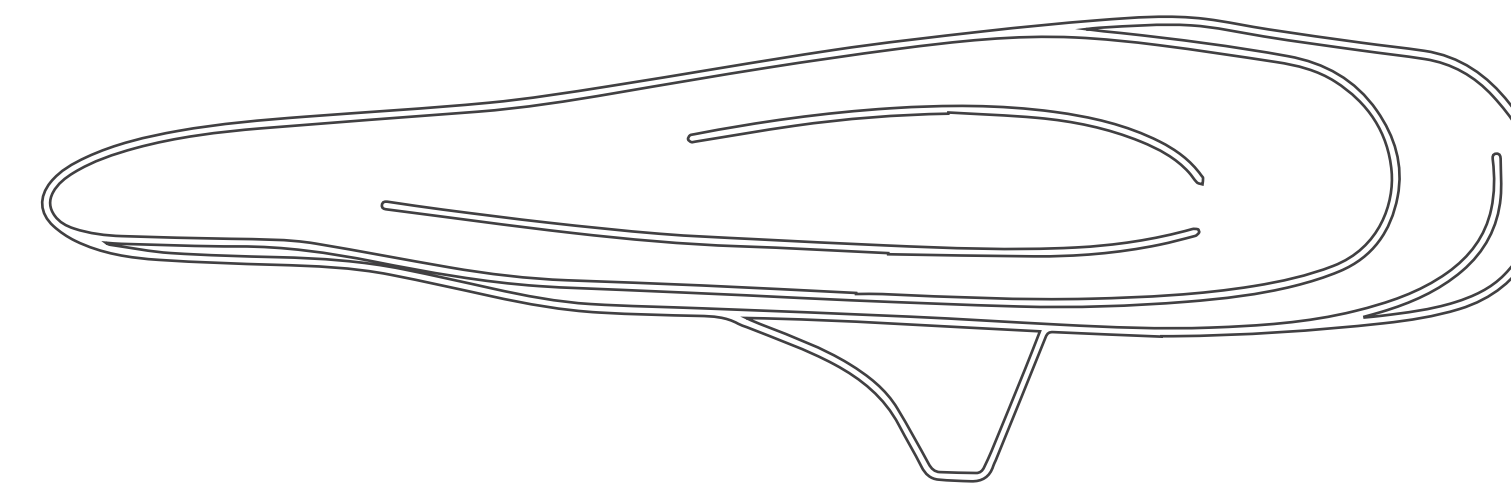
006 | Research Synthesis

Geometric Design Principles for Clay-Based Artificial Reefs

The effectiveness of an artificial reef is strongly influenced by its **geometry, surface complexity,** and **spatial organization.** Research has shown that successful reef structures emulate key characteristics of natural coral habitats by providing diverse surface conditions, shelter opportunities, and attachment points for marine organisms.

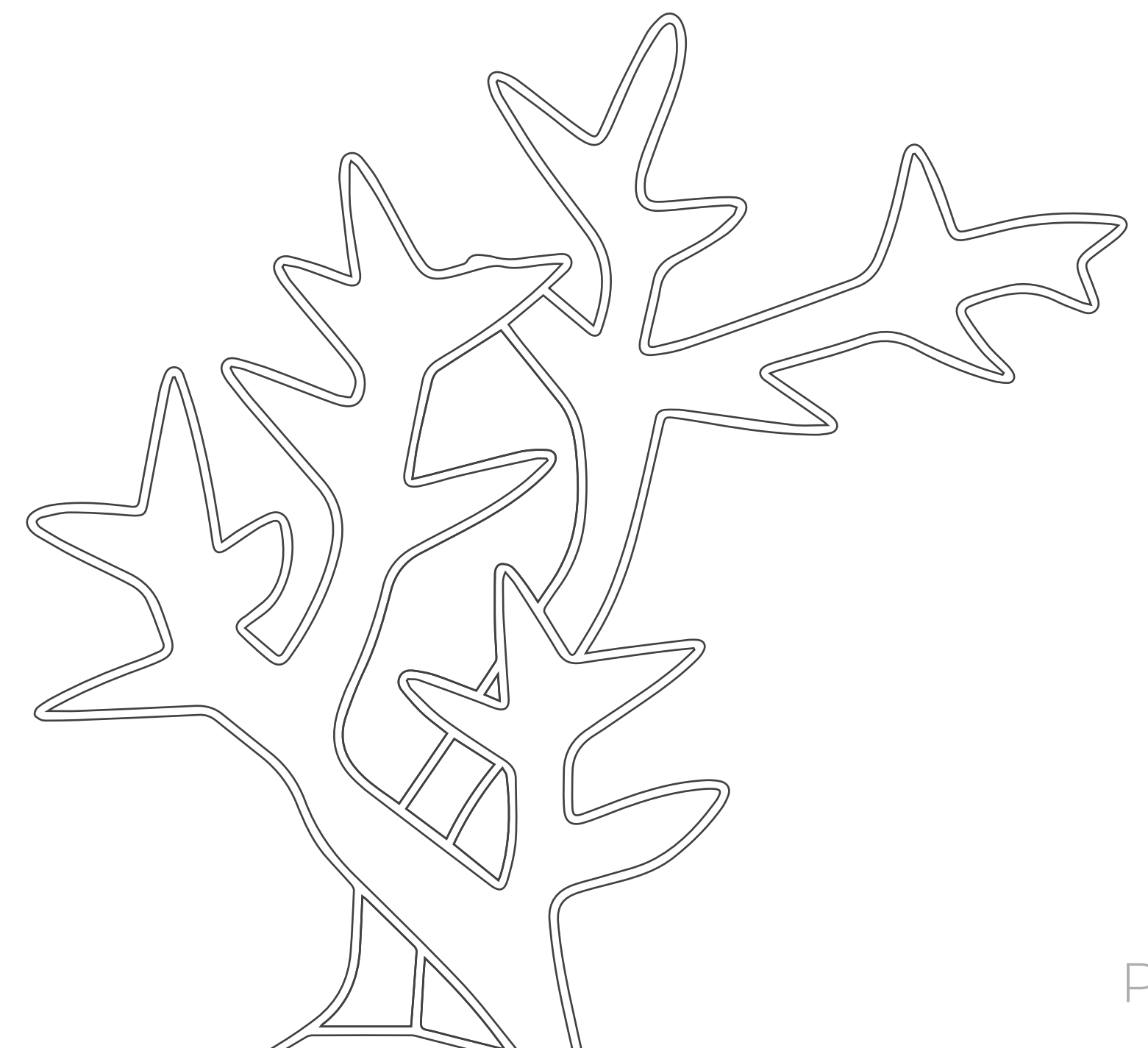
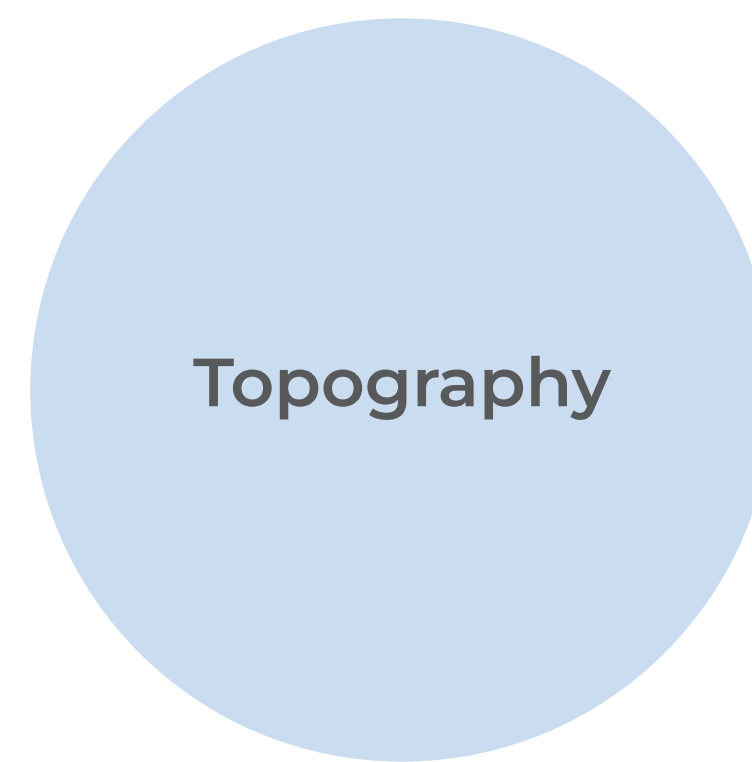
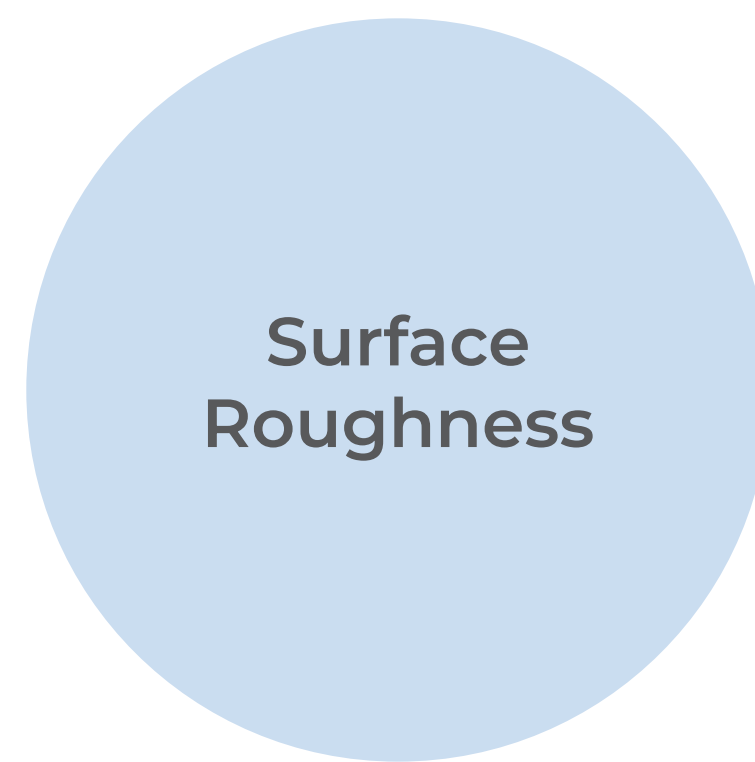
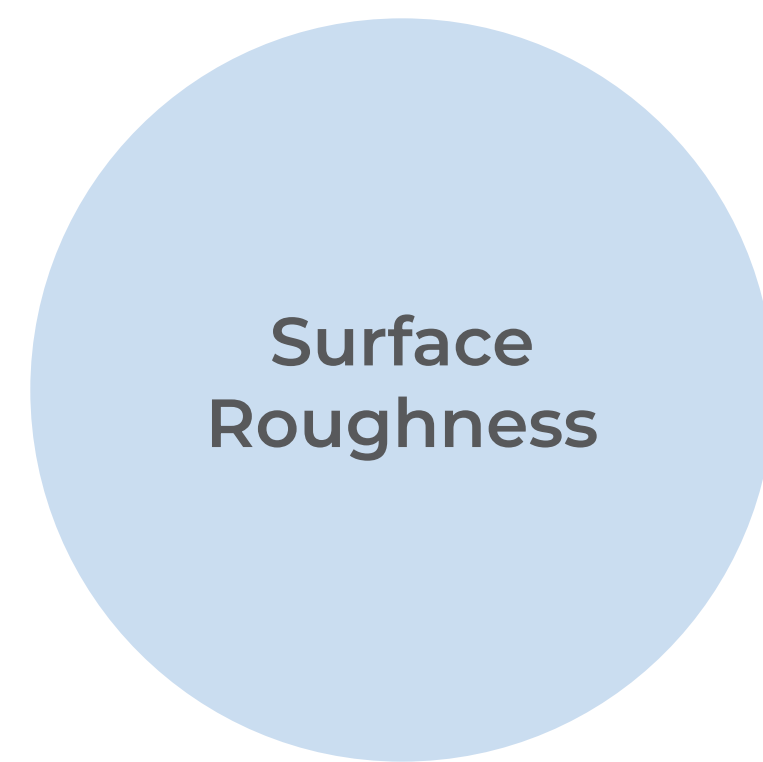
Coral larvae, algae, and other marine organisms preferentially settle on rough, textured surfaces rather than smooth ones. Micro-scale textures increase available surface area while providing protected locations where larvae can attach and develop. In clay additive manufacturing, layer lines produced during 3D printing naturally create a textured surface that can enhance biological settlement. Additional ridges, grooves, and patterned surface features can further increase habitat value.

Natural coral reefs contain numerous cavities, tunnels, and crevices that provide shelter for fish, crustaceans, and other organisms. Artificial reef modules should therefore incorporate a range of opening sizes rather than a single uniform cavity. Small voids can support juvenile fish and invertebrates, while larger openings promote water circulation and accessibility for larger species. Research suggests that structural heterogeneity increases biodiversity by accommodating organisms with different spatial requirements.



006 | Research Synthesis

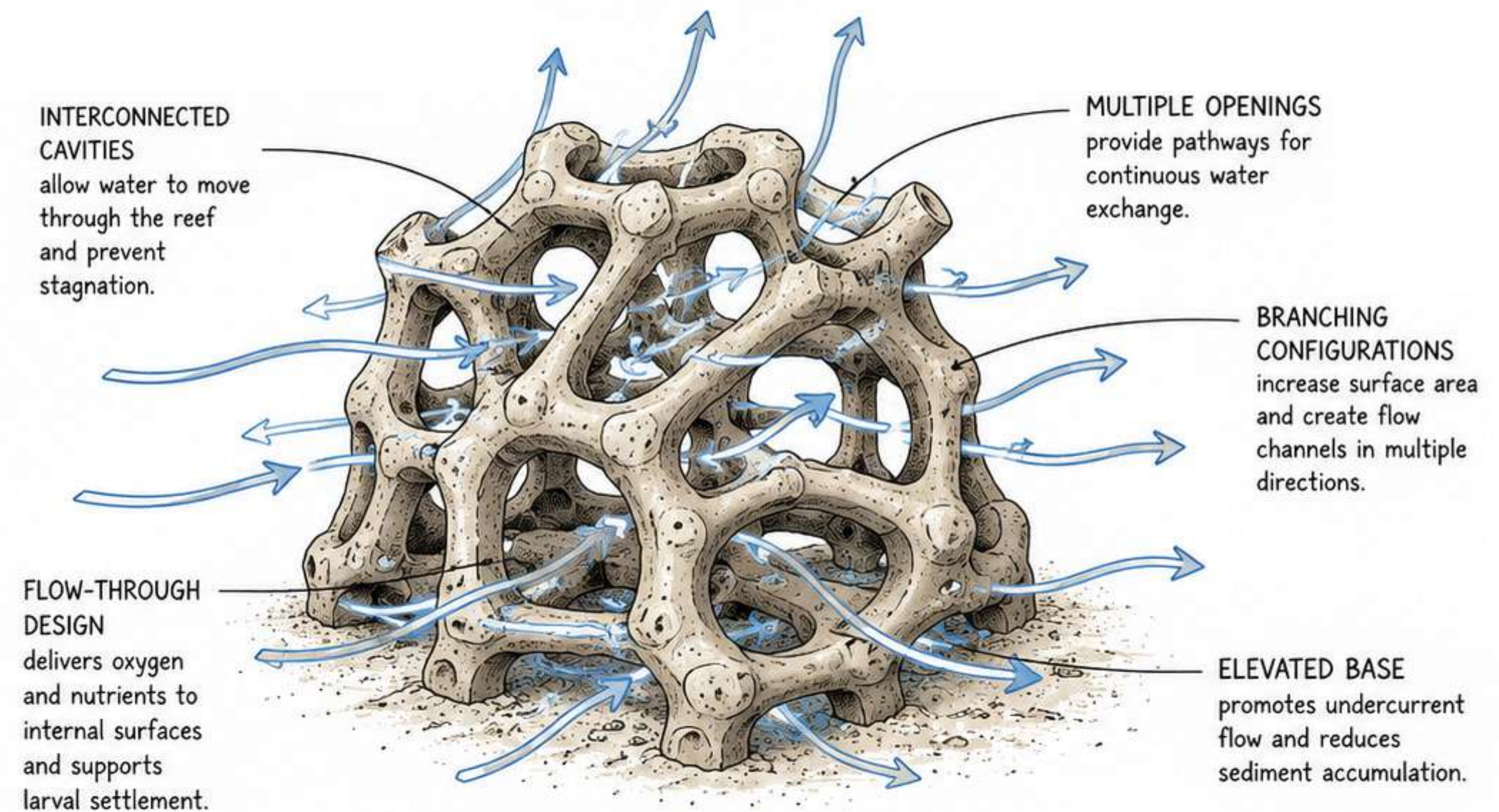
Geometric Design Principles for Clay-Based Artificial Reefs



006 | Research Synthesis

Geometric Design Principles | Water Flow and Circulation

Water flow is a critical design factor in artificial reef development because reef geometry influences local hydrodynamic conditions, larval transport, oxygen delivery, sediment movement, and settlement opportunities. Studies on artificial reef hydrodynamics and coral larval settlement show that surface topography, openings, rugosity, vertical relief, and interconnected cavities can modify flow patterns and create more favorable conditions for colonization and habitat development.

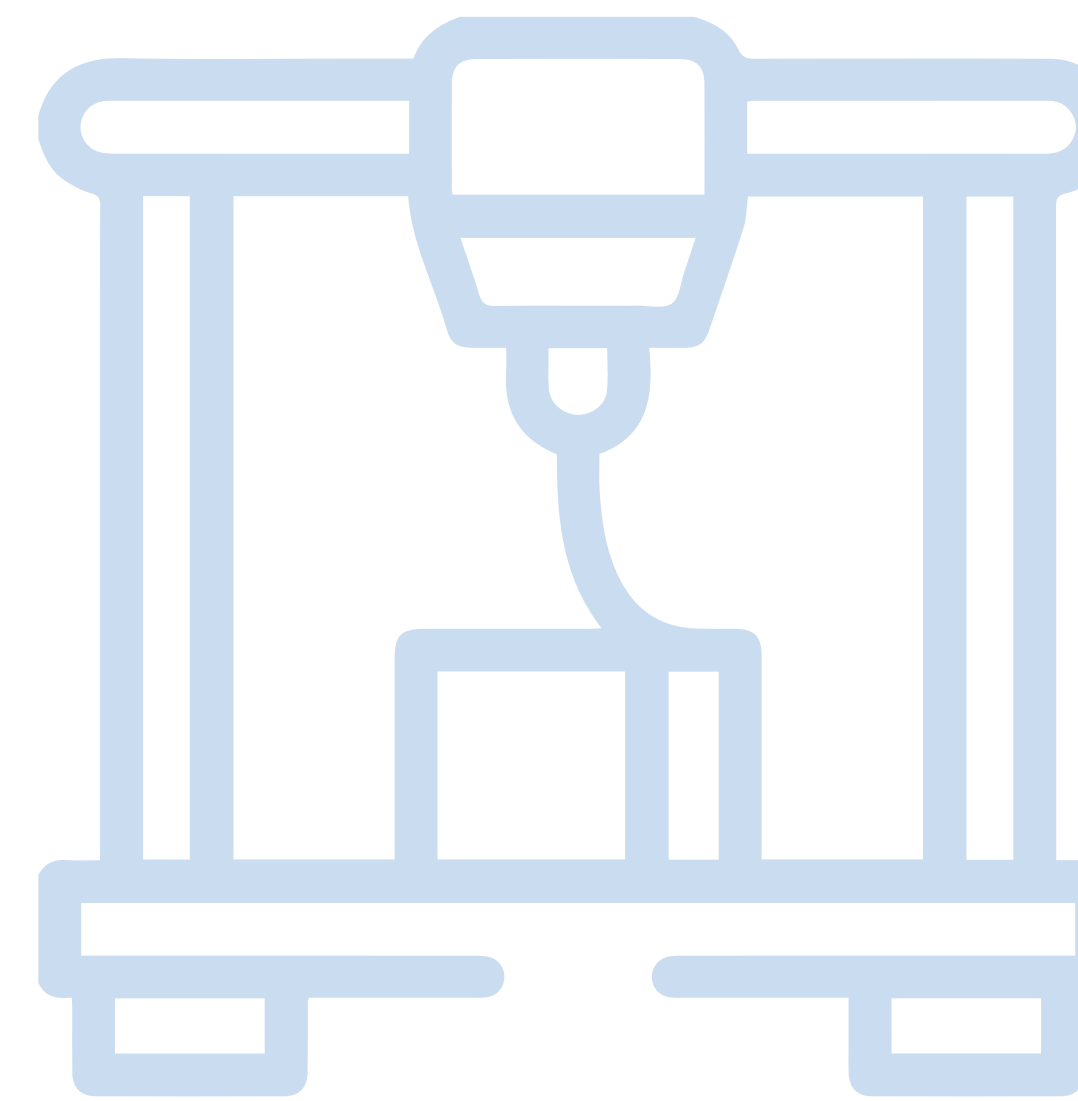


006 | Research Synthesis

Geometric Design Principles | Additive Manufacturing

Clay 3D printing enables geometries that would be difficult to produce through conventional fabrication methods. Computational design tools can generate lattices, porous networks, gradient structures, and complex branching forms while maintaining printability. The layer-by-layer process also allows the integration of multiple scales of complexity, from millimeter-scale textures to larger habitat-forming cavities.

For artificial reef applications, successful clay geometries should therefore maximize surface area, incorporate multiple cavity sizes, promote water circulation, provide vertical relief, and support modular aggregation. Rather than functioning as a single object, the reef should operate as a spatial habitat system capable of supporting a diverse range of marine organisms over time.



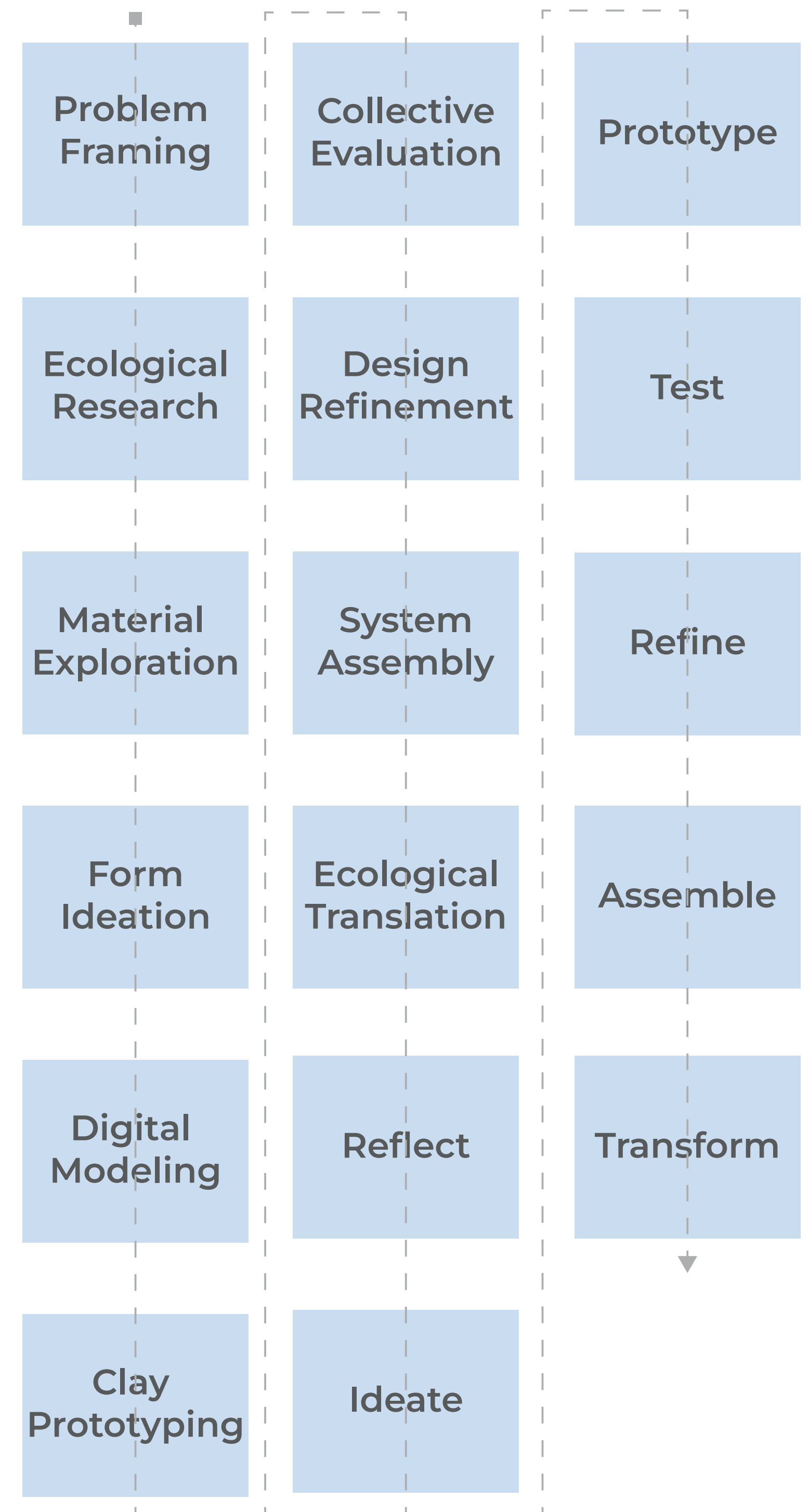


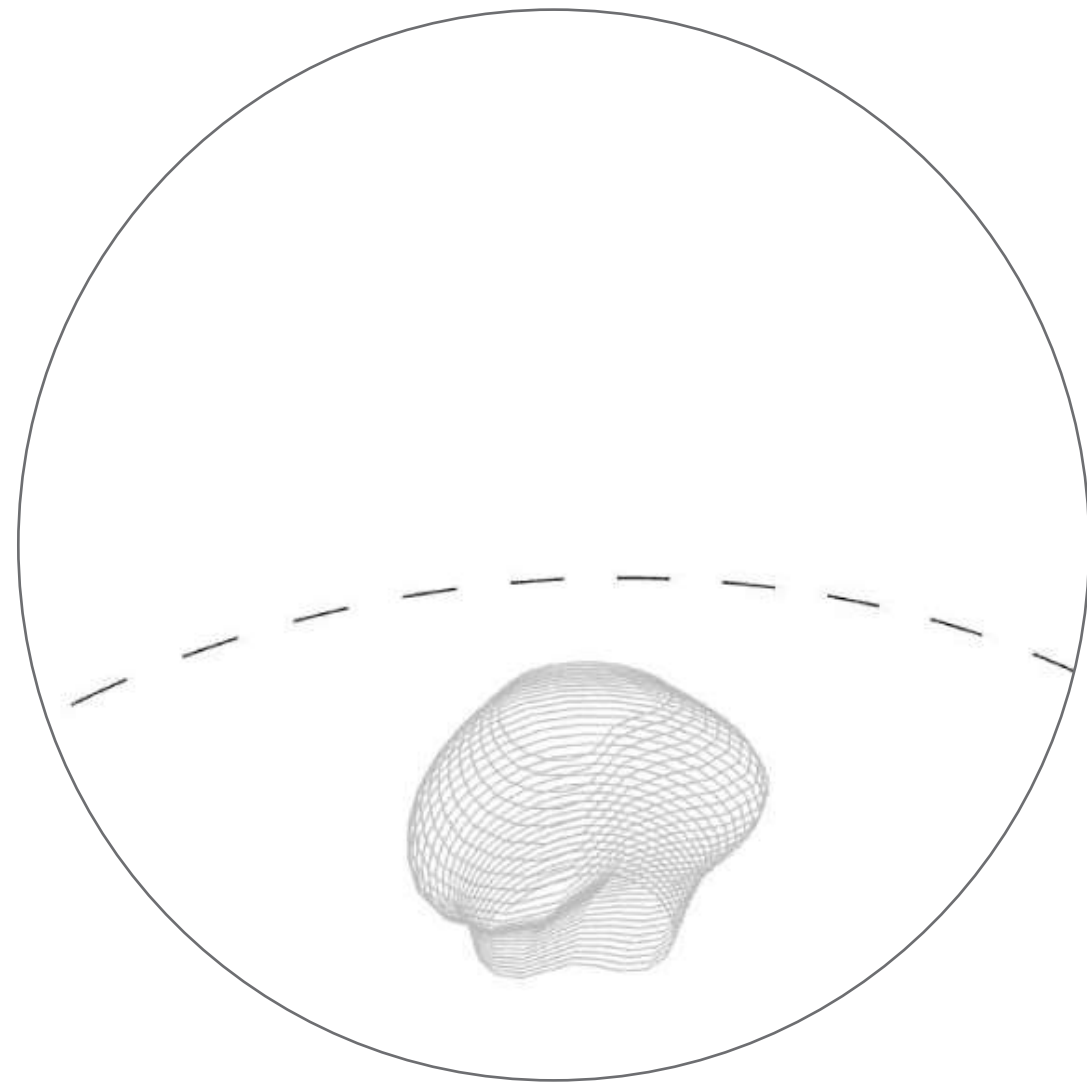
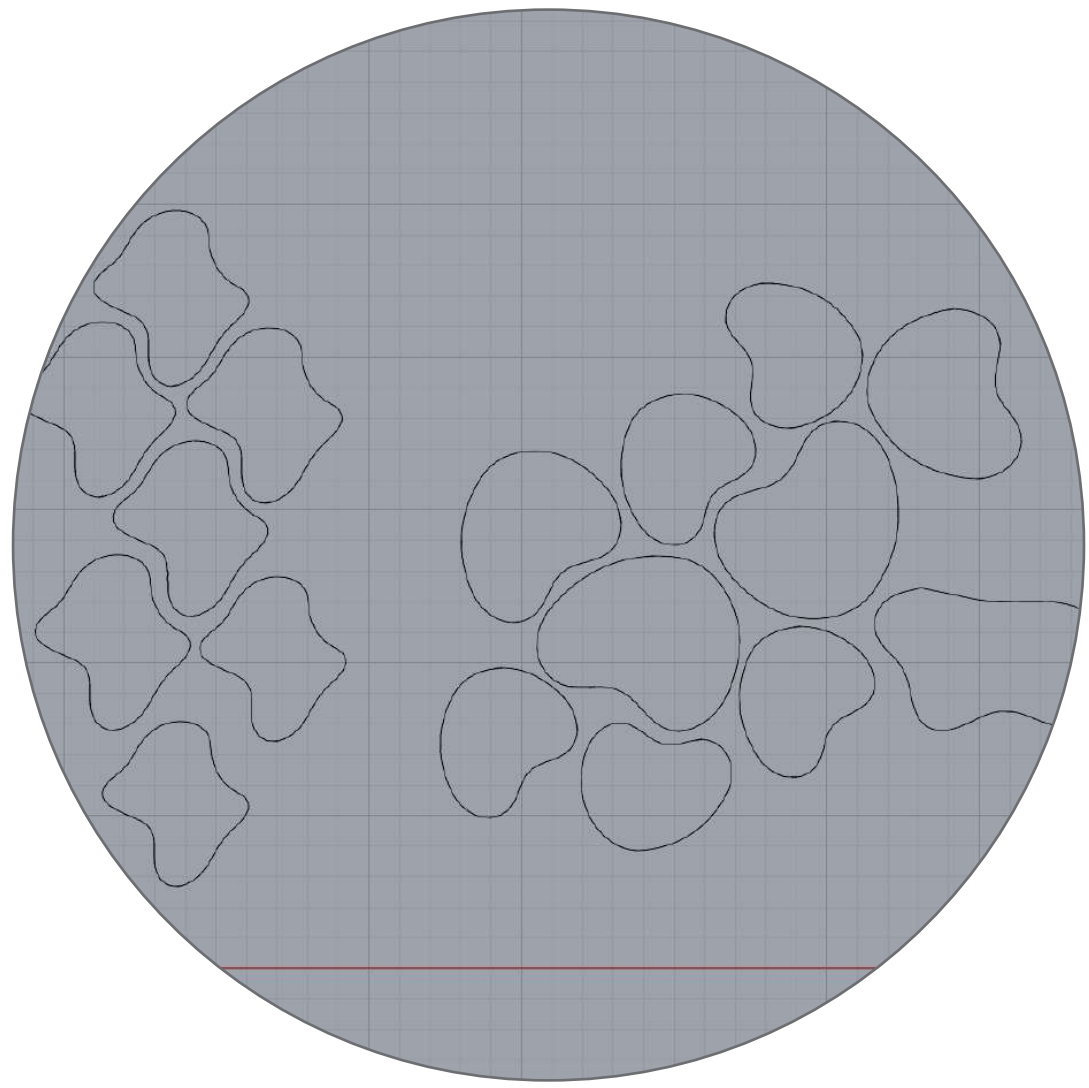
“A play of trial and error”

007 | Collective Design Process

Timeline

The process began by translating the initial concept into a series of material and form explorations. I started by studying coral reef structures, artificial reef systems, and the potential of clay as a material that can move between design and ecology. Through sketching, digital modeling, and clay 3D printing tests, different module shapes were developed to explore surface texture, openings, and methods of assembly. The process moved in parallel between designing each piece as an individual object and aligning it within a larger system, where every element could first exist on the body and later be reassembled into a structure with a new ecological purpose.





007 | Collective Design Process

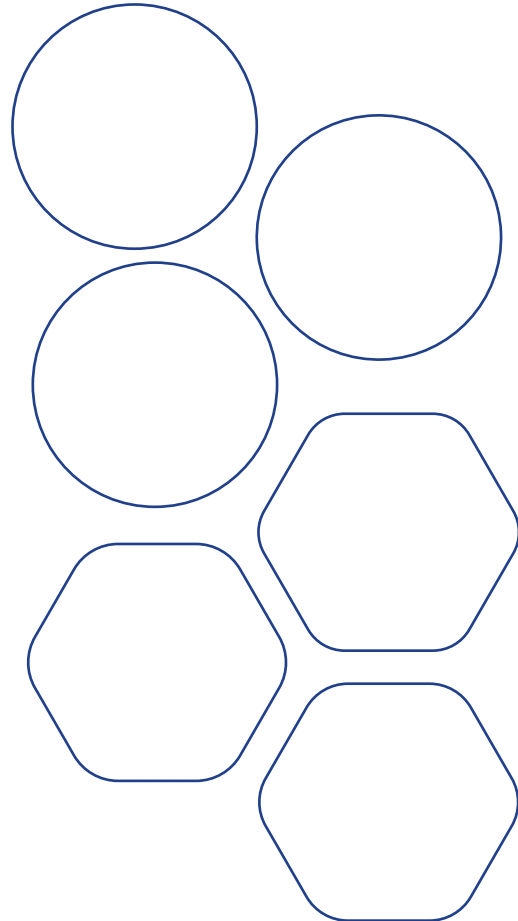
Form Ideation

The form ideation stage explored how terracotta modules could move between body, material, and habitat. Through sketching, digital modeling, and clay 3D printing, I tested different module families, ranging from regular geometric units to more irregular, coral-like morphologies. Several clay bodies were printed and tested to observe their behavior during extrusion, drying, shrinkage, cracking, and firing. This process helped define the modules' scale, thickness, texture, and attachment logic. At the same time, the studies investigated how distinct shapes establish a visual and structural language, and how these languages can be woven together across the garment before being reassembled into a new ecological structure.

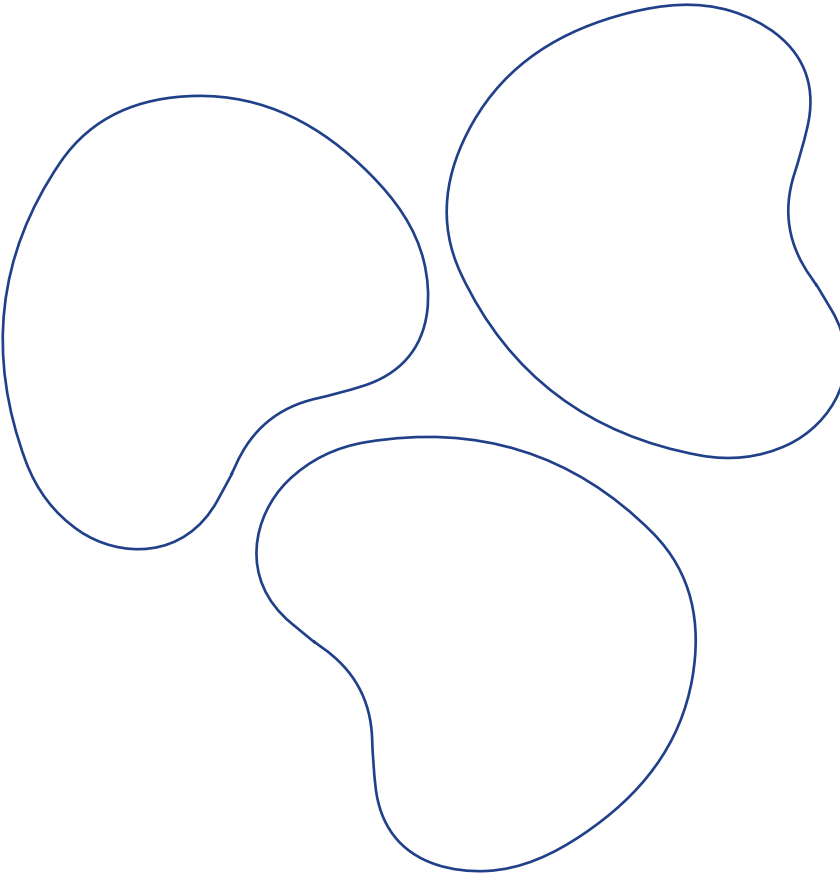


007 | Collective Design Process

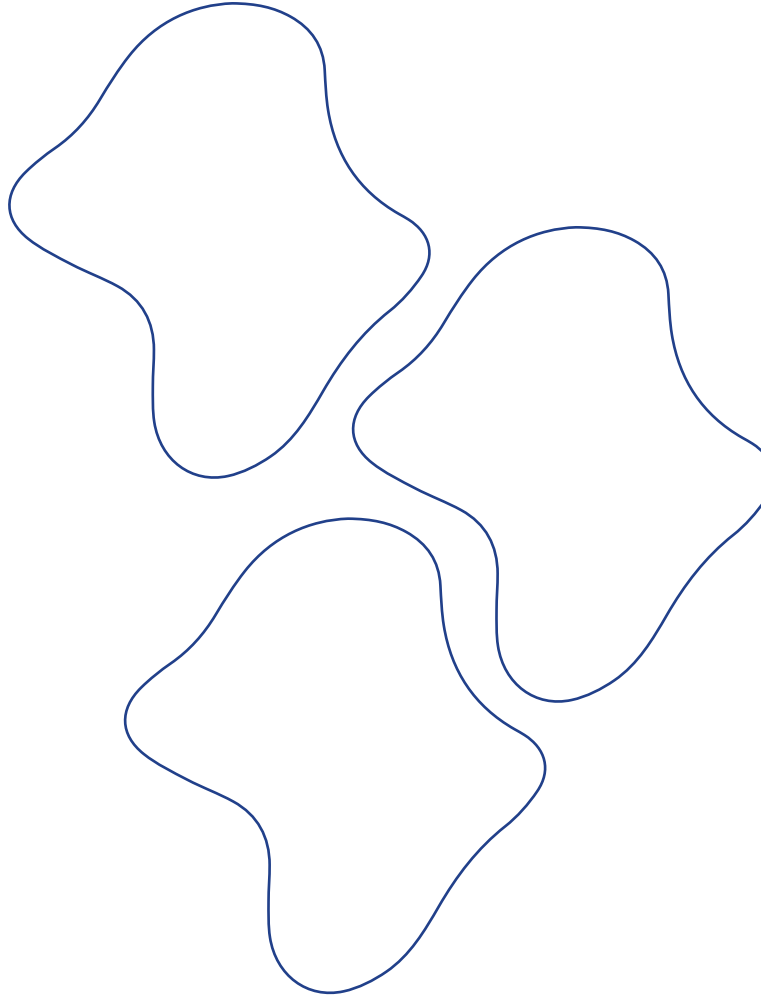
Form Ideation | Shape Development



Controlled Geometry



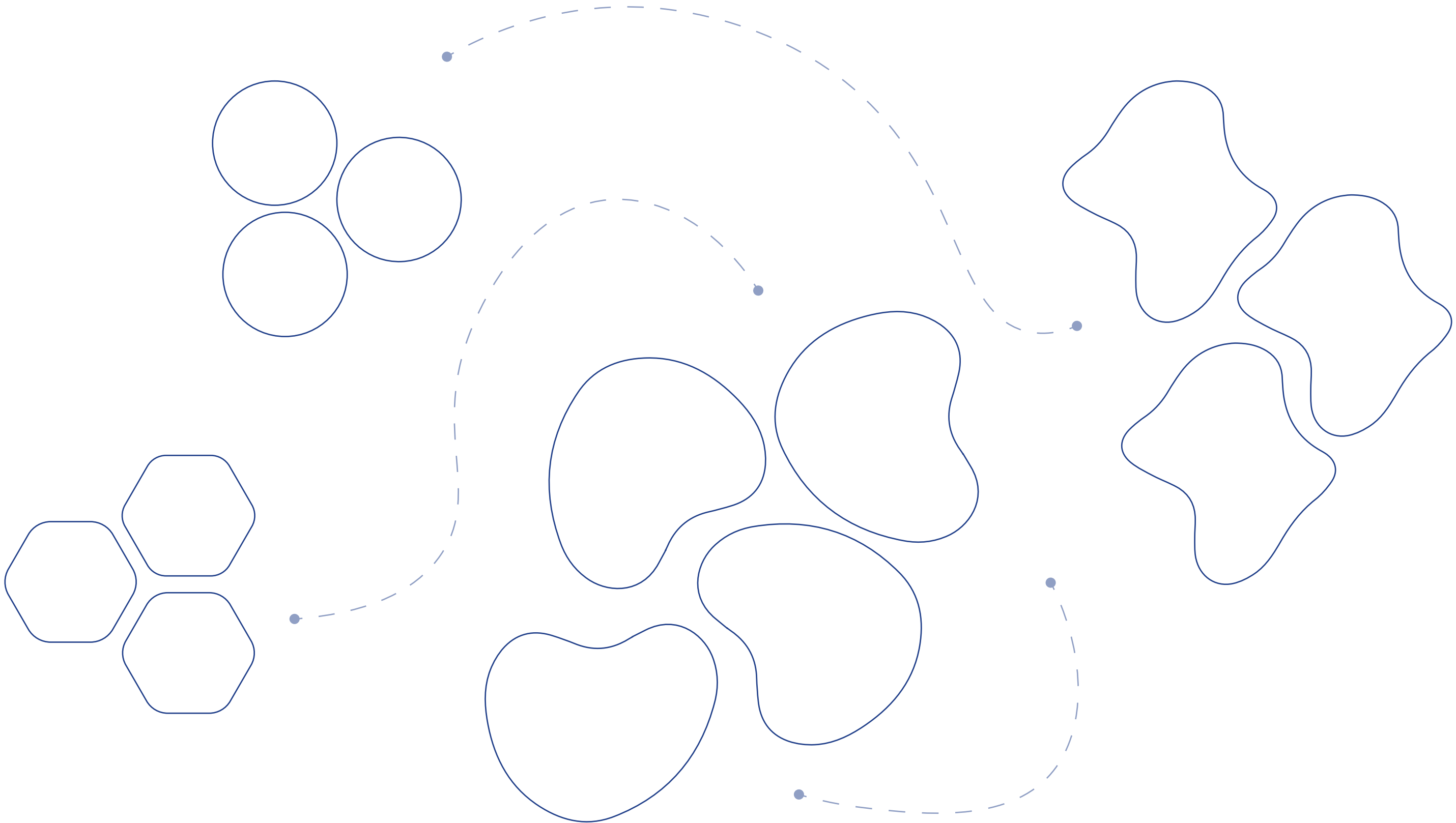
Organic Variation



Distorted Geometry

007 | Collective Design Process

Form Ideation | Possibilities

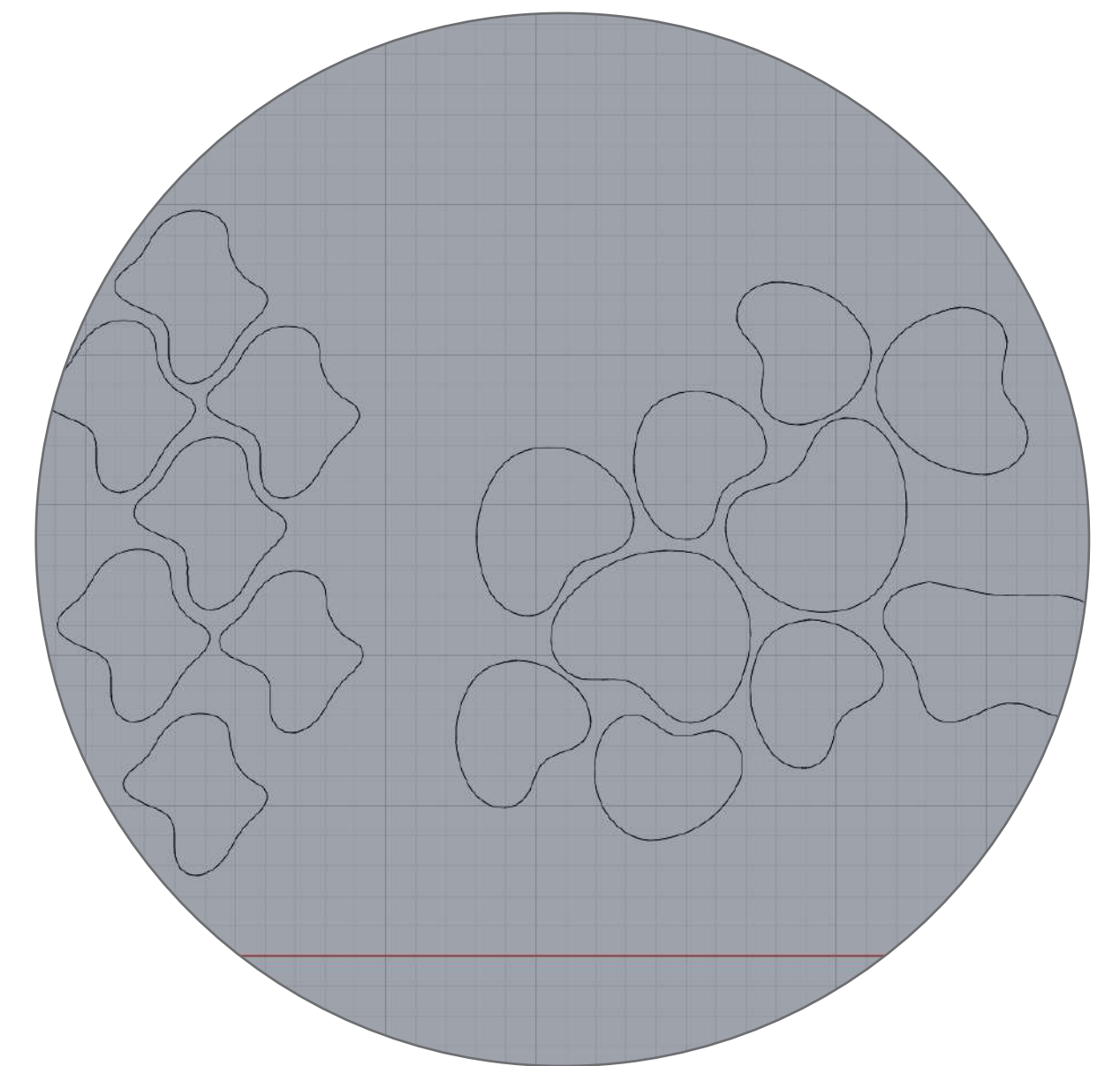


Woven possibilities of languages

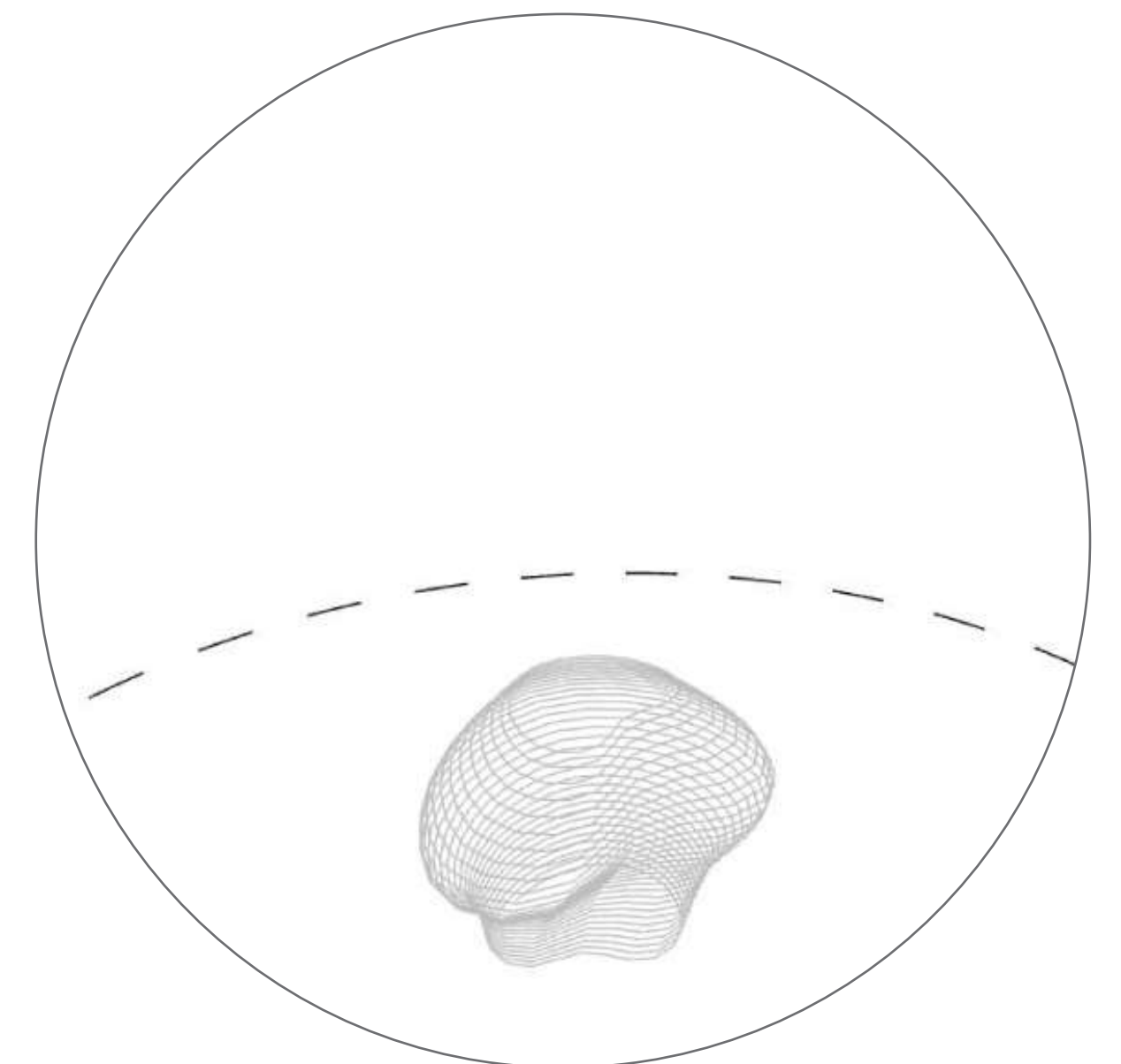
007 | Collective Design Process

Digital Modelling

The digital modelling process was organized in two main stages: base-shape development and printable morphology generation. Rhino was first used to draw and refine the initial module outlines, allowing the forms to be grouped into different families such as regular, irregular, and distorted geometries. These base shapes were then imported into WASP Slicer, where the three-dimensional qualities of the modules were developed through extrusion paths, layer height, wall thickness, and clay deposition settings. Rather than modelling the final forms only as static digital objects, the process allowed each shape to evolve through the logic of clay printing itself. As a result, every base geometry developed its own language through the rhythm of the layers, the build-up of material, and the relationship between openings, thickness, and surface texture. This workflow helped balance form, printability, attachment to the garment, and future reassembly into a larger ecological structure.



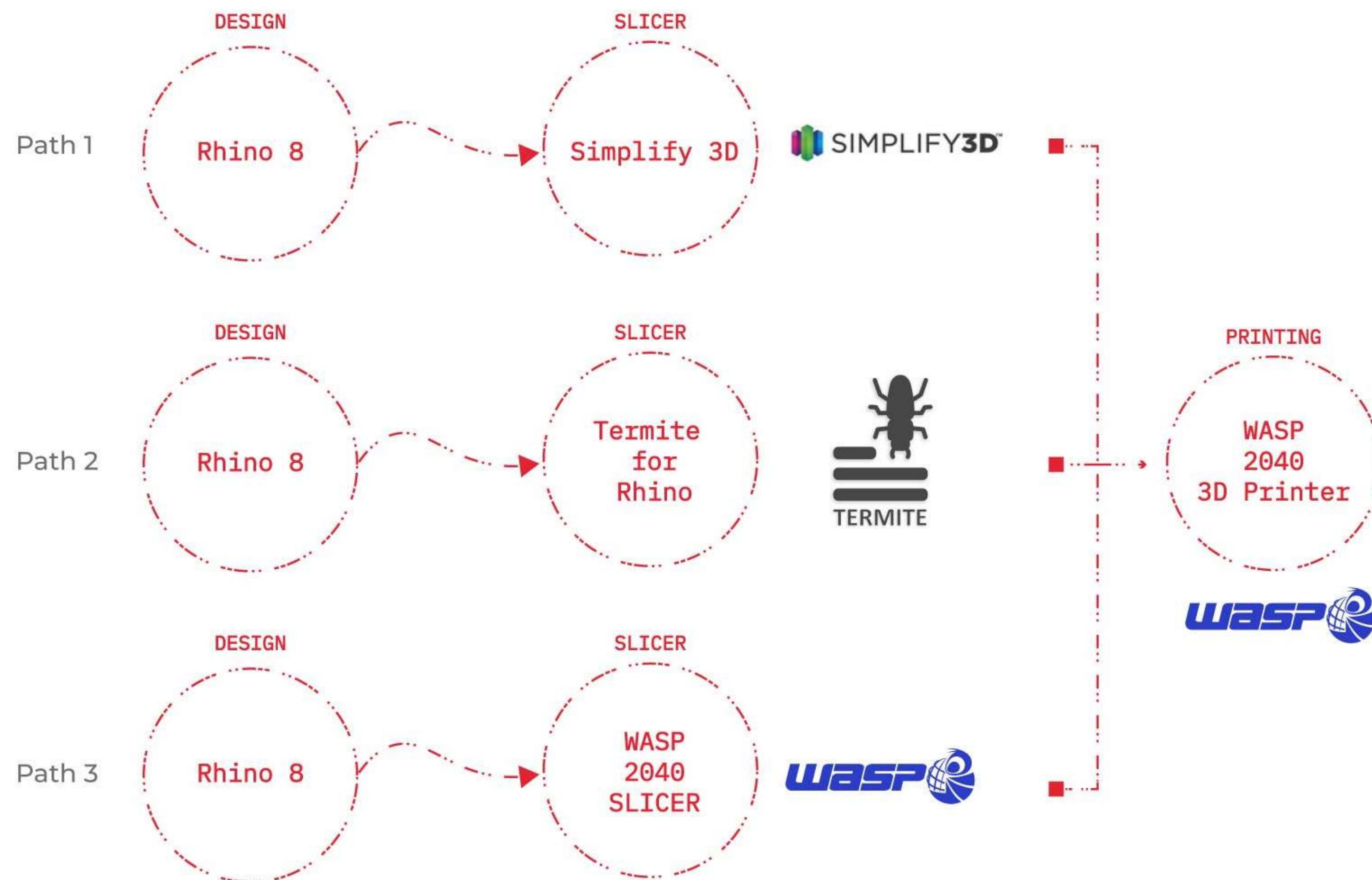
Rhino



WASP Slicer

007 | Collective Design Process

Digital Modelling | Design to Fabrication

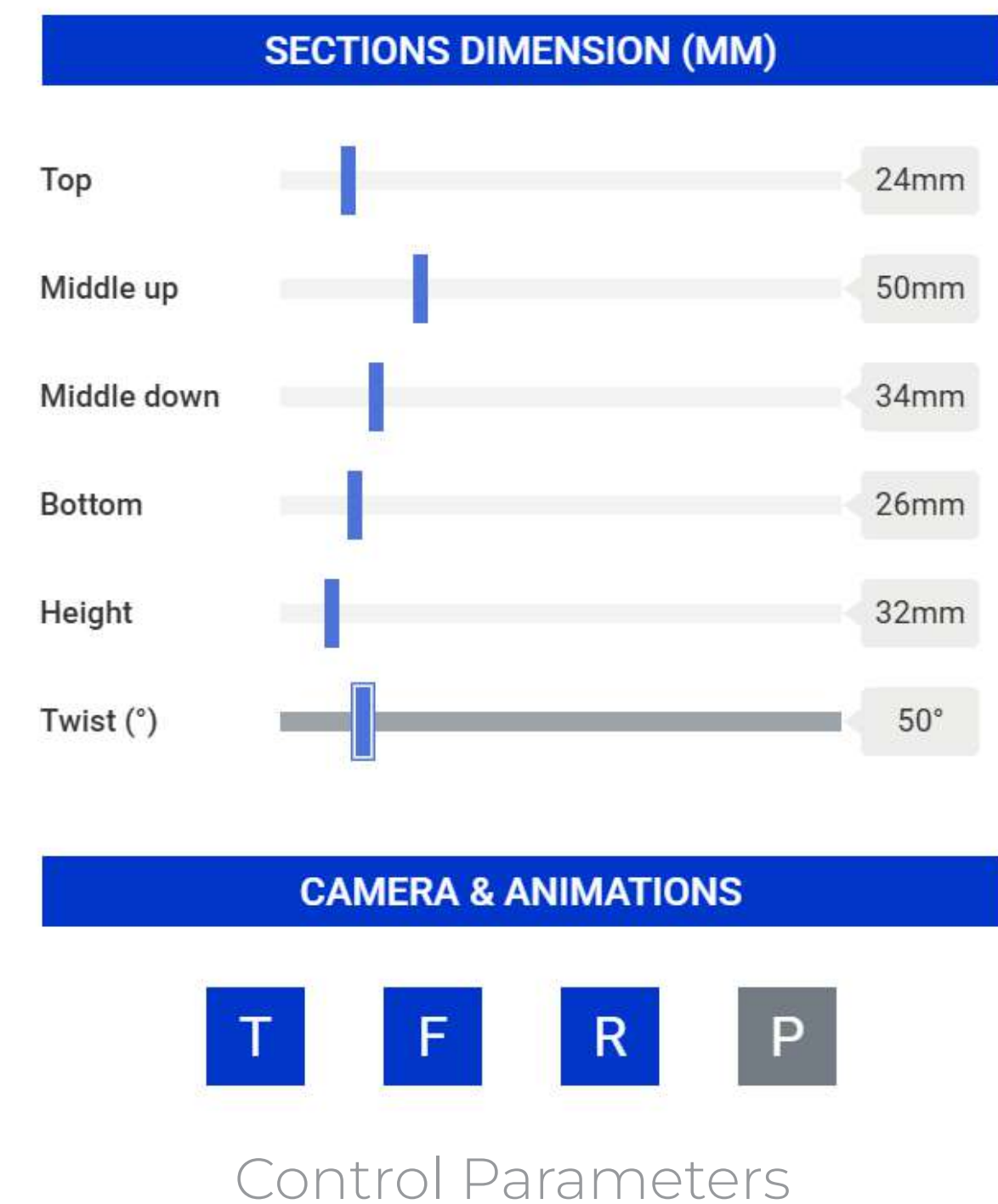


Design to Fabrication Process

007 | Collective Design Process

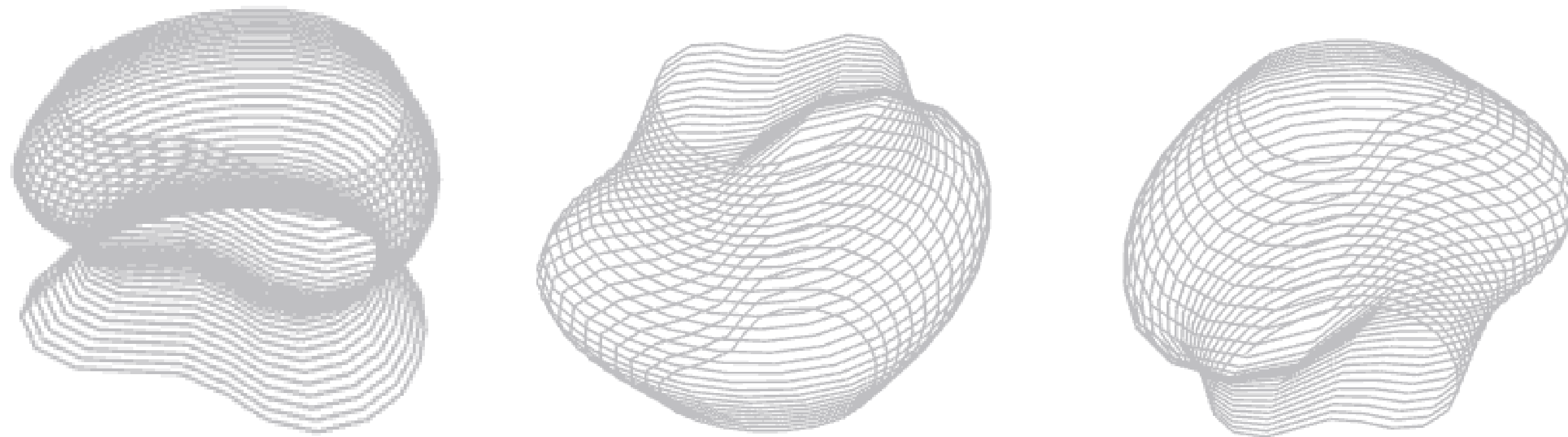
Digital Modelling | WASP Slicer

WASP Slicer played a central role in turning the base drawings into a wider study of clay morphologies. Each outline was used as a starting point, then developed through the slicer by changing the print path, extrusion thickness, layer height, and the way the clay was built upward. This made it possible to generate several variations from the same base shape, revealing how small changes in slicing settings could create different visual and structural results. The process also allowed the material behavior to become part of the design language, as the rhythm of the printed layers, the density of the walls, and the formation of openings gave each module a different character. After these digital and printed tests, the modules were explored manually through grouping, overlapping, and arranging, allowing different shape families to form their own languages and relationships across the garment.



007 | Collective Design Process

Digital Modelling | WASP Slicer



Different morphologies of a single base shape

007 | Collective Design Process

Digital Modelling | WASP Slicer

Different morphologies were also explored by interrupting the clay 3D printing process at different stages. Using the same base design, the printer was stopped at varying heights, allowing each print to become a different version of the same form. This method revealed how time, layer build-up, and material accumulation could influence the final morphology, creating a family of related modules with different thicknesses, openings, and spatial qualities.



007 | Collective Design Process

Clay Prototyping | Understanding the clay in hands

Before experimentation, understanding clay's basic properties, workability, drying behavior, and firing response, was essential. This informed shaping, crack prevention, and control over strength and porosity, though trial and error remained the most valuable learning process within this stage.

3 Types of Clay were under my initial study :



Dhana Clay



Jordanian South Clay
Sama Al Saket



Italian Clay

007 | Collective Design Process

Clay Prototyping | Understanding the clay in hands

Dhana Clay

Dhana clay is a locally sourced, coarse earthen clay characterized by a high content of sand and natural aggregates. While these inclusions can reduce shrinkage during drying, testing revealed that the material becomes brittle after firing and more prone to cracking. Its low plasticity and rough texture make it suitable for structural and experimental applications; however, it proved unsuitable after firing my terracotta modules for text.

Jordanian South Clay Sama Al Saket

Jordanian Red Clay is a refined ceramic clay characterized by its rich iron content, which gives it a distinctive red color after firing. It offers higher plasticity and workability compared to coarse earthen clays, allowing for more precise shaping and detailing. When fired, it achieves greater strength and cohesion, making it suitable for terracotta applications. Its controlled porosity and durability make it a reliable material for both crafted objects and experimental ecological uses. However, it is sensitive to contamination and can be easily stained or altered in color when fired alongside other clay types.

Italian Clay

High-quality, industrially processed ceramic clay known for its consistency, refined particle size, and reliable performance. It offers excellent plasticity and workability, allowing for precise forming and detailing. When fired, it achieves strong structural integrity with controlled shrinkage and predictable results, making it suitable for both artistic and technical applications. Its standardized composition ensures repeatability, making it a dependable choice for prototyping and refined ceramic production. It doesn't get stained or altered in color when fired alongside other clay types.

007 | Collective Design Process

Clay Prototyping | Hand Molding

This phase explored hand molding as an intuitive method for shaping clay and understanding its tactile behavior. Through direct manipulation, the material's plasticity, response to pressure, and tendency to crack or deform were observed. This process allowed for testing organic forms and surface textures, informing both the design language and the material limitations for further development.



007 | Collective Design Process

Clay Prototyping | Hand Molding



Dhana Clay



Jordanian South Clay
Sama Al Saket

Italian Clay

007 | Collective Design Process

Clay Prototyping | Clay 3D Printing | Testing:
Flat Morphology Design Studies

I began with flat morphology studies, testing bendability by 3D printing thin clay layers and manipulating them after printing. The models were developed in Rhino and sliced in Simplify3D, but the early results were limited due to my initial unfamiliarity with the printer. Later, I found that techniques such as printing on butter paper could have improved controlled bending during and after printing. Cracking in flat prints was managed through moisture control by reintroducing small amounts of water as the clay shrank.



007 | Collective Design Process

Clay Prototyping | Clay 3D Printing | Testing:
Spherical Shell (Interconnected Modules) Design Study

I continued my research by developing a spherical morphology composed of interconnected modules. In this phase, I was finalizing my exploration of the coral geometry and investigating its scalability, with a focus on generating repetitive systems of irregular modules that form micro-shelters. However, the resulting model proved to be extremely challenging to fabricate through 3D printing.



007 | Collective Design Process

Clay Prototyping | Clay 3D Printing | Testing:
Individual Modules Geometries Design Study

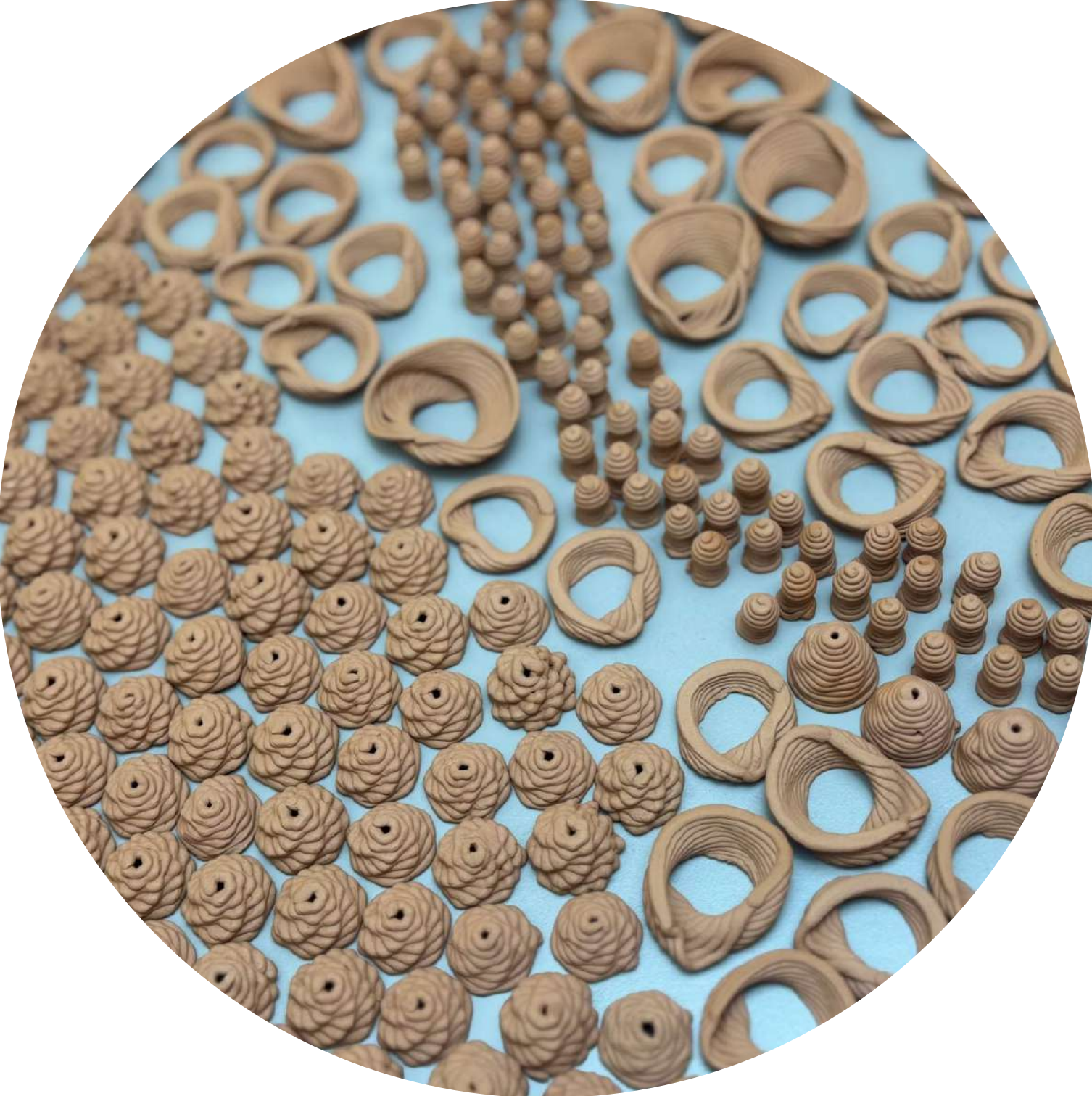
I conducted a series of individual tests on different geometries, ranging from regular to irregular forms and across multiple scales. All tests were performed using both 3 mm and 1.5 mm nozzles. This stage evolved into an extended experimental process, using Rhino to develop 2D geometries and continuing 3d stage and fabrication through the WASP 2040 slicer.

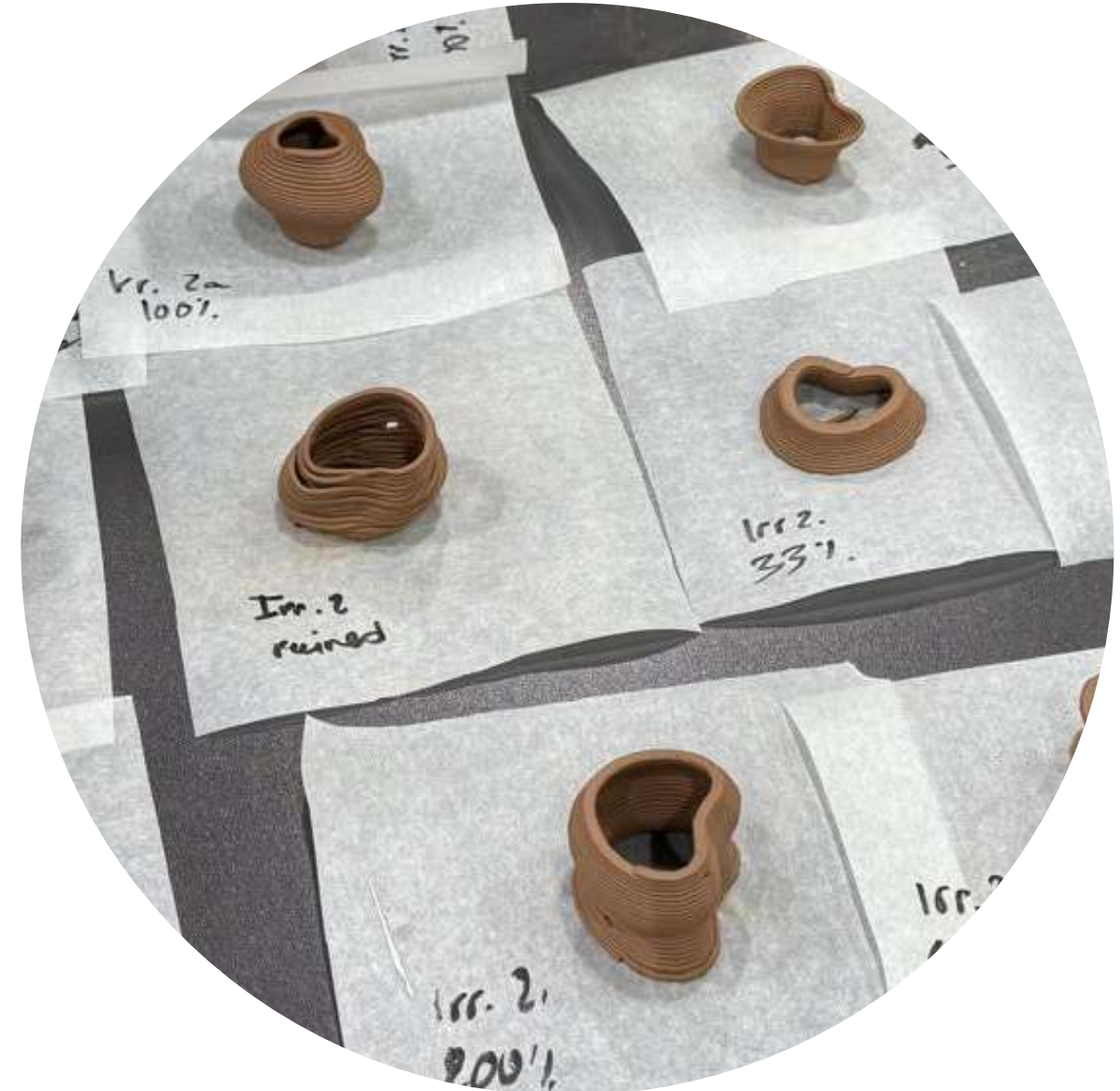


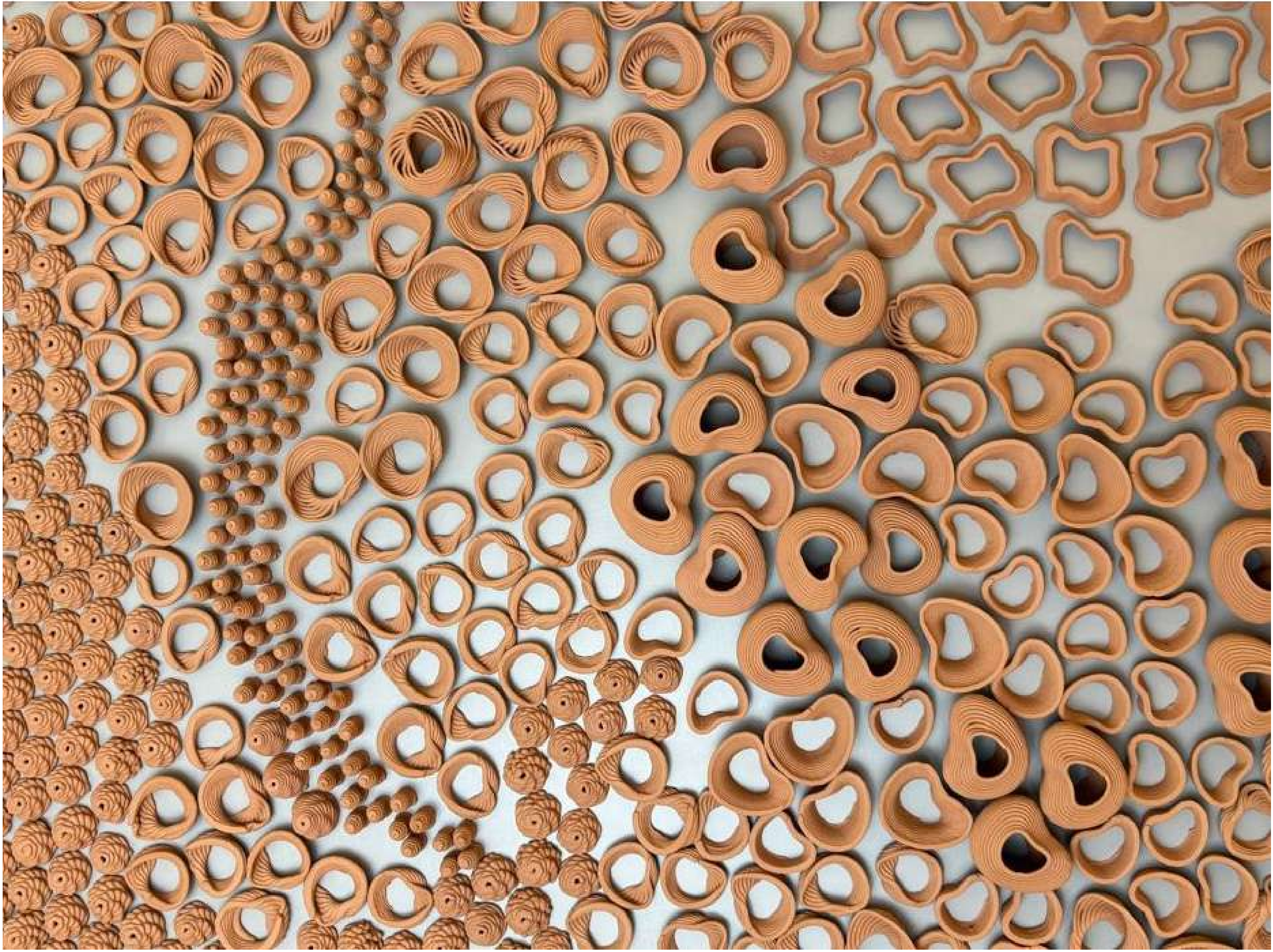


007 | Collective Design Process

Clay Prototyping | Clay 3D Printing | Final Modules





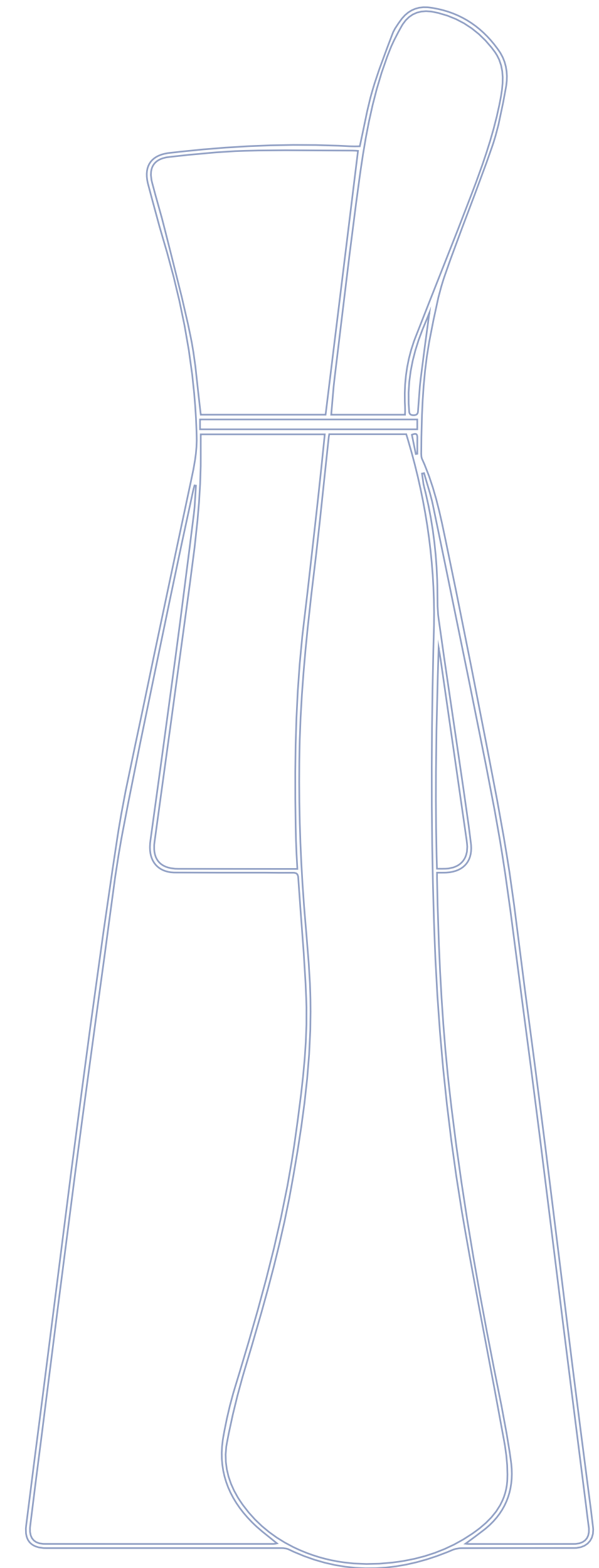


“An army of terracotta”

007 | Collective Design Process

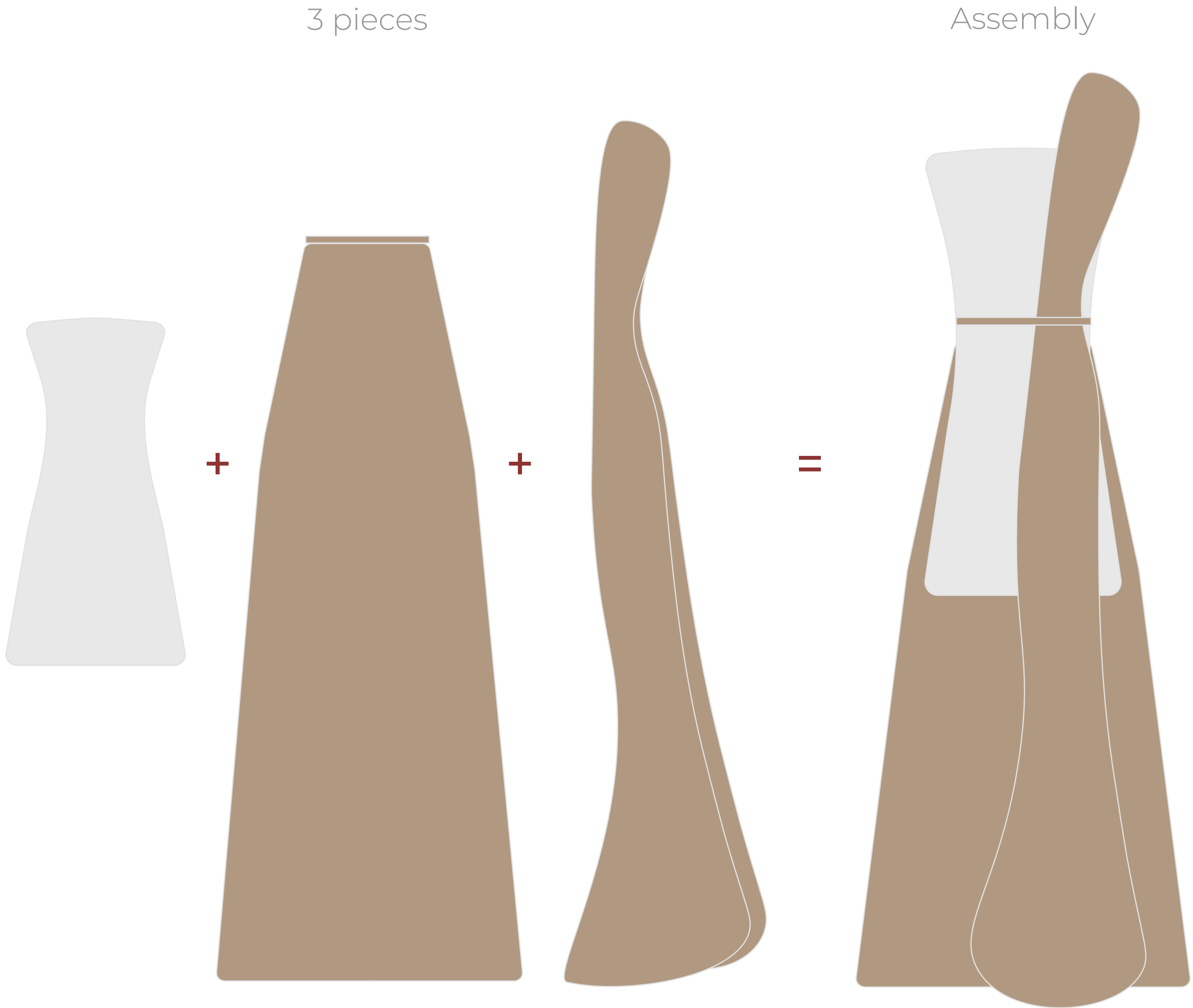
Design | Garment Base

The garment design developed from the need to balance symbolism, wearability, and disassembly. Rather than designing a single fixed dress, I wanted the piece to behave as a modular system that could be taken apart during the ritual and transformed. This led to the separation of the garment into three main elements: the off-white underlayer dress, the structured skirt, and the side sculptural piece. The underlayer represents the body and remains as the intimate base, while the outer elements carry the terracotta modules and create the architectural presence of the garment. This construction allowed the design to support the narrative of removal and transformation, where the wearable gradually loses its outer layers and shifts from a human-centered object into material for ecological reassembly.



007 | Collective Design Process

Design | Garment Base



007 | Collective Design Process

Design | Garment | Modules Assembly

The clay modules were then assembled onto specific areas of the garment according to the ritual hierarchy and the structure of the body. Each placement was chosen to support both the visual language of the piece and its later disassembly, allowing the modules to shift from wearable ornamentation into components for the future reef structure.



007 | Collective Design Process

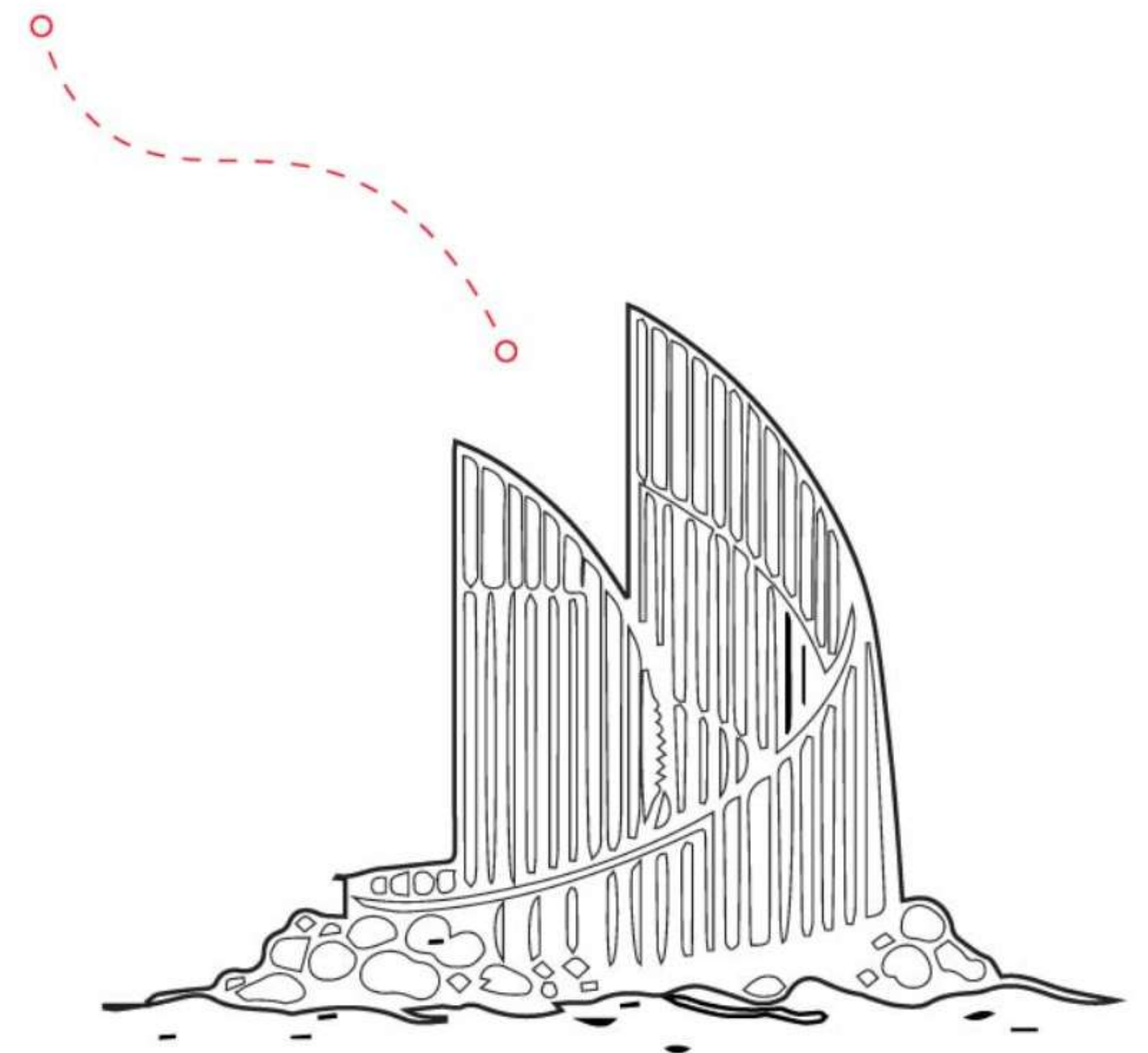
Design | Garment | Modules Assembly

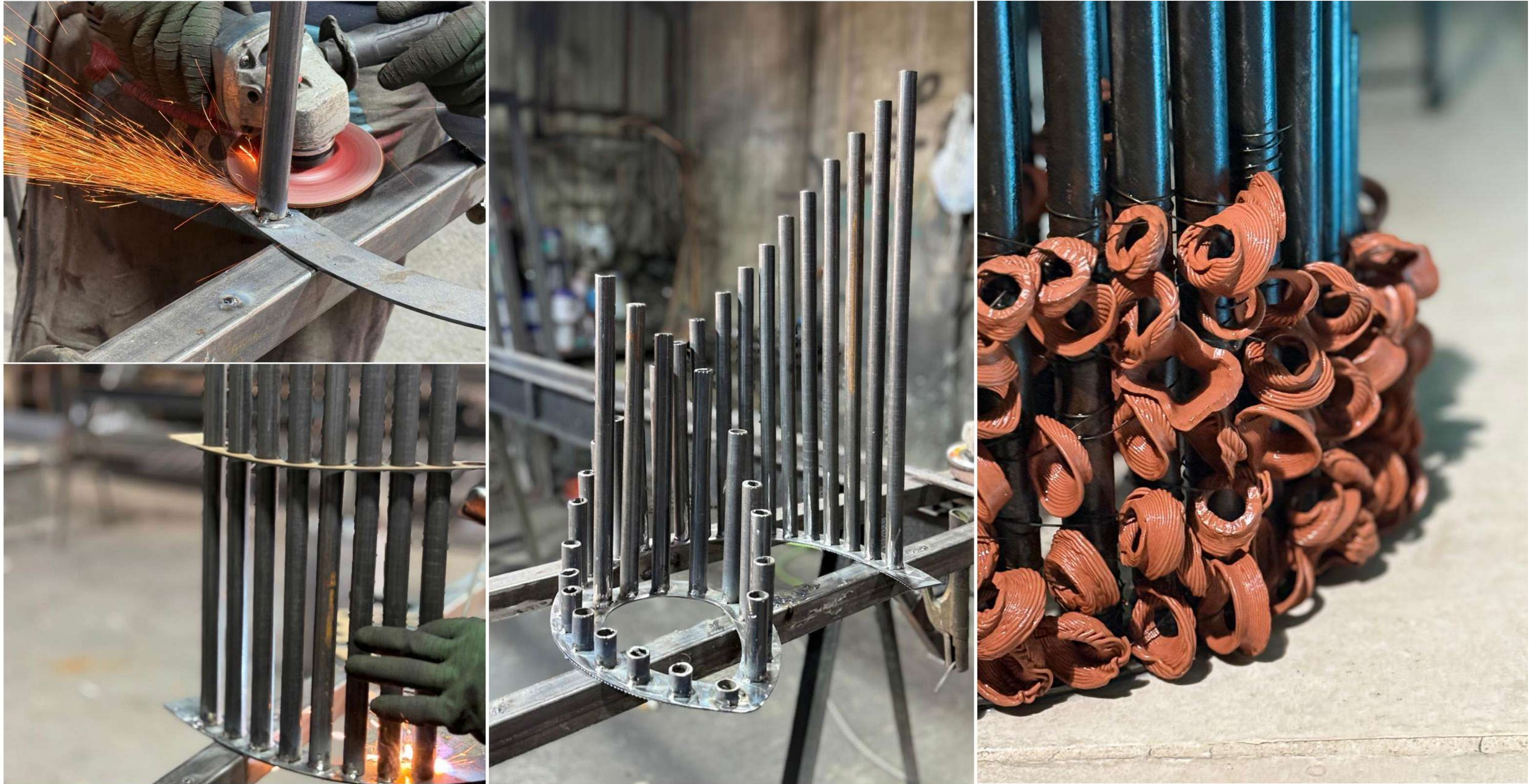


007 | Collective Design Process

Design | Treated Steel Structure

The steel installation for Resurrect is conceived as a modular scaffold designed to support the reassembly of terracotta elements in their second life. Constructed from treated scrap steel with all coatings and contaminants removed, it provides a durable and inert structure suitable for marine environments. Its geometry creates a stable framework that allows the terracotta modules to be attached, while offering structural complexity and surface conditions that support potential reef formation.

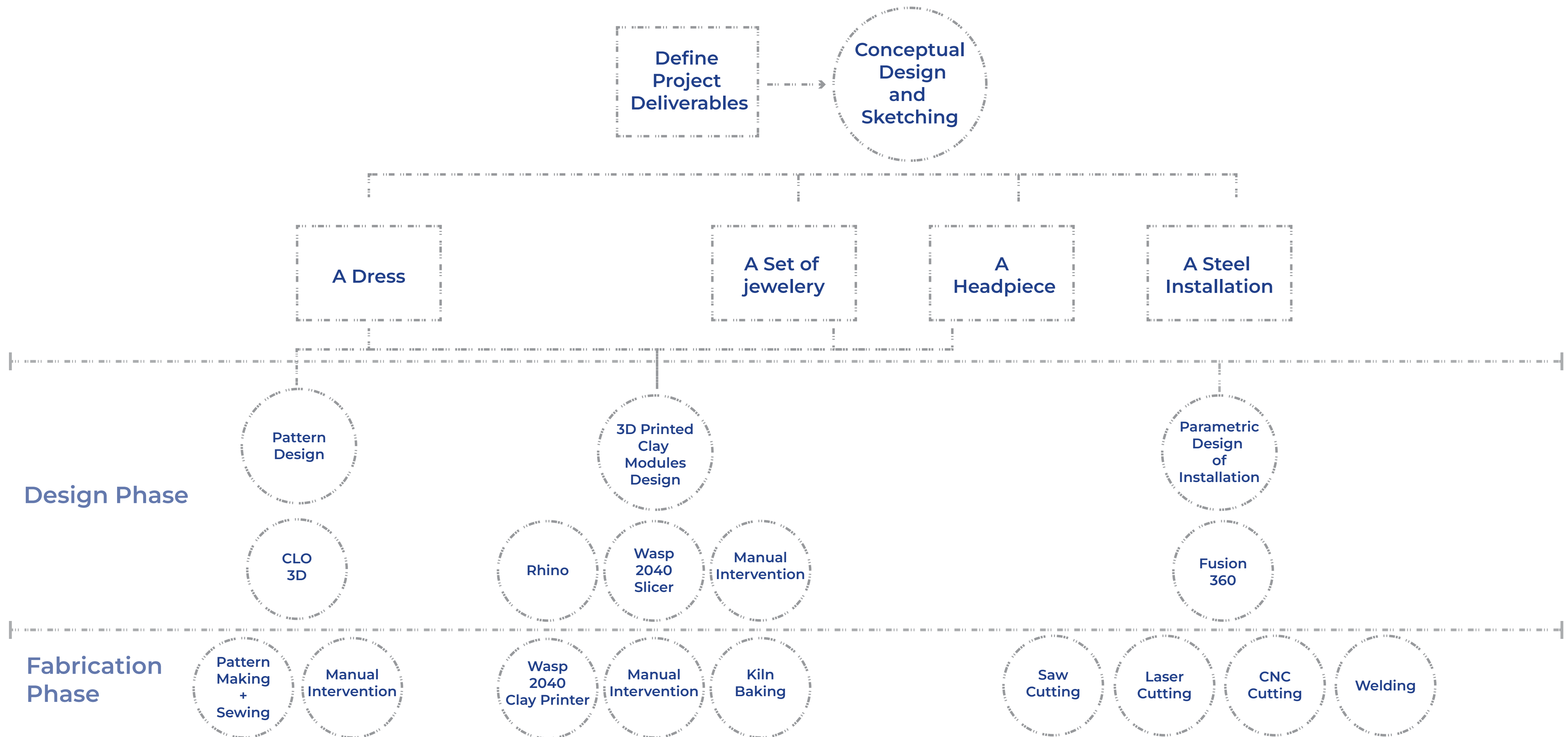




Treated Steel Installation

007 | Collective Design Process

Collective Generic Design Process



008 | Evaluation

The evaluation stage considered both the strengths and limitations of **Resurrect** as an experimental multi-life design project. The clay 3D printing tests showed the potential of terracotta modules to create rich textures, openings, and layered surfaces that could function visually on the garment and later be reassembled as reef components.

However, the process also revealed technical challenges, including cracking, shrinkage, and the need for control during drying, firing, and attachment. Critical feedback also questioned whether some of the designed forms were more influenced by the first function rather than derived from natural reef systems. This comment pushed the project to reconsider the relationship between design language and ecological reference, highlighting the need for a stronger connection between the modules' geometry and natural coral morphologies. While the garment successfully supported the ritual narrative of attachment, removal, and transformation, the project still requires underwater testing to evaluate marine performance, colonization, and long-term durability. Overall, Resurrect functions as a strong prototype, but also as an ongoing research framework that would constantly move through ecological, material, and formal development.



009 | Conclusion

Resurrect began as a question about what a designed object could become after its first life ends. Through this question, the project developed into a multi-life system that connects the body, material, ritual, and marine ecology. By working with terracotta clay modules attached to a wearable garment, the project explored how fashion can move beyond appearance and consumption toward transformation, ecological responsibility, and care.

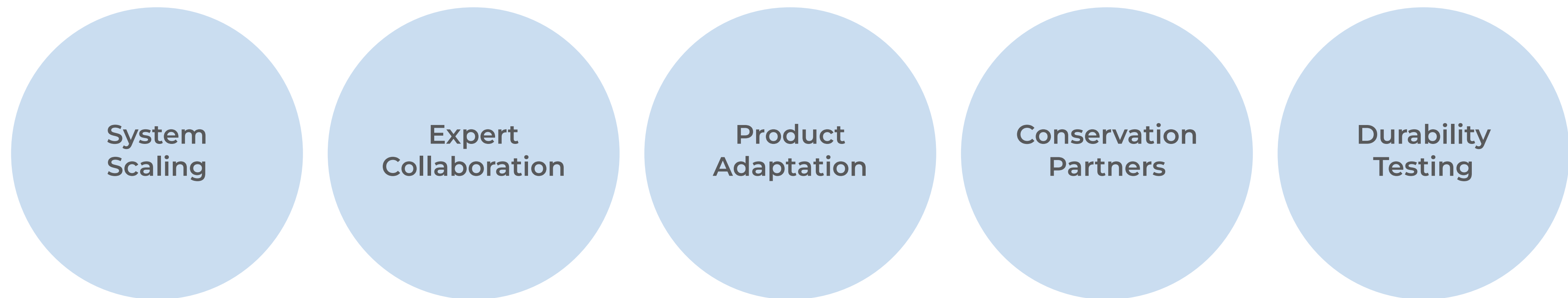
The process revealed that design can hold both symbolic and functional roles. On the body, the modules act as elements of identity, ornament, and ritual. After being removed, they are reimagined as components of an artificial reef structure, shifting their purpose from human expression to habitat support. This transition challenges the idea that a product's value ends when it is no longer worn or used. Instead, Resurrect proposes that materials can carry memory, meaning, and function into another context.

The project also exposed important limitations that require further development, including the need for underwater testing, stronger ecological validation, improved attachment systems, and further refinement of clay behavior during printing, drying, and firing. These limitations define its next stage of research.



010 | Future Steps

The next stage of **Resurrect** will focus on moving the project from an experimental prototype toward a more tested and ecologically informed system. While the current work establishes the conceptual, material, and formal foundation of the project, further development is needed to evaluate the clay modules in real marine conditions, refine their geometry, and strengthen the relationship between the wearable phase and the artificial reef phase.



011 | Galleria



011 | Galleria



011 | Galleria







012 | References

1- Coral Reefs of the Gulf of Aqaba and the Red Sea in the Kingdom of Saudi Arabia

<https://whc.unesco.org/en/tentativelists/6701/?utm>

2- Aqaba Marine Reserve

https://aseza.jo/EN/Pages/Aqaba_Marine_Reserve

3- Article ; Assessing the Effectiveness of 3D-Printed Ceramic Structures for Coral Restoration: Growth, Survivorship, and Biodiversity Using Visual Surveys and eDNA

<https://www.mdpi.com/2077-1312/13/9/1605?utm>

4- Watanabe et al. (2018). Development of Artificial Reefs Using Environmentally Safe Ceramic Material

https://www.researchgate.net/publication/324722749_Development_of_Artificial_Reefs_Using_Environmentally_Safe_Ceramic_Material?utm

5- Levenstein et al. (2022). Millimeter-scale topography enables coral larval settlement in wave-driven oscillatory flow

<https://arxiv.org/abs/2203.05645?utm>

6- Yu, V. et al. (2025). Assessing the Effectiveness of 3D-Printed Ceramic Reef Tiles for Coral Recruitment. Journal of Marine Science and Engineering

<https://www.mdpi.com/2077-1312/13/9/1605?utm>

7- Ozanam, B. et al. (2025). Choosing the right substrate to restore coral reefs through larval settlement. Restoration Ecology.

<https://link.springer.com/article/10.1186/s44315-025-00047-5?utm>

8- JREDS

<http://www.jreds.org/en-us/>

9- Millimeter-scale topography enables coral larval settlement in wave-driven oscillatory flow

<https://arxiv.org/abs/2203.05645?utm>

10- The effect of surface topography on benthic boundary layer flow: implications for marine larval transport and settlement

<https://arxiv.org/abs/2401.17216?utm>

012 | References

11- Definition of an Artificial Reef Unit through Hydrodynamic and Structural (CFD and FEM) Models—Application to the Ares-Betanzos Estuary

<https://www.mdpi.com/2077-1312/10/2/230?utm>

12- Artificial Substrate and Coral Reef Restoration: What Do We Need to Know to Know What We Need

https://scholars.nova.edu/ws/portalfiles/portal/41635113/Artificial%20Substrate%20and%20Coral%20Reef%20Restoration_%20What%20Do%20We%20Need.pdf?utm

13- Artificial reef design affects benthic secondary productivity and provision of functional habitat

<https://pmc.ncbi.nlm.nih.gov/articles/PMC7042684/?utm>

14- NOAA defines artificial reefs as human-made underwater structures that mimic characteristics of natural reefs and provide hard substrate and vertical relief.

https://sanctuaries.noaa.gov/science/conservation/artificial_reef12.html?utm_source=chatgpt.com

15- Establishing complexity targets to enhance artificial reef designs

https://pmc.ncbi.nlm.nih.gov/articles/PMC11436664/?utm_source=chatgpt.com

16- Turning subway trash into ocean treasure: how New York's train cars became homes for marine life

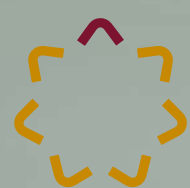
<https://www.greenmemag.com/environment/turning-subway-trash-into-ocean-treasure-how-new-yorks-train-cars-became-homes-for-marine-life/>

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