# Above

Jacob Steinberg
TU Delft I 2024/25

# Below

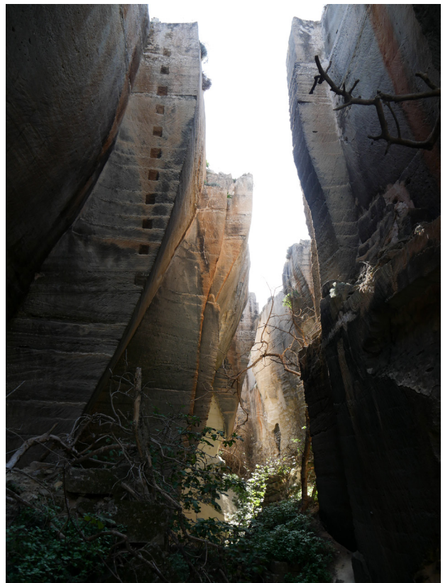
# ... exploring the interplay of nature and architecture in Favignana´s quarries over time



Jacob Steinberg I 6082572

TU Delft I 2024/25
Explore Lab Graduation Studio I 39

Tutored by Roel van de Pas, Laura Cipriani and Georgios Karvelas




# Index

# Chapter 01 | Overview

**Location**
Favignana, the largest of the Egadi Islands, has been shaped by limestone extraction since Roman times. Today, abandoned quarries cover 20% of its surface, forming a unique extraction landscape that blurs boundaries between natural and anthropogenic environments.[1]

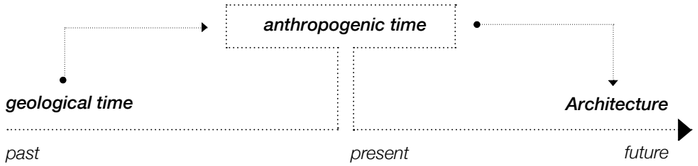

**Fascination**
The local architecture embodies a duality: the stone houses and walls above reflect the excavated voids below the surface[2]. Quarries, once reused as dwellings, gardens, or tombs, blur boundaries between construction and excavation, resisting clear categorisation of architecture's purpose or intent[3].


**Relevance**
The quarries contrast with industrial extraction, where ecosystems vanish and voids become landfills[4]. As today's extraction sites become tomorrow's habitats[5], Favignana highlights a universal challenge: resisting extractivist thinking and reimagining post-industrial landscapes as shared environments in the post-Anthropocene.

**Temporality**
Favignana's quarries reveal the interdependence of human and geological timescales: the extraction relies on calcarenite formed millions of years ago[6]. In the Anthropocene, human impact accelerates change[7], urging architects to design for durability in a post-anthropogenic future.

*source: Rocca," Gli indistinti confini: osservazioni e progetti per l'isola di Favignana"*

**Technicity**
Favignana's quarries embody both cultural processes of extraction and the inevitable decay of time. Their entropic transformation raises the question: how can architects integrate natural processes like sedimentation and erosion into their subtractive and additive design tools?




[1,3] *Ambroggi, "Cava 73. Abitare in negativo. Valorizzare il vuoto."*
[2] *Marsala and Mei, "Inland Areas between Description and Transformation. The Case of the Disused Quarries on the Island of Favignana."*
[4] *Berger, "Designing the Reclaimed Landscape"*
[5] *Ellis et al., "Anthropogenic Transformation of the Biomes, 1700 to 2000."*
[6] *Kil, "Sedimentology and 3D Architecture of a Bioclastic Calcarenite Complex on Favignana, Southern Italy: Implications for Reservoir Modelling."*
[7] *Turpin, "Architecture in the Anthropocene"*

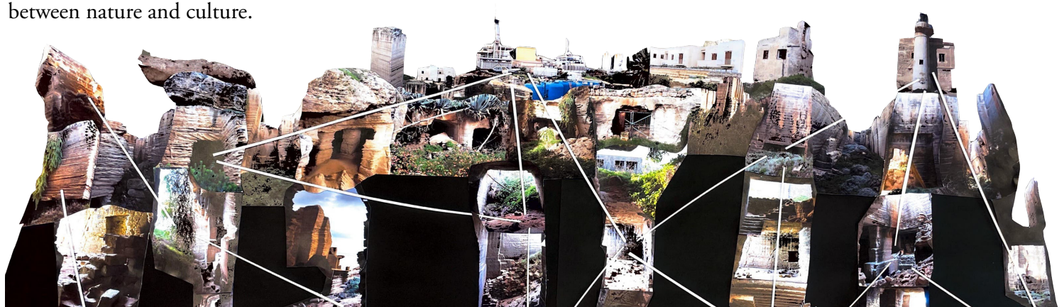


- **How do natural and cultural processes shape Favignana´s quarries over time?**
  - **How were Favignana´s quarries shaped in the past?**
  - **How are Favignana´s quarries shaped today?**

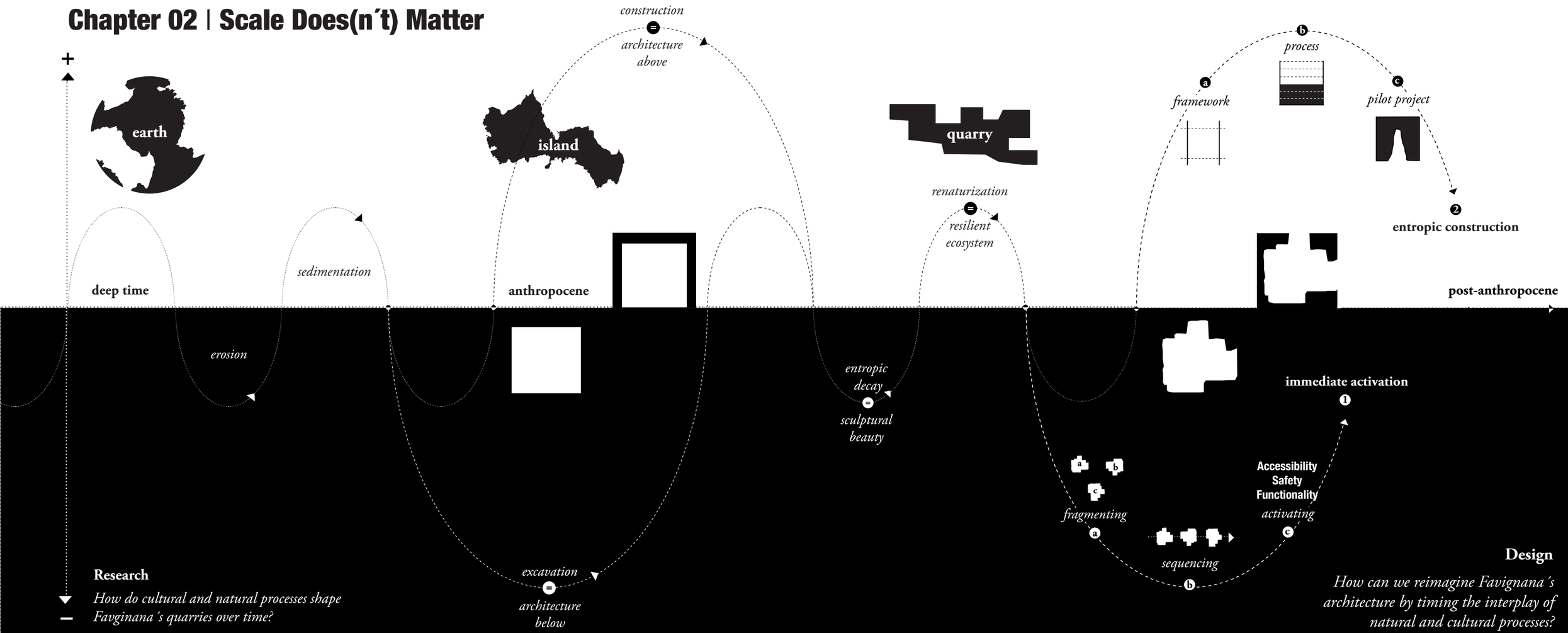
**Methodology**
My research-by-design approach combined mapping and fieldwork. Mapping established a framework of Favignana's extraction landscapes through historical study and geological-anthropological maps. Guided by intuition, I immersed myself in the quarries, using photography, scanning, and photogrammetry to document and reconstruct spatial and material conditions.

**Preliminary Outcomes**
*"Scale does(n't) matter"*
Favignana's quarries embody intertwined scales of time and space: While geological processes enabled the stone extraction on the island, the spatial condition of each quarry reflects the continuous interaction between nature and culture.


*"Quarries are Architecture, Ecosystems and Sculptures"*
Favignana's quarries reveal multiple identities. As architecture, they follow recognizable archetypes like entrances, pillars, chimneys, ladders, and gates, that define space and movement. As ecosystems, abandonment triggers ecological succession, where microclimates and human interventions foster biodiversity from pioneer plants to botanical gardens. As sculptures, the exposed calcarenite stone gradually erodes under the influence of natural elements, transforming into organic forms. These shifting conditions highlight quarries as hybrid landscapes shaped equally by cultural construction and natural transformation over time.



# Chapter 02 | Scale Does(n´t) Matter



# Chapter 02 | The Earth

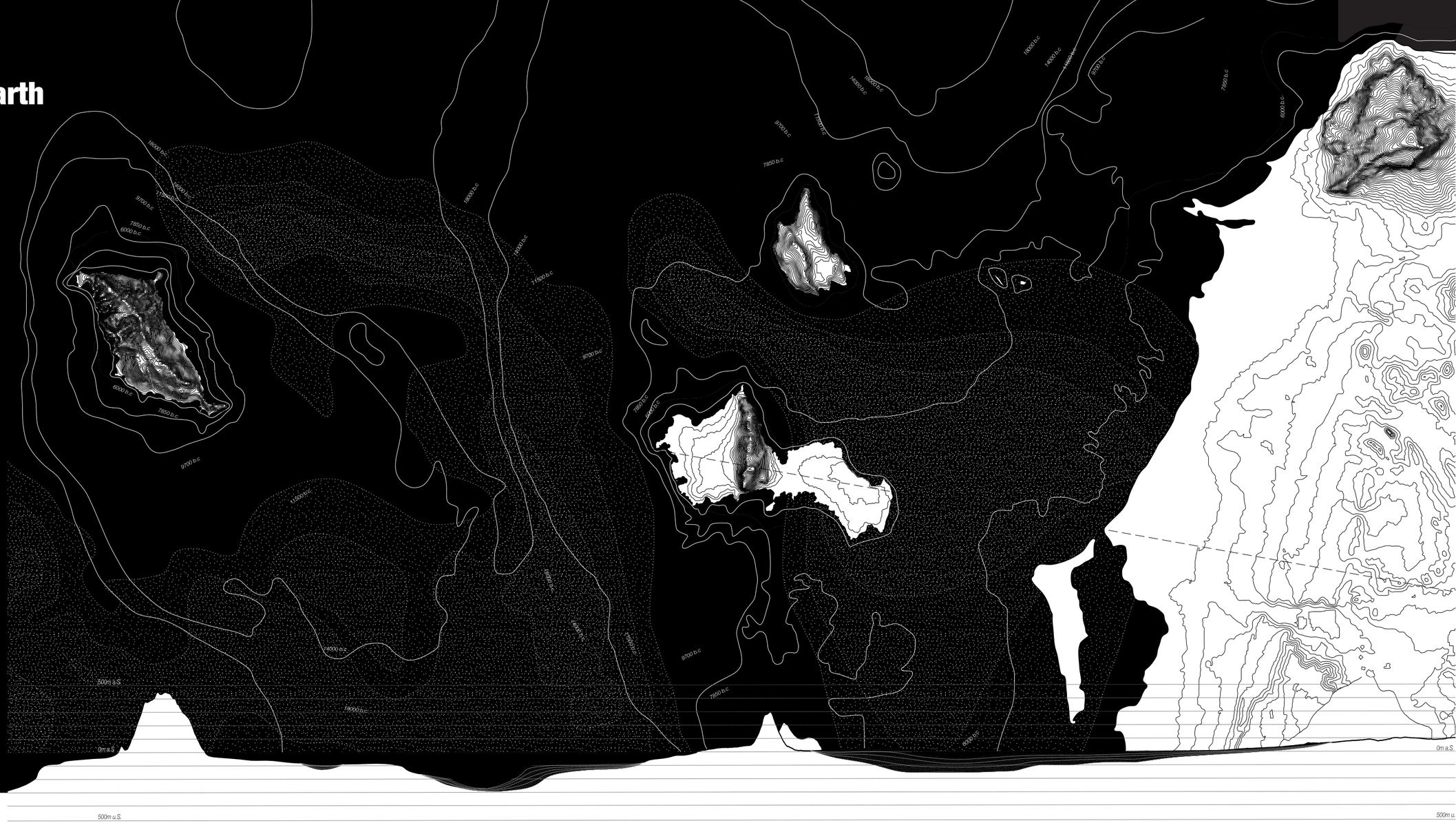
**Favignana´s Quarry History**

The geological foundation of Favignana dates to the Mesozoic (265 million B.C.), when the Alpine Orogeny shaped its topography and shallow seas nurtured calcareous organisms. In the Pliocene (5 million B.C.), uplift exposed carbonate platforms to erosion, while fluctuating sea levels deposit calcarenite on the island's east in the Pleistocene (2.58 million–11,700 B.C.).[1]

By 241 B.C. Romans started exploiting Favignana for Calcarenite Stone due to its high quality. Quarrying continued under the Saracens (~1000 A.D.) who also built the islands first watchtowers. By the 1500s, pirriaturi, the local quarrymen, lived in underground dwellings while carving  and trading stone for export. The city "Favginana" was founded in 1700 and quarrying peaked by 1900 at 530,000 stones yearly, boosting wealth and maritime export. Due to changes in the construction industry calcarenite extraction declined in the 1960s.[2]

*[1]Kil, "Sedimentology and 3D Architecture of a Bioclastic Calcarenite Complex on Favignana, Southern Italy: Implications for Reservoir Modelling."*
*[2]Ambroggi, [4]Cava 73. Abitare in negativo. Valorizzare il vuoto."*





# Chapter 02 | The Island

[1]*Marsala and Mei, "Inland Areas between Description and Transformation. The Case of the Disused Quarries on the Island of Favignana."*

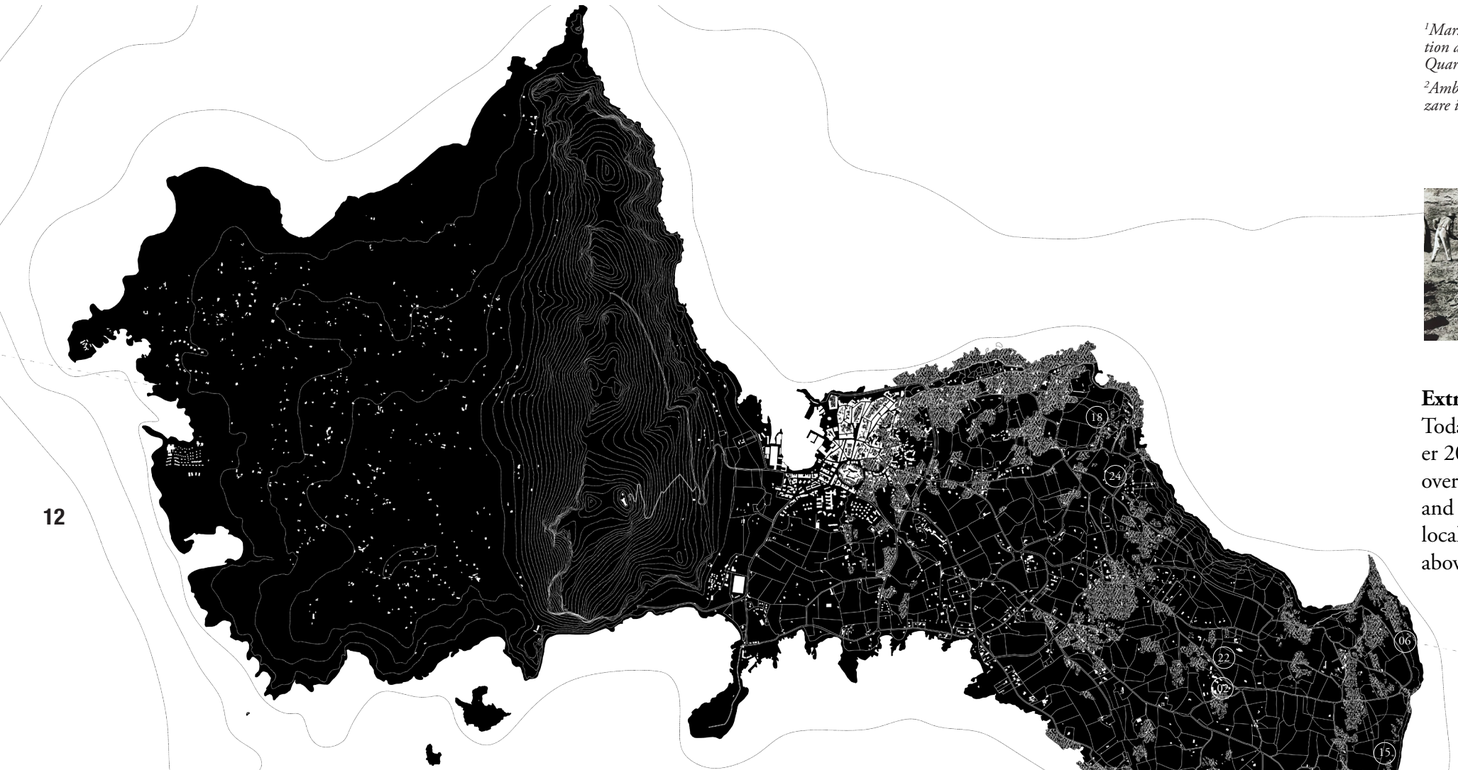
[2]*Ambroggi, "Cava 73. Abitare in negativo. Valorizzare il vuoto."*

**Extraction Landscape**
Today, abandoned quarries cover 20% of Favignana´s surface, overlaying extraction landscapes and urbanised areas. As a result, the local architecture is shaped by spaces above and below the ground.[1]

**Manual Quarries**
Layer by layer, the *pirriaturi* carved out calcarenite stone vertically or horizontally, resulting in open pits and caves. Stone blocks (=*cantuna*) where cut with axe-like tools like the *mannara* and the *zappuni*.[2]

**Industrial Quarries**
Modern quarries where dug further inland using trolleys on rails and cranes. In the 20th century, manual extraction was replaced with large stone saws, leaving a grid of saw-lines in the quarry walls.



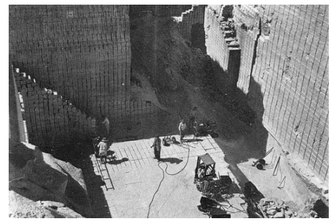



Isola di Favignana, Italy
*area = 19km*
*residents = 3000*

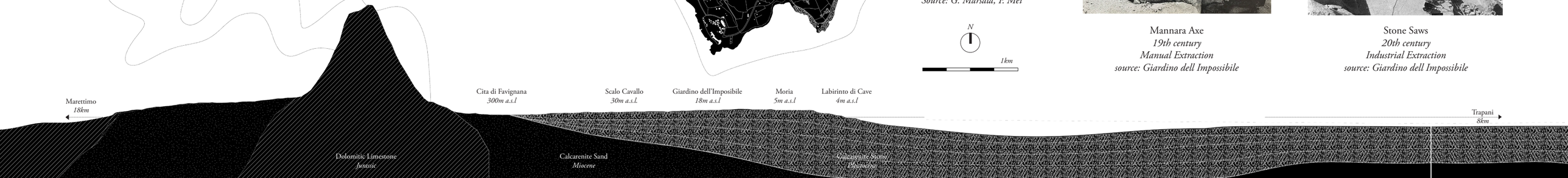
*Calcarenite Quarry*
*= 25% of the Islands Surface*
*Source: G. Marsala, P. Mei*

N
1km

Mannara Axe
*19th century*
*Manual Extraction*
*source: Giardino dell Impossibile*



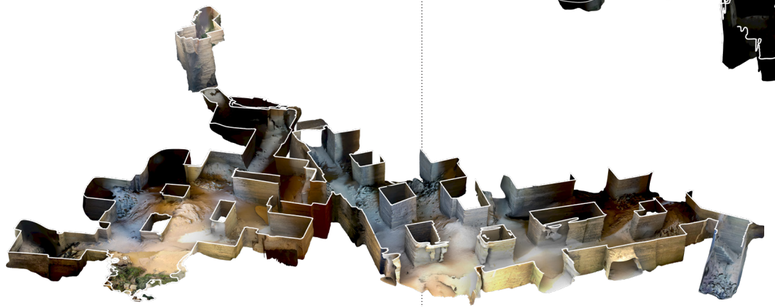
Stone Saws
*20th century*
*Industrial Extraction*
*source: Giardino dell Impossibile*



# Chapter 03 | Scanning the Quarry

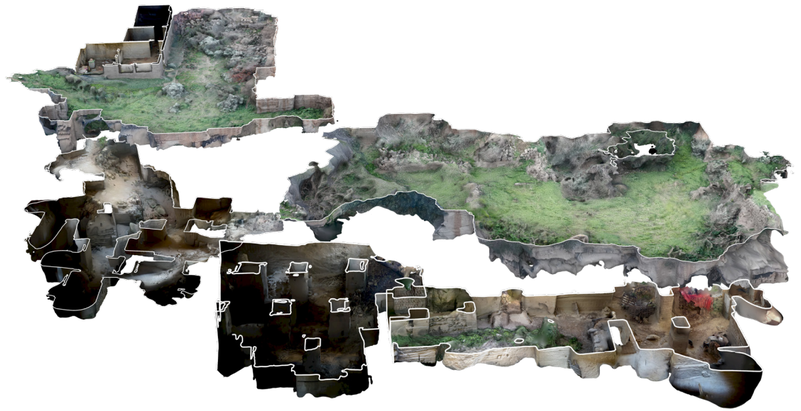
- The Pools

- The Pits



- The Caves

- The Maze



- The Dwelling

- The Garden

- The Hole

- The Scar

since
*241 BC*

since
*1000 AC*

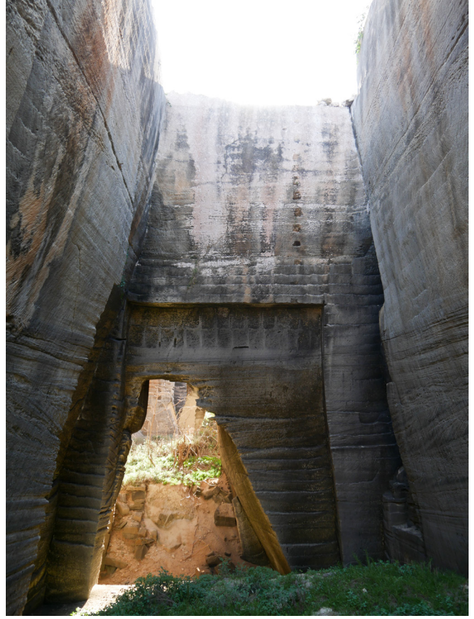
since
*1500 AC*

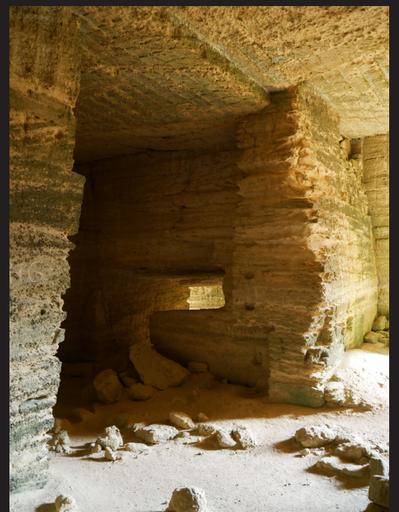
since
*1700 AC*

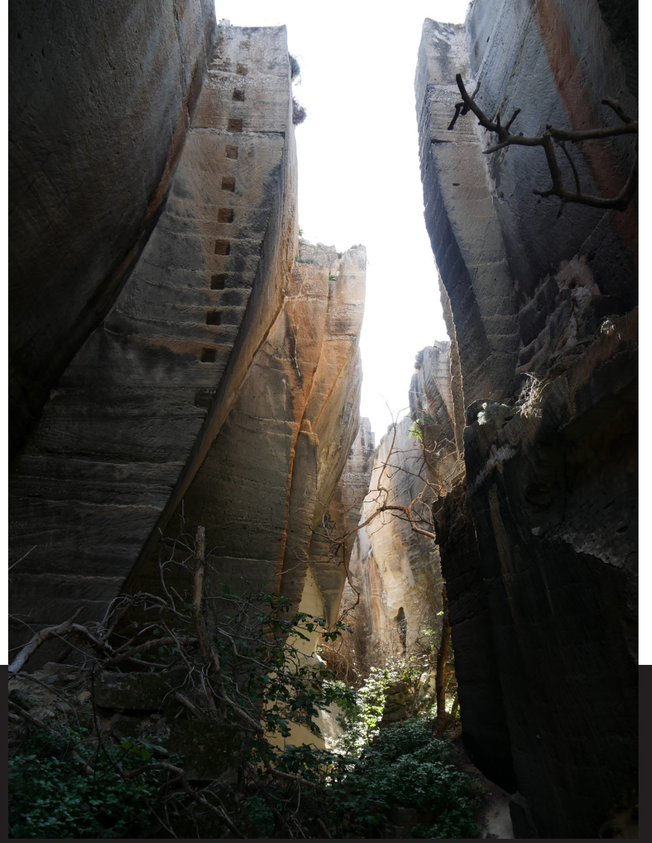
since
*1900 AC*

# Above...

Moria & Bue Marino
*10th century*
*Cave Quarry*
*photo - Jacob Steinberg*







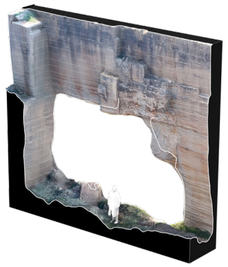
Labirinto di Cave
*17th century*
*Open-Pit Quarry*
*photo - Jacob Steinberg*

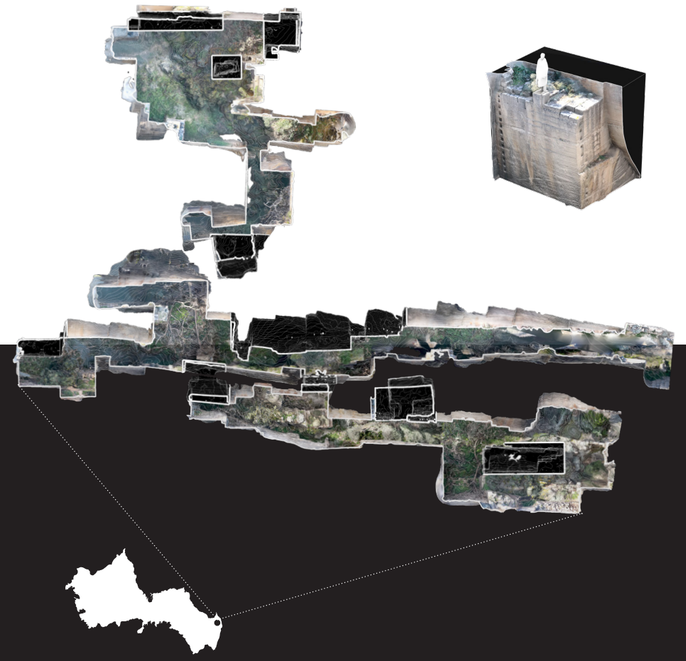
# ...Below

# Chapter 03 | Architecture Above

**Architecture Above**
The Labirinto di Cave is an open-pit quarry in close proximity to the ocean. Dating back centuries, the maze like structure consists of multiple quarries which grew together over time.

**The Gate**
A gate like opening in a quarry wall connects different quarries which were once separated. Possibly, it marked the entrance to a cave quarry, in which the ceiling collapsed over time due to poor stone quality or flawed construction technique.

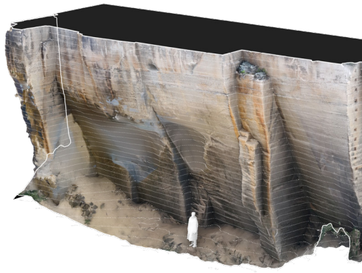






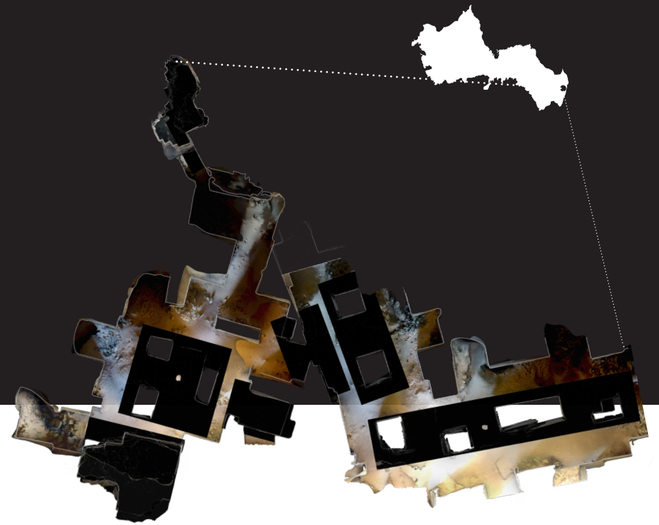
**The Plateau**
Such platforms make the open-pit quarry accessible from above. During the excavation, the *pirriaturi* left little notches in the quarry walls which later served as a lader to climb in and out.[1]

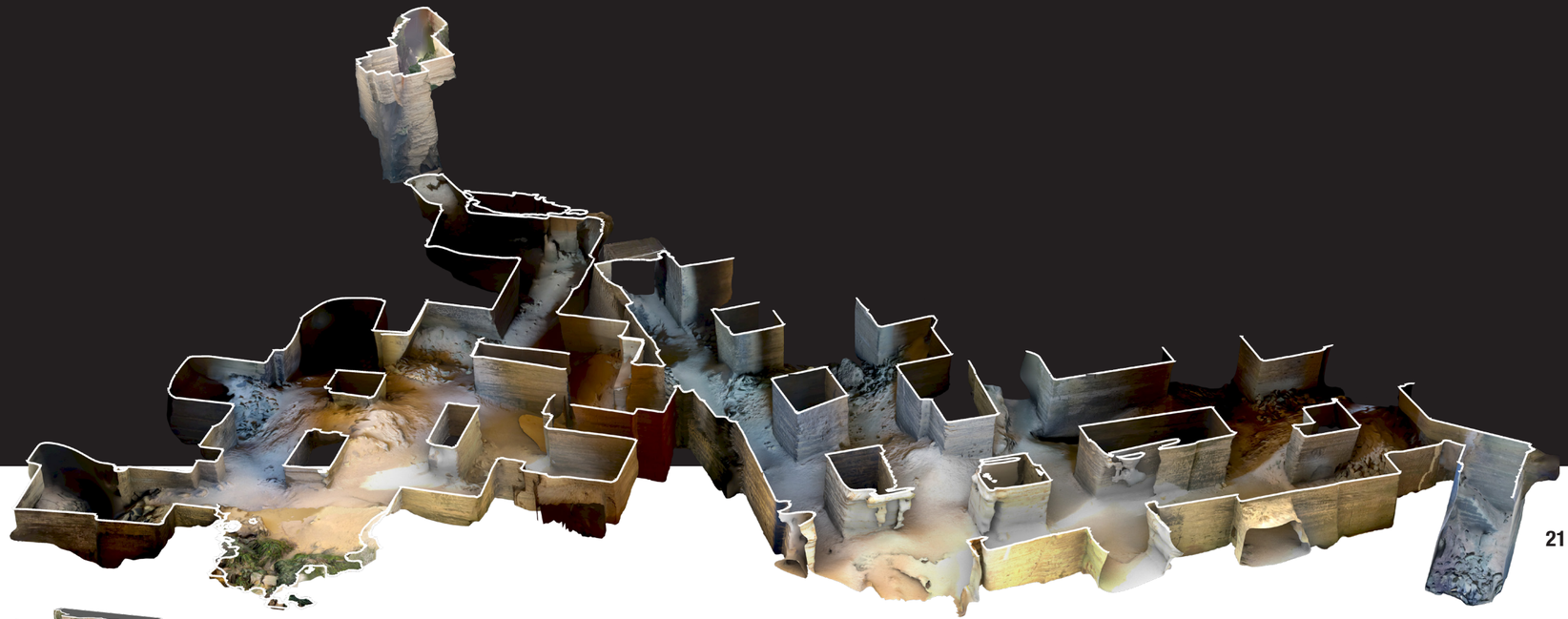
**The Tower**
Calcarenite which was either to soft, too hard or to flawed to be excavated served no purpose as a building material. Thus, if a stone was of poor quality it was left standing, making it a solitary sculpture. [2]



**The Wall**
Inclined walls reveal a story from the century-old excavation practice. When the superviser was watching from above, the quarry men below were able to excavate stones unseen to boost their daily wages.[3]

[1,2,3]Campo, "Giardino dell'impossibile"





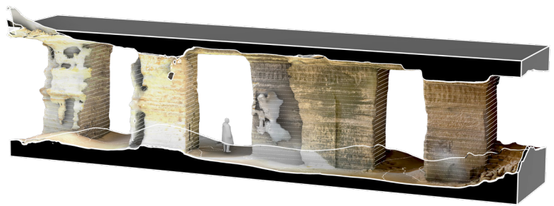


**Architecture Above**
The cave like galleries of *Bue Marino* are located in close proximity to the shore and date back to Saracen origin (1000 B.C.). Carved out horizontally, the extracted stones could be loaded directly onto boats using coastal rock slides.

Carving out stones underground promised easier access to high-quality calcarenite hidden deep within the rocky coast. A visit to the dark and dusty caves today allows vivid insights into the working conditions that prevailed here.

**The Chimney**
Working underground required a sufficient amount of fresh air. Vertical openings provided ventilation and daylight to the cave quarries.

**The Pillars**
Stone pillars were left in place to support vaults and ceiling above. The intuitive construction process required an in-depth knowledge of stone and structure.

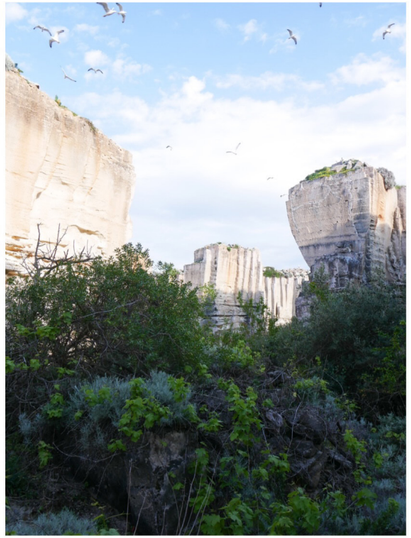


**The Entrance**
The underground galleries usually opened up to the sea, providing direct access to the waterfront. Reducing the distance between quarry and port was crucial.

# Chapter 03 | Architecture Below

## ...Wind...

Labirinto di Cave
*10th century*
*Manual Extraction*
*source: Jacob Steinberg*

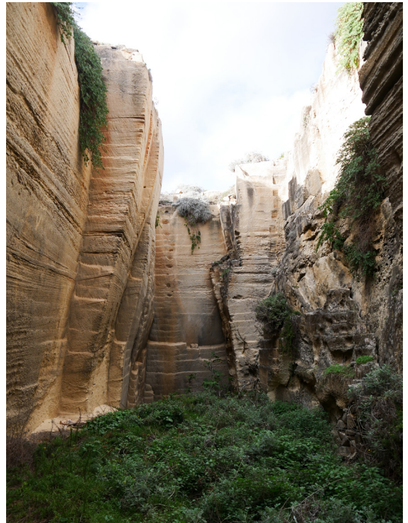






## Water...

Cita di Cave
*17th century*
*Manual Extraction*
*source: Jacob Steinberg*



## ...Soil

# Chapter 03 | Ecosystem

1992 April
1996 Mai
2000 June
2004 July
2008 August
2012 September
2016 October
2020 November
2024 December

30 km/h
25 km/h
20 km/h
15 km/h
10 km/h
5 km/h
wind speed monthly

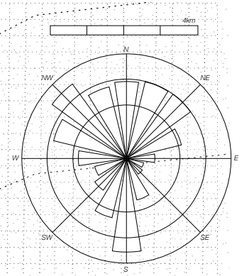
+3°C
+2°C
+1°C
temperature anomaly yearly

**Ecosystem**
After excavation has finished, quarries are usually abandoned. Traces of humans disappear as nature takes over and the habitat slowly shifts from human to non-human actors. Over time, natural elements transform the extraction landscape today into an ecosystem of the future.

**Wind**
Favignana's climate is influenced by strong winds, either from the desert in the south or the open ocean in the north. Especially winter storms have the energy to erode and deposite natural materials like stone, soil and seeds.[1]

**Water**
As the mediteranean climate is getting hotter through climate change, summer rainfalls are estimated to be 30% less already. At the same time the intensity of rain falls in winter increase.[2]

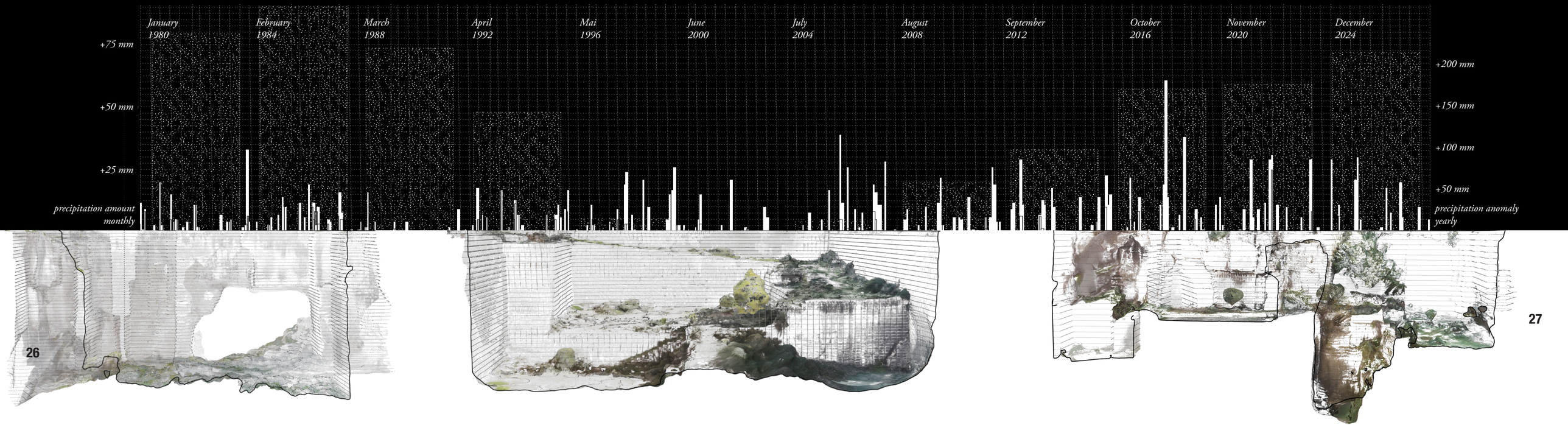
**Soil**
Over time, the void of the quarry is filled with sediments of soil and seeds. In order to reuse quarries as gardens, filling up deep holes with soil is usually the first measurement.




*source: meteoblue.com/Favignana*

[1] *Ambroggi, "Cava 73. Abitare in negativo. Valorizzare il vuoto."*

[2] *Marsala and Mei, "Inland Areas between Description and Transformation. The Case of the Disused Quarries on the Island of Favignana."*








**Renaturization**
The process of renaturization can be traced by analysing the flora and fauna of a quarry. 3D scans were desaturated and the texture erased so that only the plants are still visible. Within each quarry a glossary of local plants has been recorded.

**Biodiversity**
Following the steps of ecological succesion, pioneering plants like pine and aloe are the first to take root on the stony soil. Soon, trees and higher plants provide additional shade. Within the microclimate of a quarry, even fruit trees and palms thrive.

Pine
*9-15m, full sun*
*extreme climates, hardiness zone 7-9*
*chalkys soils, limestone*

Aloe yucca
*1.5 - 7 m, full sun*
*hardiness zone 8-11*
*sandy/mixed soil*

Pampas Grass
*2-3m, full sun*
*hardiness zone 8-10*
*moist, sandy soils*

Rock Caper
*60 - 90 cm, full sun*
*hardiness zone 8-10*
*mixed soil*

Bitter Orange
*6-9m, full sun*
*hardiness zone 9-11*
*mixed soil*

Sago Palm
*3-8m, partial sun*
*hardiness zone 8-12*
*mixed soil*

# Chapter 03 | Renaturization

# From Void...

# ... to Mass

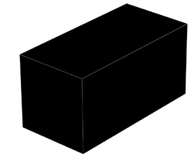




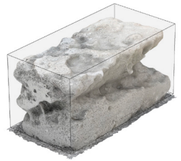
# Chapter 03 | Sculpture

**Excavation**
Calcarenite stones were cut in various dimensions depending on their use as a building material. The standardized *cantuni* had the dimensions of 25cm x 25cm x 50cm and were used for building stone walls.[1]

[1]*Ambroggi, "Cava 73. Abitare in negativo. Valorizzare il vuoto."*

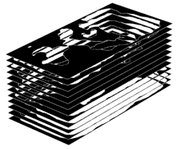


***as extracted***
*A/V = 2*



***as found***
*as (un-)natural Stone Sculpture*

***mass***
*A/V = 4,58*



***void***
*A/V = 4,97*

**Erosion**
Depending on its properties, Calcarenite stone becomes subject to erosion and natural decay. Salt, wind and water slowly shape the stone over time.

**Sculpture**
Just as the stone, quarries as well as the local architecture become (un-) natural sculptures, shaped by the interplay of natural and cultural forces. How can we harness the beauty of entropic decay in architecture today?

**Bibliography**

*Ambroggi , Chiara. "Cava 73. Abitare in negativo. Valorizzare il vuoto," July 28, 2016. https://www.politesi.polimi.it/handle/10589/122839.*

*Marsala, G., and P. Mei. "Inland Areas between Description and Transformation. The Case of the Disused Quarries on the Island of Favignana," December 2022. https://iris.unipa.it/handle/10447/585611.*

*Berger, Alan. Designing the Reclaimed Landscape. London: Taylor & Francis, 2008.*

*Calenzani, Lucio. The Architect's Handbook of Marble, Granite, and Stone Vol. 2, Overvieuw of the Italian Stone Industry. New York: Van Nostrand Reinhold, 1990.*

*Kil, R A. "Sedimentology and 3D Architecture of a Bioclastic Calcarenite Complex on Favignana, Southern Italy: Implications for Reservoir Modelling," 2010.*

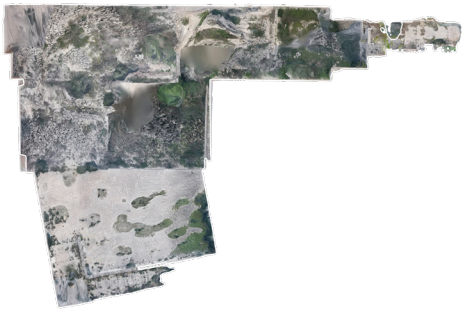
*Turpin, E. Architecture in the Anthropocene: Encounters among Design, Deep Time, Science and Philosophy. First edition. 1 online resource (250 pages) : illustrations (some color) vols. Critical Climate Change. Ann Arbor: Open Humanities Press, an imprint of Michigan Publishing, University of Michigan Library, 2013. https://www.oapen.org/download?type=document&docid=502351.*

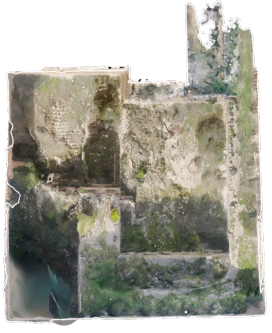
*Ellis, Erle C., Kees Klein Goldewijk, Stefan Siebert, Deborah Lightman, and Navin Ramankutty. "Anthropogenic Transformation of the Biomes, 1700 to 2000." Global Ecology and Biogeography 19, no. 5 (2010): 589–606. https://doi.org/10.1111/j.1466-8238.2010.00540.x.*

*Rocca, Teresa La. Gli indistinti confini: osservazioni e progetti per l'isola di Favignana. Medina, 1995.*

*Campo, Vincenzo and Campo, Nuncio. Giardino dell'Impossibile Favignana. "Giardino dell'Impossibile." Accessed August 30, 2025. https://www.giardinodellimpossibile.it/.*






**Jacob Steinberg**
**TU Delft I 2024/25**