

# The future of the coastal zone – adaptation and mitigation strategies

**Dr. Dr. MSc Niki Evelpidou, Professor**



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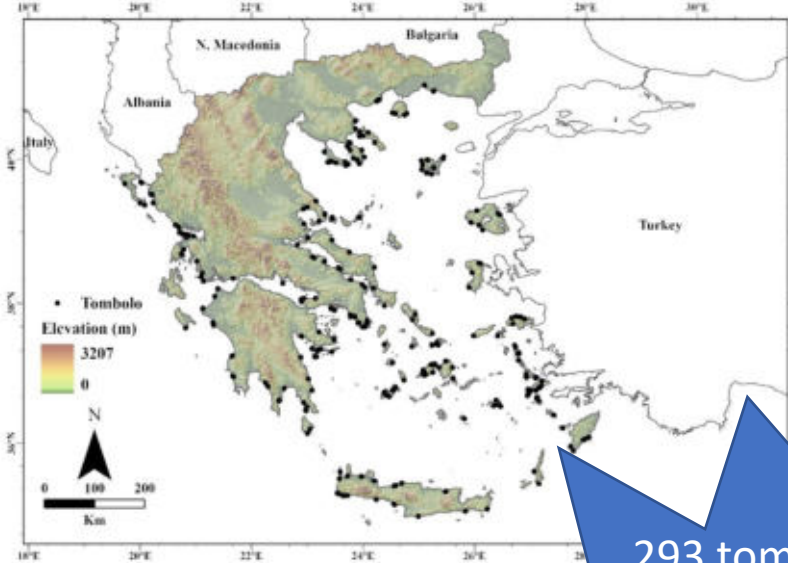
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2050	2100
13,6–15,2%	35,7–49,5%
36.097– 40.511 km	95.061– 131.745 km

- 31% of sandy beaches → >500 people/ km<sup>2</sup>
- 2050: 1/3 will be significantly threatened by erosion → 2100: 52% (RCP 4.5) to 63% (RCP 8.5) by 2100.
- 2100: Australia's at least 11.426 km total sandy coastline are threatened by erosion → 50% of the total coastline.







293 tombolo type beaches in Greece. They will all disappear!



Crete



Anavissos, Attica



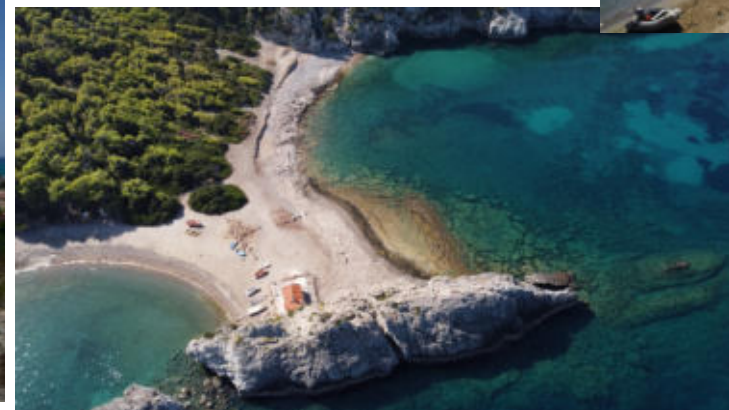
Kithira



Kithnos



Rhodes

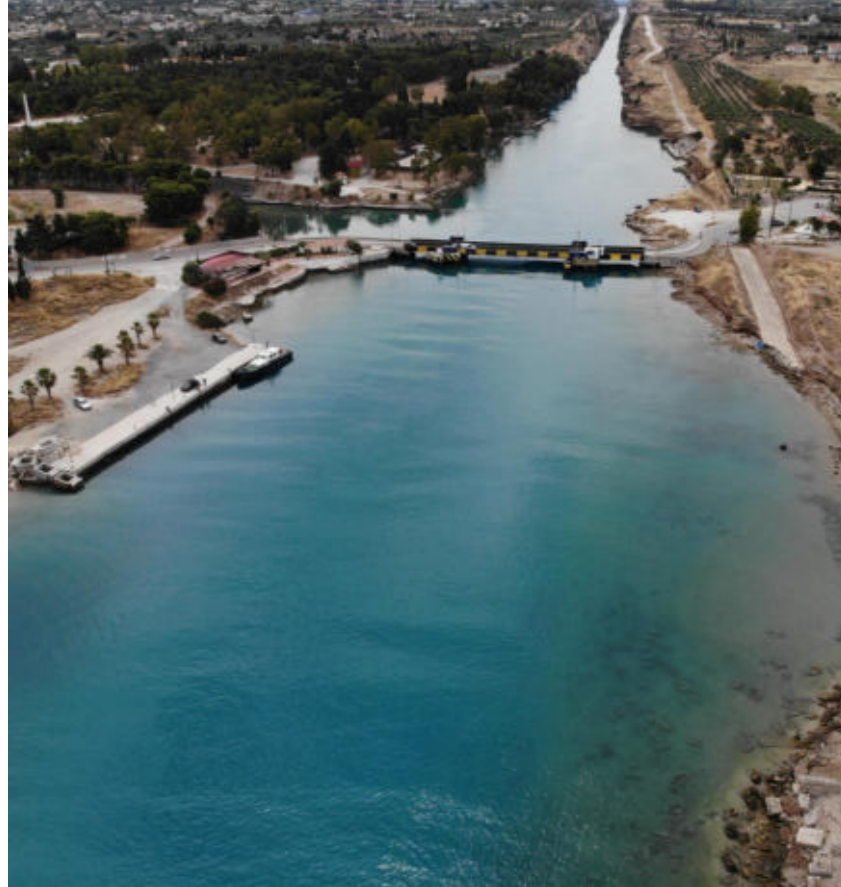


Perachora



Paros





Diolkos  
7<sup>th</sup> century BC

Our cultural heritage under erosion...





# Existing solutions

## Hard constructions



Life span?  
15-20 years!



- Expensive constructions
- Finite life time
- Cement constructions produce 7% of annual CO2 emissions
- Unpleasant
- Often partially effective

# Existing solutions

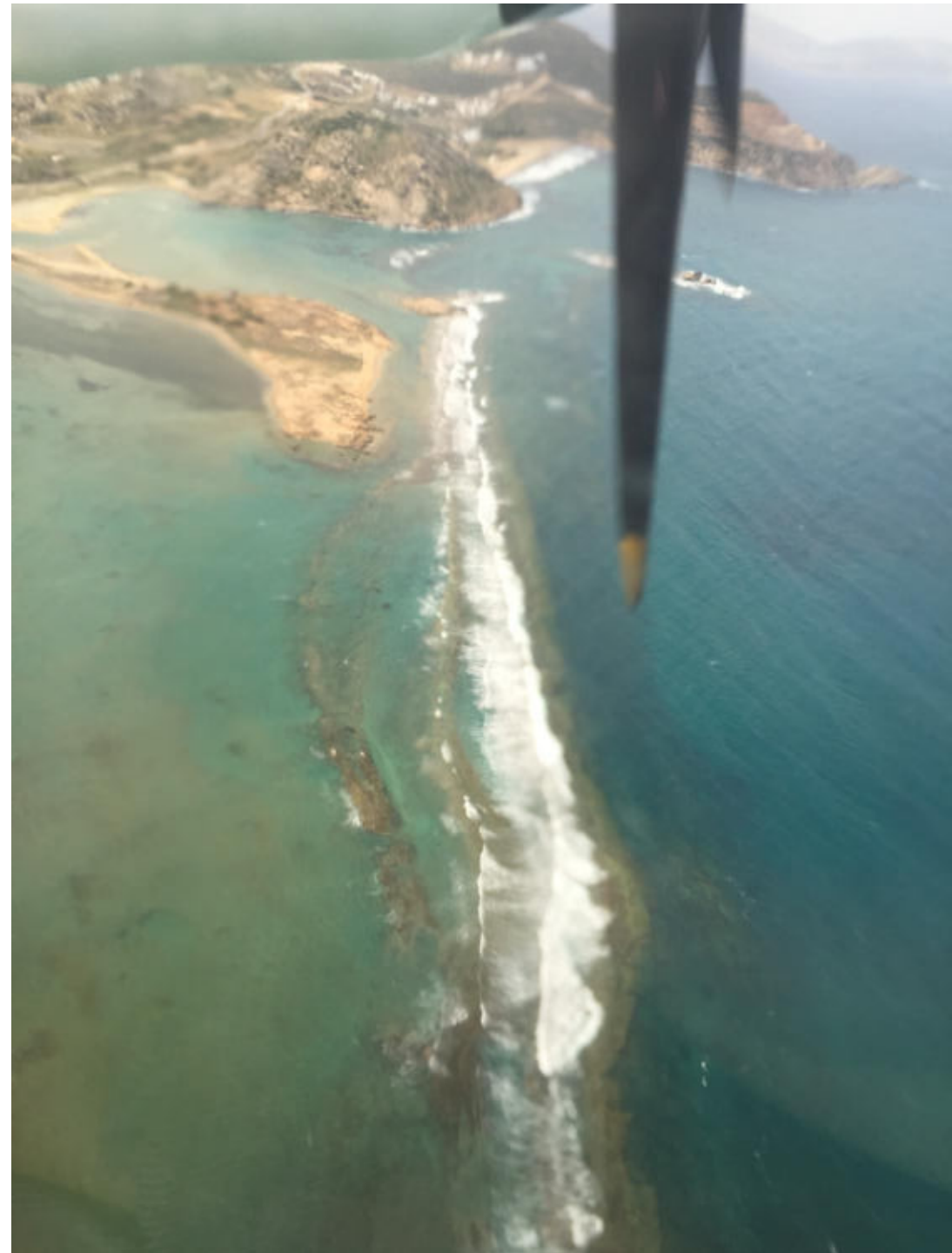
## Soft engineering

- Difficulty finding materials similar to those found on the beach.
- Marine life is buried.
- Repeated renewal application.
- It's an expensive project.
- It has a high energy cost.



Photos: <https://www.martin.fl.us/beach-nourishment>













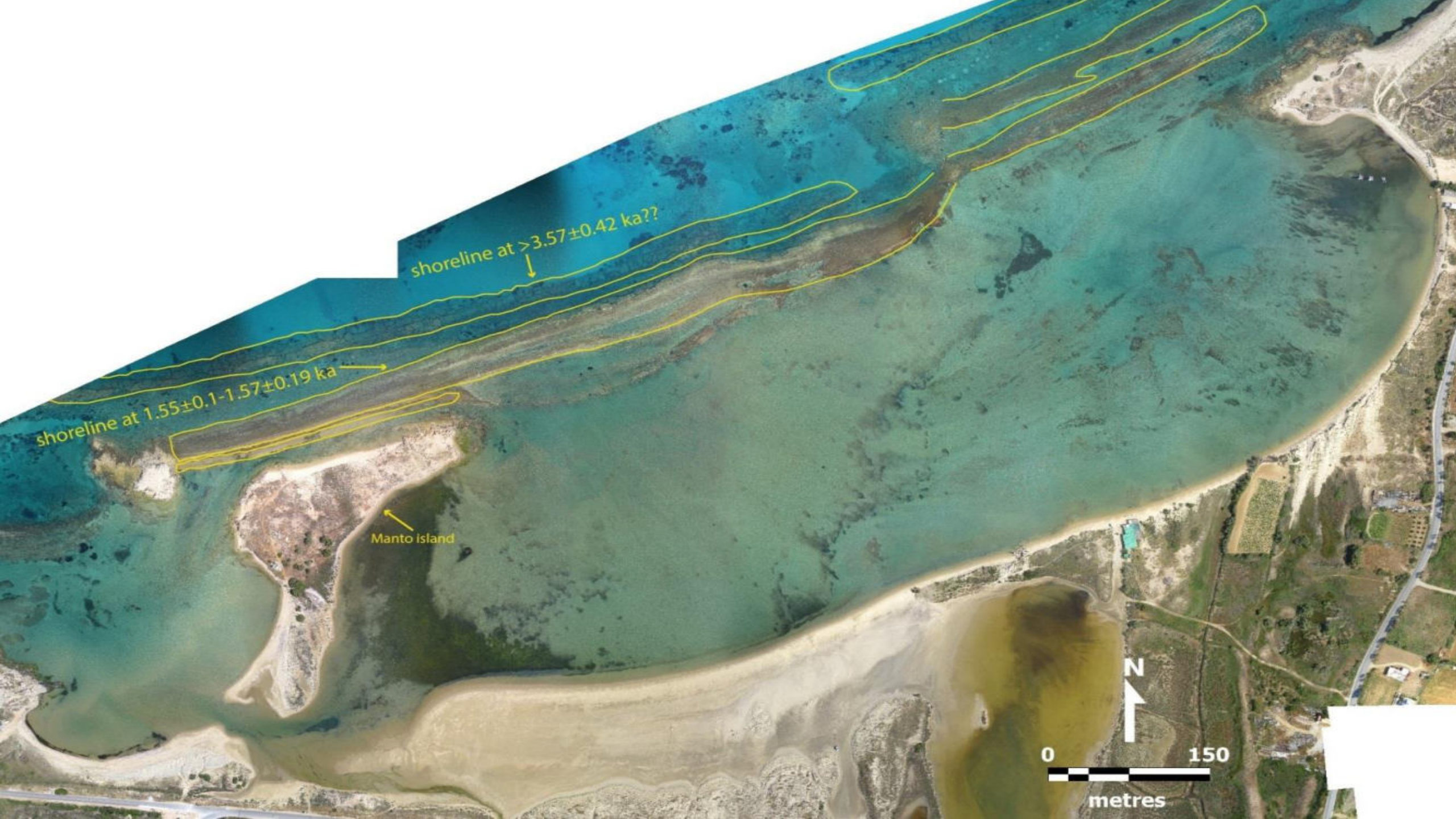


















## Fieldwork

- Beachrocks
- Beach profile
- Sand and water (for artificial beachrocks)

## Laboratory analysis

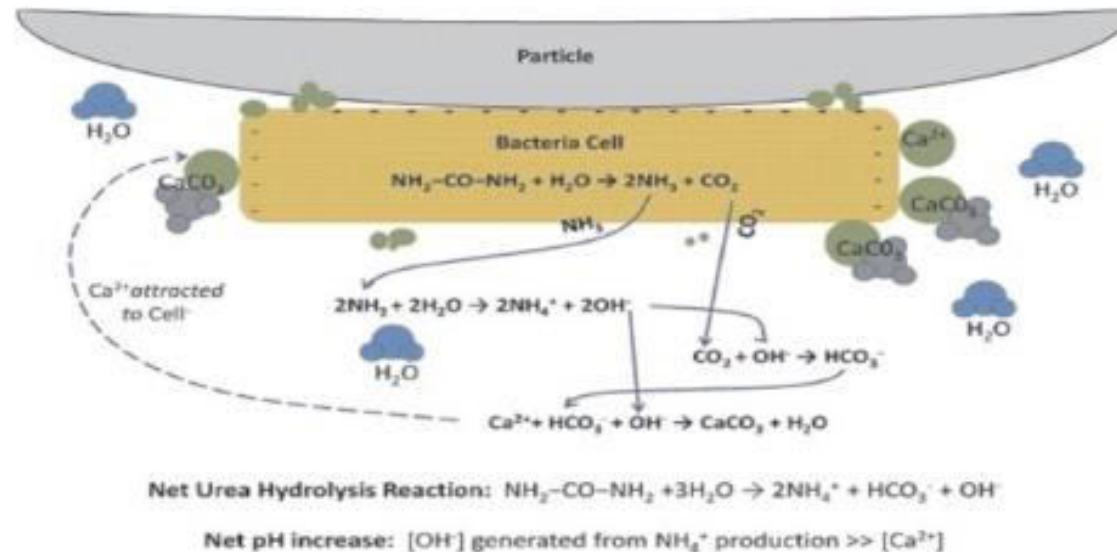
- Geomorphological interpretation
- Polarized light Microscopy
- SEM-EDS
- XRD & XRF (on selected samples)
- Beachrocks for palaeogeography reconstruction ( OSL dating)
- Artificial beachrock experiment

## Combination and correlation of data

- Beachrock composition
- Beachrock GIS spatial distribution
- Artificial beachrock data



# Biological activity



Consolidation occurs from:

a) Algae photosynthesis

b) Microbial decomposition of organic material

c) Bioclasticite

biocalcite

i) ammonification

ii) Urea hydrolysis

iii) Sulfate capture

The bacteria are living on particle surface, and they create calcite as byproduct of their biological activity which is Ureolysis.





Definition of experimental parameters

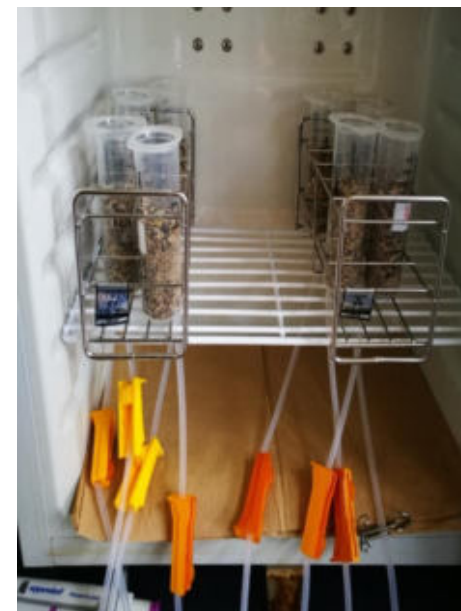
Identification and cultivation of ureolytic bacteria

Sand and water sampling



- ✓ Use of **sand** from the protected beach
- ✓ Use of protected beach **bacteria**
- ✓ **Water** study
- Laboratory studies to identify the ideal bacteria
- Sand analysis and definition of experiment parameters

- Production of bacterial solutions and administration to uncontaminated sand
- Daily administration of artificial sea water
- Administration of nutrients
- Analysis of outputs
- Daily monitoring



Laboratory experiment setting



14 days nutrient treatment with a solution of artificial seawater





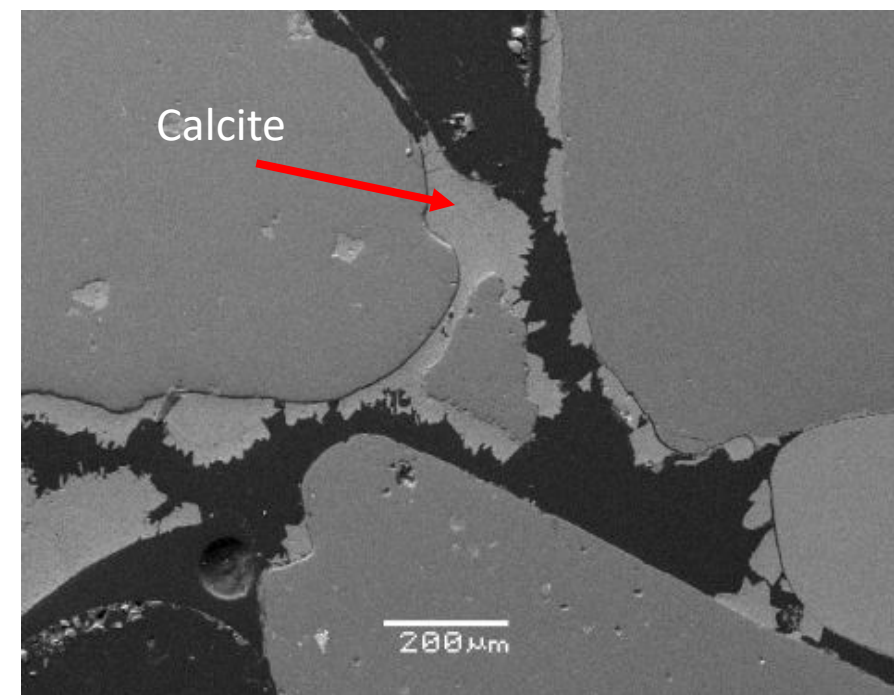
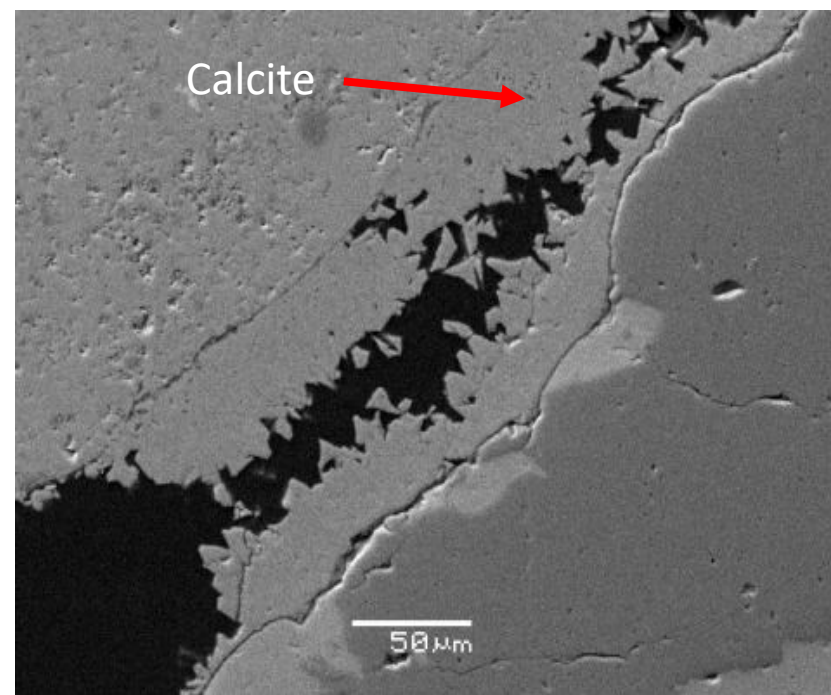
- Opening samples on the 14<sup>th</sup> day of experiment
- Total sand welding
- Sand color change due to carbonate precipitation



optical polarized microscopy



SEM-EDS

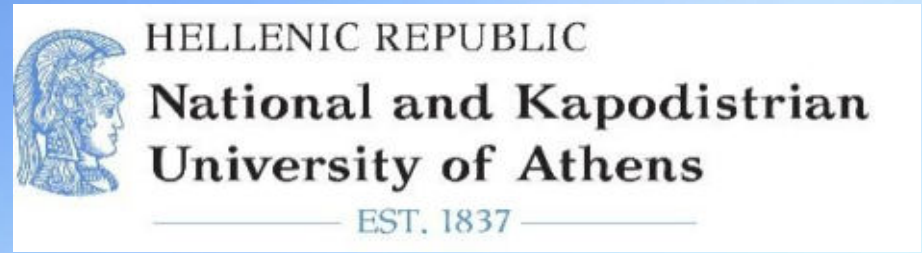






- Study of unconfined compressive strength (UCS)
- Determination of precipitated  $\text{CaCO}_3$  using hydrochloric acid
- Mineralogical study under polarizing microscope and SEM-EDS
- CT-scanning tomographies





**Thank you for the attention!**

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