



**HOKKAIDO**  
UNIVERSITY

# Innovative Approach for Addressing Coastal Erosion Protection Using Microbial Induced Carbonate Precipitation

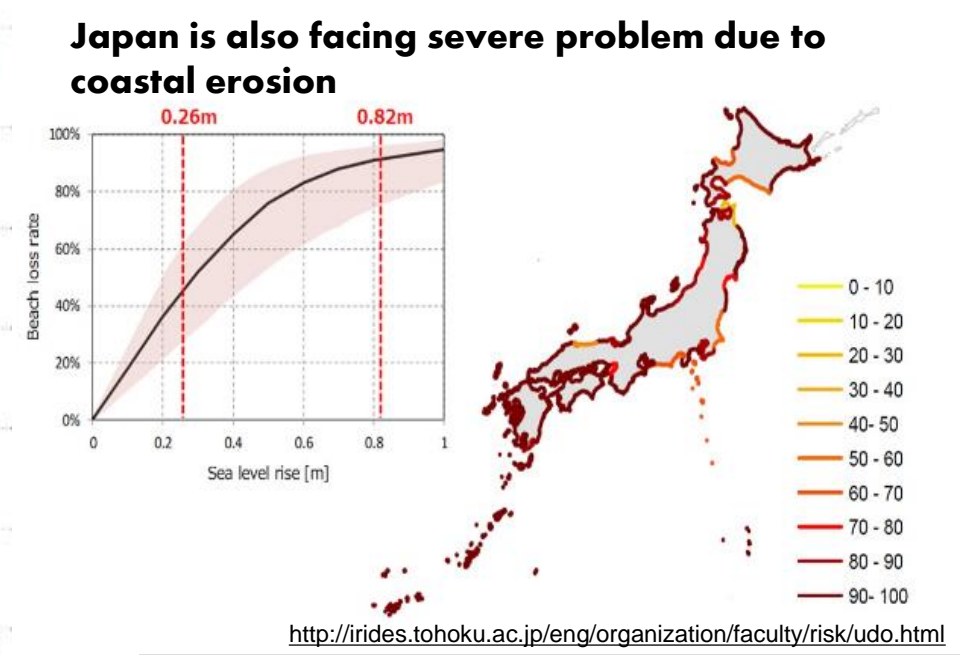
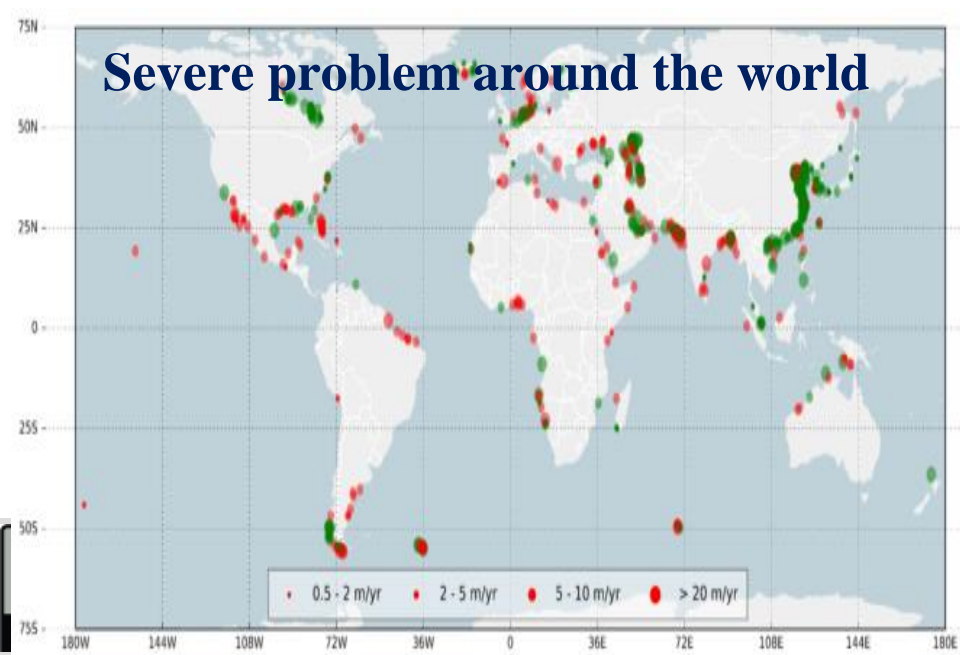
Presenter

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Graduate School of Engineering,  
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# Introduction: Why focusing on coastal erosion protection? 1



Finding a source of urease enzyme  
(MICP)

Study the **effect of urease activity** at different environmental conditions (temperature, pH etc.)

Improvement of the storage condition of the urease enzyme (easy to transport)

Sand solidification at small scale/medium scale/large scale

Field application trial

# Traditional methods for coastal erosion protection



Sea Wall



Gabion



Rip Rap (Rock Armour)



Groyne revision

**Not  
sustainable**

**Expensive**

**Not eco-  
friendly**

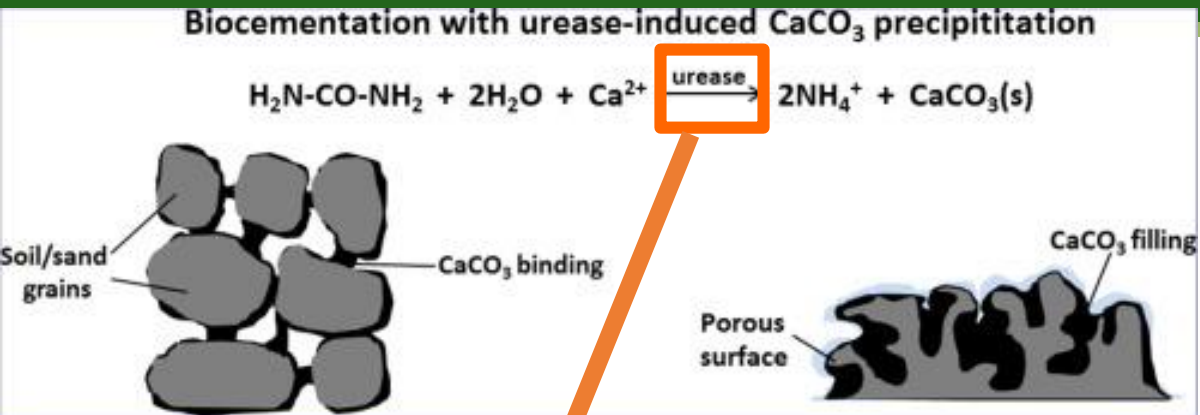
**High energy**

**Environment  
al concern**

**Alternative Solution  
need to be  
addressed**

<https://revisionworld.com/gcse-revision/geography/coastal-landscapes/coastal-management>

# Solutions using Microbes (Bio-cementation)!!



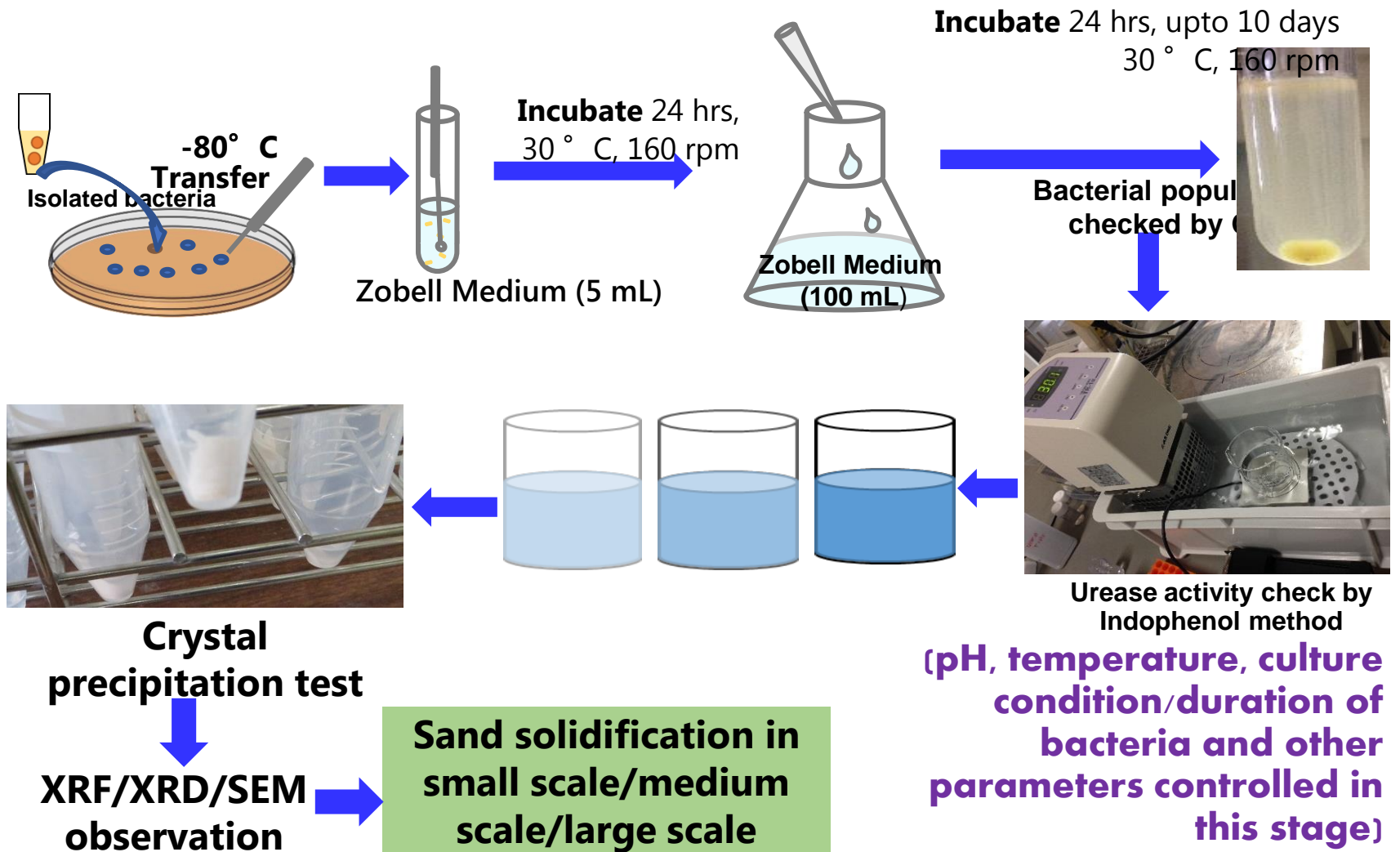
Obtained from  
Microbes

Microbially  
induced calcite  
precipitation  
(MICP)

Sustainable  
Low energy  
Cheap!!  
Eco-friendly  
Low viscosity

Easy penetration  
into the deeper  
portion of soil

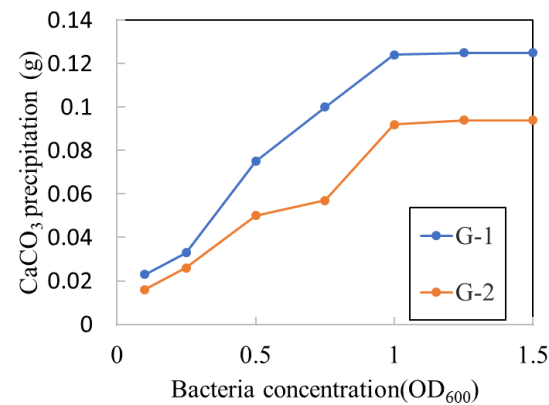
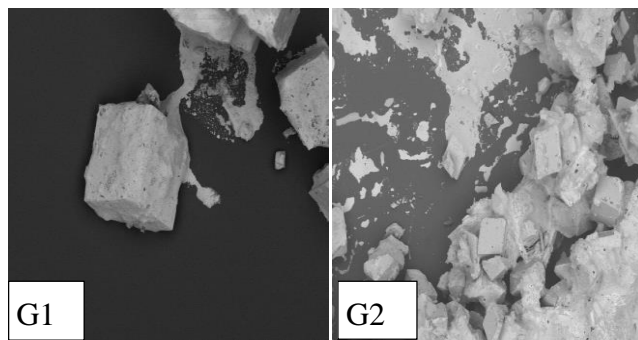
# Material and Methods



# Results and Discussion

Sample name	Sampling country	Identified species
G-1	Greece	<i>Micrococcus yunnanensis</i>
G-2	Greece	<i>Pseudoalteromonas</i> sp.

(BLAST search: International nucleotide sequence database of SIID 24360-01)



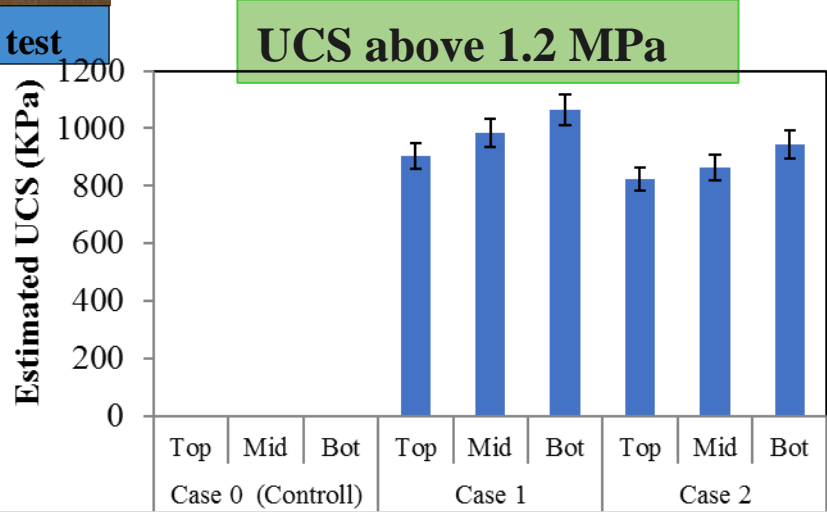
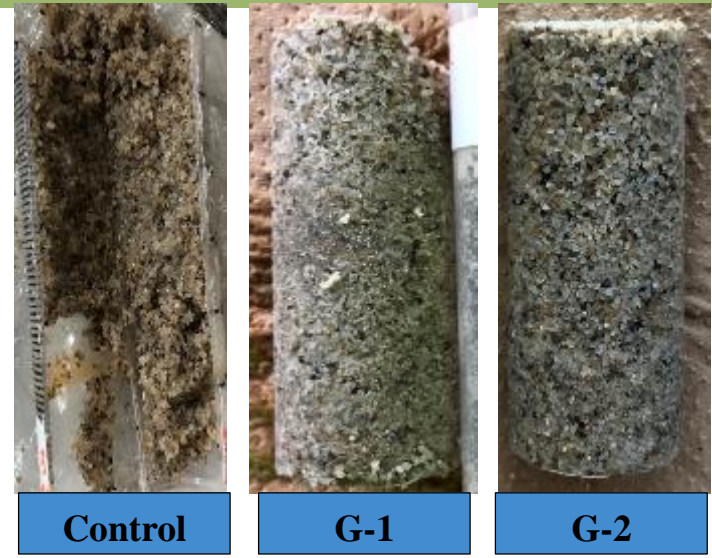
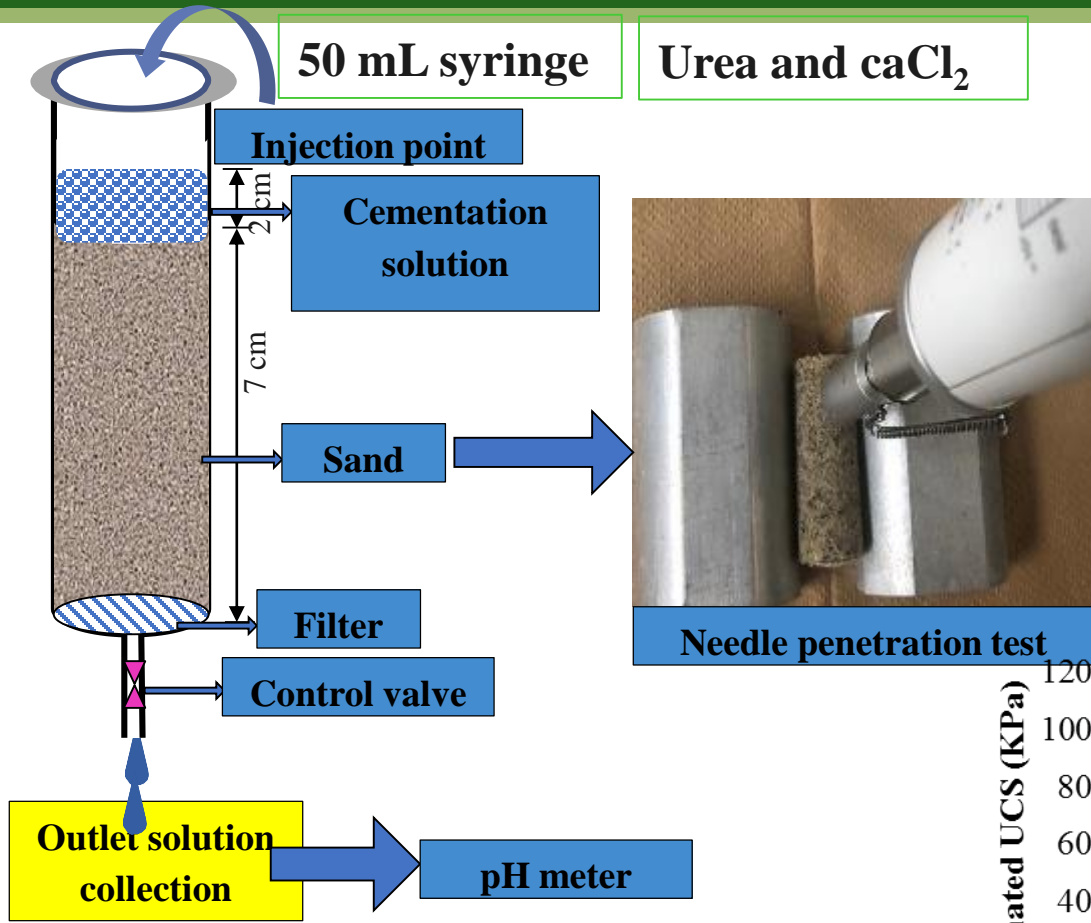
SEM images of crystal precipitation of G1 (×300), G2 (×500) species.

**Amount of crystal precipitation and shape is different**

**Higher OD<sub>600</sub> ≠ Higher CaCO<sub>3</sub> precipitation → Individual species.**

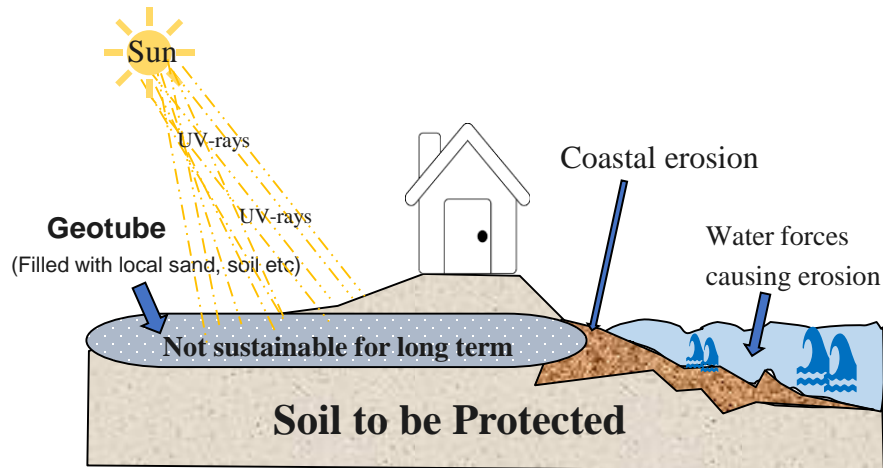
**Constant after a certain point (saturation).**

# Sand Solidification

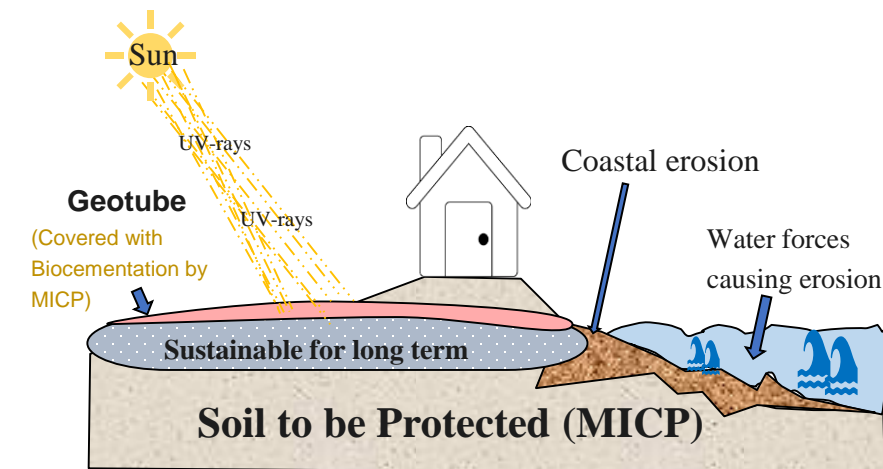




## Previous method for geotube application



## Proposed method for geotube application with MICP



## For more details please refer following journals

1. **Md Al Imran**, Shuya Kimura, Kazunori Nakashima, Niki Evelpidou, Satoru Kawasaki. Feasibility Study of Native Ureolytic Bacteria for Biocementation Towards Coastal Erosion Protection by MICP Method, *Applied Sciences*, 9(20), 4462, 2019. <https://doi.org/10.3390/app9204462>
2. **Md Al Imran**, Kazunori Nakashima, Niki Evelpidou, and Satoru Kawasaki. Factors affecting the urease activity of native ureolytic bacteria isolated from coastal areas, *Geomechanics and Engineering*, Vol. 17, No. 5 421-427, 2019. DOI: <https://doi.org/10.12989/gae.2019.17.5.421>
3. **Md Al Imran**, Mai Shinmura, Kazunori Nakashima and Satoru Kawasaki. Effects of Various Factors on Carbonate Particle Growth Using Ureolytic Bacteria, *Materials Transactions*, 59(9), 1520-1527, 2018. DOI: <https://doi.org/10.2320/matertrans.M-M2018830>
4. **Md Al Imran**, Kazunori Nakashima, and Satoru Kawasaki. Combination technology of geotextile tube and artificial beachrock for coastal protection, *International Journal of GEOMATE, Geotec., Const. Mat. & Env.*, ISSN:2186-2990, Vol.13, Issue 39, pp.67-72, 2017. DOI: <https://doi.org/10.21660/2017.39.7144>

THANK  
YOU

