

Area (Green Innovation)

# Study on Swelling and Penetrating Behavior of Bentonite with Gap Filling Sands

Graduate School of Creative Science and Engineering  
Major in Civil and Environmental Engineering  
Doctor 1st Year /Komine Hideo Lab.  
Chiharu Urano



## 1 Self Introduction

### Career:

~2016: Hong Kong  
2017~2020: Waseda University Senior High School  
2020~2024: Waseda University English Based Bachelors Program  
2024~2025.9: Waseda University English Based Masters Program  
2025.9~: Waseda University English Based Doctoral Program

### Speciality:

Bentonite, Environmental Geotechnics

### Academic Memberships:

Japan Society of Civil Engineers, Japanese Geotechnical Society

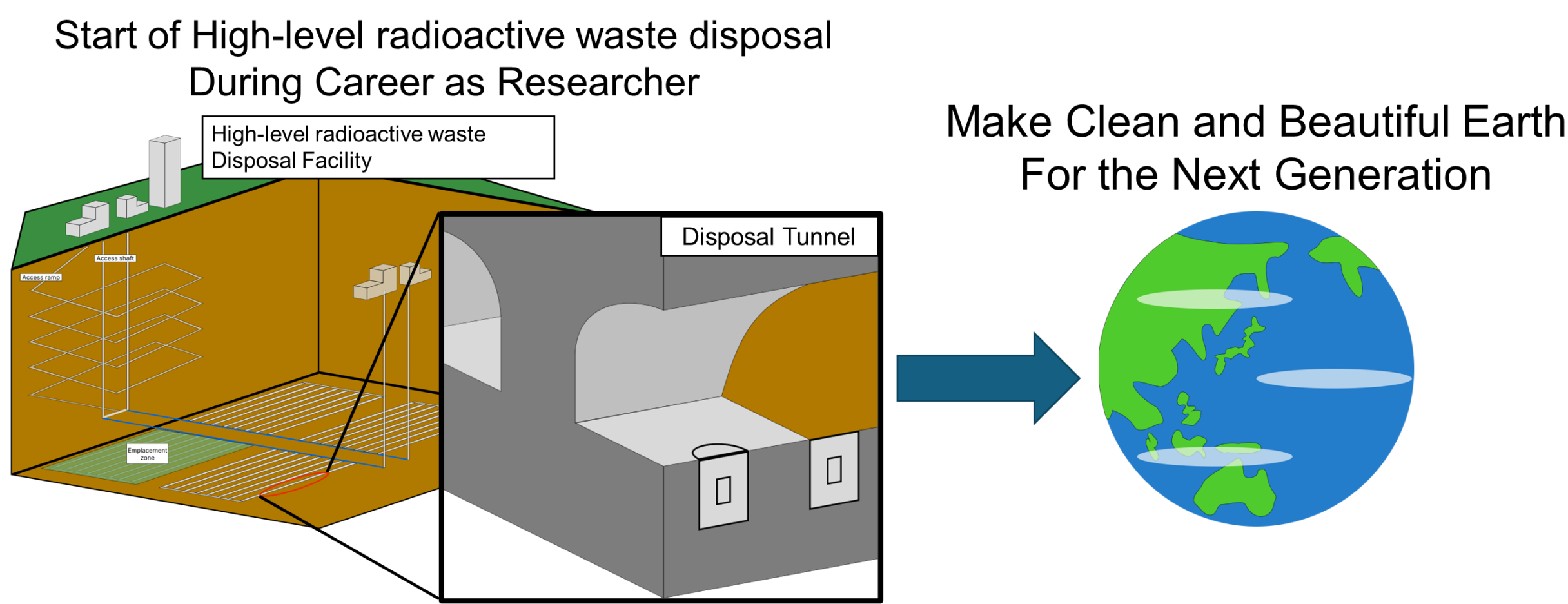
## 3 Career Design

### Future Career:

Researcher specialized in geotechnical engineering

### Dream:

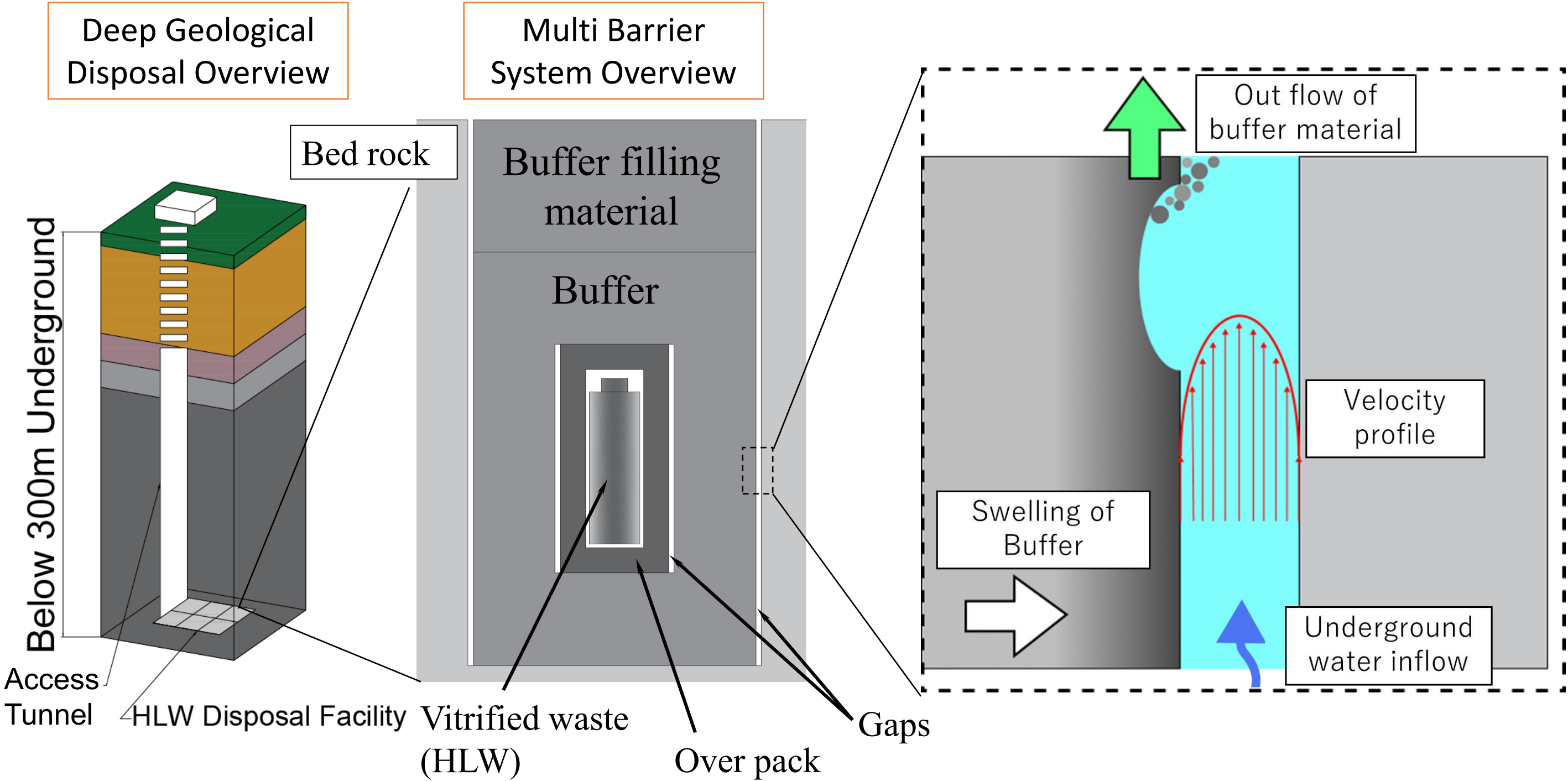
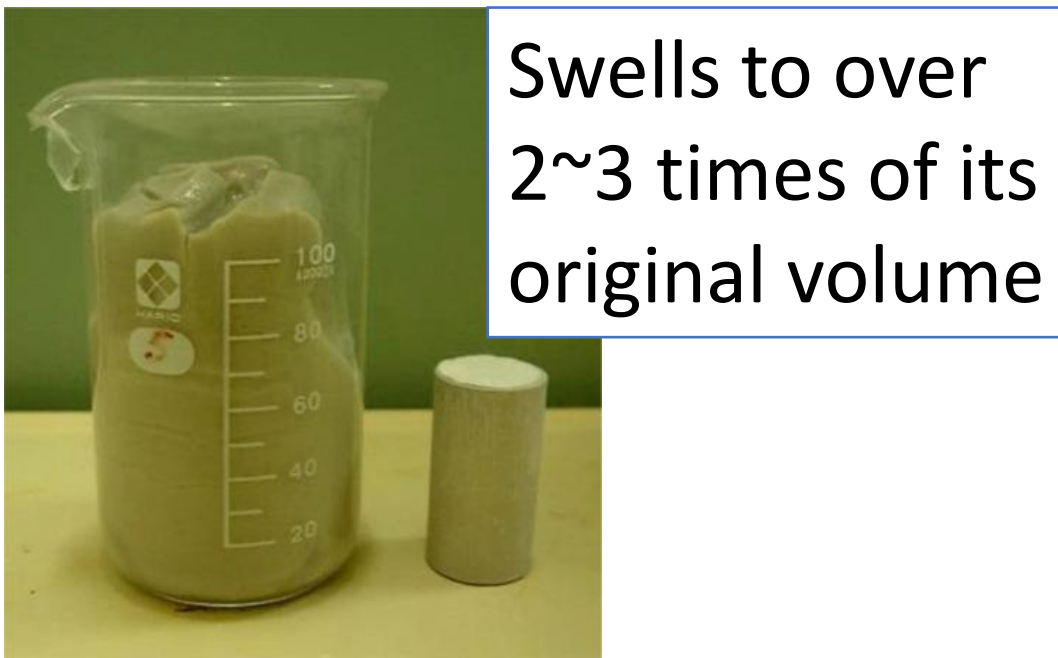
Contribute to the completion of deep geological disposal project



## 2 Research Content

### Research Background

- ❖ Disposal of **High-level radioactive waste (HLW)** generated during the recycling process of nuclear fuel is a major problem
- ❖ **Deep geological disposal method** which buries the HLW below 300 m underground and isolates it with the **multi barrier system** (Bed rock, Buffer, Over pack, Vitrified Waste) for over **1000 years** is considered<sup>1)</sup>
- ❖ Bentonite is used for buffer material
  - ❖ Swelling properties
  - ❖ Low hydraulic conductivity
- ❖ During installation of barriers gaps between barriers are known to appear and the gaps are concerned to cause the **outflow** of buffer material<sup>2)</sup>

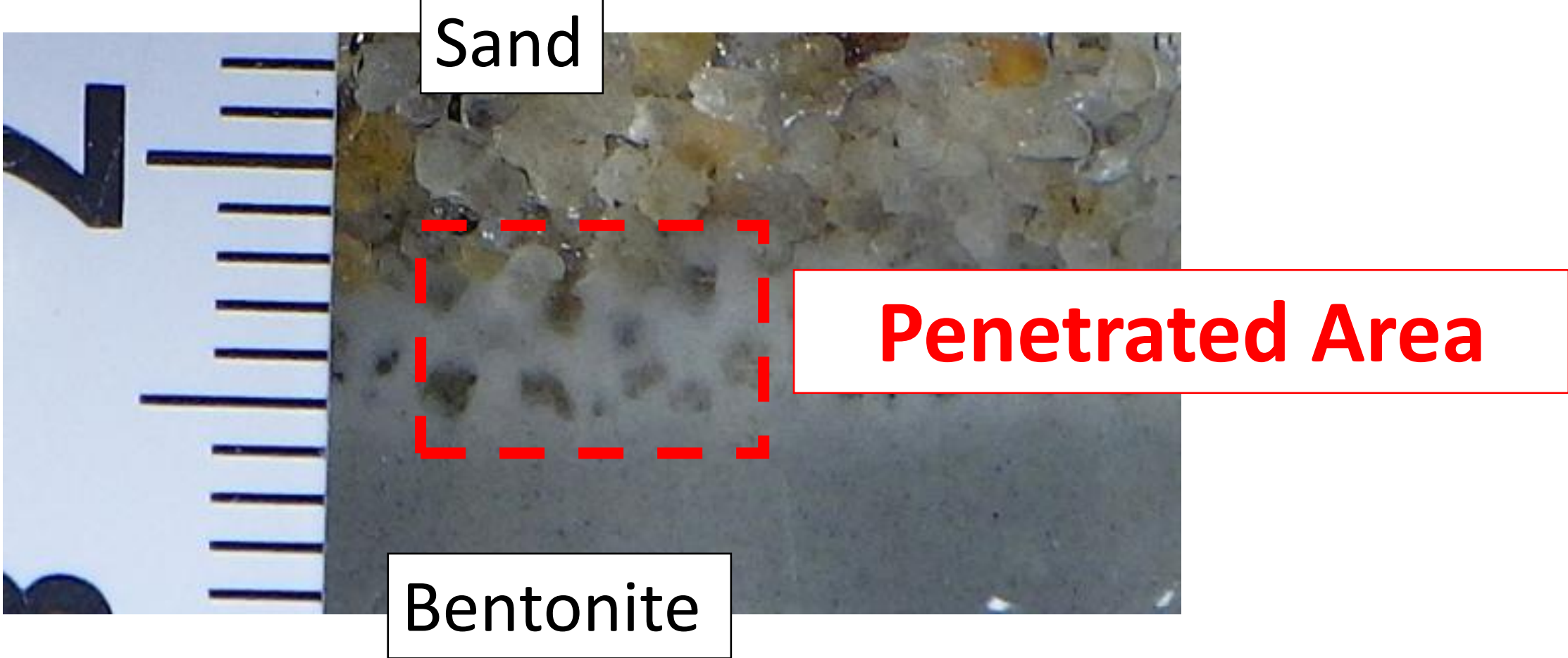


- ❖ As a countermeasure filling the gaps with a soil material (Excavated Soil, Bentonite Pellet, **Silica Sand**) is being considered

References: 1) Nuclear Waste Management Organization of Japan (NUMO), 2022. The NUMO Pre-siting SDM-based Safety Case, NUMO-TR-21-01. 2) Hayashi, D., 2022. Phenomena and engineering measures in erosion of buffer material; Towards the development of optional technology for design and construction of disposal facilities. Journal of the Atomic Energy Society of Japan, 64(11) p.627-631.

### Objective

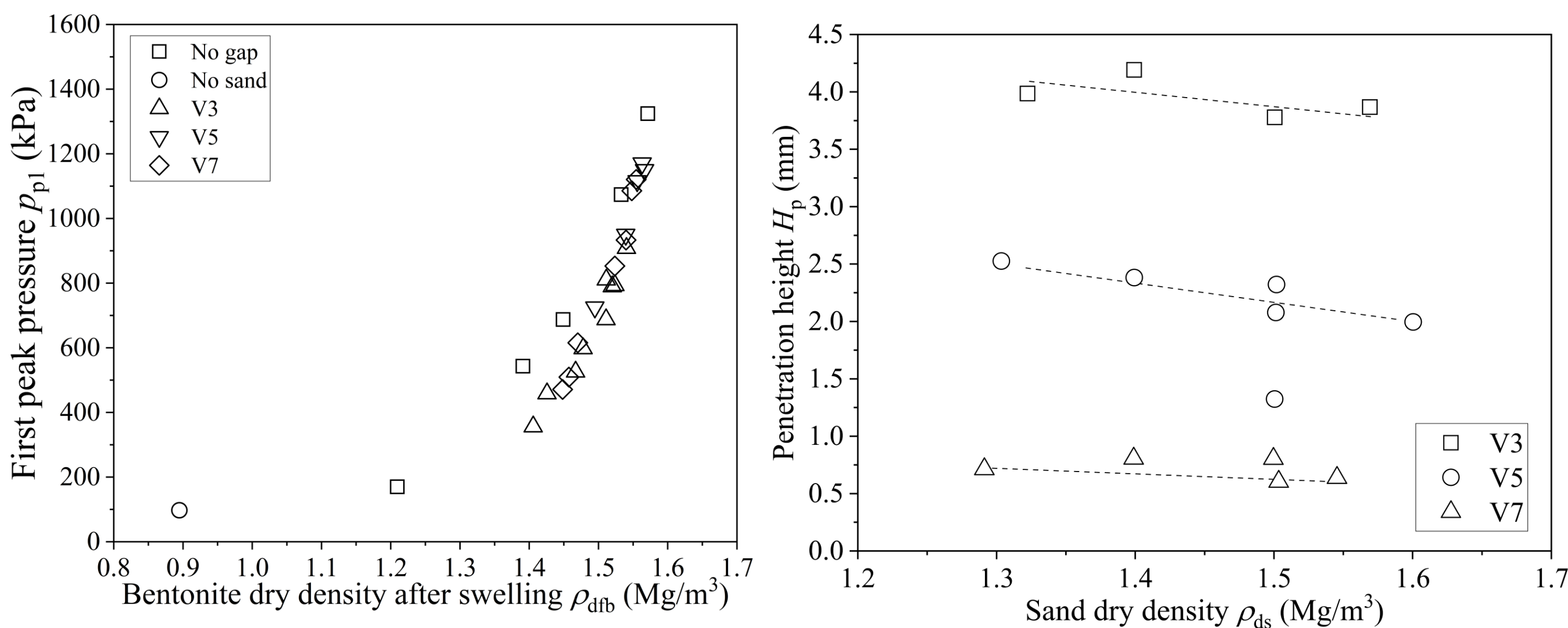
- ❖ When silica sand is used as a gap filling material, the **penetration** of swollen bentonite into the pores of the sands have been observed.



Elucidate the penetration phenomenon mechanism and effects onto barrier performances

### Results<sup>3)4)</sup>

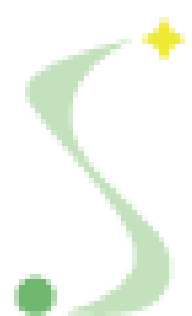
- ❖ Gap filling sand were found to keep swelling pressure compared to cases without sands
- ❖ Penetration height was found to have a negative correlation with sand dry density and a positive correlation with sand size



3) Urano, C., Wang, H., Ruan, K., Ito, D., & Komine, H., 2026. Swelling characteristics of compacted bentonite with gaps filling by sands. Soils and Foundations 66(4). 4) Urano, C., Komine, H., Ruan, K., Ito, D., Wang, H., Effect of Sand Particle Size and Dry Density on Bentonite Penetration Behaviors into Sand Voids, The 3rd International Conference on Energy Geotechnics 2025, Paris, France, June 2025.



国家戦略分野の若手研究者及び博士後期課程の育成事業  
次世代 AI 人材育成プログラム  
(博士後期課程学生支援)



次世代研究者挑戦的研究プログラム  
Support for Pioneering Research Initiated by the Next Generation