



Requirements and preferable features for the selection of host rocks

Workshop on “**Assessing the suitability of host rock**”

-Developing practical approaches to assess geological characteristics
influencing repository design and performance assessment-

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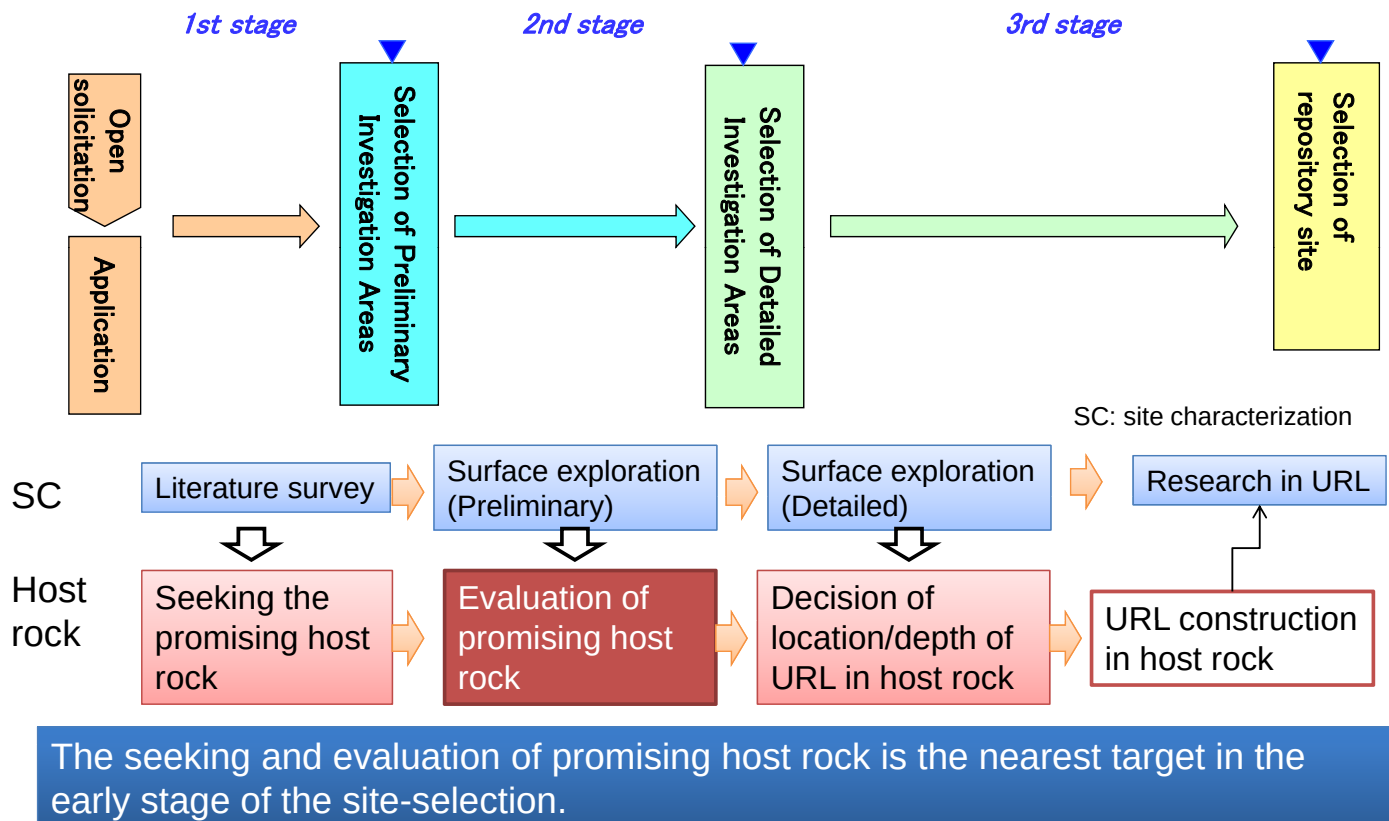
Nuclear Waste Management Organization of Japan (NUMO)



Outline of the presentation

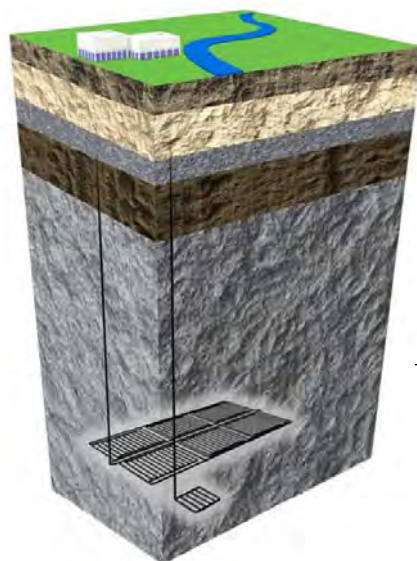
- Background of the evaluation of the host rock in the stepwise site-selection
- Requirements and preferable feature of the host rock
- Summary

Schedule of the site-selection and activities on host rock



Concepts of host rock(formation)/natural barrier

Host rock: The geological formation(s) in which the underground facility is constructed. (In the final disposal act, the term of “*target formation*” is used).



Surrounding formation

Host rock
(target formation)

Need discussion:
What is the difference in the concepts of “host rock” from “natural barrier”?

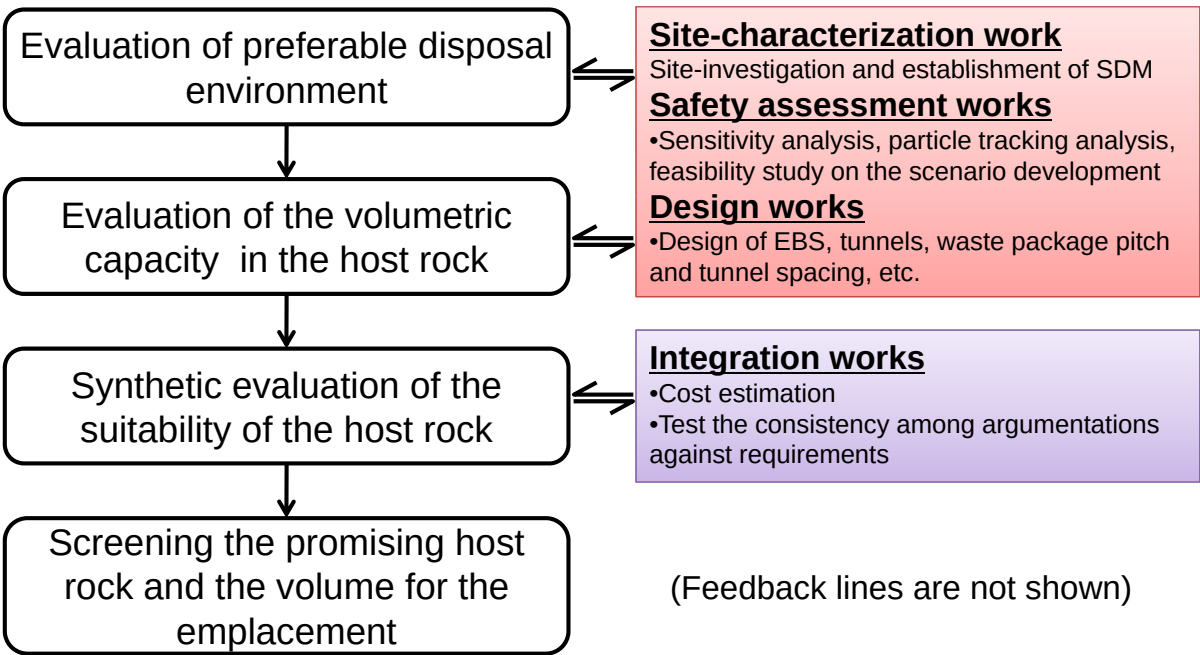
In case of SKB: NB~host rock?
In case of Nagra: NB incl. host rock?

The definition of “host rock” could depend on the geology of a site.



- **Safety functions for host rock**
 - As a part of multiple barrier system
- **Providing the preferable disposal environment**
 - Consideration of the preferable feature along the T, H, M, C factors
 - The features should allow to achieving the long-term safety and engineering feasibility efficiently.
- **Capacity and engineering/economical constraints for the repository**

To determine the potential volume for



Safety functions on post-closure containment

Safety concept	Safety functions		Components
Isolation	Protection from long-term geological phenomena (volcanic activity, active faults, uplift/erosion)		-
	Prevention of human intrusion		-
Post - closure containment	Prevention of leaching from waste form	Restriction of leaching	Vitrified waste
		Prevent contact of waste form with groundwater during high heat generation phase	Overpack
	Restriction of nuclide migration	Restrict advective nuclide transport	Buffer
		Prevent colloidal migration	Buffer
		Retardation of nuclide migration by sorption	Buffer
		Decrease the migration flux by dispersion	Host rock/NB
	Prevention of short-cut pathways along the access tunnel	Prevent the formation of short-cut pathways along access tunnel	Backfill
			Plug

Providing the preferable disposal condition

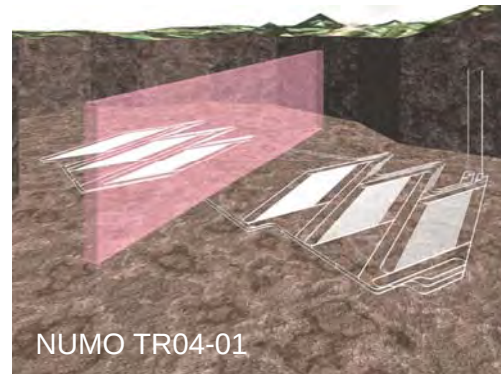
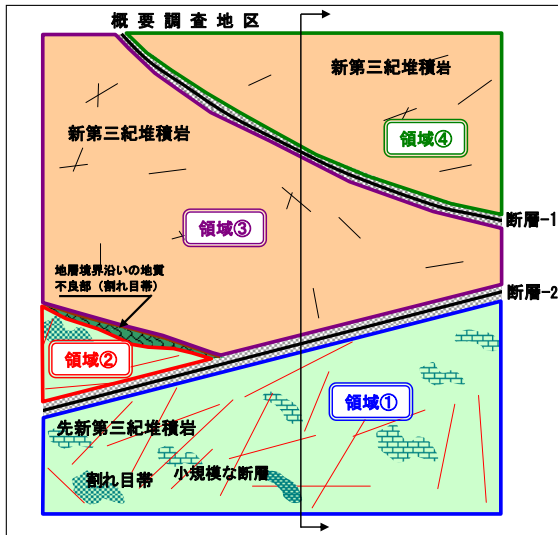
FACTORS	Preferable disposal condition	Features of geological environment
T: Thermal feature	The temperature of the repository should be low after closure.	Thermal gradient/temperature of rock etc.
H: Hydraulic feature	The velocity and flux of ground water flow around the repository should be low after closure.	Hydraulic head, permeability, Nature of fracture (density/anisotropy) etc.
M: Mechanical feature	The mechanical stability should be maintained during operation.	Mechanical feature of bedrock
C: Geochemical condition	The chemical conditions around the repository should be suitable for maintaining the low solubility of radionuclide and the stability of the EBS materials after closure.	pH, Eh, chemical composition of ground water

Volumetric capacity of the host rock (formation)

✓The discontinuous feature* in the host rock could be a key feature that determines the volume.

*Discontinuous structure: The formation boundary, faults, fractures, unconformity)

✓Consider the volume surrounded with boundaries defined by the discontinuous structures that can be identified in PI stage.



The repository can distribute over the discontinuous feature.

Hydraulic feature of host rock is the most effective feature for evaluation

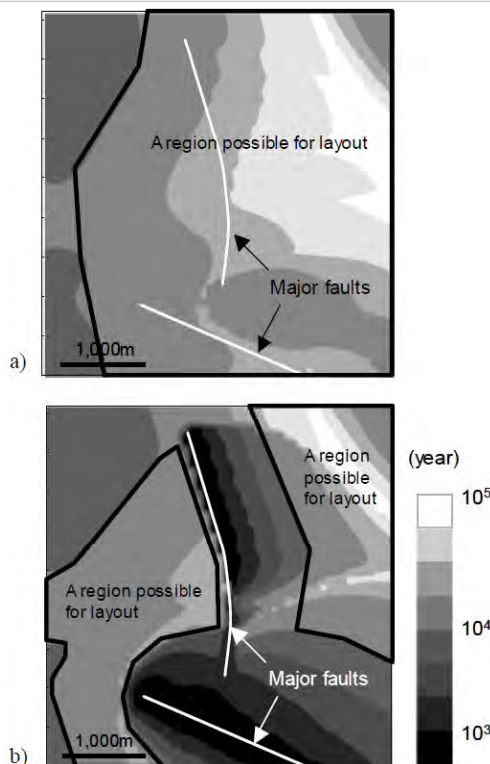


Figure 2. Distribution of groundwater travel time from repository to surface for 2 test cases. Hydraulic conductivities of major faults are lower than surrounding host rock in 2a, and are higher in 2b. Groundwater flows from the right to the left.

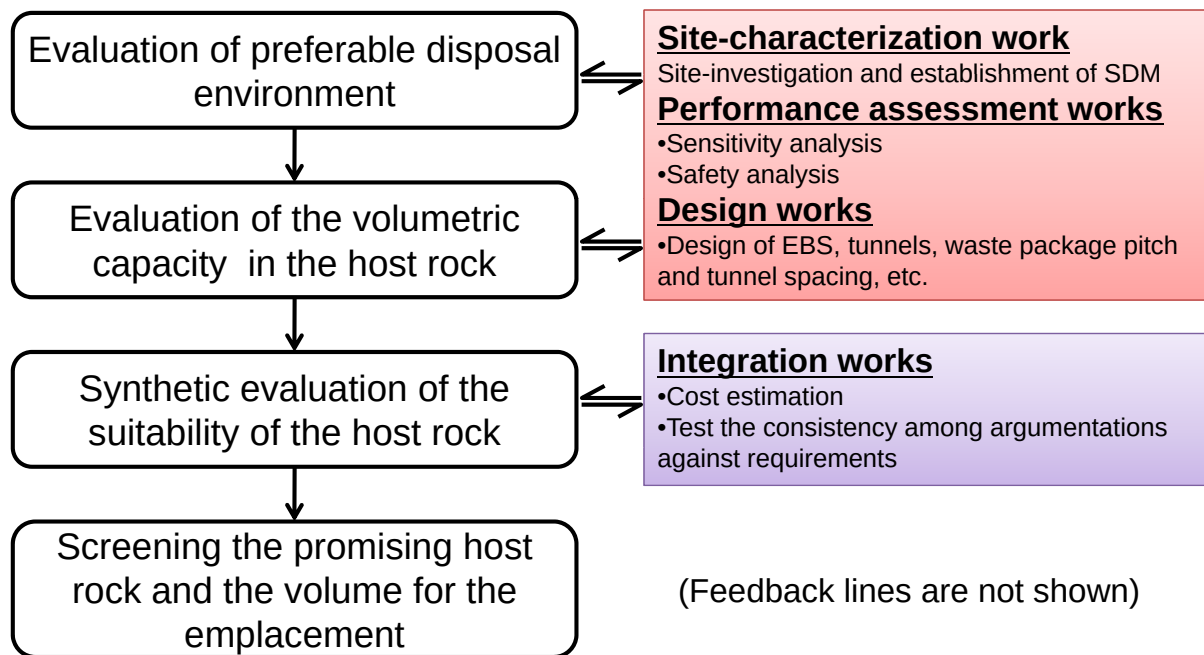
It is important to identify the locations and characteristics of large water-conducting features as well as the extent of low-permeability domains within a repository region. (Ijiri et al., 1999, GEOTRAP4)

Need discussion:

- The larger geological feature may be identified by the surface exploration in the PI stage. What is the classification criteria for, e.g. the size of faults?
- Large uncertainty on the property of faults may be considered. How can we define the volume capacity for the emplacement of the waste-form in the host rock in PI stage.



The overall evaluation flow of host rock along the requirements



Remaining uncertainty in the PI stage will be followed by the DI plan.



Discussion points

- What is the difference in the concepts of “host rock” from “natural barrier”?
- The larger geological feature may be identified by the surface exploration in the PI stage. What is the classification criteria for the size of faults?
- Large uncertainty on the property of faults may be expected. How can we define the volume capacity for the emplacement of the waste-form in the host rock in PI stage.