A consideration on the Possible Deep Borehole Disposal in Japan -Update of the Presentation at Seoul-

DBD Working Group Meeting
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Contents of this presentation

- Update on the current status related to high-level waste disposal program in Japan
- Update on the DBD-related information
  - NUMO (2004) report
  - Japanese practice on deep drilling
- Discussion points for DBD in Japan
  - Amount of the waste
  - Size of the vitrified waste
  - Discussion on retrievability
  - Geological setting of Japan (update)
  - Possible application of the DBD concept
- Concluding remarks

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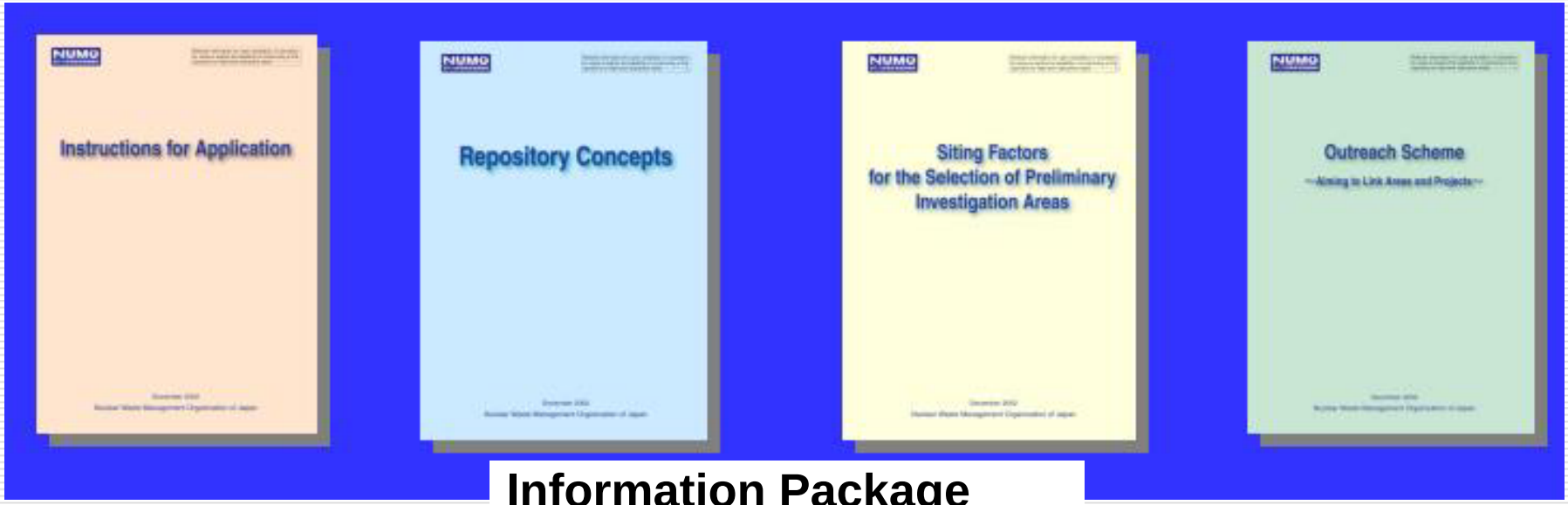
Open solicitation

- **19 Dec. 2002**
  - **Commencement of Open Solicitation**
  - **Sending an "Information Package" to all 3,239 municipalities and other relevant organizations in Japan**
- **All municipalities have a right to apply for the Open Solicitation.**
- **Deadline of the Open Solicitation is not set at present stage.**



Information Package

(http://www.numo.or.jp/english/publications/main.html)

Progress in Siting Process

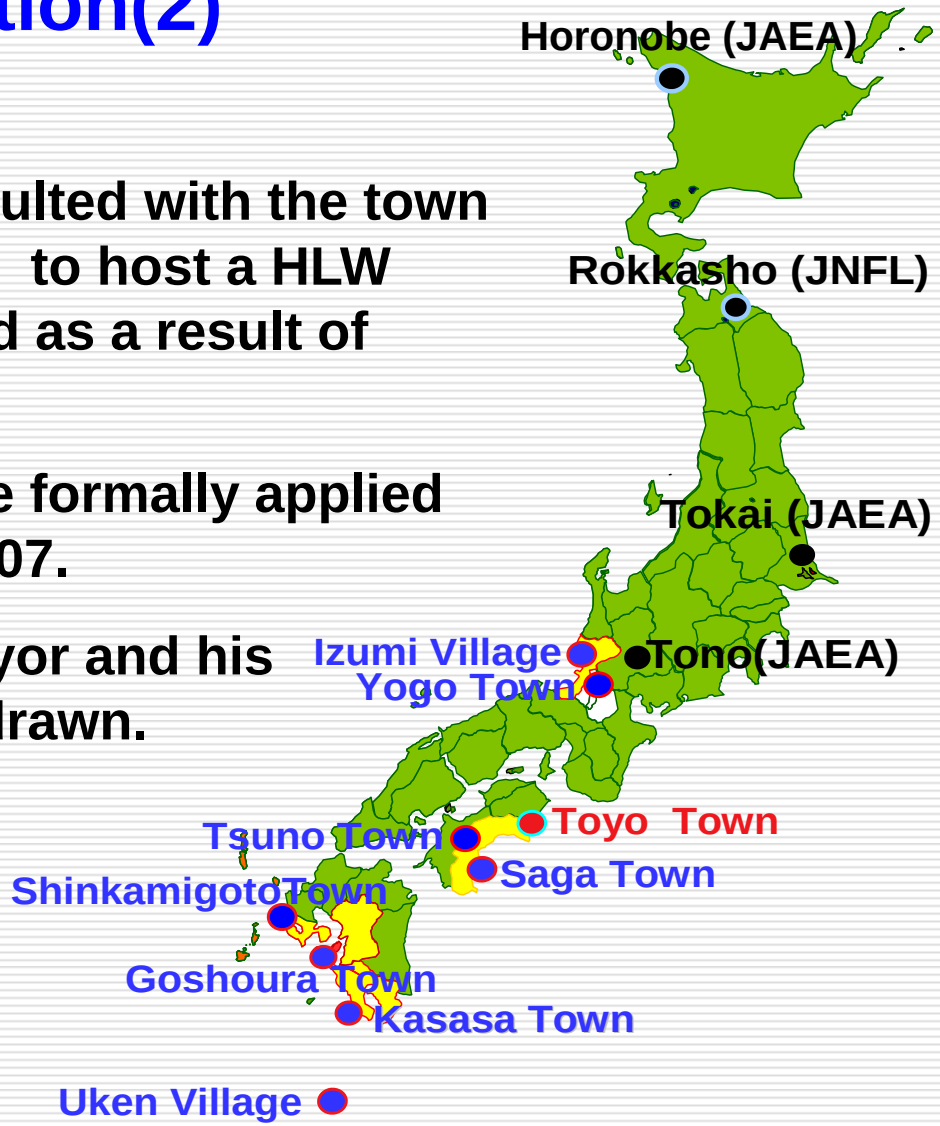
Reaction to open solicitation(1)

1. 9 municipalities expressed their interest to be a volunteer site since the first voice from Izumi village on April 2003.
2. 6 municipalities decided to call off further consideration as soon as the local paper exposed the plan to host a HLW repository. Mayors of these municipalities made almost the same comments as " I am not confident to answer the growing public concern over safety of repository in the local communities".
3. Most governors of the prefecture persuaded mayors of local municipality to give up hosting a repository.

Progress in Siting Process

Reaction to open solicitation(2)

4. In 2 municipalities, the mayor consulted with the town council about a petition requesting to host a HLW repository, but they were dismissed as a result of deliberation.
5. Only Toyo town in Kochi-prefecture formally applied to NUMO for literature survey in 2007.
6. Because of the election of new mayor and his decision, the application was withdrawn.



Major activities after 2007

- 2007
  - Add an option for proposal acceptance
  - NUMO as implementing body for disposing TRU wastes
  - JAEA as implementing body for disposing radioactive wastes produced by research activities
- 2010
  - Japan Atomic Energy Commission (JAEC) sent a request to the Science Council of Japan (SCJ) to deliberate recommendation for activities to disclose literature and information on the disposal of HLW to the public.

Open solicitation
Application

An open solicitation of municipalities nationwide is being carried out in a search for suitable areas to carry out feasibility studies for the possible construction of a final repository.

Proposal
Acceptance

The opinions of the people in regions will be fully respected and the government can take the step of proposing to municipalities that a literature survey be carried out.

Literature survey

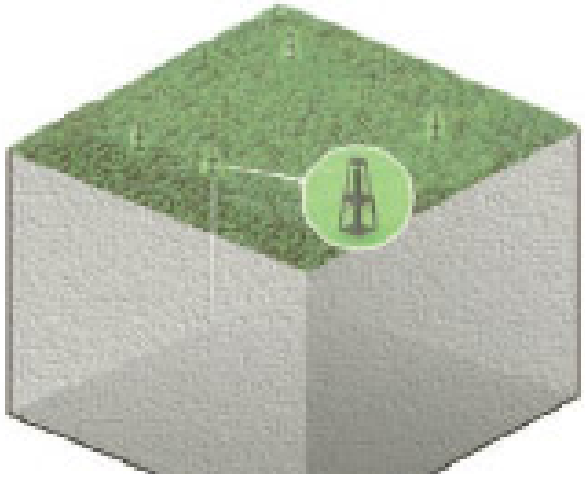
Checks of previous earthquake activity, volcanic eruptions, fault activity, uplift and erosion and other relevant tectonic phenomena will be made using records of past activity, written references and other documents in order to determine the suitability of applicant areas and the surrounding regions.

1 Selection of Preliminary Investigation Areas (PIAs) based on literature surveys

It will be confirmed from past records that there are no indications of pronounced geological perturbations resulting from natural phenomena such as earthquakes and that there is no risk of such phenomena occurring in the future.

Preliminary investigations

Studies will be made - from the ground surface · rock properties, geological structures, groundwater characteristics



http://www.numo.or.jp/en/jigyou/new_eng_tab03.html

Major activities after 2007 (Contd.)

- 2011
  - Tohoku Earthquake and Tsunami
  - Fukushima nuclear disaster
- 2012
  - SCJ sent “Issues concerning HLW Disposal (Reply)” back to JAEC on September 11, 2012.
    - Reconstructing the policy framework
      - Identifying the limits of scientific and technical viability
      - Ensuring scientific autonomy
      - Temporal storage and total volume control
      - Streamlining of procedures for determining reasonable policies in terms of fair burden sharing
      - Making multistage agreements by providing a venue for discussion

Major activities after 2007 (Contd.)

- 2012
  - JAEC reconsidered and issued the following approaches on December 18, 2012:
    - Clarify the amount and nature of HLW for disposal in association with nuclear energy and fuel cycle policies.
    - Apply the latest earth science knowledge to a viability study of geological disposal, and share the result with the public.
    - Improve the operation according to the discussions on the need and significance of interim storage.
    - Provide a system of sharing disposal techniques and the site selection process with the public.
    - The government leads policy restructuring.

Major activities after 2007 (Contd.)

- 2013
  - Agency for Natural Resources and Energy, METI, holds a subcommittee on the Nuclear Waste Disposal on May 28, 2013

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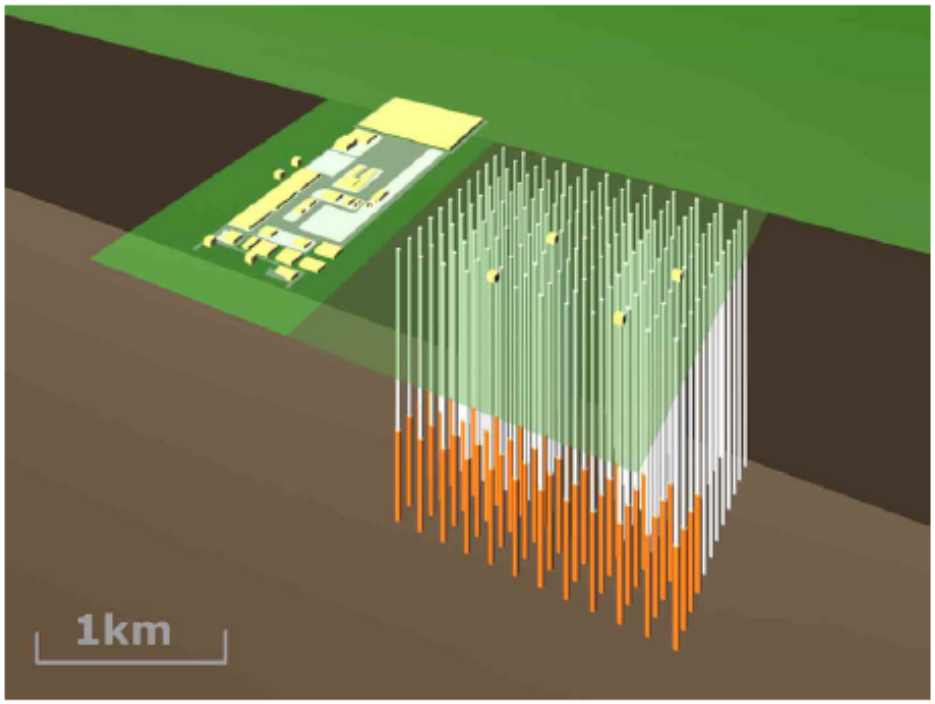
NUMO(2004) report (NUMO-TR-04-03)

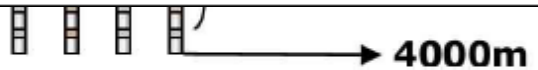
- Development of Repository Concepts for Volunteer Siting Environments.

6. Vertical deep boreholes

- Great depth of disposal increases waste isolation.
- Requirements on host formation reduced.
- Minimal EBS may be sufficient (e.g. overpack only or simple IWP).

N.B.: This option involves some fundamental changes in the basic safety philosophy, but is included for the sake of completeness.





Deep Drilling Experience in Japan (update)

- Two deep wells (vertical well)
  - METI Shin-Takenomachi (1993) : 6,310 m
    - Hole diameter: 8-1/2” (~21.5 cm)
    - Casing plan: 7” (~17.8 cm OD)
    - Bottom temperature: 197 degree Celcius
  - METI Mishima (1992) : 6,300 m
    - Bottom temperature: 226 degree Celcius

Example of casing plan

- METI Higashi-kubiki (1989-1990): 6,001 m
  - 0-401 m: 30” (~76.2 cm)
  - 401-1,491 m: 20” (~50.8 cm)
  - 1,491-3,583 m: 13-3/8” (~34.0 cm)
  - 3,583-5,000 m: 9-5/8” (~24.4 cm)
  - 5,000-6,001 m: 8-1/2” (no-casing) (~21.6 cm)

casing diameters indicate OD

Morita et al. (1997)

cf. diameter of vitrified waste: 43 cm

Necessary considerations

- Casing program
  - Diameter-strength-weight
- Stability of borehole
  - Borehole collapse/casing damage and possible stuck

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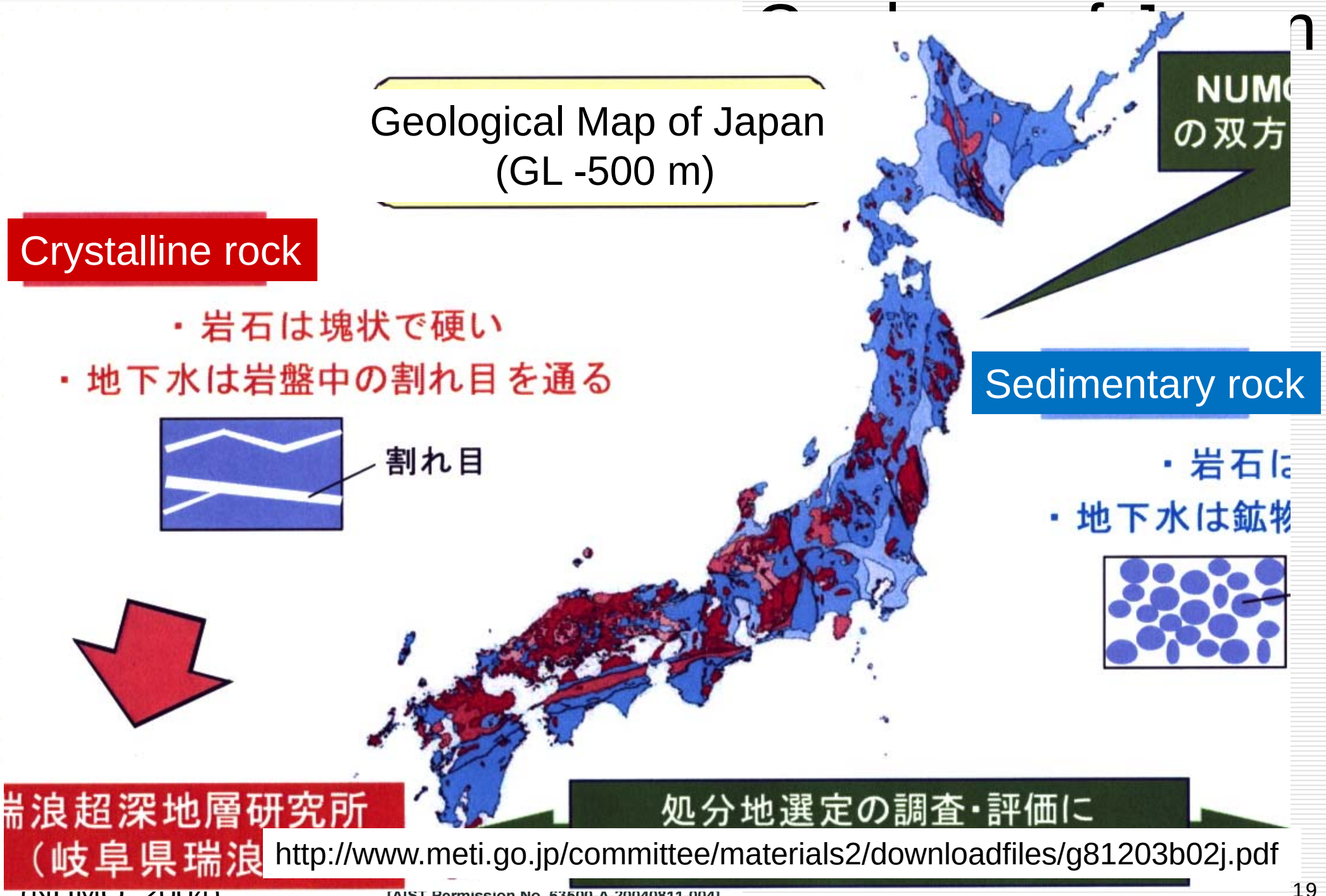
Discussion on the possible DBD in Japan

- Current plan for HLW disposal by NUMO
  - 40,000 vitrified wastes or more
  - More than 100 ultra-deep borehole necessary? (in the case of 400 wastes per hole) ……. Feasible???
- Size of the vitrified waste
  - 43 cm outer diameter
  - Technically challenging to drill ultra-deep borehole with large diameter
  - Possible to set 18-5/8” (~47.3 cm) casing to ca. 3,000 m (ID ~45.1 cm, low strength)

    (without considering geologically induced problem)
- Retrievability
  - Very difficult if multiple wastes are lowered into a borehole
  - Keeping the possibility to retrieve HLW is considered to be necessary until the site be finally closed



(NUMO, 2004)

Upwelling of deep-fluid (update)

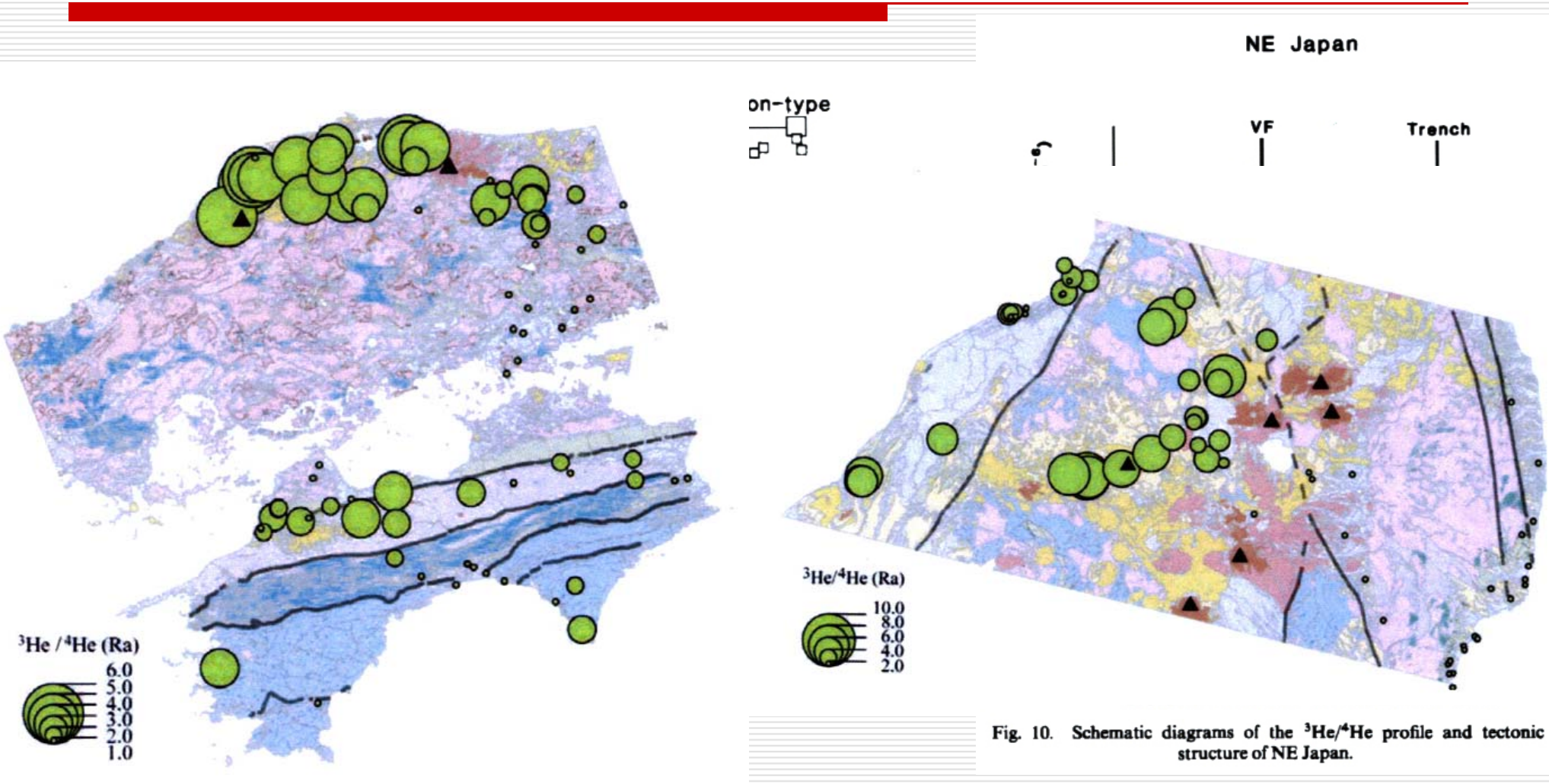


Fig. 10. Schematic diagrams of the ^{3}He/^{4}He profile and tectonic structure of NE Japan.

Geological survey of Japan (2012)
http://www.gsj.jp/data/openfile/no0560/gsj_openfile_560.pdf

Possible DBD application

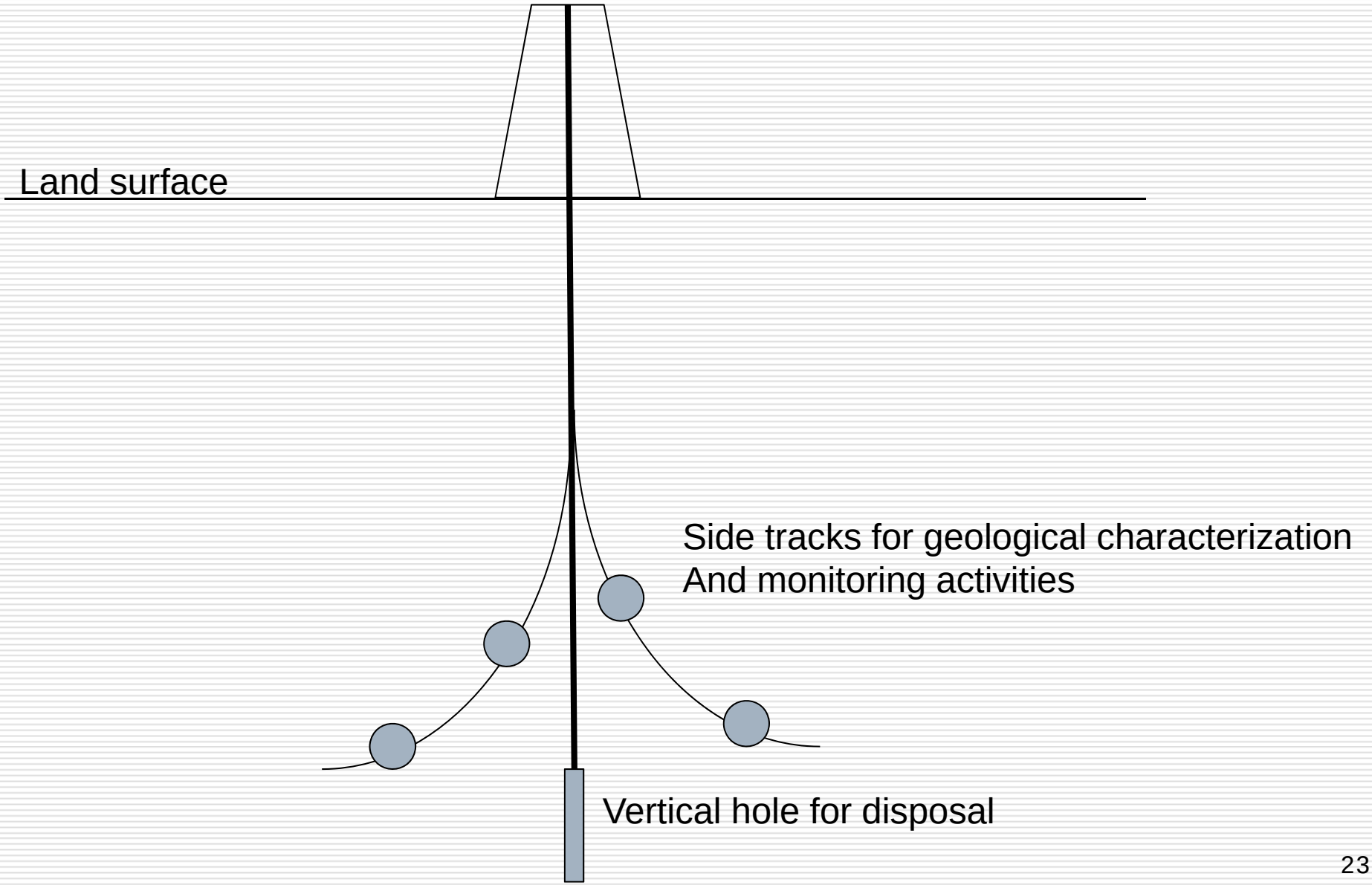
- An advantages of DBD
  - Do not depend on the type of the waste

- Could be used for radioactive wastes with small volume, for example:
  - Debris inside the Fukushima-daiichi NPP
  - Fuel/spent fuel in the pool at Fukushima-daiichi
  - Radioactive wastes from research institutions
  - ^{129}I (^{14}C) in TRU waste

Possible DBD application (contd.)

- Advantages of DBD for small volume wastes
  - May not be necessary to separate wastes
  - Small volume can be accommodated by smaller diameter borehole
  - Small volume can allow us to have retrievability option even for DBD
  - Characterization of the site and monitoring can be achieved by side-track holes
  - Can contribute to overcome our difficulty to handle wastes at the Fukushima-daiichi NPP

Possible DBD application (contd.)



For implementing DBD (update)

- Need to develop the scenario for safety analysis
  - Engineered barriers may not be effective.
  - Concept for long-term safety is considerably different from mined repository.
- Improve the understandings on the ultra-deep geological situation.
  - If we take an option to use DBD for small-volume wastes, side-tracking technology can help us better understand the geological situation, and at the same time provide us opportunity for monitoring.
  - Deep fluid migration can be an issue in Japan.
  - Finding the site is still an issue.
- Cost estimation etc.