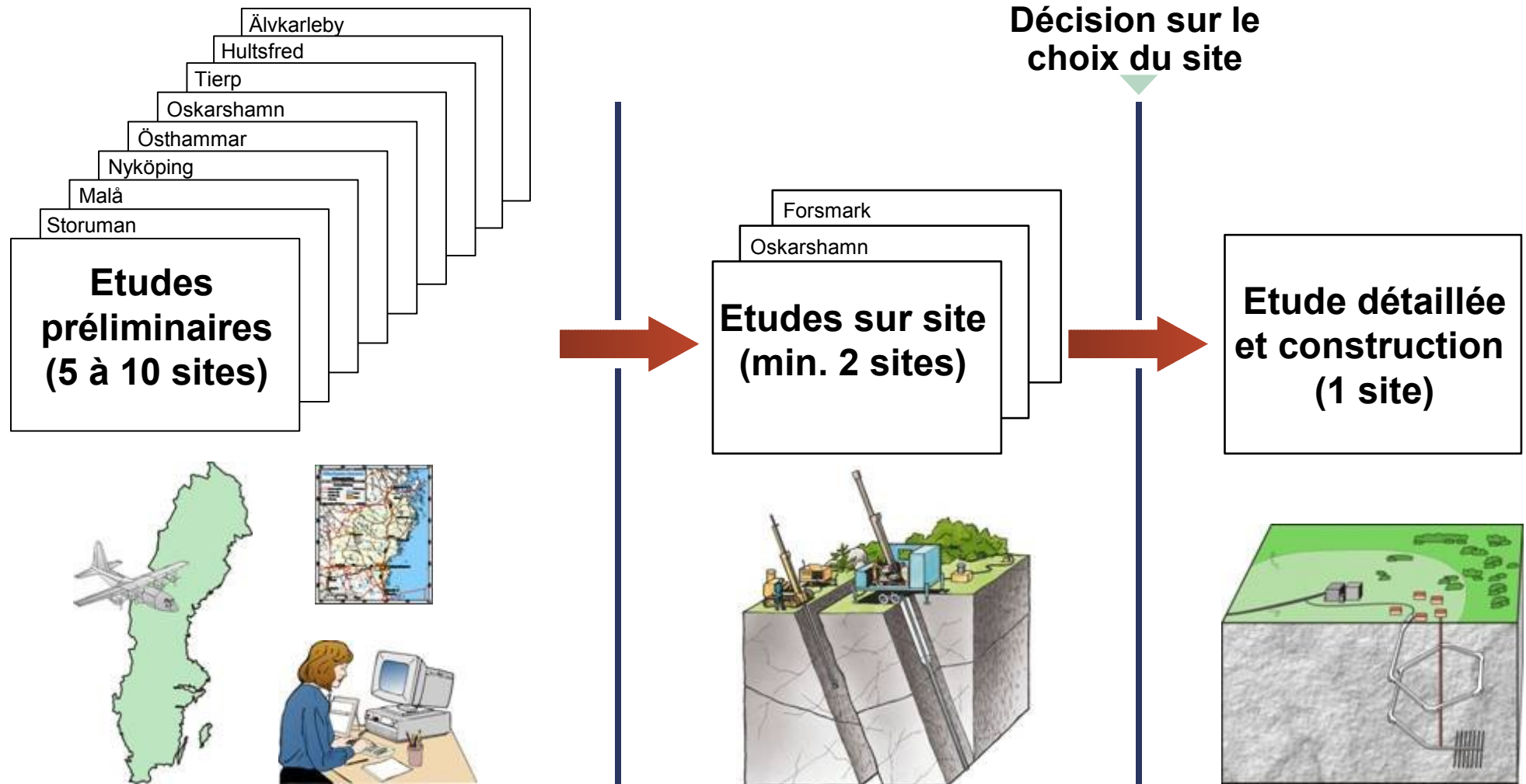


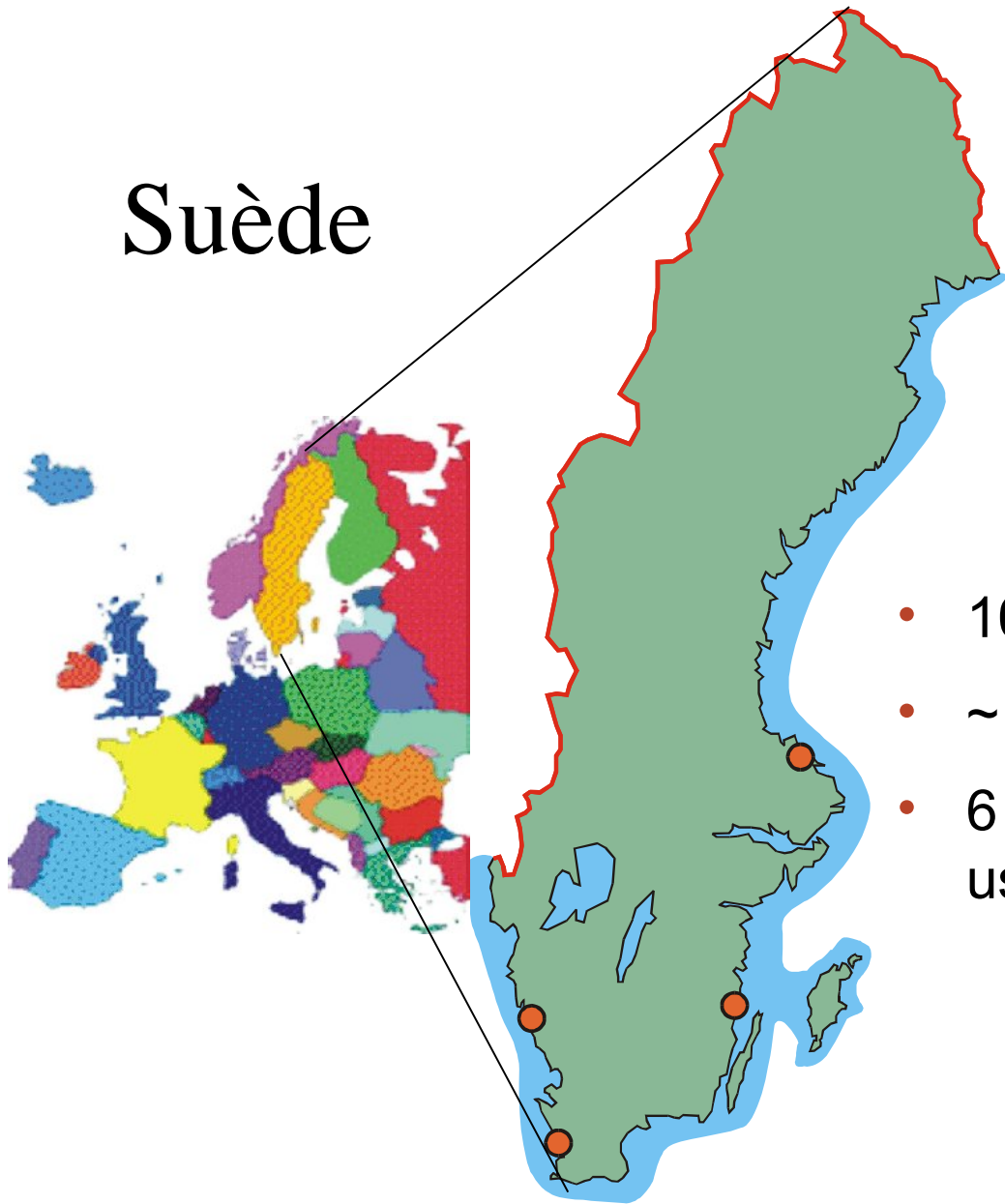
La R & D de la gestion des déchets nucléaires en Suède

Saida L. Engström
SKB

Stockage profond – Processus de choix de site



Suède



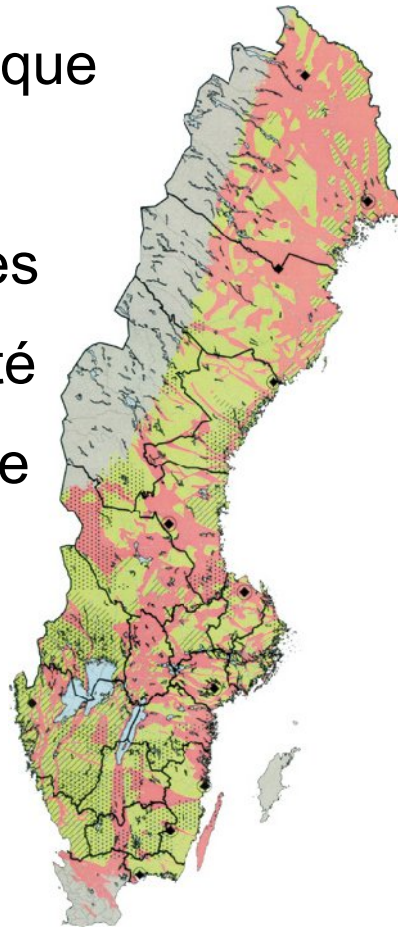
- 10 (12) réacteurs sur 3 (4) sites
- ~ 50 % production électrique
- 6 000 – 9 000 t. combustibles usés

Conditions préalables au stockage profond

Critères géologiques

Dans le bouclier baltique

- Etudes régionales
- Etudes typologiques
- Etudes de faisabilité
- Recherches sur site

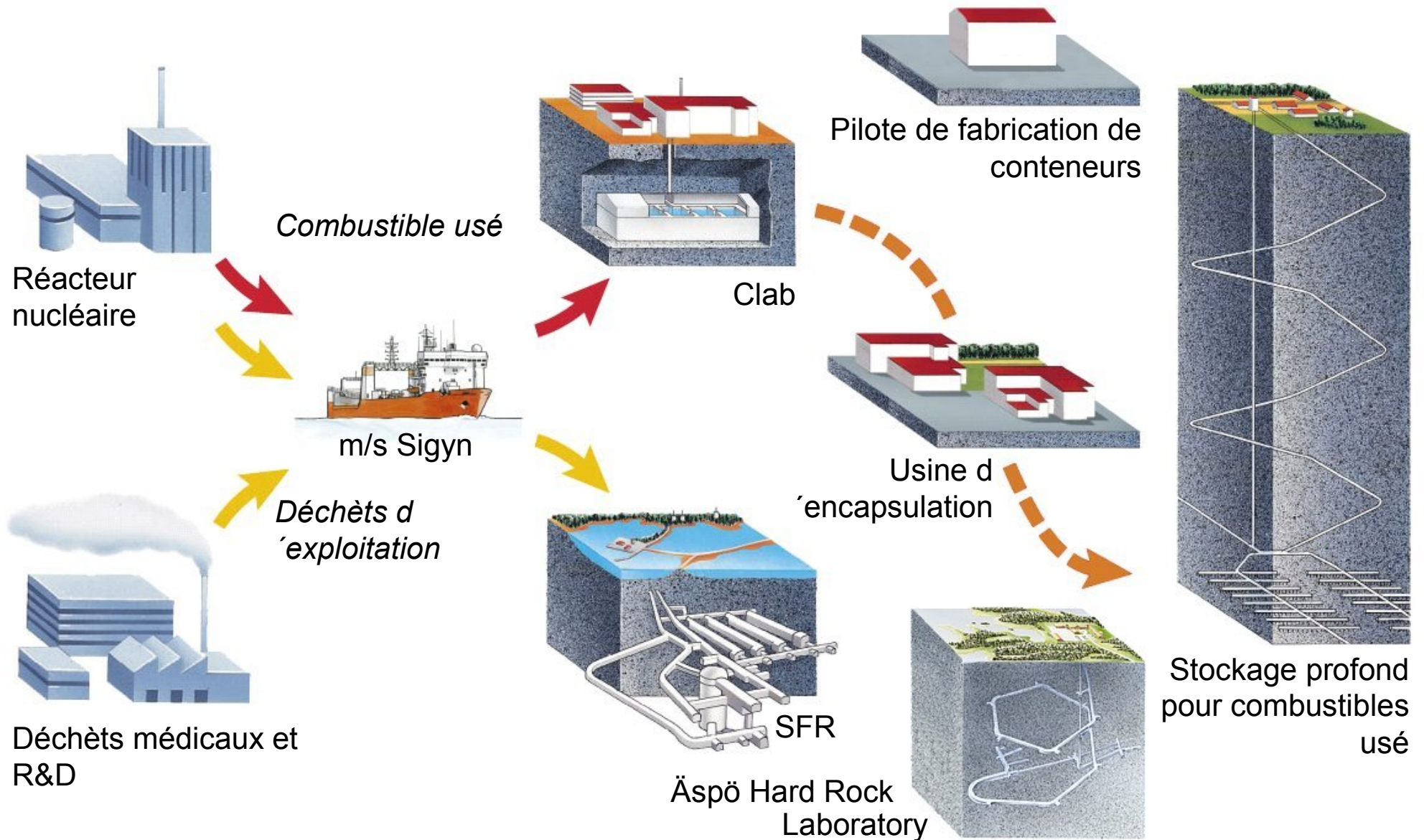


Société

- 9 millions d'habitants
- 290 municipalités
- Législation environnementale poussée
- Droit de veto municipal



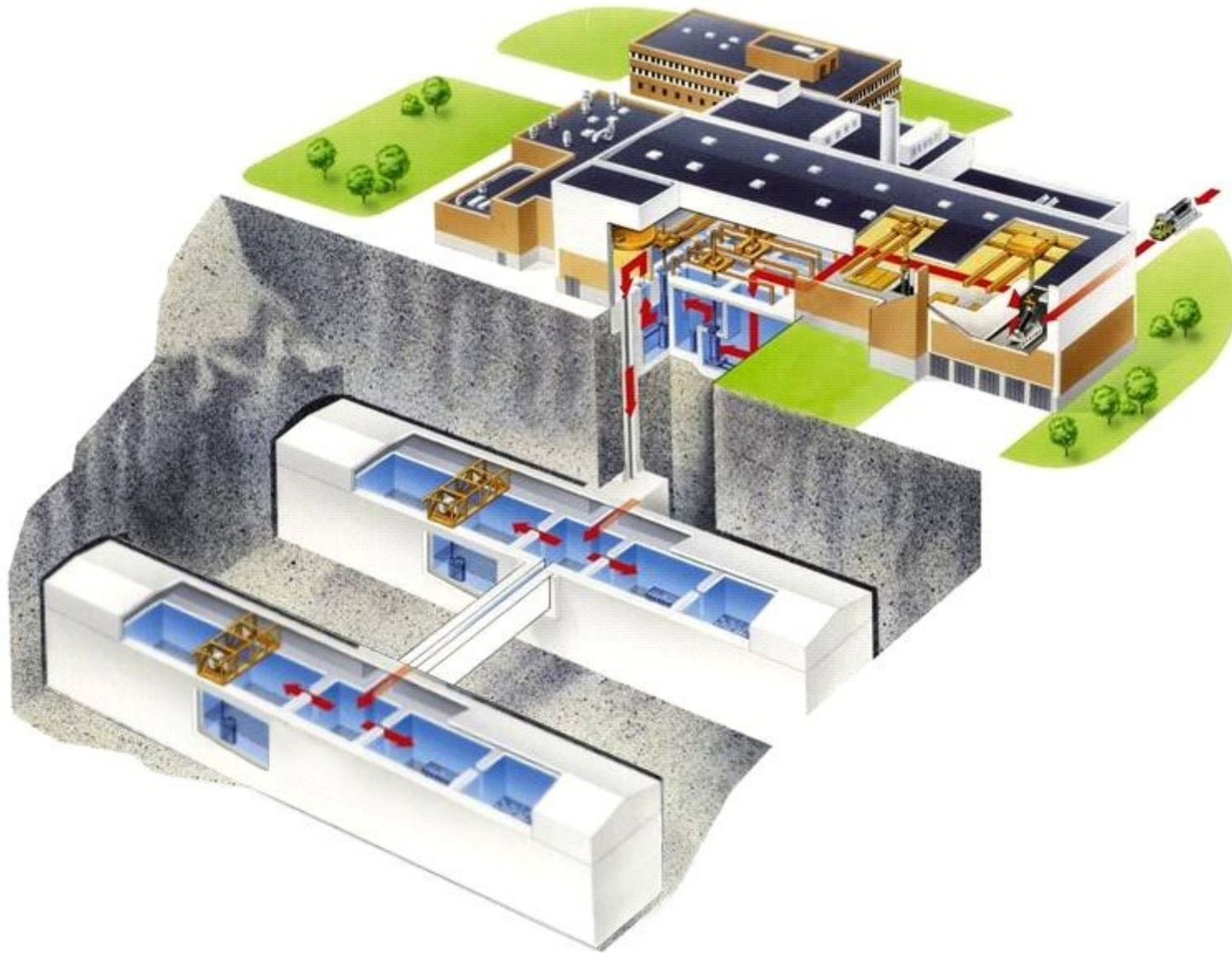
Les installations de SKB



Clab, Centre d'entreposage des combustibles usés



Clab



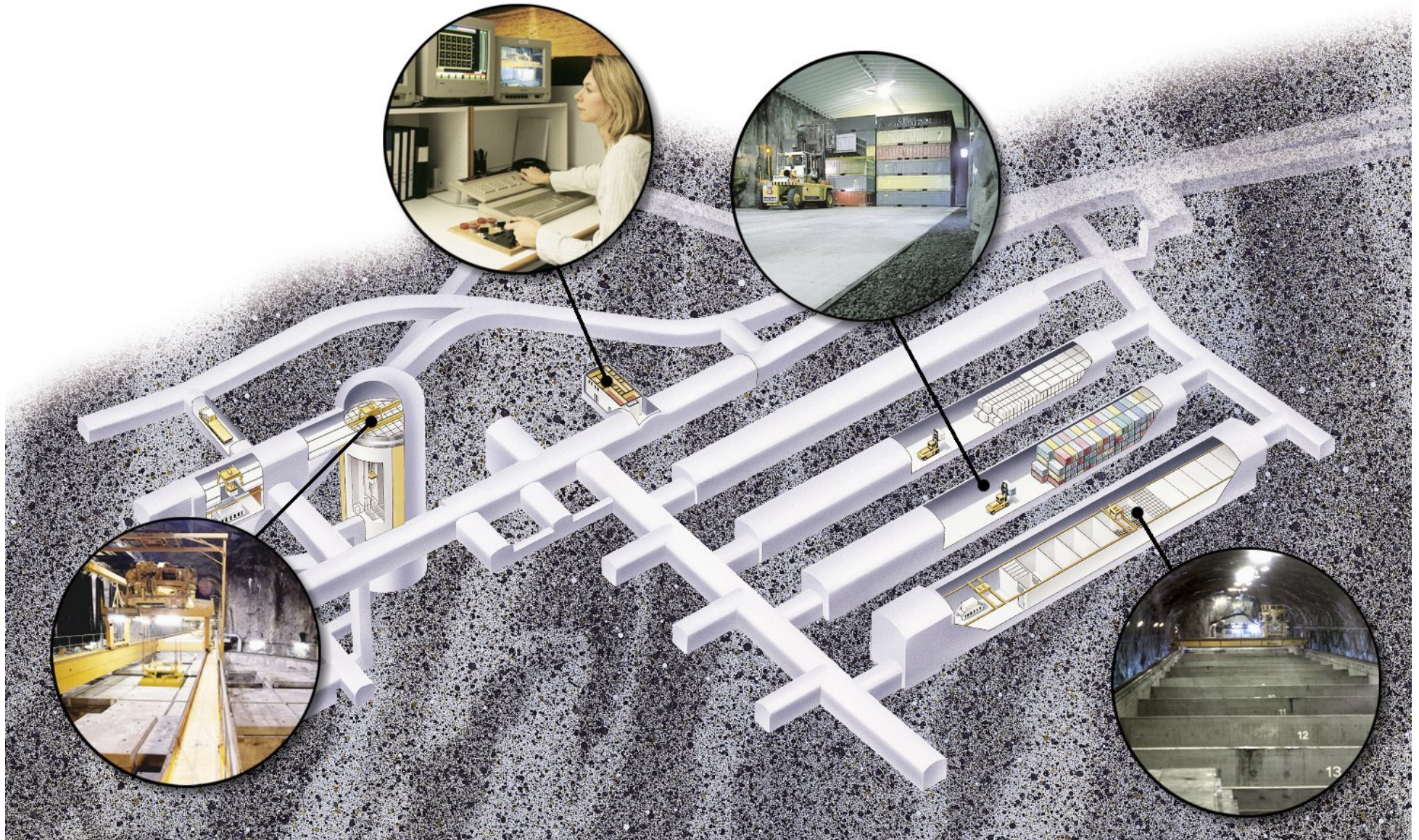
Clab 2 – Le nouveau hall de stockage



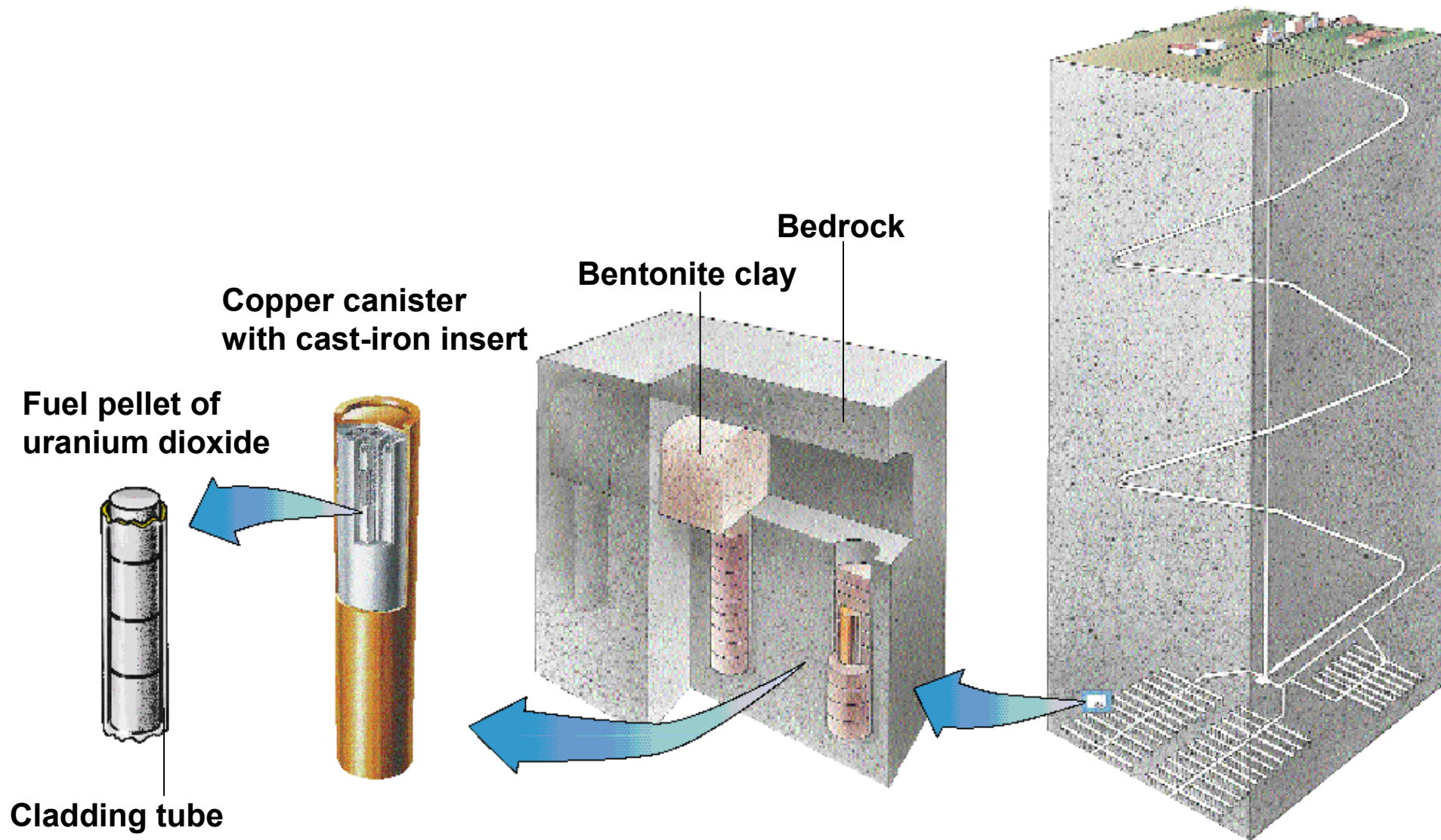
SFR – Centre de stockage définitif pour les déchets d'exploitation



SFR



Les multiples barrières de sûreté

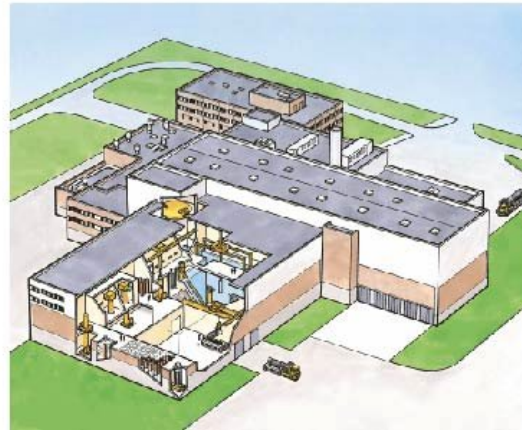


Installations à implanter, autoriser, construire et mettre en service d'ici 2017

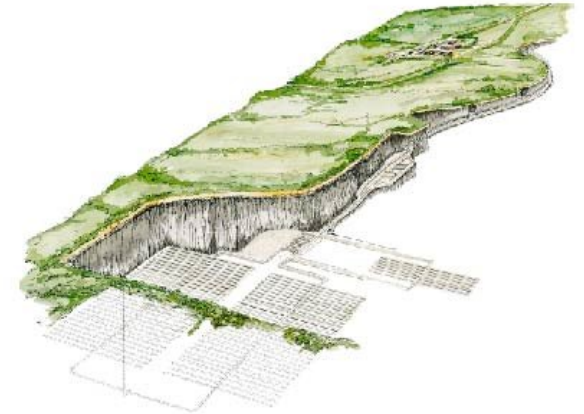
Canister Factory



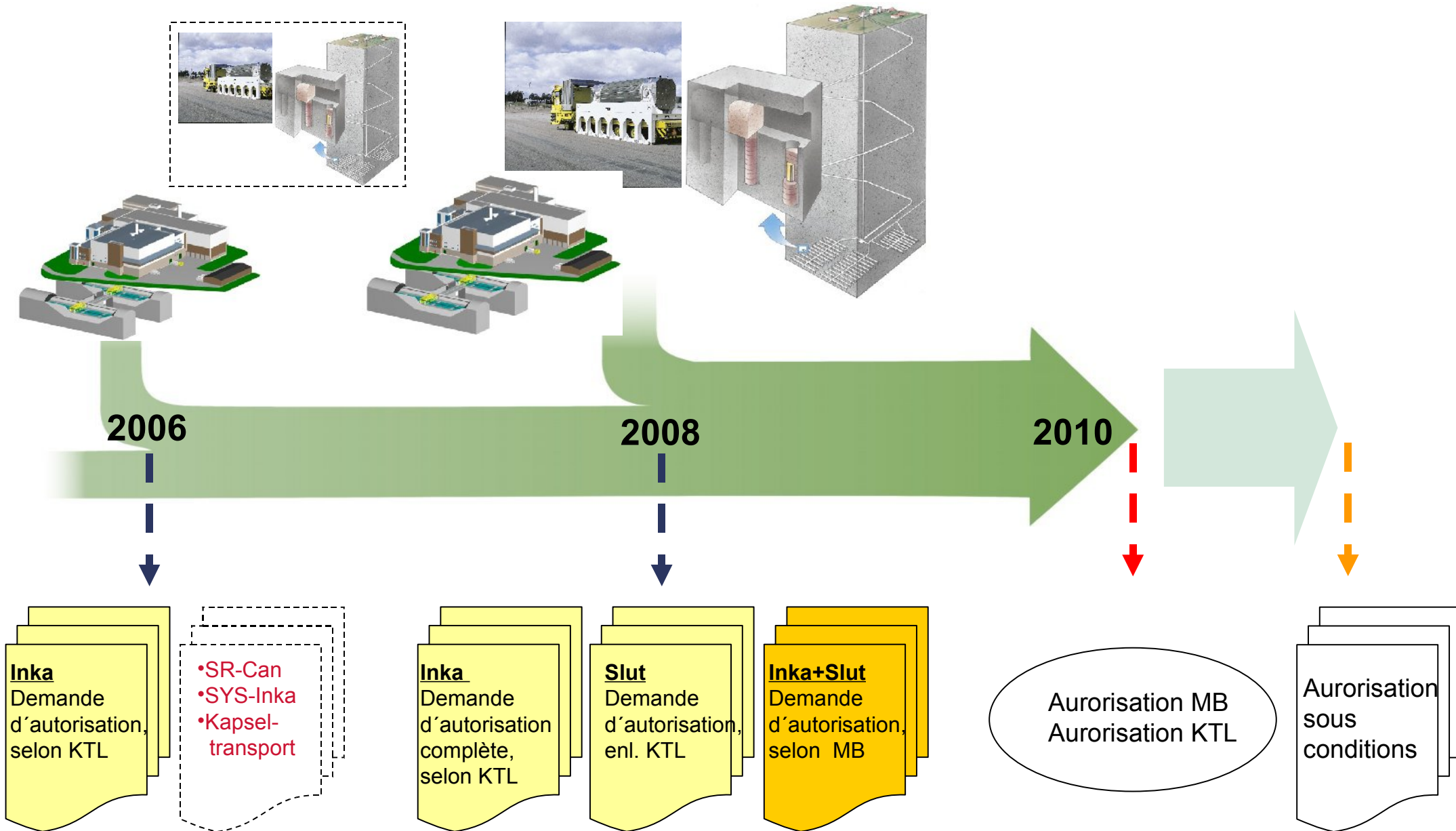
Encapsulation Plant



Deep Repository



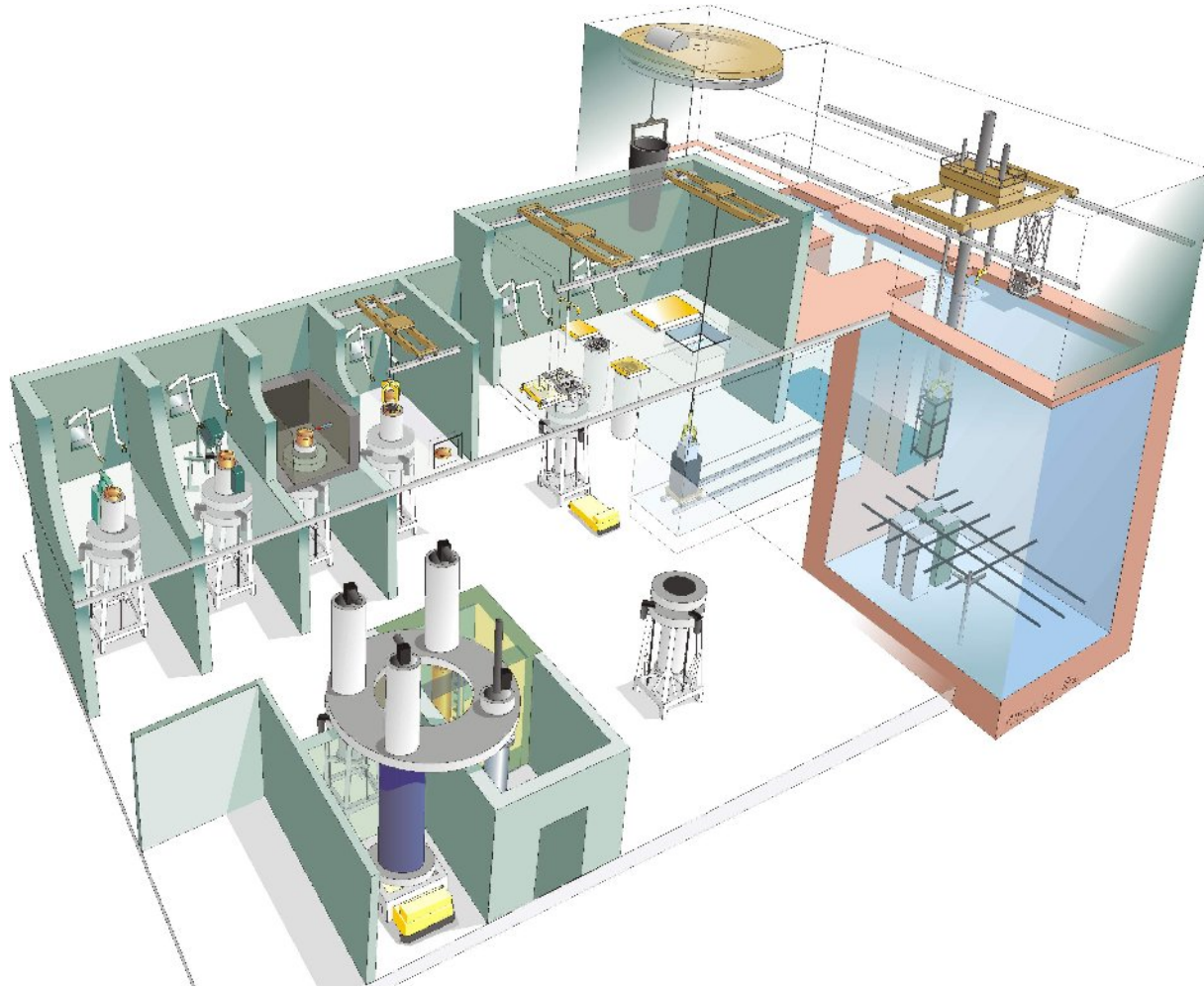
Processus d'autorisation



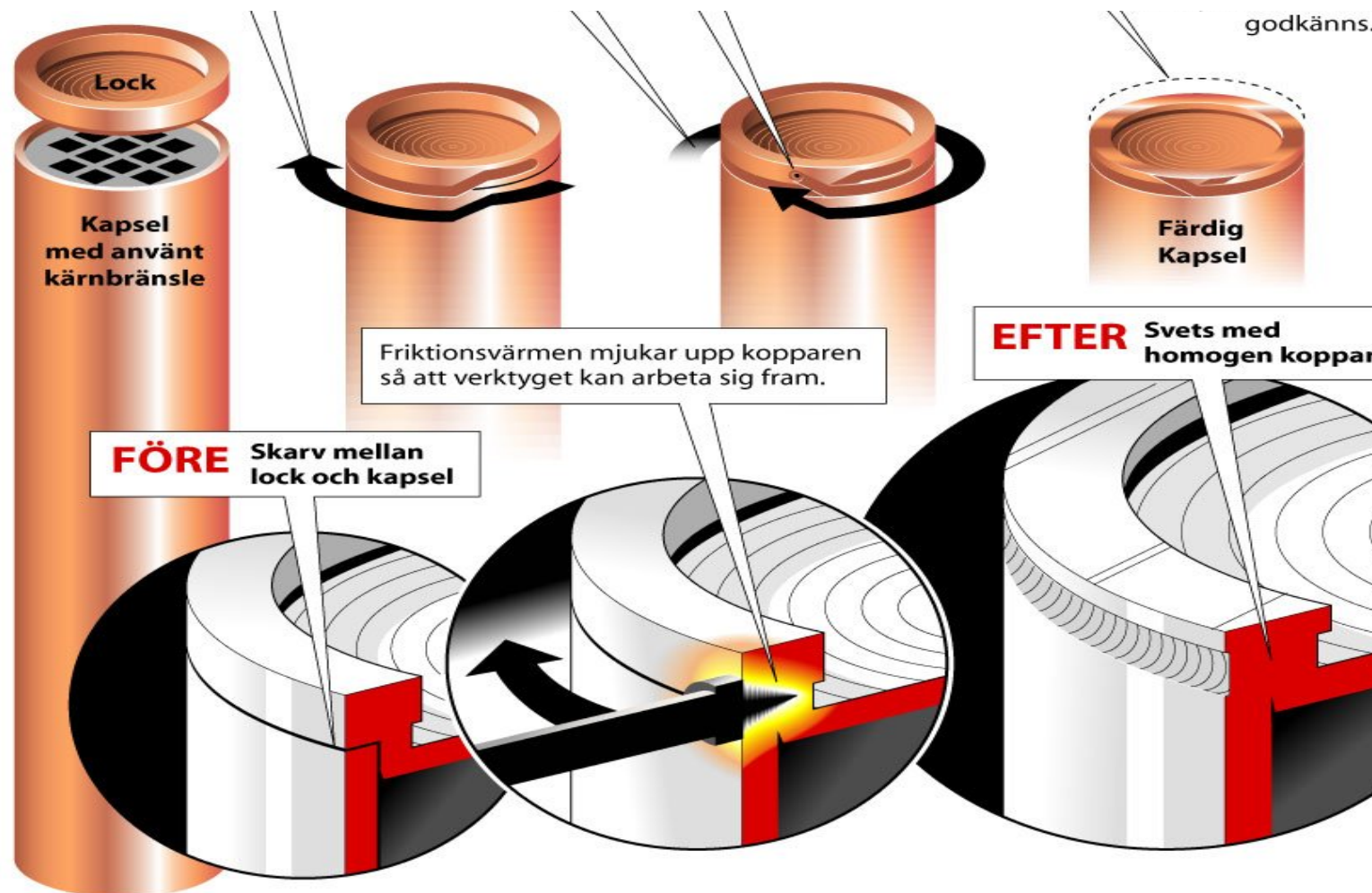
Fabrication des conteneurs



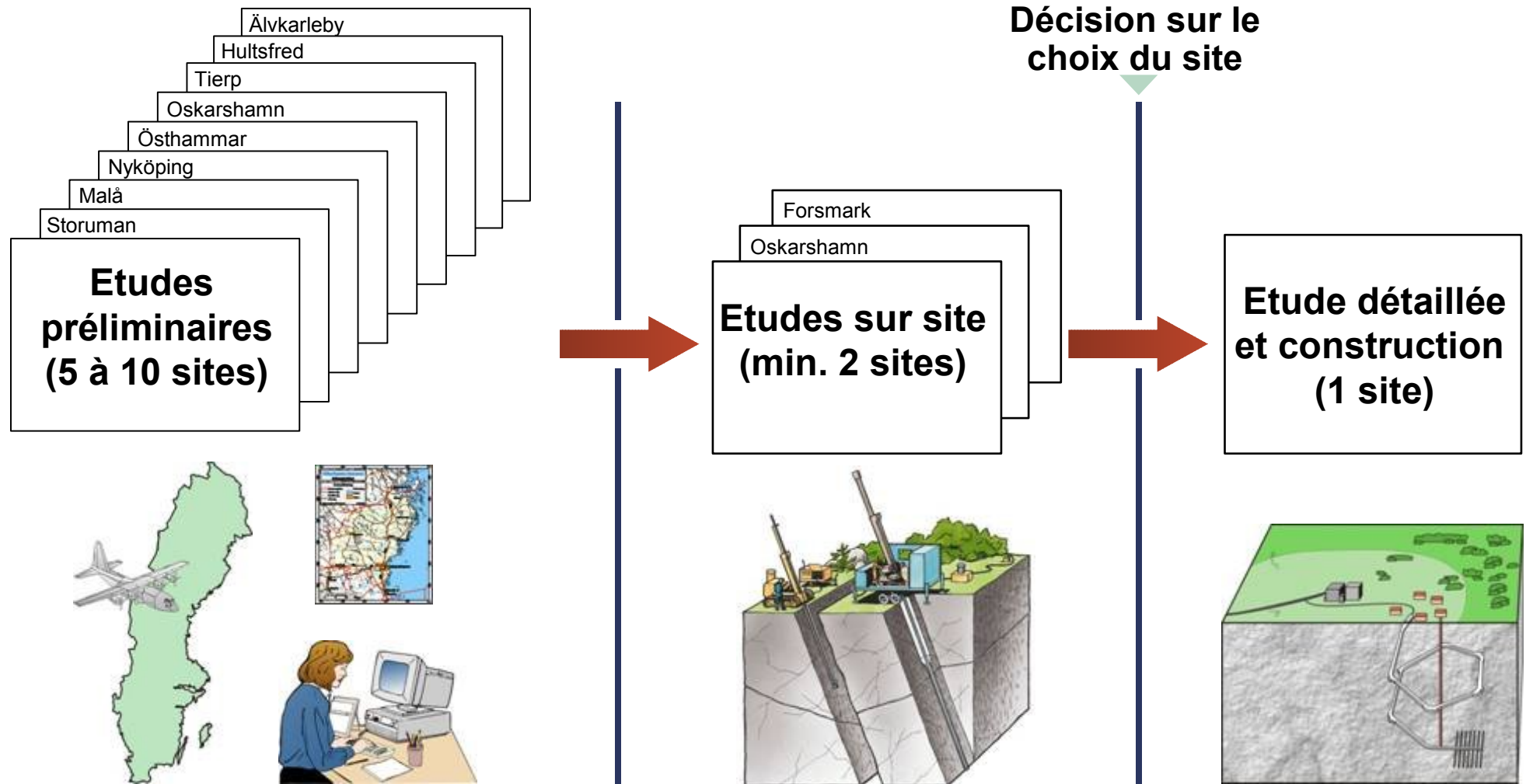
Usine d'encapsulation



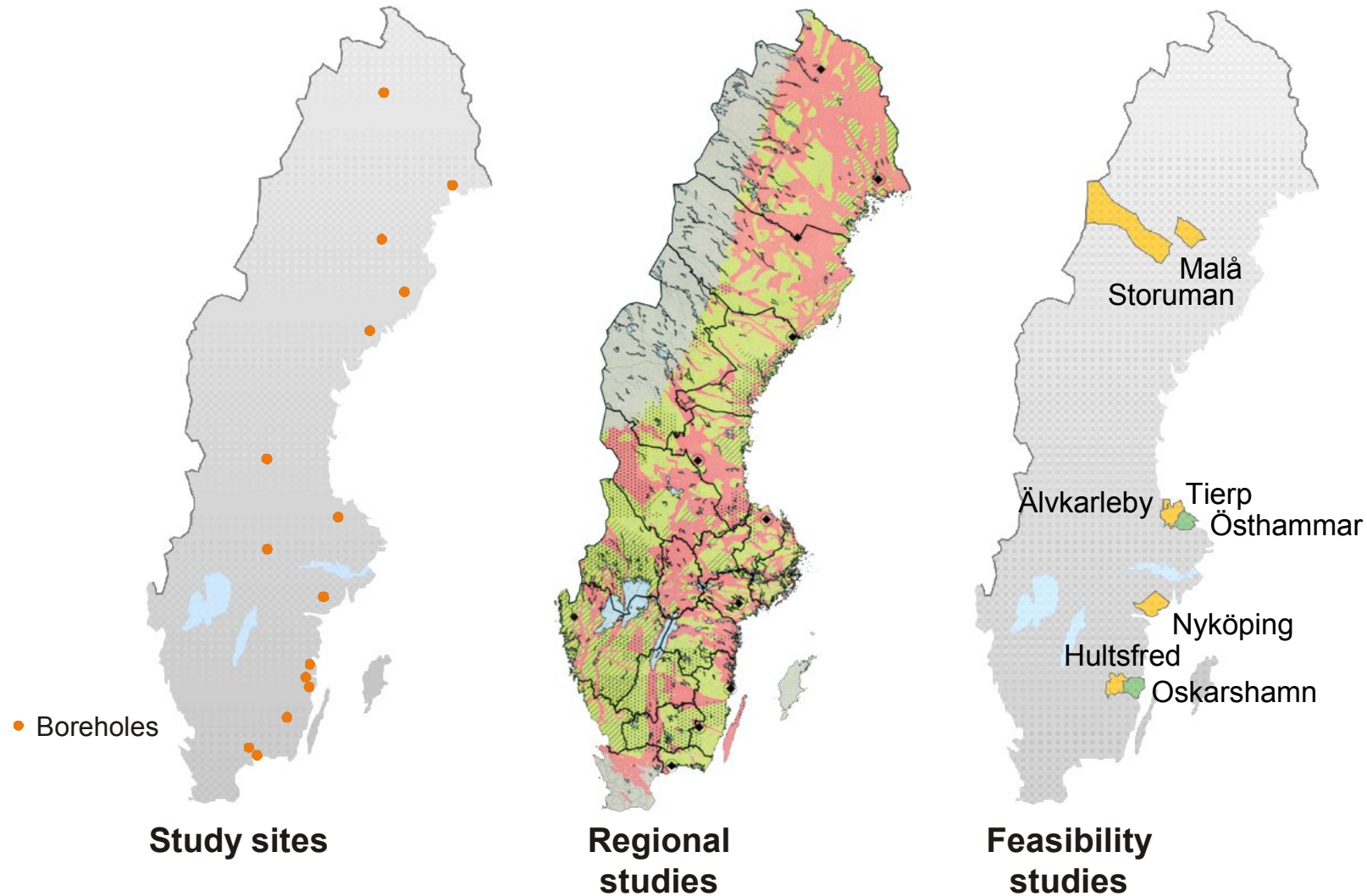
Soudage par friction thixotropique



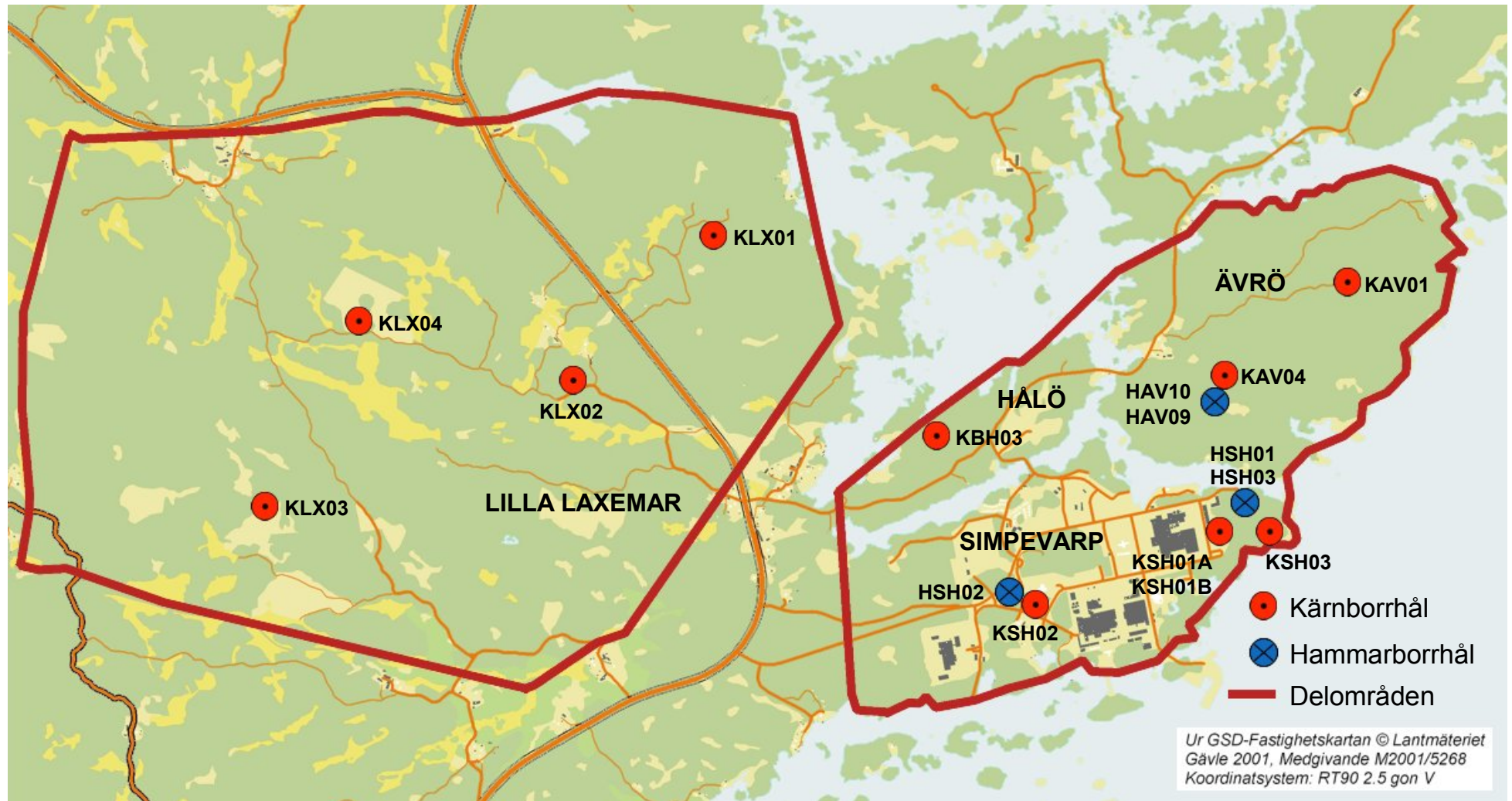
Stockage profond – Processus de choix de site



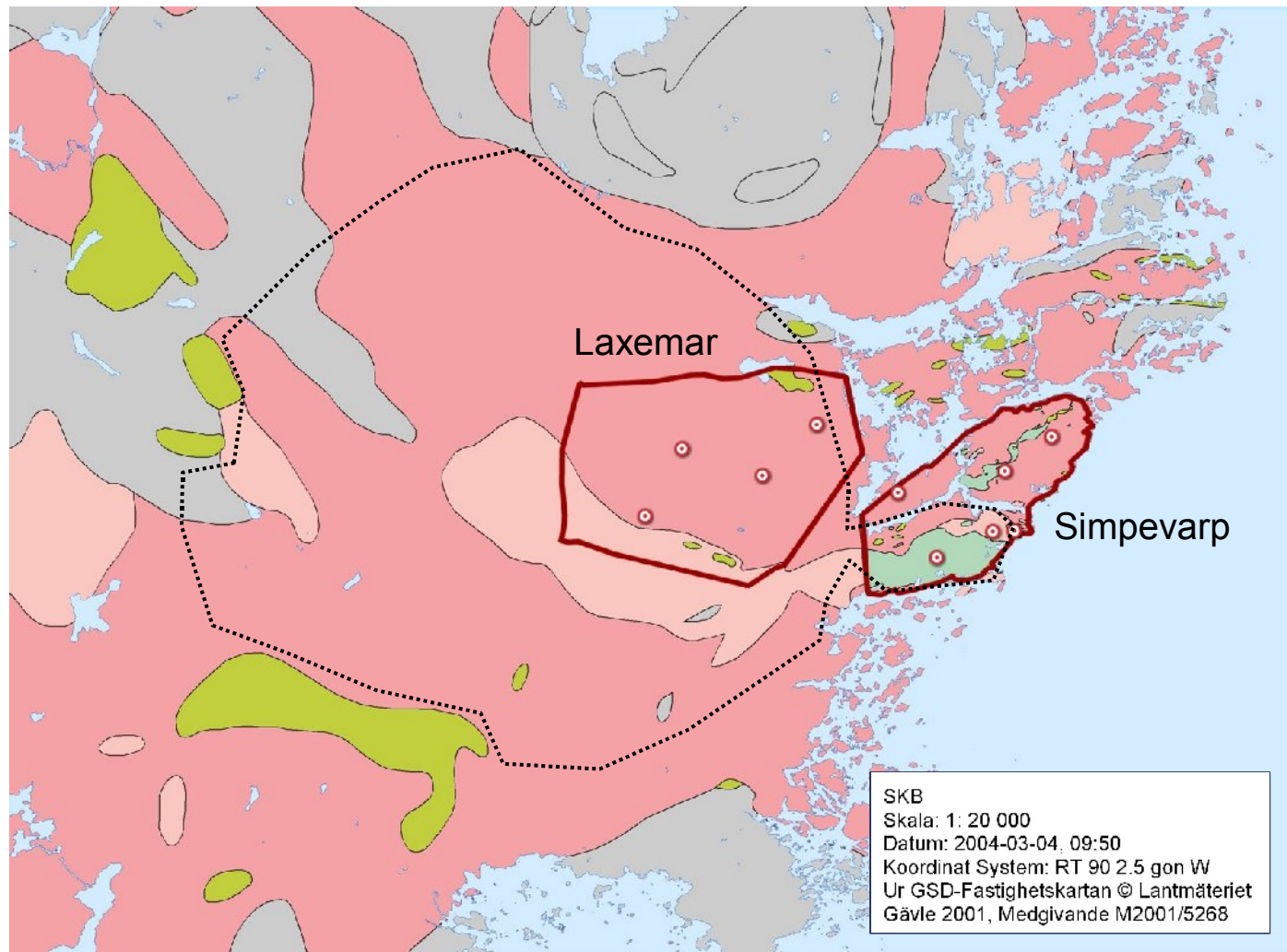
Etudes d'implantation 1977–2000



Forage – Simpevarp

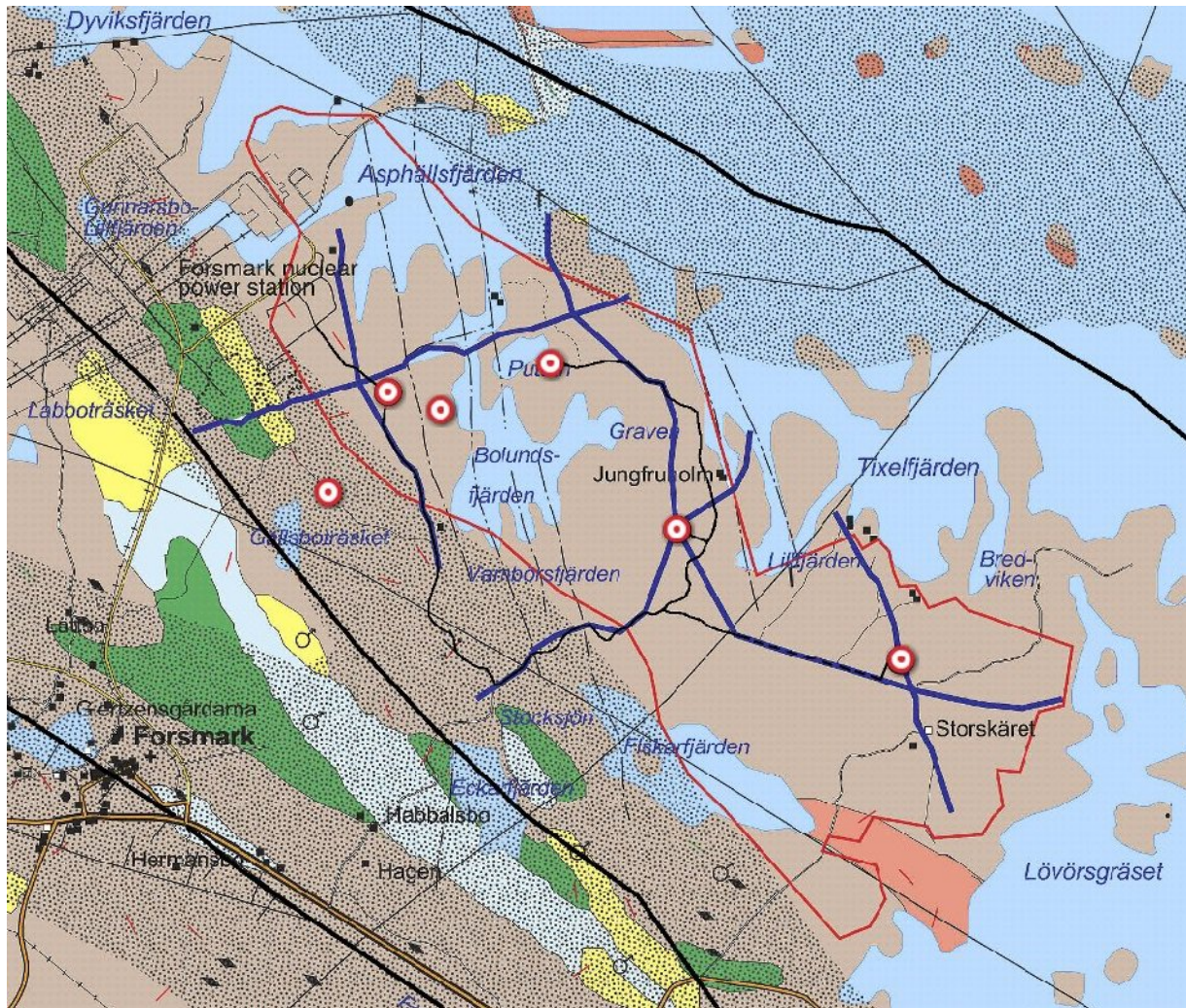


Géologie - Oskarshamn



- Ävrö granite
- Quartzmonzodiorite
- Fine-grained dioritoid
- Diorite to gabbro
- Other rock types
- Cored drill hole
- Investigation area
- Candidate area

Géologie - Forsmark

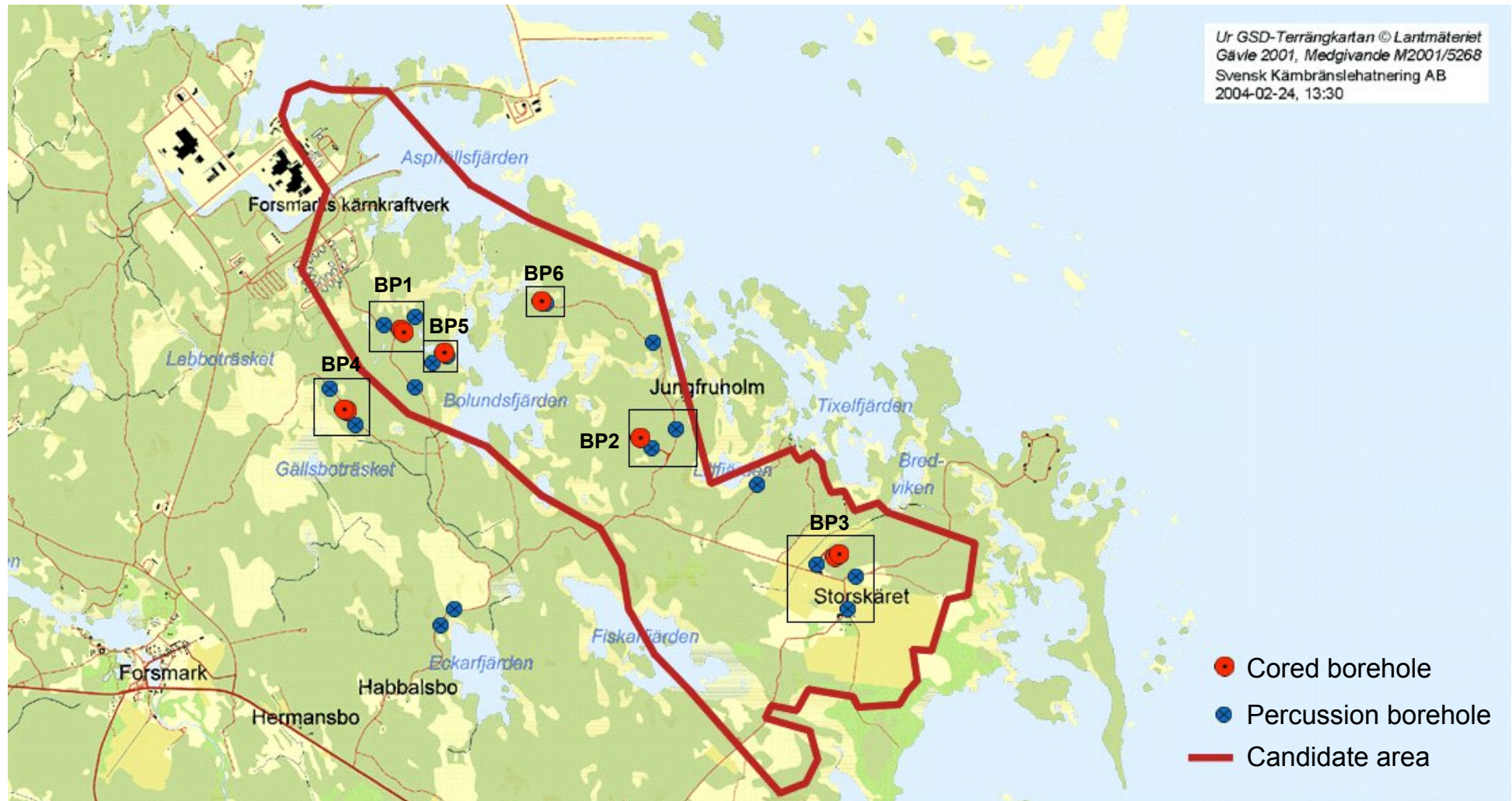


- Deformed rock
- Major fracture zone
- Metagranitoid
- Cored borehole
- Forsmark area boundary
- Reflection-seismic survey

Rock types:

- Metasedimentary rock, acid metavulcanites, metagabbroid, etc.

Forages – Forsmark

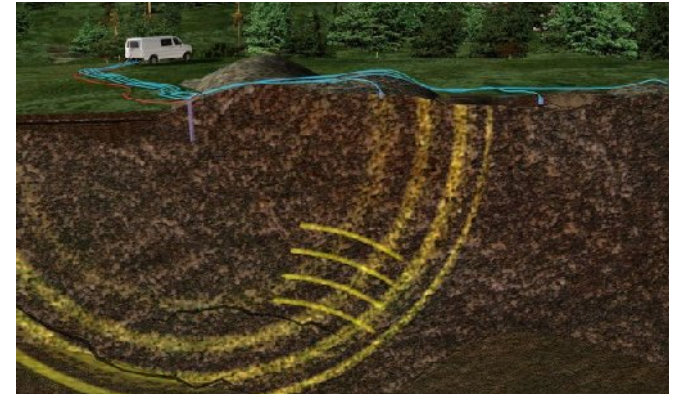


Recherches sur site

Etudes géophysiques sur toute la zone



Reflection-seismic studies



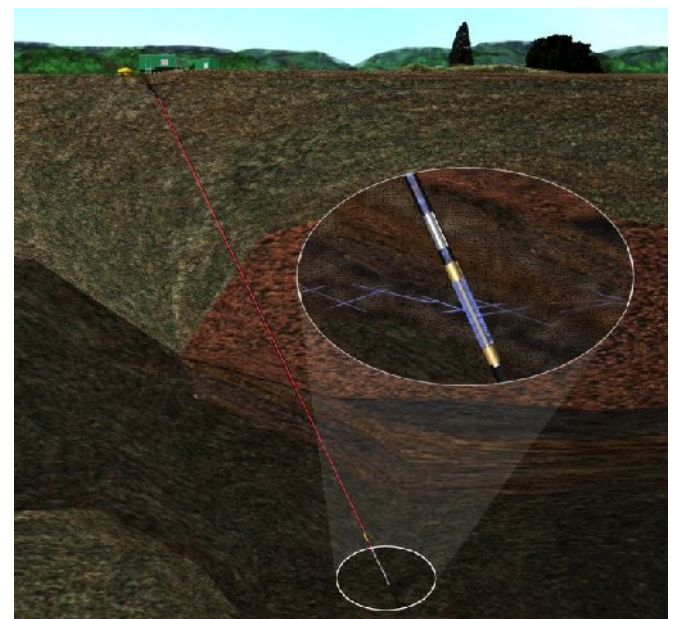
Helicopter surveys



Recherches sur site

Forages

Ground water measurement



Borehole radar

Recherches sur site

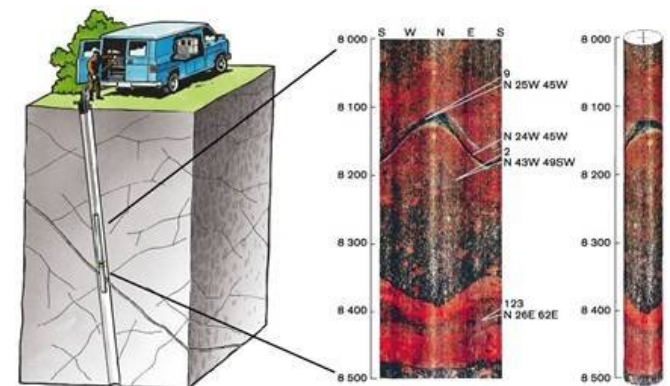
Type de roche et fracturation



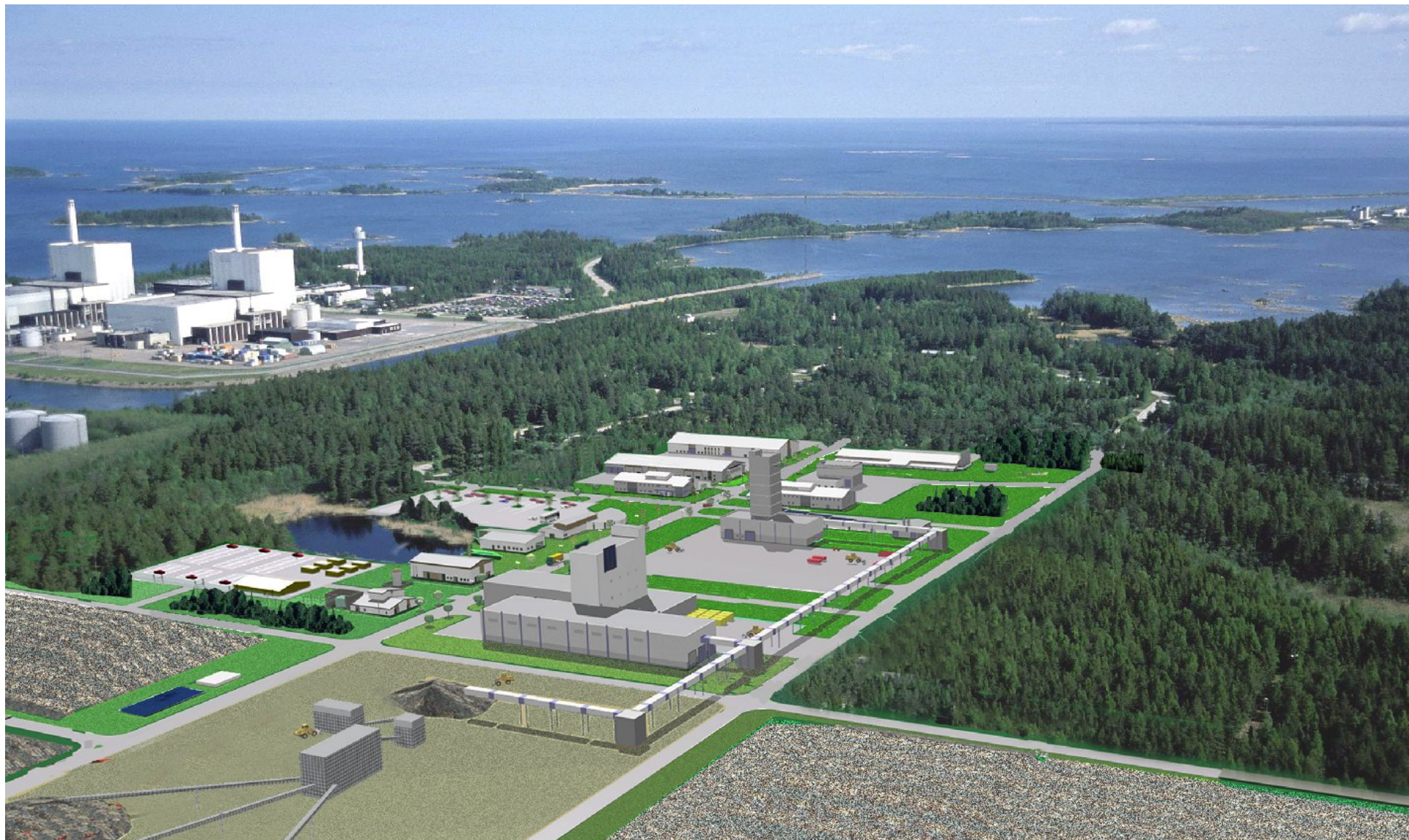
Borehole TV



Drill cores are studied in detail

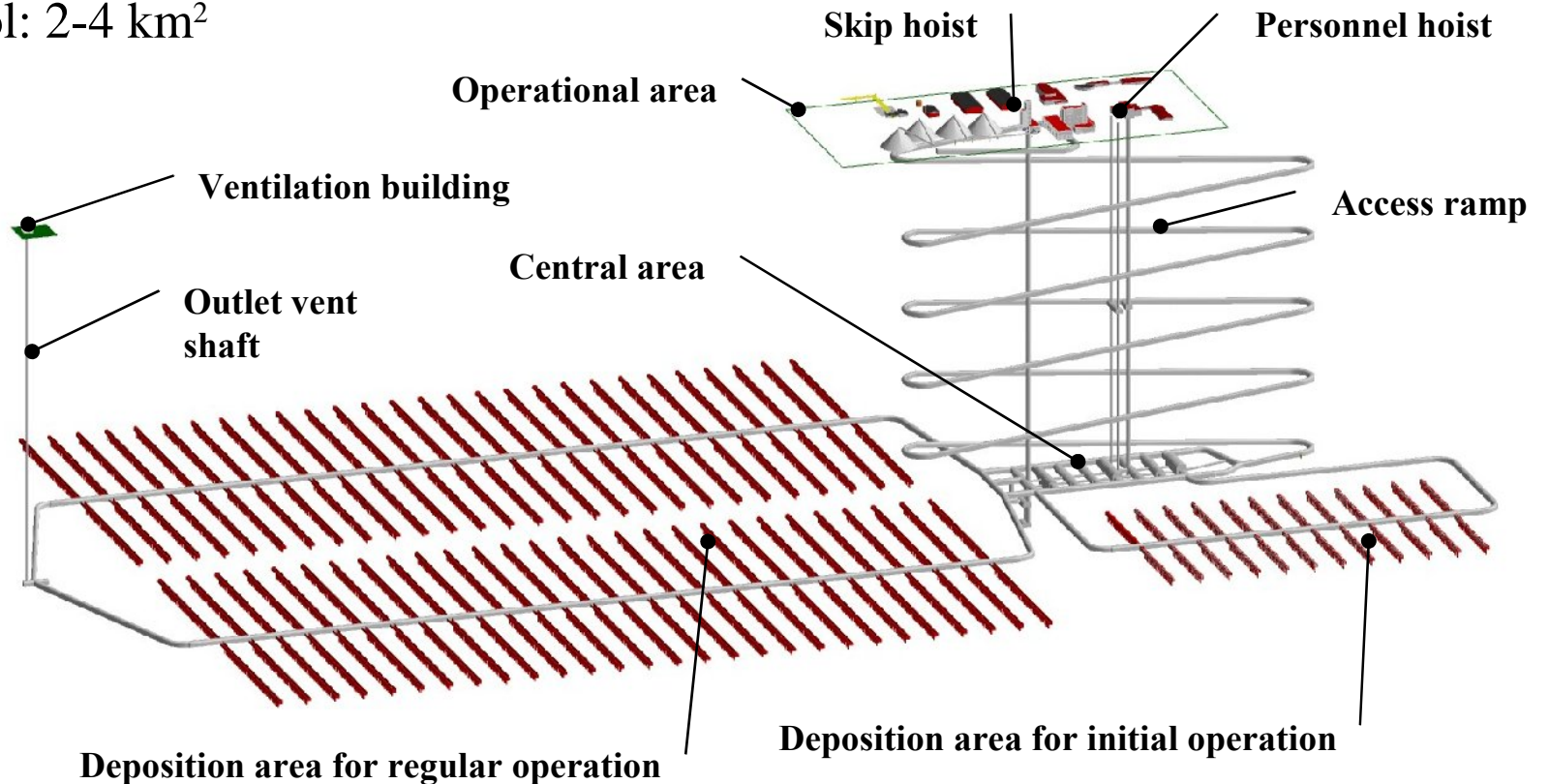
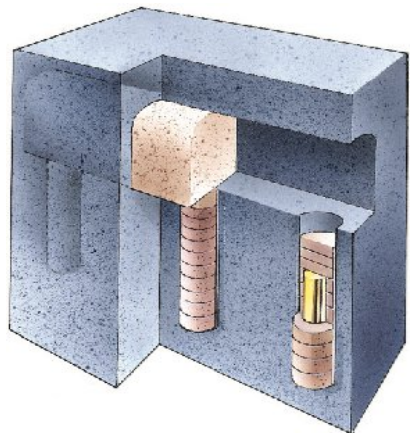


Forsmark – Implantation

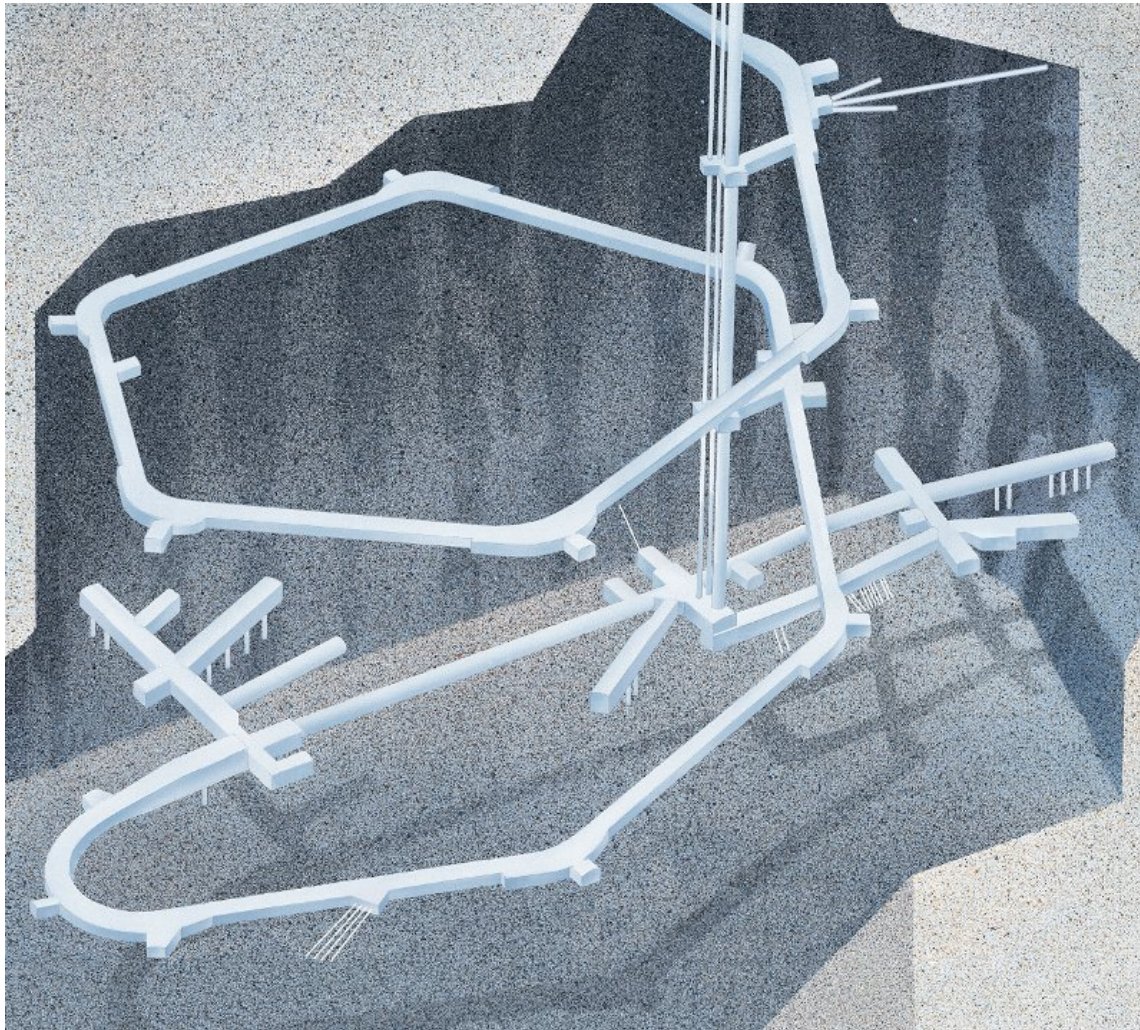


Stockage profond pour combustibles usés

- Capacité prévue :
 - 9 300 t. (U)
- Profondeur: 400-700 m
- Occupation au sol: 2-4 km²
- Volume total
 - ~ 1.7 M m³



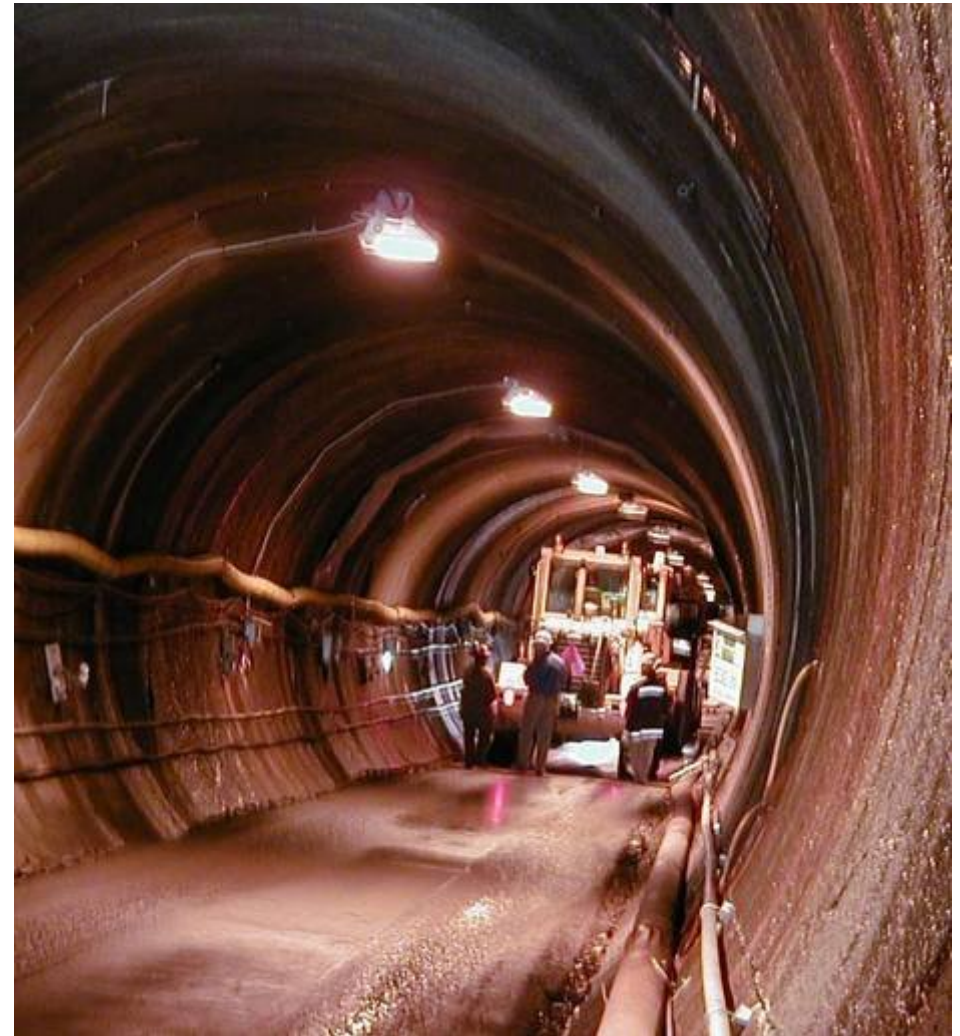
Le laboratoire d'Äspö



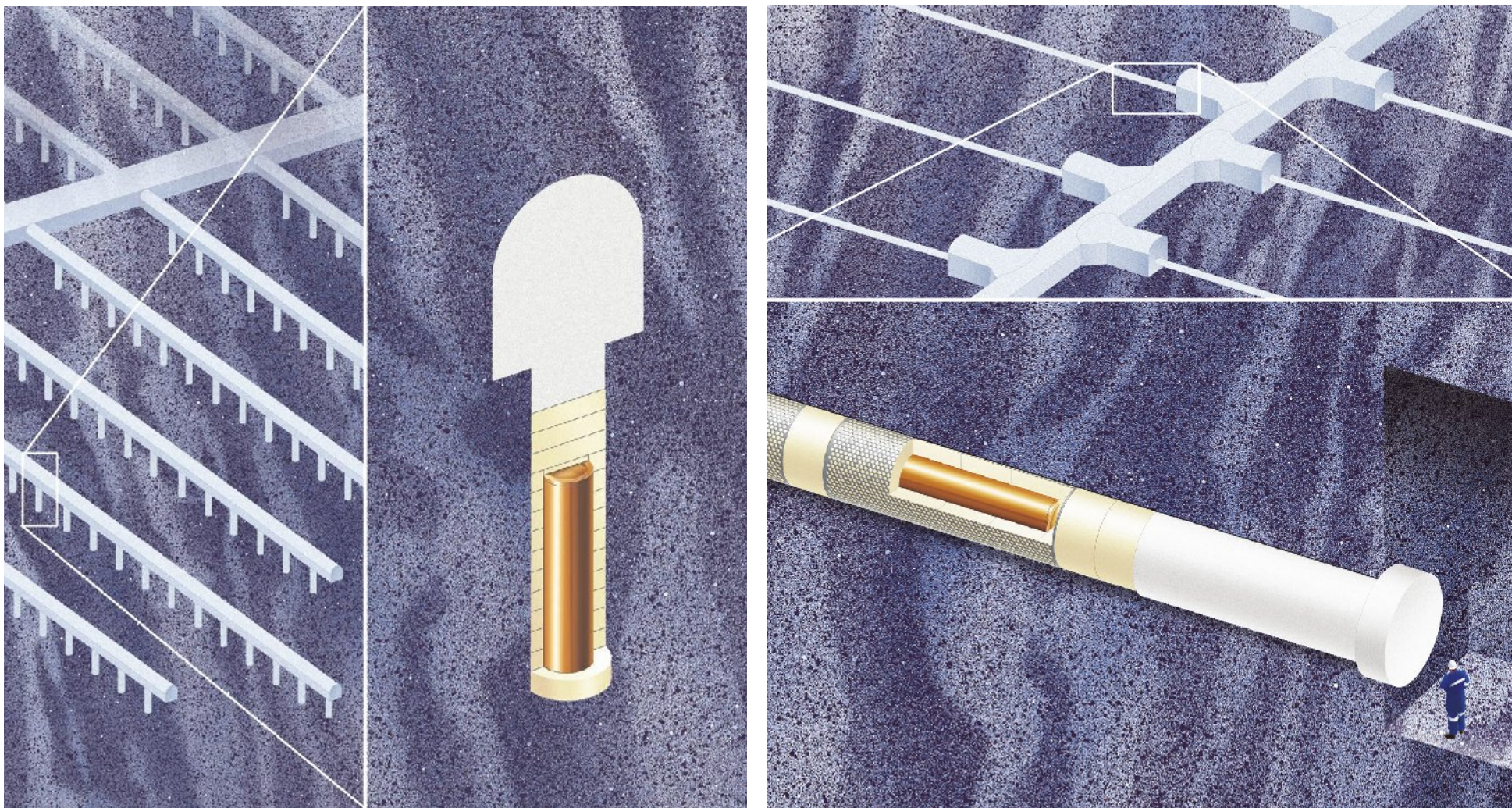
Phase pilote

The Äspö Hard Rock Laboratory demonstrates:

- Natural barriers
- Engineered barriers
- Barrier interaction
- Rock characterization
- How well models coincide with reality, particularly over time



KBS-3V ou KBS-3H



Construction

Forage des galeries

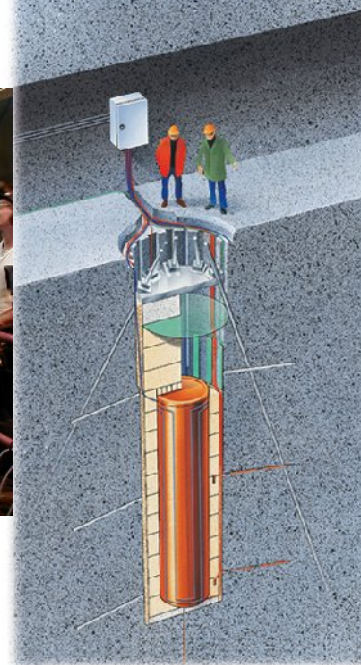
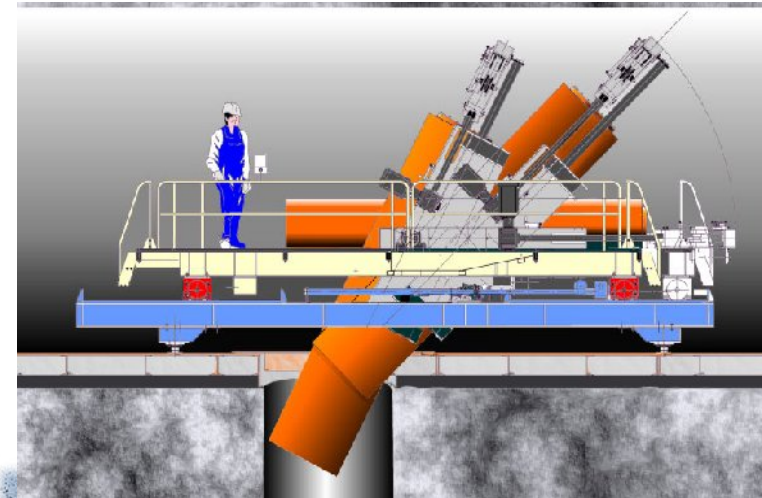


Exploitation (retrait)



Technologie et caractéristiques principales du système de stockage

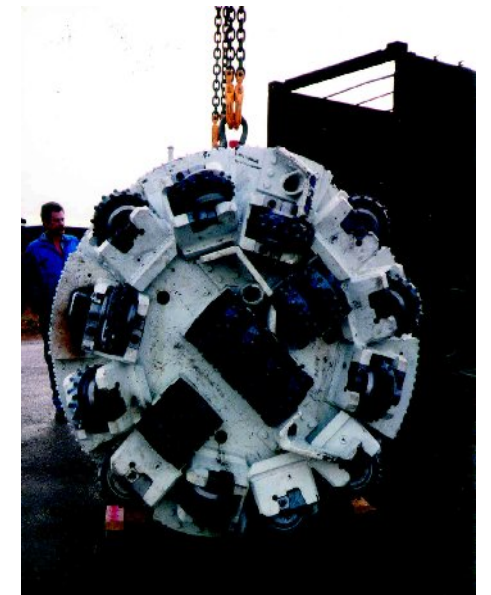
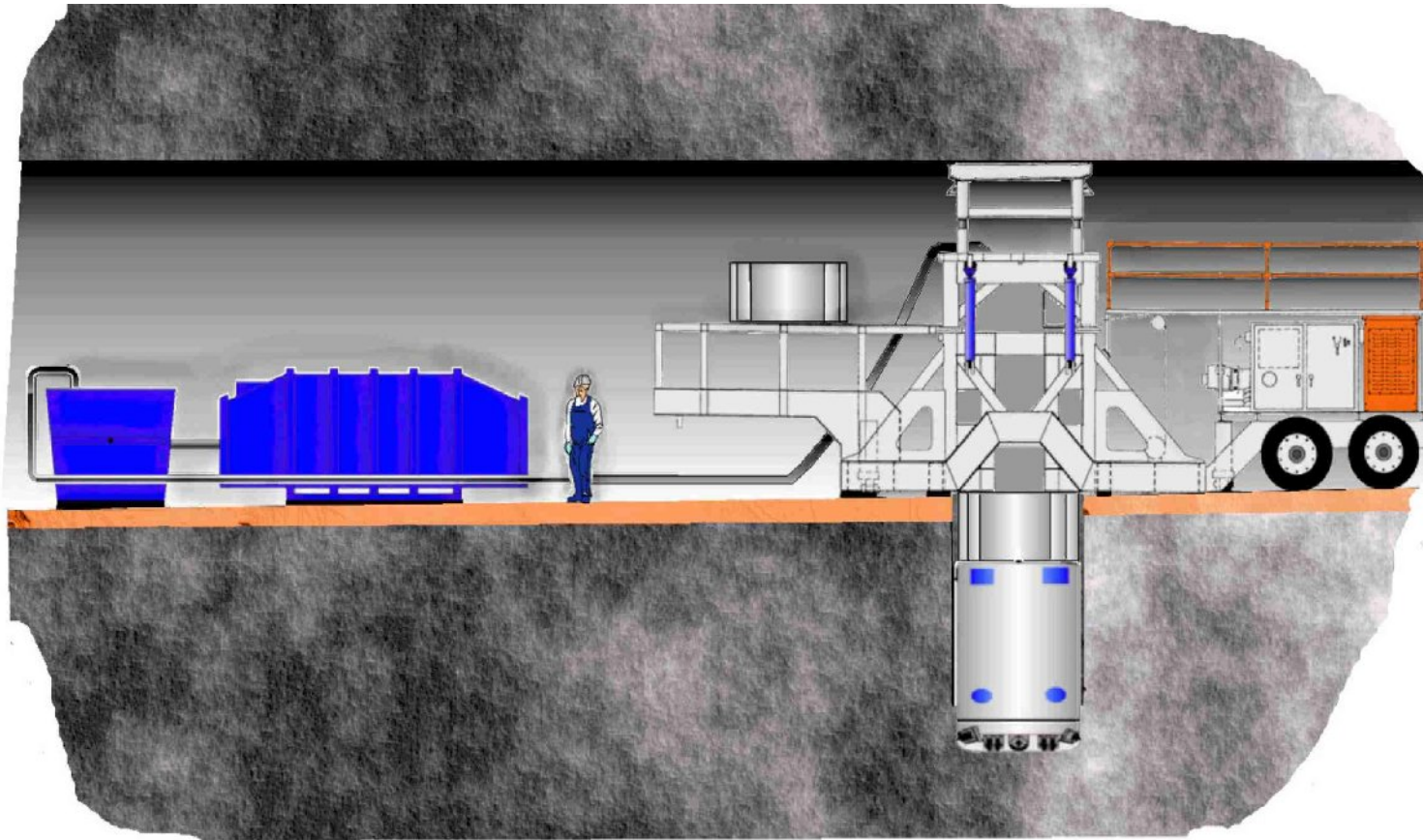
- Prototype Repository
- Backfill and Plug Test
- Canister Retrieval Test
- Long Term Test of Buffer Material - LOT
- DEMO of Disposal Technology



Centre prototype de stockage



Forage du puits d'accès



Positionnement du bloc de bentonite



Mise en place du conteneur

A close-up photograph showing the lower portion of a large, cylindrical container with a metallic, ribbed surface. The container is being lowered into a red-painted metal structure. A white plastic sheet is visible at the bottom of the structure, and a white cable is attached to the container.



Principaux domaines de recherche

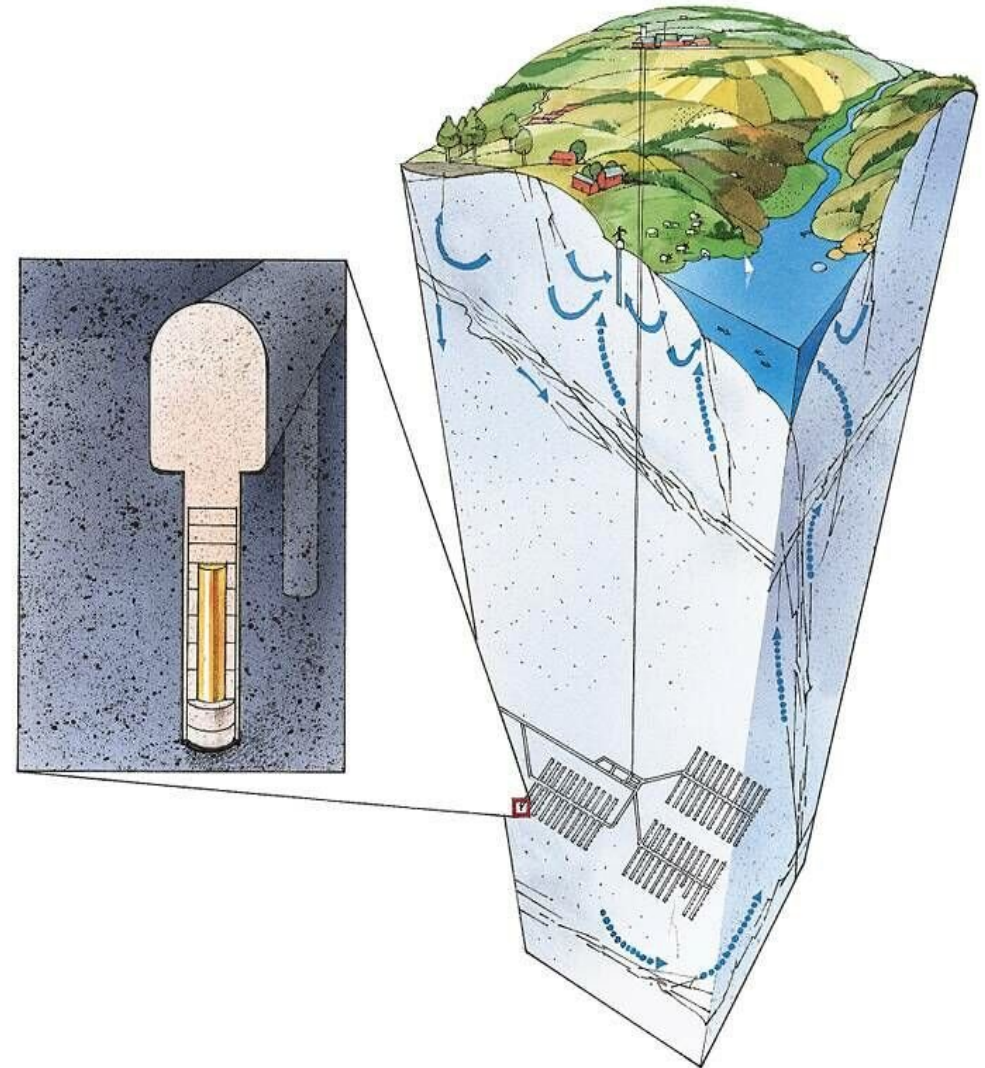
Long-term changes in the repository

- **Thermal**
- **Hydraulic**
- **Mechanical**
- **Chemical**

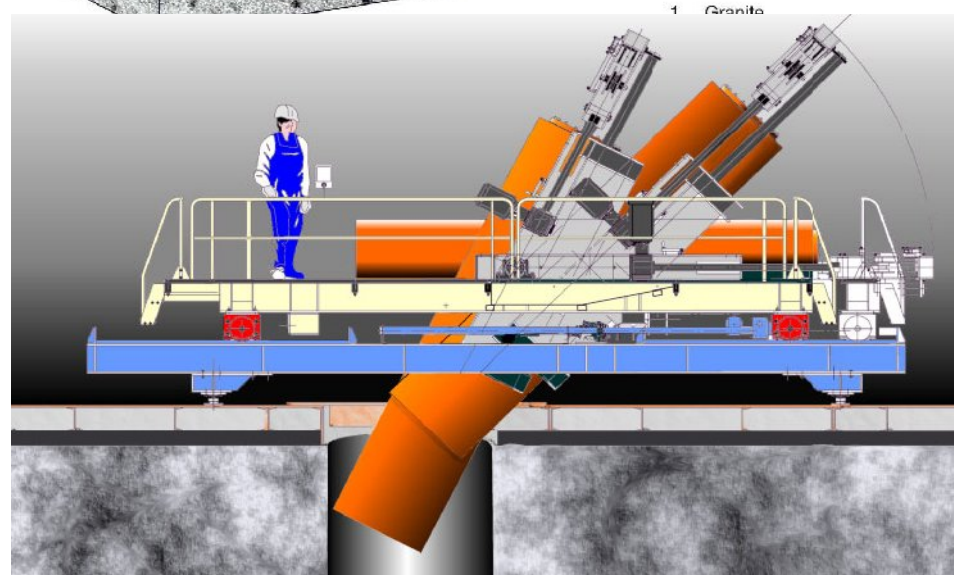
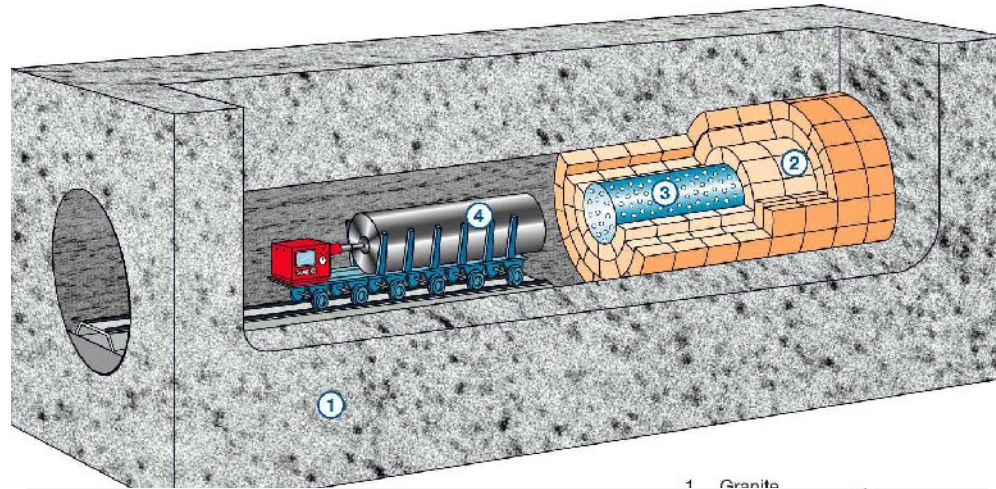


Principaux domaines de recherche

- **Rock movement**
- **Geo-chemical stability**
- **New biosphere code**
- **Permafrost and ice ages**



Développement des compétences techniques par des essais et de la formation

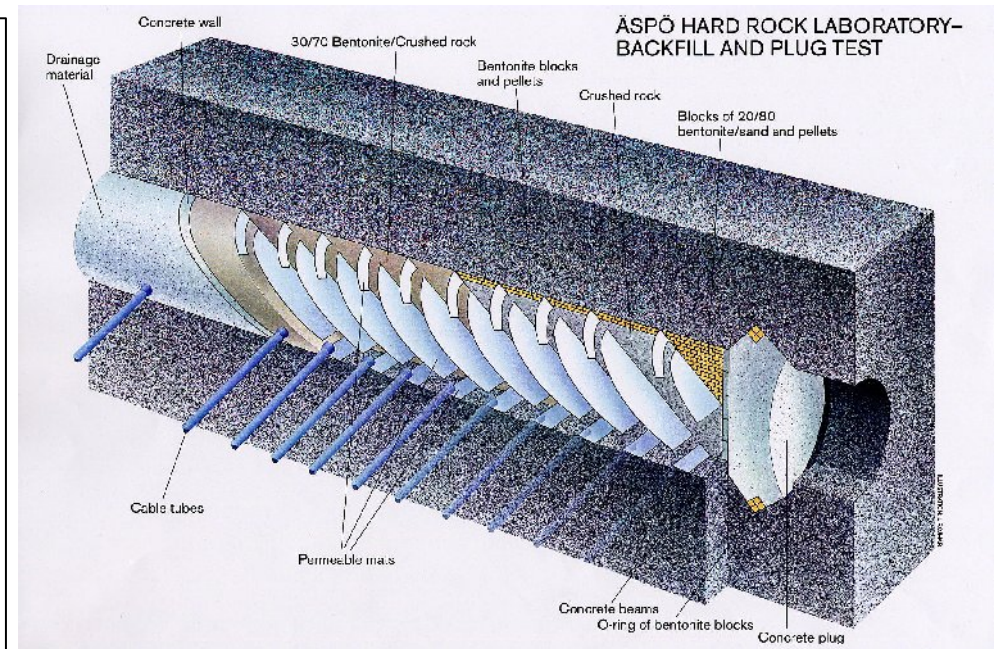


*”Ce n’est pas parce que
les choses sont difficiles que nous n’
osons pas, c’est parce que nous n’
osons pas qu’elles sont difficiles”*

Sénèque

Principaux domaines de recherche

- **Backfill and Plug Test**
- **Long Term Test of Buffer Material**
- **Large Scale Gas Injection Test**
- **Long Term Diffusion Experiment**



Un conteneur grandeur nature



Principaux développements récents Äspö Hard Rock Laboratory

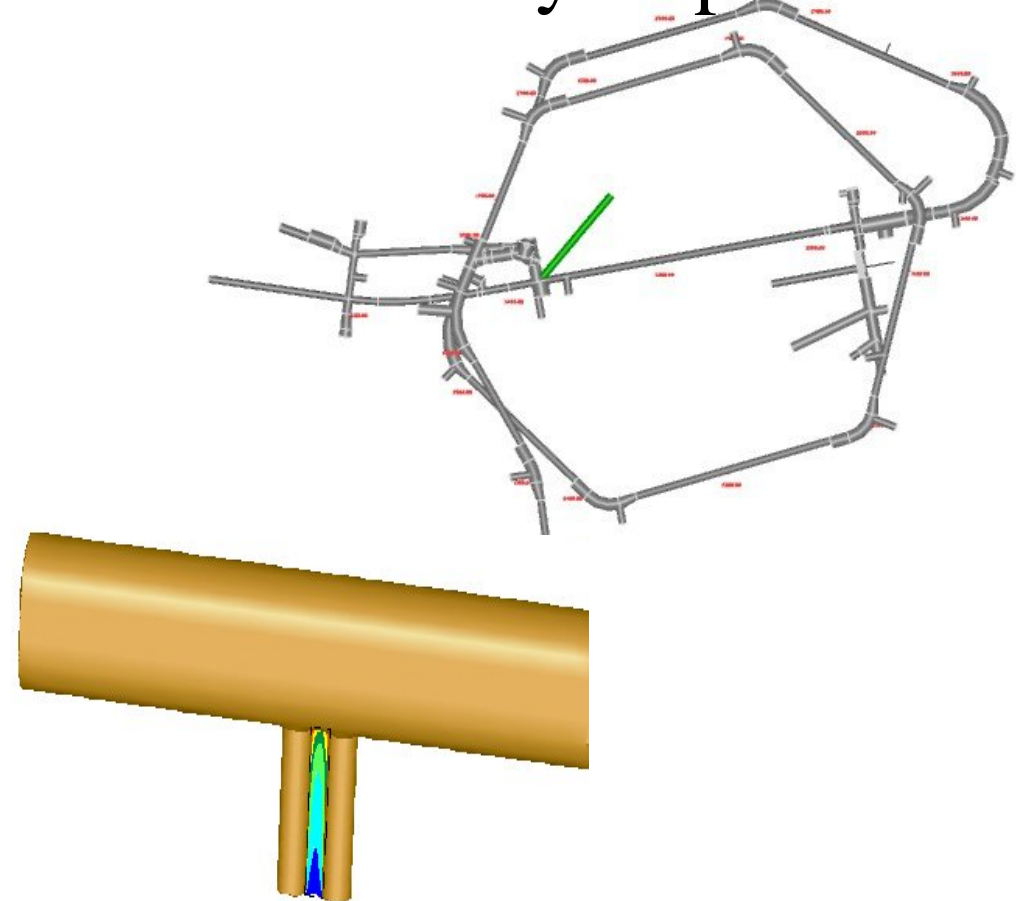
Objective

- Demonstrate the capability to predict spalling in a fractured rock mass, and compare 2D and 3D modelling results

Status

- Drift and two full-scale deposition holes excavated
- Instruments installed including heaters in the rock
- Preparations are made for start of heating (the means of over-stressing the rock)

Aspo Pillar Stability Experiment



Principaux développements récents Äspö Hard Rock Laboratory

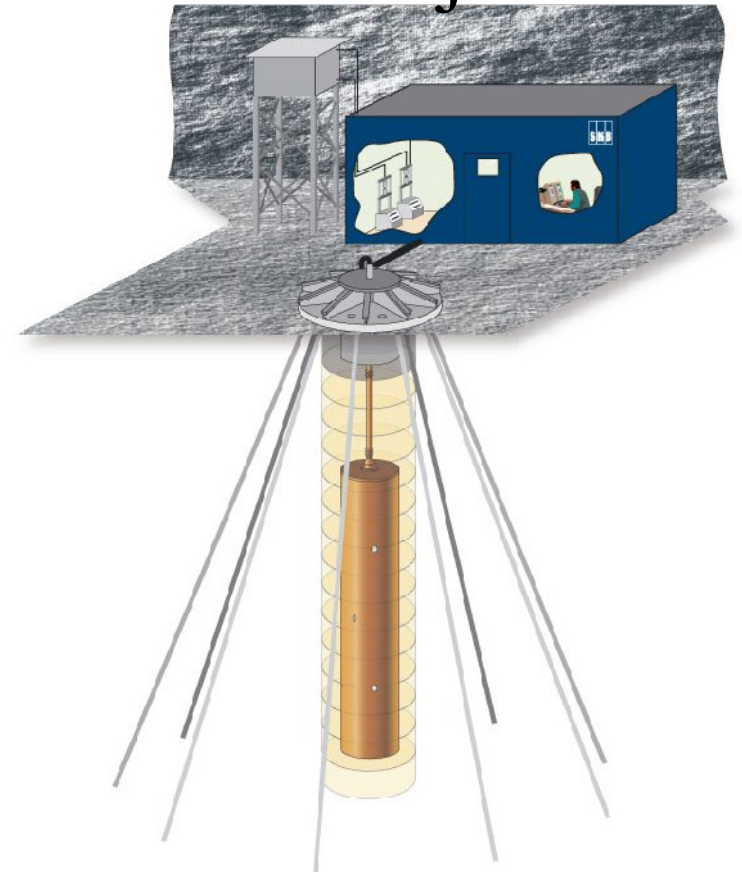
Objective

- Test gas migration from a KBS-3 canister through a saturated buffer

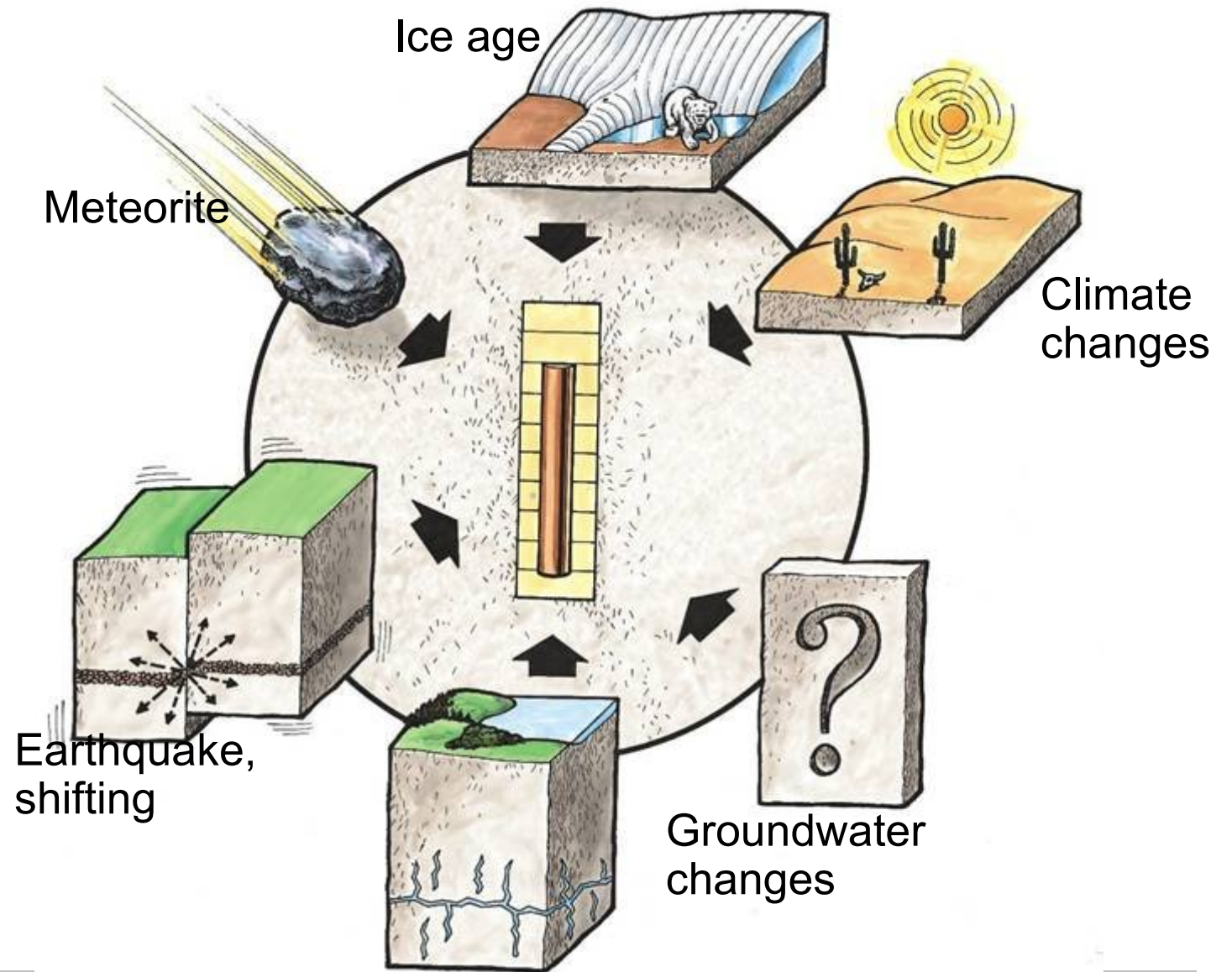
Status

- Canister, bentonite blocks with high degree of saturation, and control container have been manufactured.
- Holes for cable bolts have been drilled
- Installation will be made in September 2004

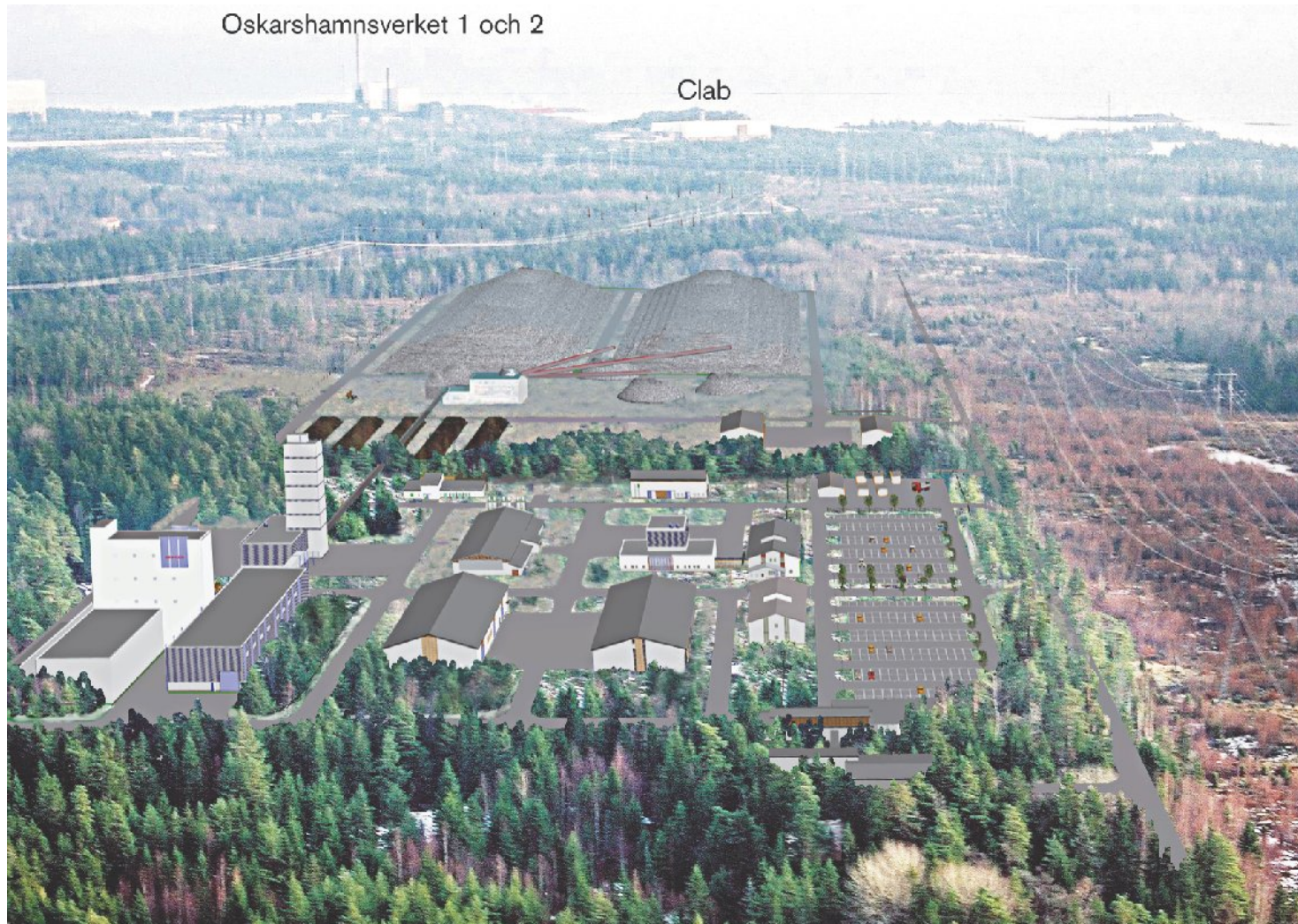
Large Scale Gas Injection Test



Etudes de sûreté - scenarii



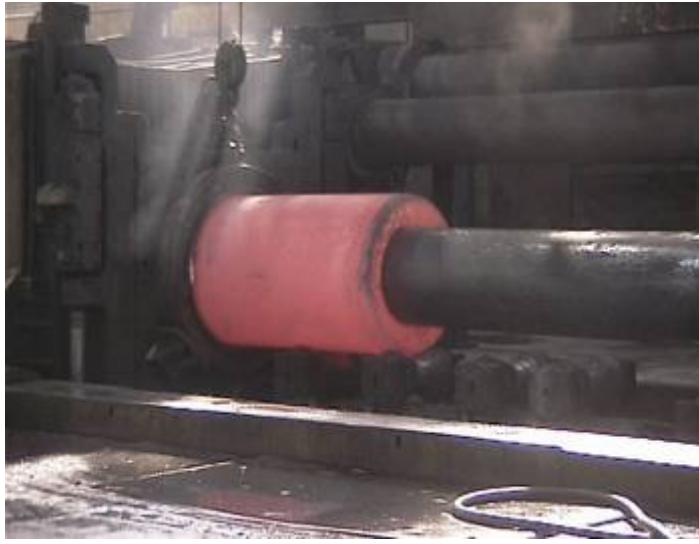
Implantation dans le district de Laxemar



Procédé de soudage



Fabrication des conteneurs



Programme R&D et phase pilote 2004

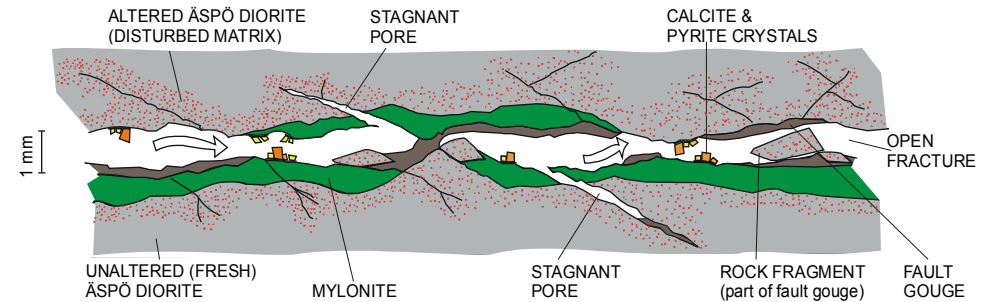
- Programme et plan d'action de SKB
- Développement technologique
- Recherche et Etudes de sûreté
- Déchêts de faible et moyenne activité



TRUE

Tracer Retention Understanding Experiment

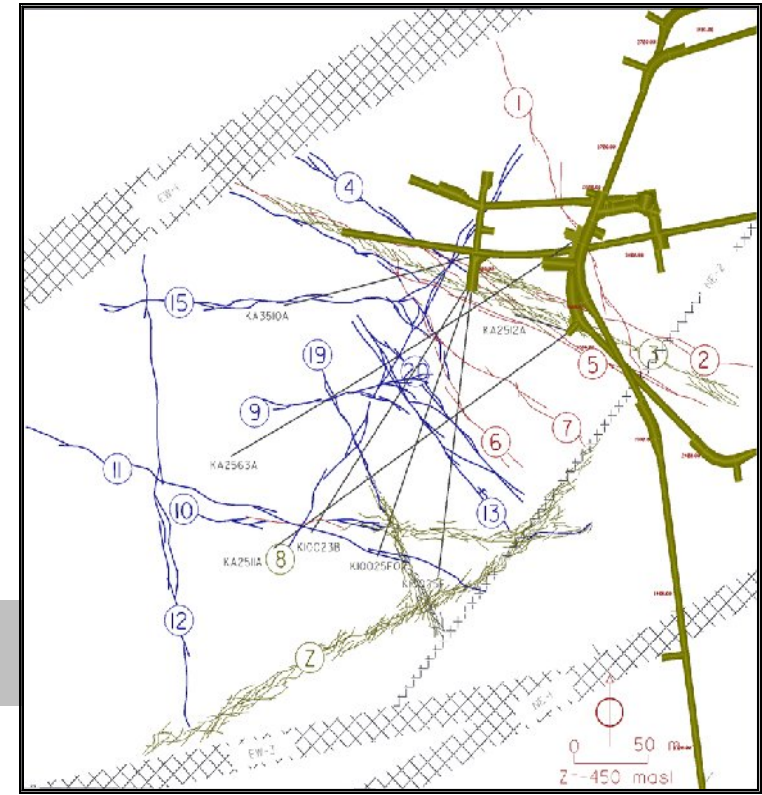
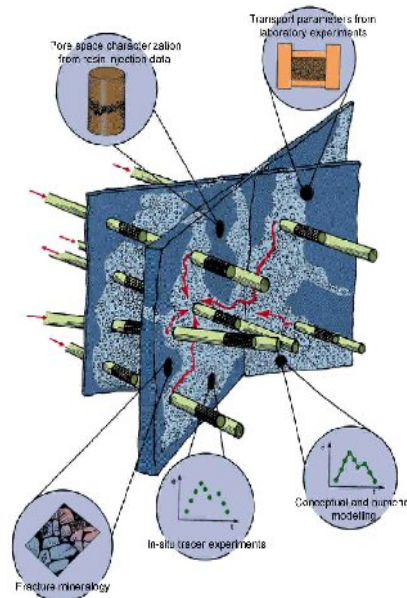
CONCEPTUAL REPRESENTATION OF FEATURE A



FRACTURE APERTURE TO SCALE. OTHER GEOLOGICAL UNITS NOT TO SCALE

Objectif

- Utiliser des traceurs pour comprendre la rétention et la vitesse de migration des radionucléides dans le granite.



Mise en place verticale et horizontale

