Plans for detailed investigations

NEA-IRT - Forsmark, December 14, 2011

Programme for detailed characterisation

Detailed characterisation during construction and operation of the repository for spent nuclear fuel at Forsmark is including:

- Investigations – methods and instruments
- Modelling – methodology and integration
- Monitoring – long term observations
- Datasystems – modelling, QC, etc.
- Documentation - data handling
- Managment system, QA/QC

The report presents:

- overall premises and strategies for the detailed characterisation programme
- how the programme can be applied during construction and operation of the final repository in observance of requirements on long-term safety
- plans for continued development of the characterisation programme, methods and tools for investigations, modelling, data handling and quality assurance


R-11-14

Framework programme for detailed characterisation in connection with construction and operation of a final repository for spent nuclear fuel

Svensk Kärnbränslehantering AB

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Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co

Box 250, SE-101 24 Stockholm
Phone +46 8 459 84 00

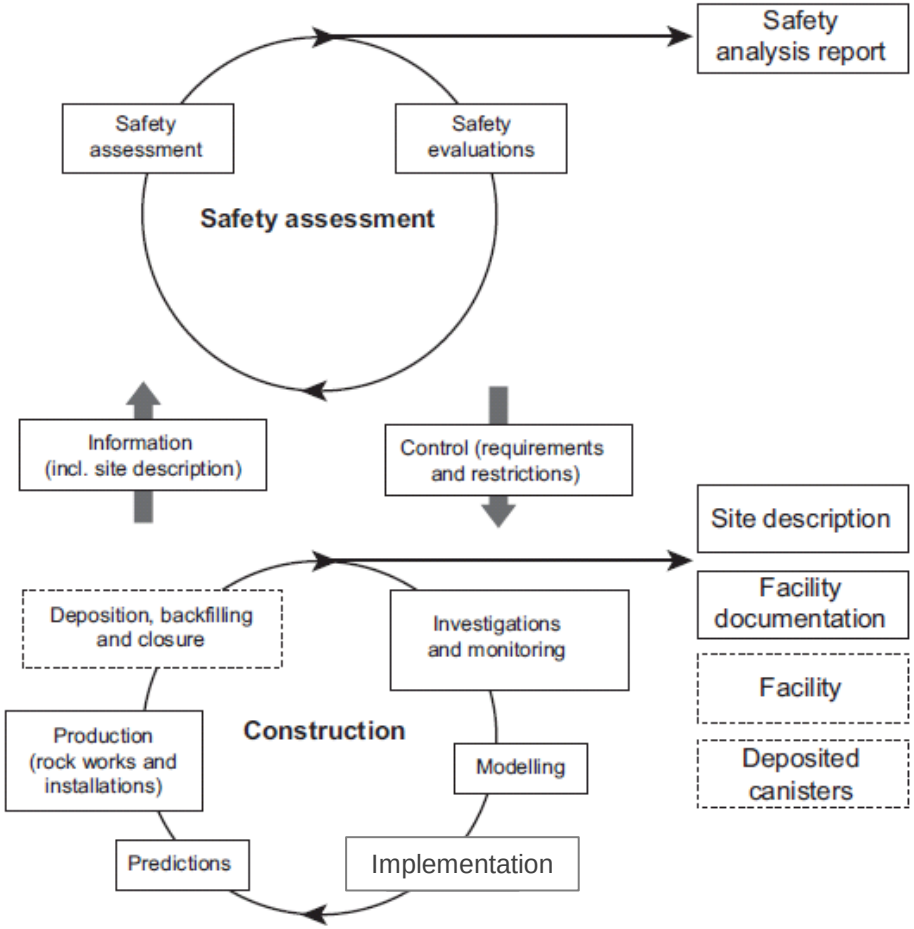
Purpose of detailed characterisation

- To provide a basis for adaptation of the repository to the site-specific conditions in order to meet the design premises, e.g. with respect to long-term safety.
- To provide a basis for engineering-related decisions concerning e.g. grouting and rock support measures.
- To update site descriptive models, which will in turn serve as a basis for long-term safety assessments.

Main clients for investigation and characterisation data

- Safety assesment
- Design

Main processes - Construction and Safety assessment



Reducing uncertainties

The SR-Site safety assessment showed that only certain site-specific properties are of essential importance for long-term safety.

The most important parameters in this category are:

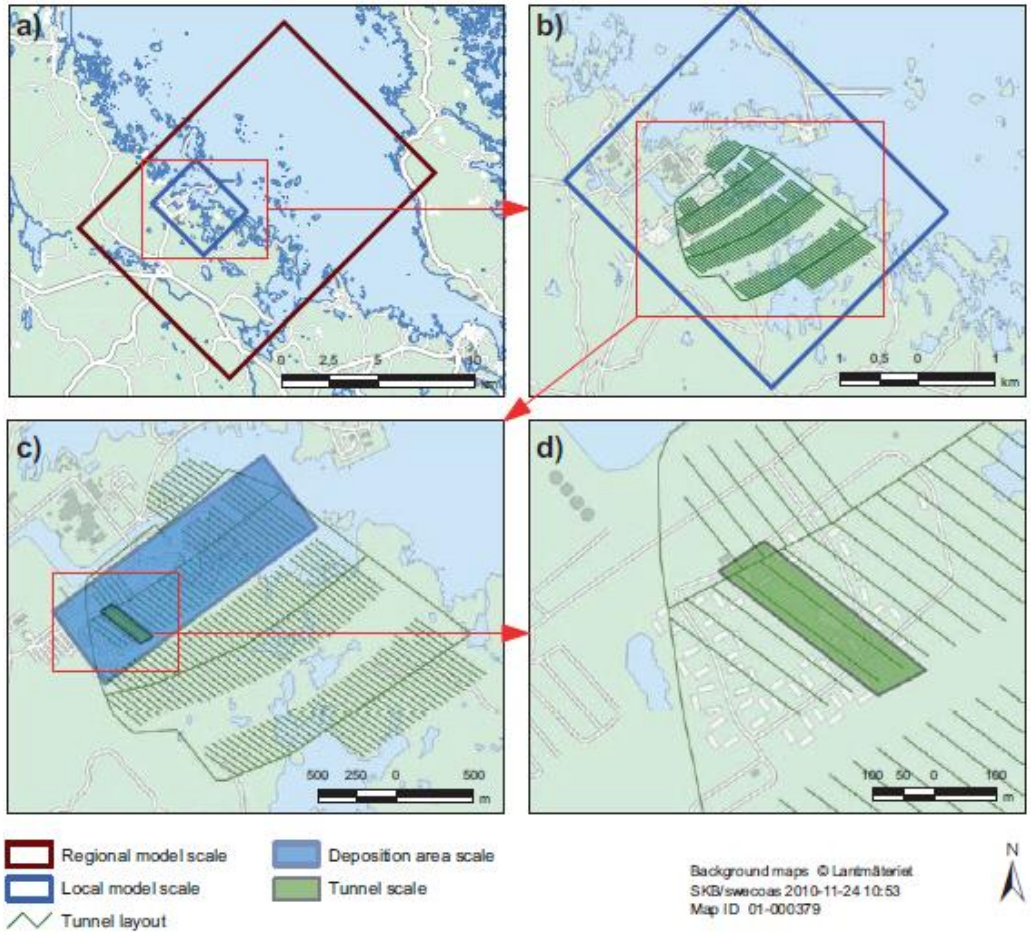
- The frequency and distribution of open water-bearing fractures and their potential influence on groundwater lowering (drawdown) in the vicinity of the shaft and ramp.
- In situ stress magnitudes and orientations at repository level.
- Spatial distribution of deformation zones that can impact the repository layout.
- Spatial distribution of amphibolite with lower thermal conductivity that can be of importance for the distance between deposition holes.

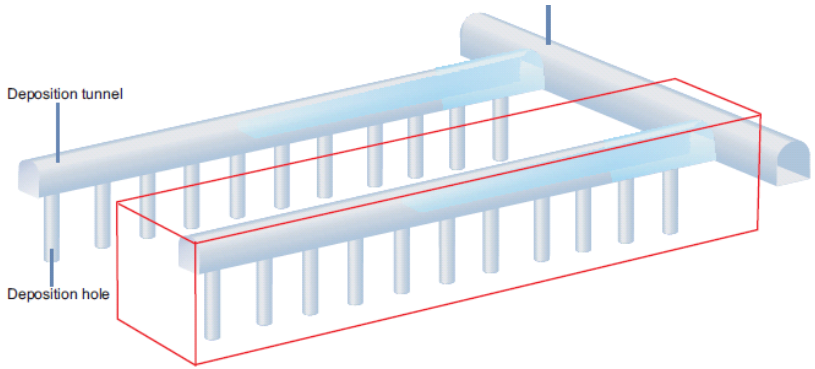
Fulfillment of design premises

- Distance to deformation zones > 3 km
- “Large fractures” to be avoided
- Rocks with low thermal conductivity
- Groundwater chemistry in deposition volumes
- Water inflow to deposition hole
- Limited excavation damage

Modelling

- At different scales
  - Detailed scale (tunnel scale) updated often
  - Site scale updated based on information from detailed scale model
- Conceptual model
  - Based on existing SDM
  - Revised if data from detailed scale shows a need to that
- Used for
  - Planning/decisions on where to place deposition tunnels and deposition holes
  - Verify fulfilment of design premises
  - Input to Safety Assessment

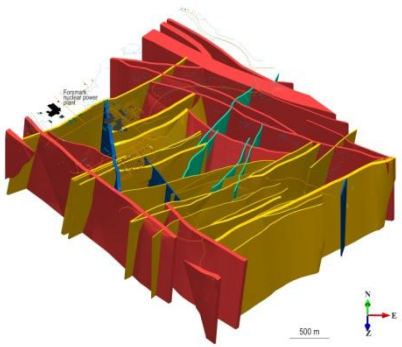


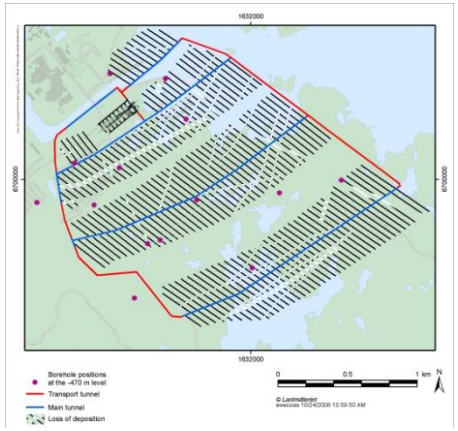


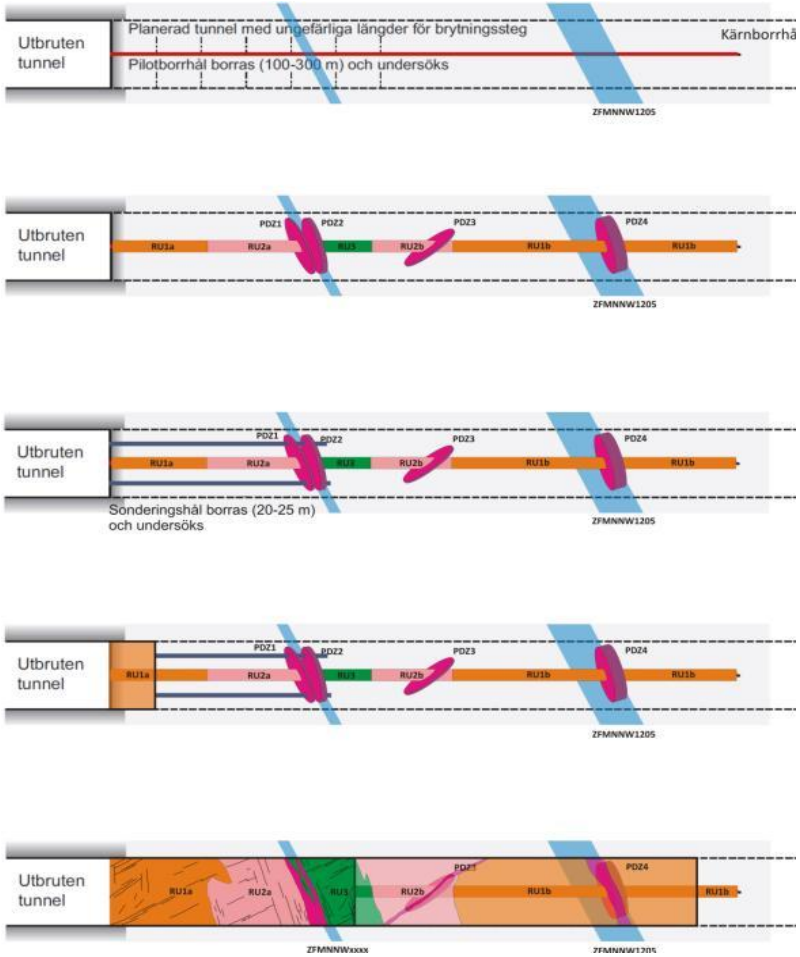
Detailed investigations

Detailed investigations - part of the cyclic construction process.

- Pilot hole drilling with investigations
- Investigations in probe holes and grouting holes
- Tunnel mapping
- Installations and continued monitoring
- Model updating and documentation







Repository area – Decitions acceptance

Decision on boundaries of the deposition area prior to a build-out step

- **Detailed characterization in conjunction with construction of transport and main tunnels for new deposition area**

Decision on location and construction of deposition tunnels

- **Detailed characterization in conjunction with construction of deposition tunnels**
  - **Pilot drilling for deposition tunnels with associated investigations**
  - **Investigations during and after construction of deposition tunnel**

Decision on deposition positions in deposition tunnels

- **Detailed characterization in conjunction with excavation of deposition holes**
  - **Drilling of and investigations in pilot holes for deposition positions**

Decision on execution of deposition hole

  - **Drilling of and verifying investigations in the deposition holes**

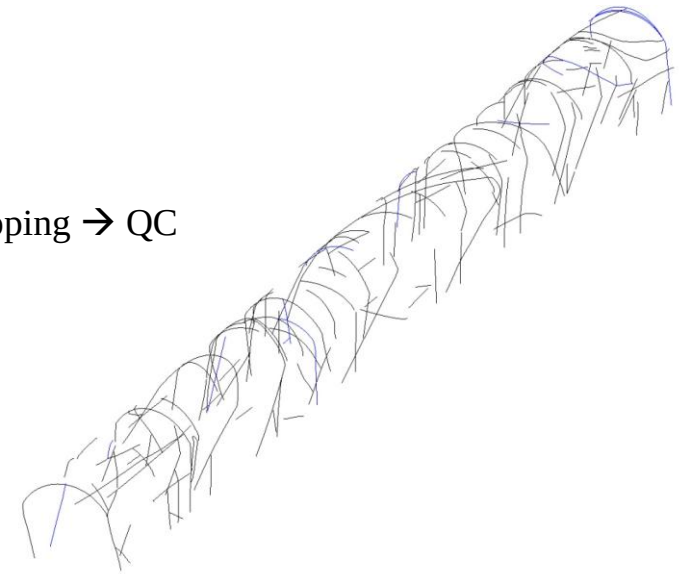
Decision on approval of deposition hole for deposition of canister

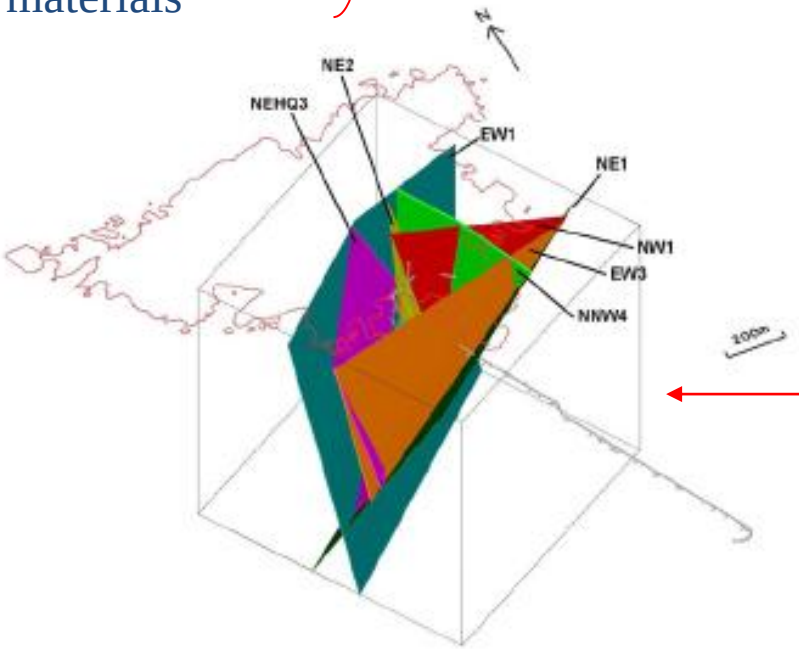
  - **Documentation of the initial state of the approved deposition holes**

Documentation of tunnels and QA/QC

- rock types
- fractures
  - geometry
  - properties
- deformation zones
- water inflow
- tunnel geometry
- half pipes (blasting)
- stray materials

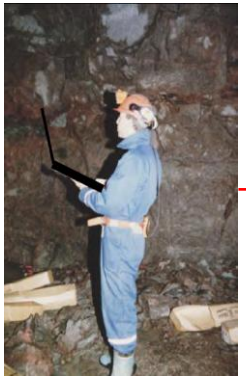
Results from tunnel mapping → QC



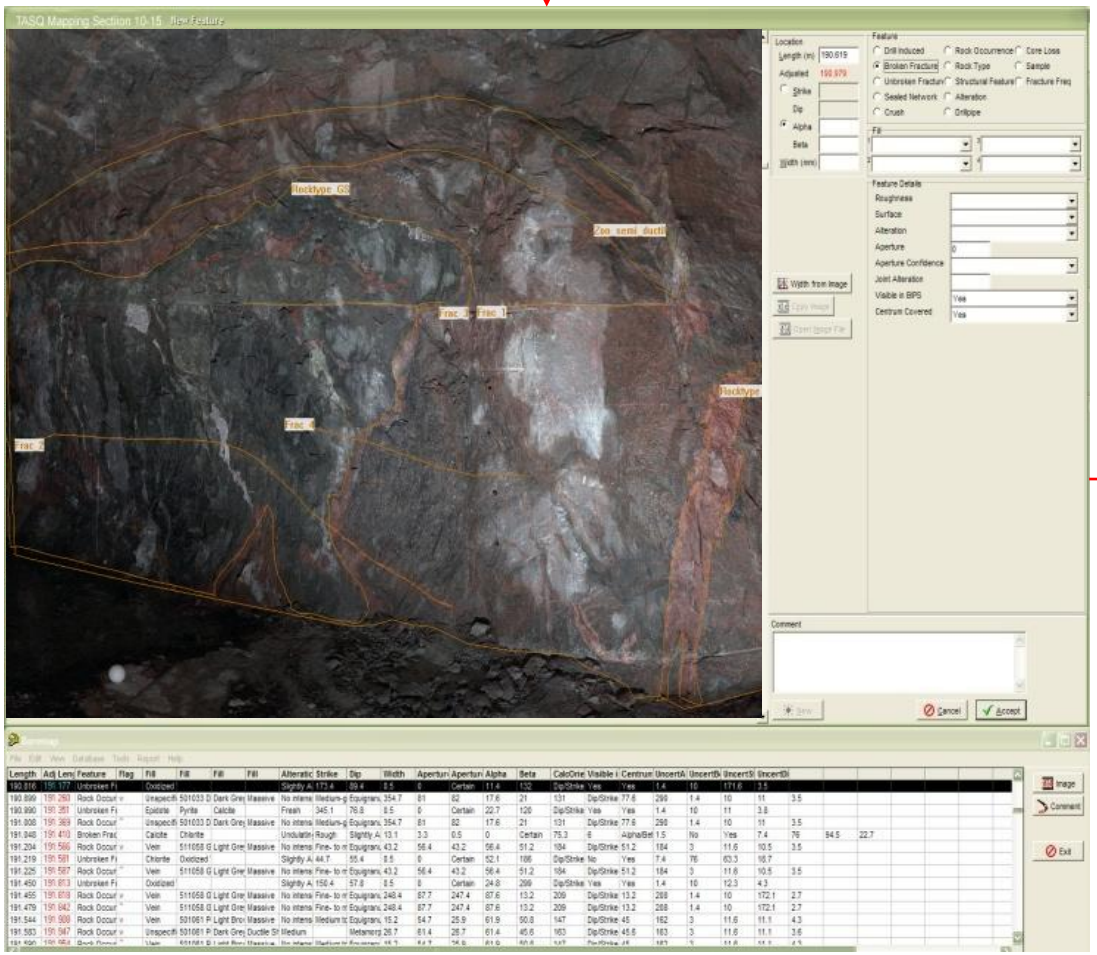


Modelling

Äspö tunnel mapping



Touch screen

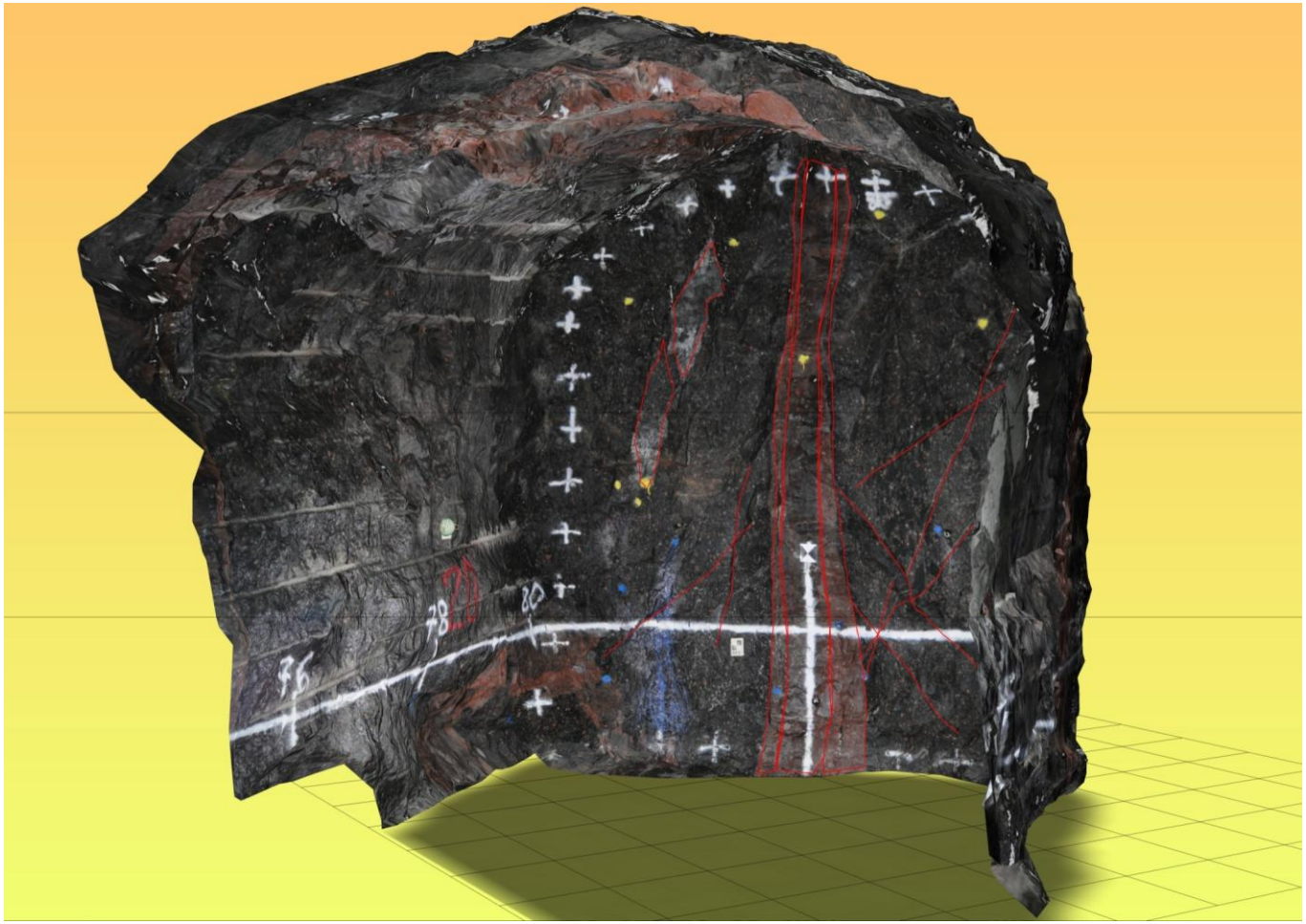


SICADA database

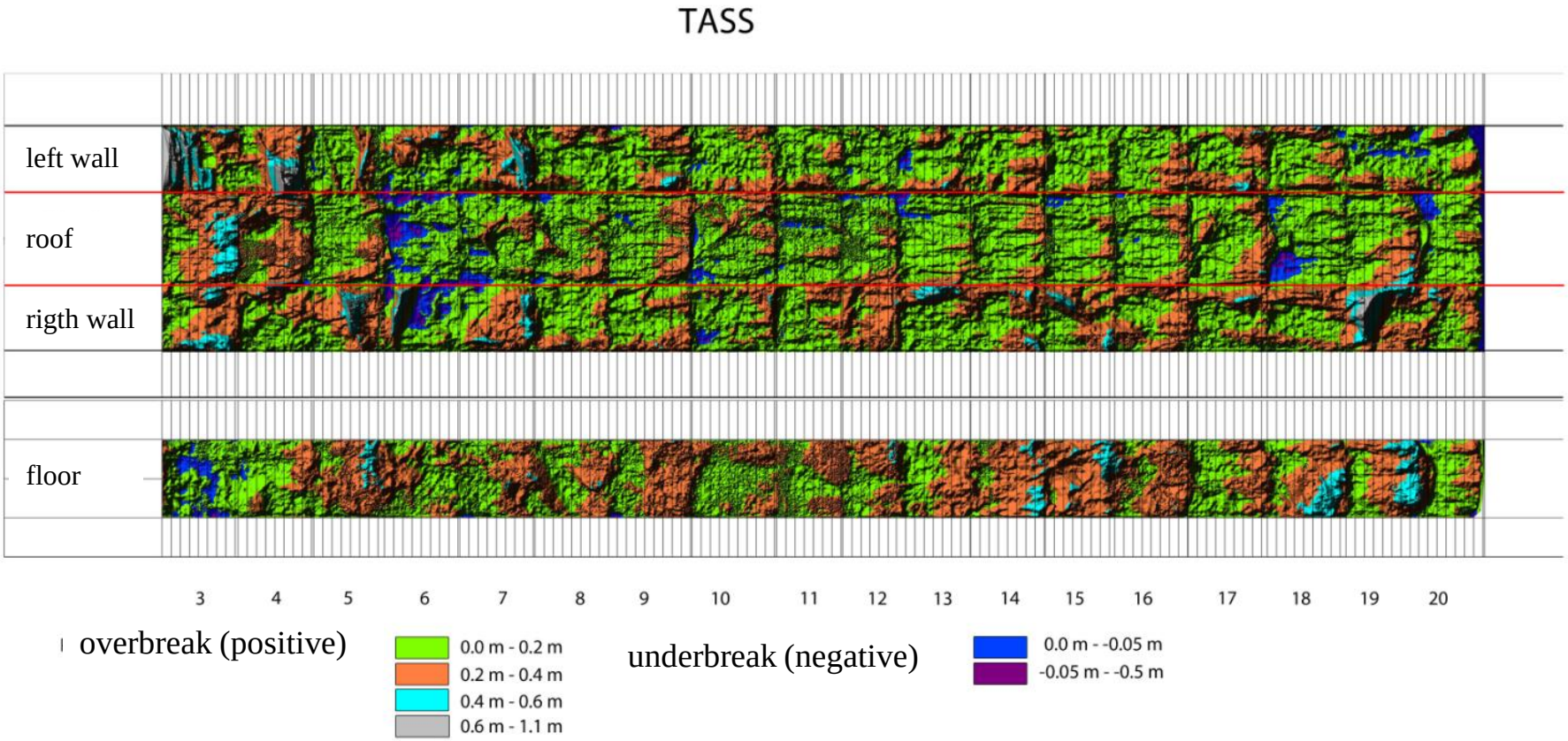
Photogrametry - simple set-up

- Standard camera and lens
- Led lights
- Wireless transmission – camera computer
- Survey of fix points - not time critical

3D image

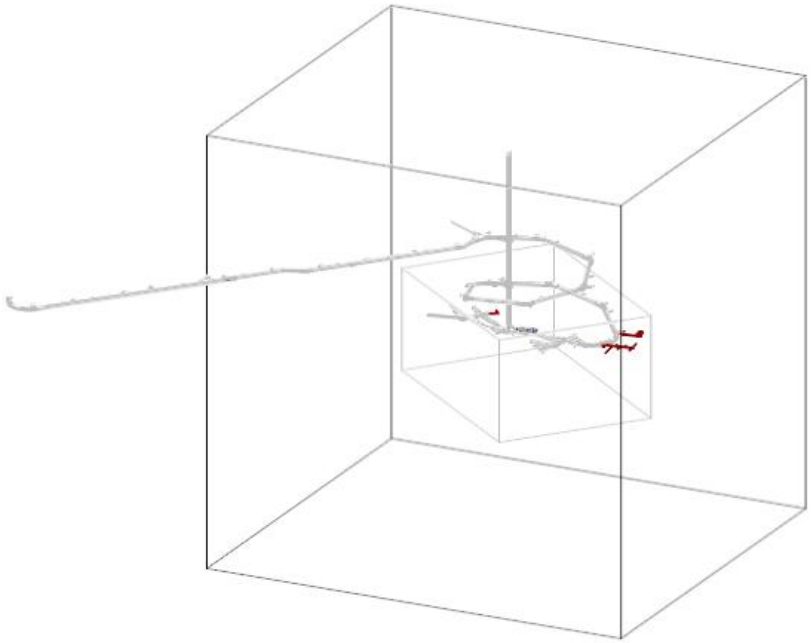


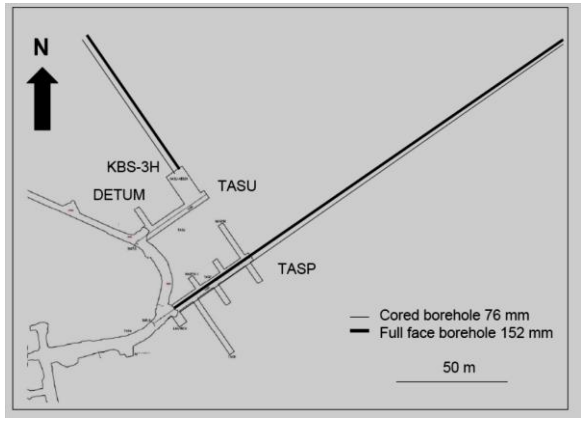
Calculations of over- and underbreak



Implementation Trial at Äspö HRL

- Test of routines and documentation of investigations and geoscientific predictions during the construction process
- Test and optimization of data management processes data flows and QC in the building process
- Testing of the tunnel mapping system RoCS
- In close collaboration with the OM/ design and rock excavation





Safety In Project - SIP

- Unforeseen events can occur during execution which may have a bearing on long term safety. A function called Safety In Project (SIP) is included to ensure uniform documentation and management of these events.
- To ensure a consistent, documented and controlled handling of safety issues is the function of the Safety In Project (SIP) that puts forward proposals for the project manager for a decision. There are two main objectives of the SIP functionality:

1. SIP will exercise a continuous control of geoscientific conditions affecting the site adaptation, such as thermal properties, “large fractures”, water inflow, etc. This control also includes assessing whether the conceptual site model is valid or would need a significant revision. Similarly, a continuous monitoring and reporting, with any non-conformities, the completed underground work.
2. SIP is an early alert to unforeseen events that may affect the quality of critical phases of the project. SIP shall analyze the significance of the event from a broad perspective and put forward proposals so that the project can take steps to counteract the suffix

- The goal of SIP is that it should exercise continuous monitoring of geoscientific conditions that affect site adaptation, underground work and deposition work (including monitoring and inspection of stray materials). By means of SIP, events that can affect quality-critical elements in the project can be detected and dealt with at an early stage