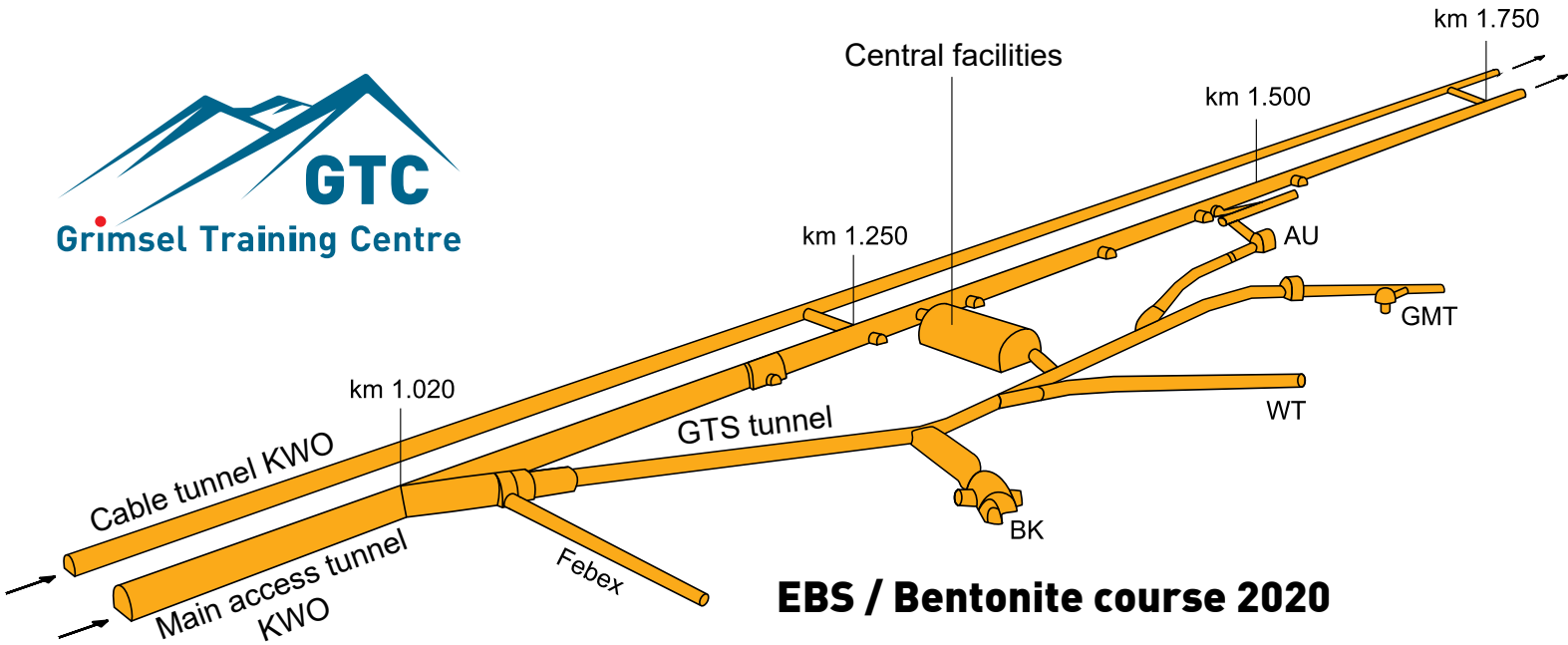
GTC
Grimsel Training Centre




# EBS / Bentonite course 2020

## Engineered Barrier Systems (EBS) - BENTONITE properties and applications (with some focus on gases in the EBS)

### Dates

07. September 2020 -
11. September 2020

### Accomodation

Can be arranged in the nearby town of Meiringen

### Location

Nagra's underground rock laboratory (Grimsel Test Site), near Guttannen, Switzerland (www.grimsel.com)

### Aims and Objectives of the Bentonite Training Course

As part of the Grimsel Training Centre programme 2020, Nagra offers a 5-day workshop at the Grimsel Test Site covering the various aspects related to Engineered Barrier Systems (EBS) and specifically bentonite. Participants will get an introduction to engineered barrier / bentonite requirements, properties and applications in radioactive waste topics. Some lectures will especially focus on gases in an EBS. International and national experts will provide keynote lectures and experience, discussion forums will allow the exchange of knowledge and current research strategies. GTS lab visits will provide first hand insights of ongoing experiments and will support the discussion of related topics in the course. A lab visit to one of the national universities collaborating in GTS-research will be included.

The course aims to impart both theoretical and practical knowledge and experience. The course shall help participants in defining, managing, planning, tendering and carrying out their own field (URL) and lab experiments at various scales and how to interpret data and results with respect to their safety case. The covered topics will be transferable to various field investigations and implementers RD & D requirements.

Daily activities will be organized in alternating lecture blocks and visits to experiments at the Grimsel Test Site. Additionally, a laboratory visit to one of our collaborating universities (ETH Zürich, University of Bern) will be organized.

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GTS

## Main topics of the Bentonite Training Course

### Safety requirements

General introduction to radioactive waste disposal concepts and requirements and the role of the host rock and engineered barrier systems

### Clays and Bentonites as engineered barriers

Properties (chemical, physical, thermo-hydro-mechanical); Bentonite origin, types and properties
THM/THC behaviour; Interactions with cements, metals, host-rocks and gasses
Bentonites/clays and Bentonite production and quality

### Modelling bentonite behaviour

Approaches and computer codes; Validation with field data

### Experiments

Scale issues (lab – mock-up – field scale); Safety requirements and large-scale experiments (demonstration vs processes understanding)
Designing and constructing experiments; Monitoring and excavating experiments;
Management of experiments

### Onsite visit and discussion of GTS Experiments (and others)

Under construction: HotBENT (high temperature buffers)
Running: CIM (Carbon Iodine Migration), CFM (Colloid Formation & Migration),
GAST (GAs permeable Seal Test), MACOTE (MAterial COrrosion TEst),
Completed: FEBEX (Full Scale Engineered Barrier EXperiment)

## Detailed programme

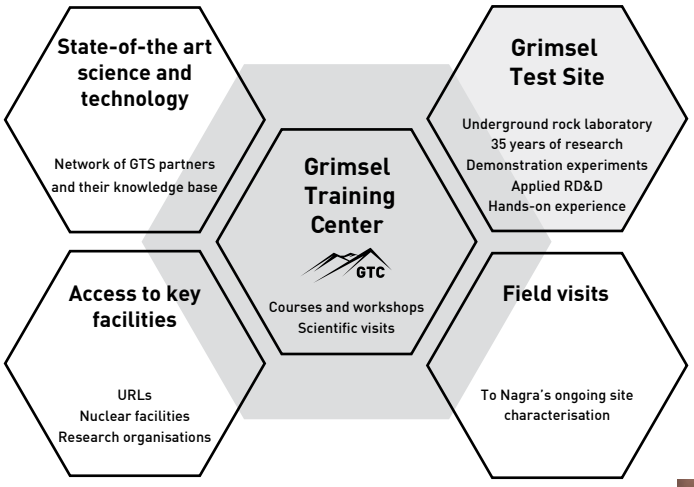
| time | Day 1<br>07.09.2020 | Day 2<br>08.09.2020 | Day 3<br>09.09.2020 | Day 4<br>10.09.2020 | Day 5<br>11.09.2020 | 12.09.2020 |
|---|---|---|---|---|---|---|
| Departure from Hotel to GTS | **07:45** | **07:45** | **07:45**<br>University of Bern | **07:45** | **07:45** | departure from Baden station will be annouced later |
| 8:30 - 10:00 | Welcome, Organisation of Bentonite School<br>(*F. Kober, Nagra*)<br>Introduction to Engineered Barriers & safety requirements;<br>Clays and Bentonites in rad waste<br>(*O. Leupin/F. Kober, Nagra*);<br>**SPECIAL TOPIC of SS:**<br>Intoduction to Gases and EBS<br>(*O. Leupin/A. Reinecke, Nagra*) | THM of Bentonites (1)<br>(*E. Romero, UPC*) | Bentonite Interfaces - Introduction<br>(*P. Wersin/U. Mäder, Uni Bern*) | Engineered Barriers & Experiments<br>(*P. Sellin, SKB*) | Modelling clays and bentonites in rad waste (1) - concepts, codes<br>(*A. Ferrari, EPFL*) | **optional: visit to ZWILAG (CH-Interim Storage Facility)**<br>**OR**<br>**visit to URL Mont Terri (NN, F. Kober)** |
| **10:00 - 10:30** | **coffee** | **coffee** | **coffee** | **coffee** | **coffee** | |
| 10:30 - 12:00 | Clay Mineralogy<br>(*S. Kaufhold, BGR*) | THM of Bentonites (2)<br>(*E. Romero, UPC*) | -University of Bern Lab visit<br>(*P. Wersin/U. Mäder, Uni Bern*) | Mock-Up & Field Experiments - SKB focus<br>(*P. Sellin, SKB*) | Modelling cont. (2) - detailed THM; THC - modelling discussion<br>(*A. Ferrari, EPFL*) | |
| **12:00 - 13:30** | **lunch** | **lunch** | **lunch** | **lunch** | **lunch** | |
| 13:30 - 15:00 | Basic properties of Clays and Bentonites;<br>The various bentonites worldwide<br>(*S. Kaufhold, BGR*) | THC of Bentonites (1)<br>(*Th. Schäfer, FSU Jena*) | Bentonite - Concrete<br>(*U. Mäder, Uni Bern*) | Mock-Up & Field Experiments (1): - design & construction<br>FEBEX, FE, HE-E, EB, …Bure examples<br>(*J.L. Siñeriz, Amberg*) | Strength and Weakness of bentonite, Conceptual Models, Integration of EBS experiments in the safety case<br>(*I. Gaus, Nagra*) | |
| **15:00 - 15:30** | **coffee** | **coffee** | **coffee** | **coffee** | **coffee** | |
| 15:30-16:30 (17:00) | URLs in rad waste:<br>purpose, stages & types<br>(*I. Blechschmidt/F. Kober, Nagra*)<br>**FLG Experiment visit**<br>**SUMMER SCHOOL Dinner hosted by NAGRA** | THC of Bentonites (2)<br>Bentonites: radionuclides and colloids<br>(*Th. Schäfer, FSU Jena*)<br>**FLG Experiment visit** | Bentonite - Metals / Corrosion / Microbiology<br>(*P. Wersin, Uni Bern*)<br>**Bern city visit** | Mock-Up & Field Experiments (2): Monitoring and Sampling Mock-up and Field Experiments<br>(*J.L. Siñeriz, Amberg*)<br>**FLG Experiment visit** | Bentonites and RD & D topics<br>(*I. Gaus, Nagra*)<br>summary and closure of the Bentonite Summer School<br>(*F. Kober, Nagra*) | |
| Departure from GTS to Hotel | **~17:30** | **~17:30** | **~ 20:30 - return to Meiringen** | **~17:30** | **~17:00** | arrival at Baden station ~14:00 |

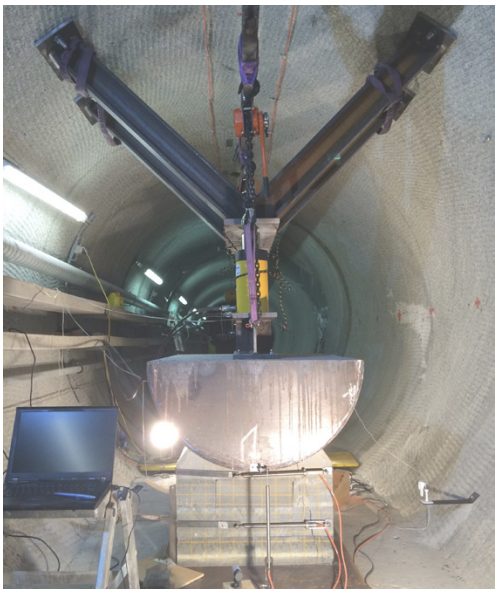
## Grimsel Test Site

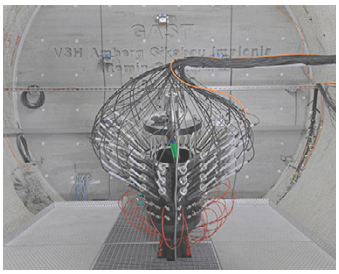
The Grimsel Test Site (GTS) located in the Swiss Alps was established in 1984 as a centre for underground Research and Development (R&D) supporting a wide range of research projects on the geological disposal of radioactive waste. International partners from Europe, Asia and North America are working together at this unique facility.
The (GTS) is located at an altitude of 1730 metres in the granitic rock of the Aar Massif in Switzerland. It lies at a depth of around 450 metres beneath the surface and is reached by an access tunnel belonging to the local hydro-power company (Kraftwerke Oberhasli AG, KWO). The GTS tunnel system is around one kilometre long and was excavated in 1983 using a full-face tunnelling machine (diameter 3.5m).

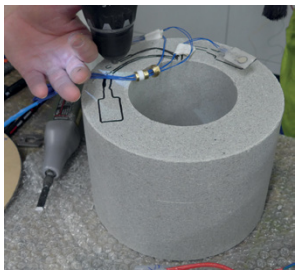
## GTC

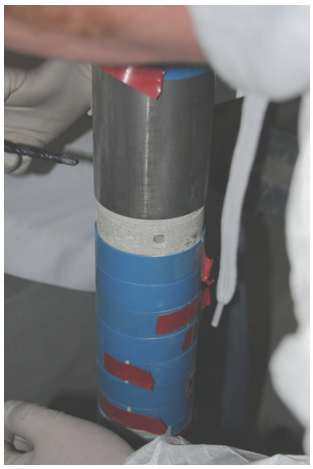
To provide the opportunity to exchange knowledge and to provide training in the necessary skills for working underground and for the safe disposal of radioactive waste in general, Nagra established the Grimsel Training Centre (GTC) in 2017, as a permanent platform. Facing the long-lasting programmes of the radioactive waste management, training the next generation of radioactive waste management scientists was identified by many organisations as one major challenge for the next few years and decades. To meet the various needs of training and knowledge transfer, the GTC team developed a programme which allows both tailor-made and established courses repeated every two or three years. Also, the combination of more theoretical lectures and hands-on training renders this programme very attractive for various levels of experience and expertise. High quality and relevance of the courses is achieved by involving lecturers from the GTS partner organisations.









## Costs

CHF 3'000, which includes lunches, one dinner, and transfers from Meiringen to the GTS and back (excl. travel, accommodation and VAT).
We are happy to support you to organise appropriate accommodation or local transportation if desired.

## Requirements

Participants shall bring their own laptop. Clothing should be adequate for an early summer mountainous regional environment.

## Registration

The expected number of participants is a minimum 10. Please note that in the case of not reaching the minimum number of participants the course will not take place.

**The deadline for preliminary registration is April 30th, 2020.**

### GTS course 2020 - EBS & BENTONITE properties and applications

| | |
|---|---|
| Title | |
| Surname | |
| First name(s) | |
| Profession | |
| Function | |
| Organisation | |
| Complete Adresse | |
| Nationality | |
| Date of Birth | |
| Phone | |
| E-mail | |

Please indicate briefly your:

| | |
|---|---|
| Working background | |
| Level of experience (years) | |
| Motivation / expectations | |
| Remarks<br>(e.g. Diets, Allergies, ...) | |
| Optional field trip<br>Yes/No<br>(extra costs, ca. 100 CHF) | |

(Hereby I confirm if participation is cancelled less than two weeks before the course starts, I accept to pay 30% of the course fee.)

**Date / Signature participant:** .....

Please submit your registration no later than 30th April 2020 to Ms. Andrea Wettstein – De Marco (andrea.wettstein@nagra.ch).

**The Grimsel Test Site (GTS)**
**International Underground Research Laboratory**
**www.grimsel.com**

**General GTS enquiries**
**Andrea Wettstein - De Marco**
**andrea.wettstein[at]nagra.ch**
**Tel: +41 56 437 1310**