

# GRIMSEL TEST SITE (GTS) NEWSLETTER

APRIL 2019 YEAR 01, VOL. 1



## News and Activities . EDITOR'S NOTE

Dear colleagues and partners,

For 35 years, Nagra and its partners have been conducting underground research projects at the Grimsel Test Site (GTS) to contribute to the development and confirmation of safe geological disposal concepts and to the characterisation of suitable host rock formations. Over the years, the results of this internationally recognised research programme have been, and continue to be, incorporated directly into exploration programmes, modelling, safety and engineering feasibility studies on options for the realisation of deep geological repositories.

From the start, the GTS has been a platform for focused international research and cooperation. Currently there are more than 20 partner organisations from 12 countries, who steer the GTS activities and secure a state-of-the-art RD&D programme. In 2018, we welcomed KIGAM (Korea Institute of Geoscience & Mineral Resources) as a new member of the GTS family.

As we enter the next five-year period of GTS activities (2019 to 2023), I would like to thank all the GTS collaborators and partners for contributing to what we have achieved so far and look forward to the upcoming activities.

Your sincerely,

**Dr. Ingo Blechschmidt**

Head of the Grimsel Test Site (GTS)



“ With this newly established Newsletter, we would like to highlight major activities at the GTS on a regular basis and try to bring the “flavour of working underground” closer to you.

**THE GRIMSEL TEST SITE (GTS)**  
INTERNATIONAL UNDERGROUND  
RESEARCH LABORATORY

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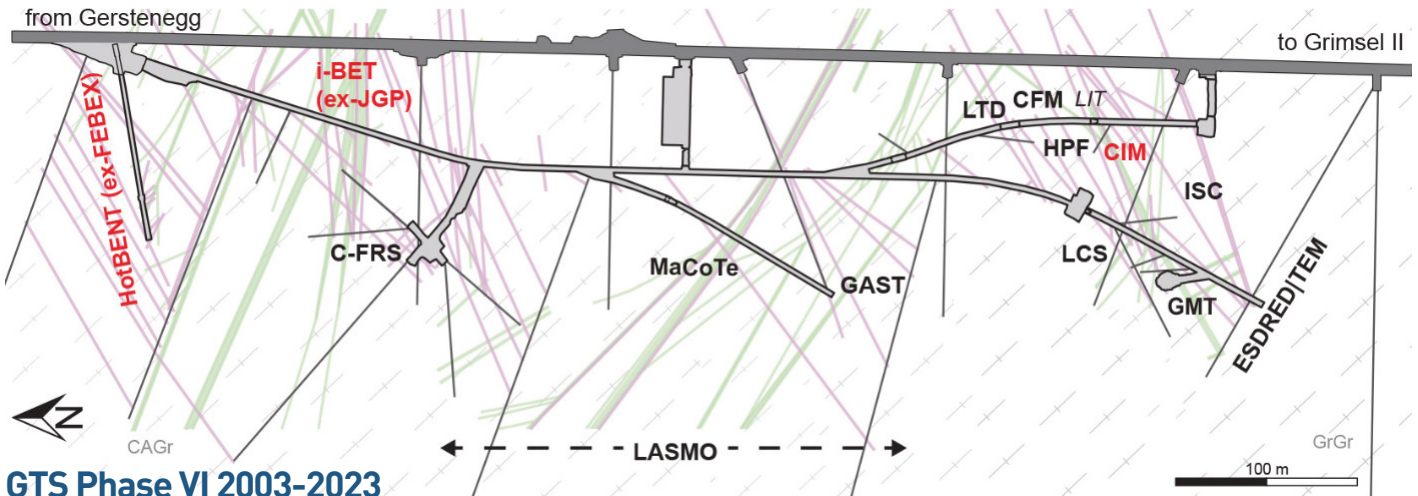
GTS

Participating Countries



# GTS Current Activities . HIGHLIGHTS

New experiments concerning radionuclide and colloid migration phenomena (CIM, i-BET) and studying the performance of a buffer under extreme conditions (HotBENT) are currently being set up as part of the activities in GTS Phase VI. Their locations are shown in Fig. 1. Performing them at or near the sites of previous experiments allows benefit to be taken of the existing site-specific knowledge and / or existing installations from the preceding experiments.



## GTS Phase VI 2003-2023

<b>CFM</b>	Colloid Formation and Migration	<b>FEBEX</b>	Full-scale Engineered Barriers Experiment	<b>JGP</b>	JAEA Grouting Project
<i>LIT</i>	Long-term In-situ Test				
<i>i-BET</i>	In-Rock Bentonite Erosion Test	<b>GAST</b>	Gas-permeable Seal Test	<b>LASMO</b>	Large Scale Monitoring
<b>CIM</b>	In Situ Migration of C-14 and Iodine in Cement	<b>GMT</b>	Gas Migration Test in the EBS	<b>LCS</b>	Long-Term Cement Studies
<b>HotBENT</b>	High Temperature Bentonite Project	<b>HPF</b>	Hyperalkaline Plume	<b>LTD</b>	Long-Term Diffusion
<b>C-FRS</b>	Cripi Fractured Rock Studies	<b>ISC</b>	In-situ Stimulation and Circulation Project	<b>MACOTE</b>	Material Corrosion Test
<b>ESDRED/TEM</b>	Test and Evaluation of Monitoring Systems				

Fig. 1: The GTS layout and the new projects (in red) planned within GTS Phase VI.

### HotBENT

Bentonite at High Temperatures

F. Kober

HotBENT, the newest in-situ experiment dedicated to the study of high (up to 200 °C) temperature effects on bentonite-based buffers under realistic conditions, is taking shape. The Detailed Design phase was initiated in the autumn of 2018 and will serve as the anchor for all the field work, which will start toward the end of this year. At the Detailed Design meeting in November 2018, a possible layout was defined by the partners for further evaluation (Fig. 2). Numerous scoping calculations have been performed to best meet the partners' wishes and the overarching common experiment aims. Preparation of the experiment plan is ongoing. In parallel, the former FEBEX gallery, in which the experiment will be carried out, is being characterised with geological and hydrological tests. As of the end of March 2019, the HotBENT team consisted of the following 5 partners: USDOE, RWM, SURAO, NWMO and NAGRA, and 2 associated organisations: ENRESA and Obayashi. Discussions with NUMO are also quite advanced and a decision is expected in the following few months.

### HotBENT Experiment layout concept - MAXI Variant

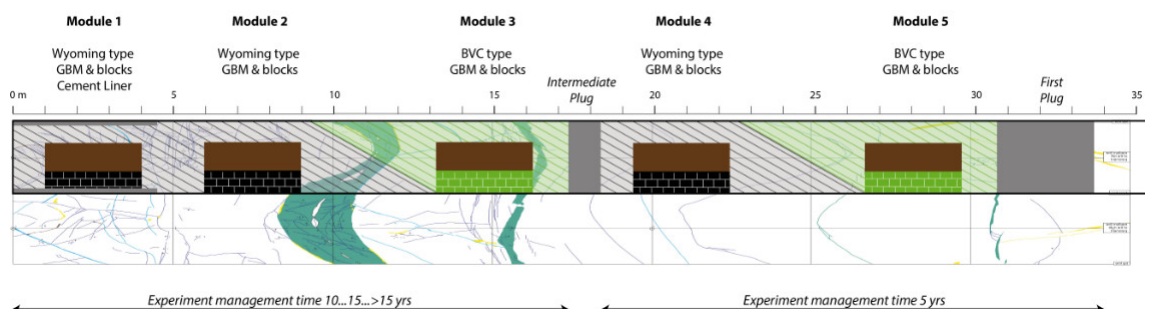


Fig. 2: The current HotBENT set-up (in discussion).

## CIM

Carbon Iodine Migration  
A. Martin

The main objective of the CIM project is to study the role of cement in carbon-14 and iodine-129 retardation (in-situ transport and sorption in cement and the granitic host rock). The experiment concept is to circulate a radionuclide-bearing cocktail inside 14-year-old cement within a backfilled borehole at the GTS (Fig. 3).

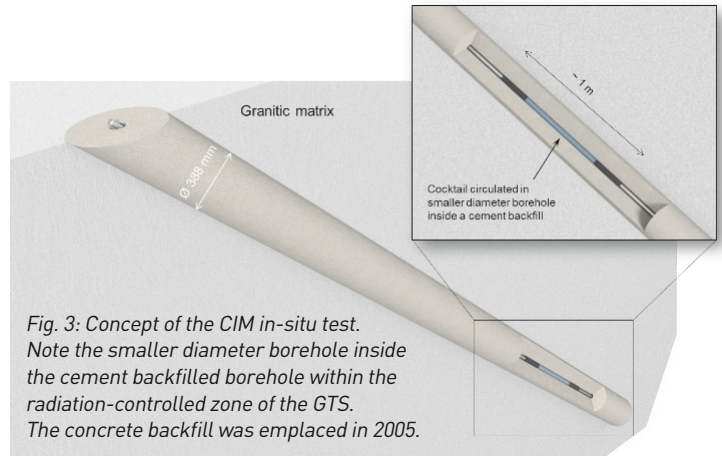


Fig. 3: Concept of the CIM in-situ test. Note the smaller diameter borehole inside the cement backfilled borehole within the radiation-controlled zone of the GTS. The concrete backfill was emplaced in 2005.

During the experiment, the concentration of the input solution in the circulation borehole and in the monitoring boreholes in the near-field will be measured and analysed. Post-mortem analysis will allow diffusion profiles in the cement and the surrounding rock to be measured. Field activities started in 2018 and included the selection of the borehole for the in-situ test and sampling of both cement cores and cement-rock interfaces. The final experiment design was defined by the CIM partners (NAGRA, NUMO, RWM, SURAO, HYRL) at NUMO's offices in Tokyo in November 2018.

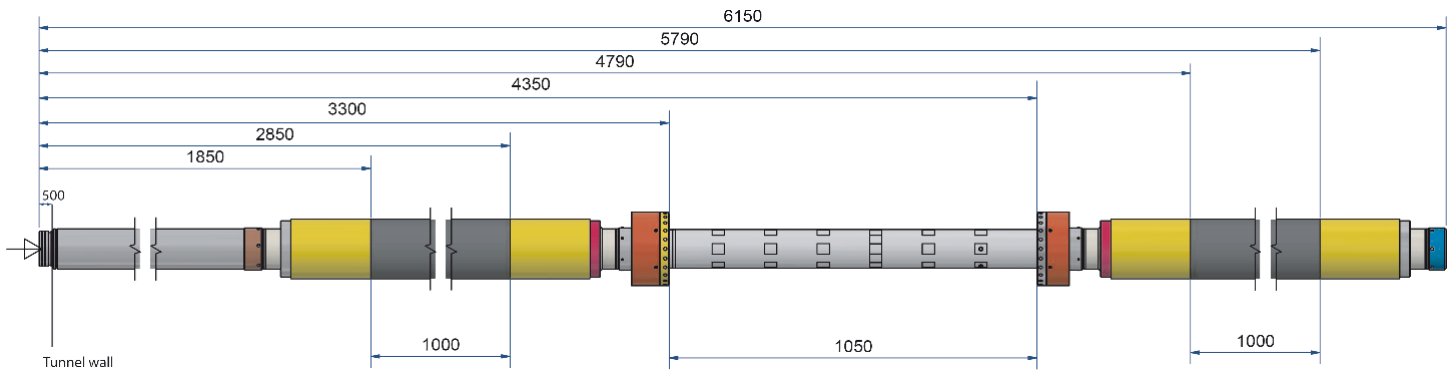


Fig. 4: Schematic drawing of the bentonite source packer system (lengths in mm).

## CFM i-BET

In Situ Bentonite Erosion  
I. Blechschmidt

The i-BET experiment aims at characterising bentonite loss in a natural flow field and at a scale larger than that in typical laboratory tests. i-BET is a subtask of the CFM project. The actual duration of the test will depend on the saturation time and observed mass loss, but a minimum of two years is envisaged. The experiment is installed at the former JGP site of the GTS, thus benefiting from a well-characterised flow field. In December 2018, the custom-made packer with the bentonite source was successfully emplaced (Fig. 4).

The bentonite source is composed of 7 Wyoming-type bentonite rings (outer diameter: 21 cm, thickness: 15 cm) with the following specifications: dry density of 1.7 g/cm<sup>3</sup>; porosity of 0.39; initial water content of 16.9 wt%. All interfaces are equipped with sensors to monitor the relative humidity, the total pressure, the swelling pressure and the porewater pressure (Fig. 5). Online water chemistry and a sampling programme are in place to provide detailed information on colloid concentrations during the test.

Fig. 5: CFM i-BET source assembly (bentonite rings and sensors, left) and installation at the experiment site (centre & right).



Images:  
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<b>Project</b>	<b>Description</b>
<b>CFM</b> Colloid Formation and Migration I. Blechschmidt	CFM Phase 3 (2014-2018): LIT overcoring finalised and laboratory analysis started CFM Phase 4 (2019 – 2023): preparation of work programme ongoing i-BET: Successful installation and start of monitoring/sampling phase started (further details in Highlights, page 2).
<b>CIM</b> Carbon Iodine Migration A. Martin	Implementation of the project has started. (further details in Highlights).
<b>FEBEX-DP</b> Full-Scale Engineered Barrier Experiment F. Kober	Dismantling project. 18 of 19 project reports documenting the results from the various work packages have been published and the last one is scheduled for May 2019. The overarching FEBEX-DP synthesis report is in preparation. The tunnel is currently being modified and prepared for the HotBENT experiment.
<b>GAST</b> Gas-Permeable Seal Test N. Giroud	The first gas injection tests took place in the first semester of 2018. Data analysis, modelling and interpretation of the test results are ongoing. The sand/bentonite core of the seal is being resaturated, targeting a hydraulic pressure close to 2 MPa with a view to future additional gas tests. In parallel, a mock-up experiment on a scale of half a metre is being initiated to extend the database with results from the mesoscale (typical small-scale laboratory tests cm scale, large-scale test 10 m scale).
<b>ISC</b> In-situ Stimulation and Circulation A. Reinicke	Ongoing analysis and numerous publications by ETHZ. Various smaller post-stimulation tests performed.
<b>LASMO</b> Large Scale Monitoring F. Kober	The field activities were completed at the end of 2018. Data analysis and interpretation is ongoing and a summary report that includes an update on the geoscientific knowledge (geology, structures, hydrology and hydrogeochemistry, stress state) is in the final review stage (see below). Follow-up activities are being evaluated and outlined. Schneeberger, R. et al. (in prep.): Grimsel Test Site: Revisiting the site-specific geoscientific knowledge of the GTS. Nagra Technical Report NTB 19-01.
<b>LTD</b> Long Term Diffusion A. Martin	Circulation of a radionuclide cocktail solution in the second in-situ test was completed according to plan and borehole cores were retrieved for analysis by intersecting the diffusion plume with both near-field and far-field sampling boreholes. Analysis of rock coupons sawn from the drill cores and comparison with diffusion and sorption models with the focus on scaling from lab to in-situ conditions and process understanding are currently being performed by the LTD partners.  Preparations are being made for a follow-up in-situ test in the controlled zone to study the effects of fracture heterogeneity on radionuclide sorption and diffusion into the rock matrix. The experiment concept is to circulate the radionuclide cocktail solution within a fracture (dipole configuration) and to overcore the fracture and the surrounding matrix.
<b>MACOTE</b> Material Corrosion Test A. Martin	Analyses of the 1-year samples are now complete and will be discussed and presented at the next partner meeting at Harwell, UK, in May. Two additional modules containing cast steel coupons from Japan will be inserted into the non-heated test in April. At the same time, two modules that have been in the borehole for over four years will be retrieved for detailed chemical and microbial analysis.
<b>TEM</b> Test and Evaluation of Monitoring Systems A. Reinicke	Re-start of the water injection system with higher rates is planned to allow degassing and faster saturation of the bentonite buffer in order to investigate the mechanical properties of the shotcrete plug. The magneto-inductive wireless monitoring system which has been working for about eleven years - well beyond the expected functioning period of approximately 5 years - has reached its limit of its lifetime. The observations during this period showed the capability of this technology to provide reliable information in such experiments in underground laboratories.

# GTS Upcoming Events . 2019

Event	Description
<b>ISCO Meeting</b> 2019	The annual international steering committee meeting of the GTS will take place: <b>June 12th-13th, 2019 at Handeck Hotel, Guttannen, Switzerland.</b> Further information and invitations were sent out in March 2019.

## GTC Grimsel Training Centre . COURSES 2019 & 2020



[www.grimsel.com](http://www.grimsel.com)

Date	Description
<b>June 2019</b> 3 days	<b>From geophysical field data to geological models.</b> Theory and hands-on workshops.
<b>September 2019</b> 1 week 3 days	<b>Fundamentals of hydraulic testing in URLs.</b> Theory and hands-on workshops. Module 1: Theory and practical training, test analysis and QA. Module 2: Advanced interpretation techniques and development of hydraulic models.
<b>October 2019</b> 1 week	<b>Geological investigations and characterisation of core material from deep boreholes.</b> Theory and hands-on workshops.
<b>June 2020</b> (provisional) 1-2 weeks	<b>Fundamentals of geological disposal.</b>
<b>September 2020</b> (provisional) 1 week	<b>Engineered Barrier Systems (EBS) BENTONITE properties and applications.</b>

## GTS The view from the GTS onsite team

**GTS**  
Operation  
and Safety



The underground railway  
Handeck ↔ Gersteneegg.

In addition to the overall administration and maintenance of the GTS, the onsite team was instrumental in recent months in completing the CFM project (LIT overcoring and sample preparation, i-BET installation).

As with every year, severe winter conditions required ad hoc decisions for accessing the GTS due to closed roads to Guttannen and Handeck (the avalanche risk was highest in the Central Alps after heavy snowfalls in January this year). As a result, it occasionally occurred that access to the GTS was under the slightly cramped conditions in the adventurous underground railway system.

As part of ongoing education about avalanche danger, the local GTS team also participated in an avalanche and rescue course organised by the local hydropower company (KWO).

A further focus is on the preparations for the upcoming GTS visitor season, with several groups and events already planned.

The empty Raeterichsboden lake (part of the dam) covered in snow.



## GTS Information . MISCELLANEOUS

- GTS Website**            The GTS virtual tour was recently extended: [www.grimsel.com/Virtual\\_Tours/](http://www.grimsel.com/Virtual_Tours/)
- GTS Publications**        Please visit our GTS publication area to find the most recent updates on reports and publications:  
[www.grimsel.com/media-and-downloads/grimsel-test-site-publications/grimsel-brochures](http://www.grimsel.com/media-and-downloads/grimsel-test-site-publications/grimsel-brochures)
- GTS Meetings**            Planned upcoming GTS project meetings and GTC activities are online now.
- GTS Links**                News from the Swiss national programme: [www.nagra.ch/en/](http://www.nagra.ch/en/)



### GTS VIRTUAL TOUR

Take a high-quality virtual tour through all of the Grimsel Test Site

### THE GRIMSEL TEST SITE (GTS)

International Underground Research Laboratory

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