MIND: Microbiology In Nuclear waste Disposal
NEWSLETTER 4 – September 2017

*The **Microbiology In Nuclear waste Disposal (MIND)** programme is a unique multidisciplinary project which brings together a broad range of leading research institutions and stakeholders in the field of radioactive waste disposal to address the Euratom 2014–2015 Work Programme topic NFRP 6 – 2014: Supporting the implementation of the first-of-the-kind geological repositories.*

The aim with the project is to contribute to a more complete and realistic safety case and to communicate the effects that microbiological processes will have on the geological disposal of intermediate and high level radioactive wastes.

Content of this Newsletter

Project Annual Meeting

Work Package 1: ILW Organic Polymer Degradation

Work Package 2: HLW Waste Form Degradation

Work Package 3: Evaluating and Sharing the Knowledge

Work Package 4: Project Management

For more information please contact: mind15@skb.se
or visit our webpage: www.mind15.eu
Follow us on Twitter: @mindh2020

This project has received funding from the Euratom research and training programme 2014–2018 under grant agreement No. 661880

Project Annual Meeting (PAM)

The second PAM was held in Prague May 3-5 and was hosted by the Technical University of Liberec (TUL) and Centrum výzkumu Rez (CVRez). Close to 50 participants including project members, endusers and observers. The meeting included a pre-meeting workshop and a visit to the laboratory in Rez.

Photo: Daniel Svensson

Pre-meeting workshop

The meeting started with a pre-meeting workshop organized by Micans on May 3nd. The workshop was divided into two sets of parallel sessions. Invited speakers Achim Albrecht (ANDRA) and Patrik Sellin (SKB) initiated the morning and afternoon session respectively. The workshop sessions, included informal presentations and group tasks to analyse and discuss Performance Assessment of microbially mediated processes, some key scientific uncertainties and microbiological techniques.

Photo: Birgitta Kalinowski

Post-meeting excursion

A visit to the CVRez laboratory was made in the afternoon, where the attendees had the opportunity to either visit the laboratories or the research reactor.

Photo: Petr Polivka and CVRez

Photo: Petr Polivka and CVRez

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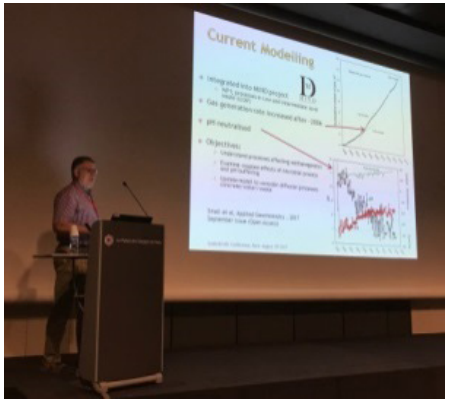
Implementers' Review Board (IRB):

Johan Andersson (SKB), the chair person of IRB organized the first IRB meeting in connection to PAM. The following organizations were represented: ANDRA, NWMO, Nagra, RWM, Posiva, SKB, TVO, SURAO and NIRAS/ONDRAF (members). NUMO, IRSN and LANL were there as observers.

Photo: Daniel Svensson

Other meetings

At **Goldschmidt 2017**, MIND was in charge for the session: Biogeochemical Processes and Radioactive Waste Disposal. Andrea Cherkouk (HZDR) and Jon Lloyd (UniMan) organized and chaired the session. There were 11 oral presentations and 11 posters on the session.



Joe Small, the leader of the Intermediate level waste work package was one of the presenters. Photo Jon Lloyd.

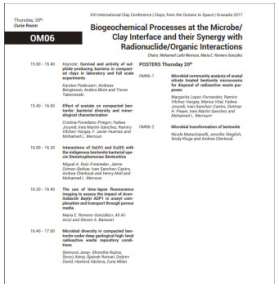
Photo: Jon Lloyd

16th INTERNATIONAL CLAY CONFERENCE

CLAYS, FROM THE OCEANS TO SPACE - Granada 17-21 July 2017

At the **16th International Clay Conference** in Granada, the MINDers Mohamed Merroun and Maria Romero González chaired the session: "Biogeochemical processes at the microbe/clay interface and their synergy with radionuclide/organic interactions". There were 5 oral presentations and 2 posters.

Parque de las Ciencias in Granada, Spain



XVI International Clay Conference (Clays, from the Oceans to Space) Granada 2017

Thursday, 20th
Date Room:

OM06

Biogeochemical Processes at the Microbe/Clay Interface and their Synergy with Radionuclide/Organic Interactions

Chairs: Mohamed Lahdi Merroun, Maria C. Romero González

POSTERS Thursday 20th

15.00 - 15.40 Keynote: Survival and activity of sulphide-producing bacteria in compacted clays in laboratory and full scale experiments
Karsten Pedersen, Andreas Bengtsson, Andrea Blom and Trevor Tullborsmeds

15.40 - 16.00 Effect of metals on compacted bentonite: bacterial diversity and mineralogical characterization
Cristina Povedano-Priego, Fadwa Jroundi, Ivan Sanchez-Castro, Víctor Vargas, J. Javier Huertas and Mohamed L. Merroun

16.00 - 16.20 Interactions of Sr(II) and Eu(III) with the indigenous bentonite bacterial species Stenotrophomonas Bentonitica
Miguel A. Ruiz-Fresneda, Jaime Gómez-Brandón, Ana Isabel Jiménez, Andrea Cherkouk and Henry Wolf and Mohamed L. Merroun

16.20 - 16.40 The use of time-lapse fluorescence imaging to assess the impact of Aspergillus niger on U(VI) and Eu(III) speciation and transport through porous media
Maria C. Romero-González, Ali Al-Mamun and Steven A. Banwart

16.40 - 17.00 Microbial diversity in compacted bentonite under deep geological high level radioactive waste repository conditions
Dimitrios Jones, Shreeha Rajna, Enrico Mirra, Sparsh Rawat, Dolores David, Manfred Walzbau, Zona Milan

OM06 - 1 Microbial community analysis of wood chips treated bentonite microcosms for the disposal of radioactive waste purposes
Margarita Lopez-Fernandez, Ramiro Vilchez-Vargas, Marina Vital, Fadwa Jroundi, Ivan Sanchez-Castro, Dietmar H. Pieper, Cristina Povedano-Priego and Mohamed L. Merroun

OM06 - 2 Microbial transformation of bentonite
Nicole Matschiavelli, Jennifer Shigilski, Emily Hoge and Andrea Cherkouk

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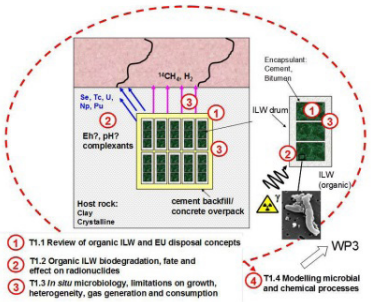
Work Package 1:
ILW: Organic Polymer Degradation

Long-lived intermediate level waste (ILW) requiring geological disposal can include a variety of organic wastes or encapsulants. These organics provide an energy and carbon source with the potential to fuel microbiological processes in ILW waste packages and in the repository.



http://www.mind15.eu/work-packages/wp-1/

Progress

Experimental work at UNIMAN concerning the degradation of polyvinylchloride (PVC) and cellulose materials subject to irradiation and biodegradation has been delivered and has been submitted for journal publication. Further studies concerning bitumen biodegradation will be completed this year, followed by biodegradaton studies of irradiated ion exchange resins.

Studies of radionuclide interactions in involving U and Se in microbially active experimental systems are yielding novel results.

To date, four peer reviewed papers have been published from WP1 research.

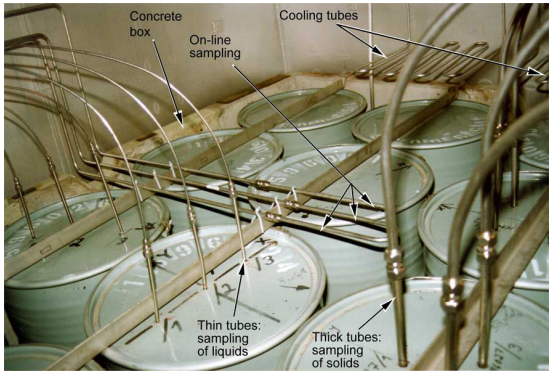
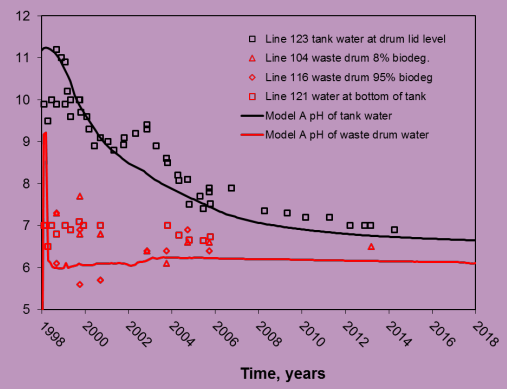


Photo: TVO

Research Highlight

An 18 year data set from TVO's large scale gas generation experiment, Olkiluoto, Finland has recently been published in Applied Geochemistry https://doi.org/10.1016/j.apgeochem.2017.07.012. The paper presents geochemical and gas composition data collected from 16 drums of Low Level Waste under repository conditions. The data has been interpreted with the aid of a biogeochemical model that illustrates the complex coupled processes involved, including the effects of microbial activity on pH buffering, and the importance of heterogeneity. This extensive data set records an increase in CH_4 gas generation rate since 2006 that is attributed to neutralisation of pH, declining sulphide concentration and homogenisation of the chemical conditions.



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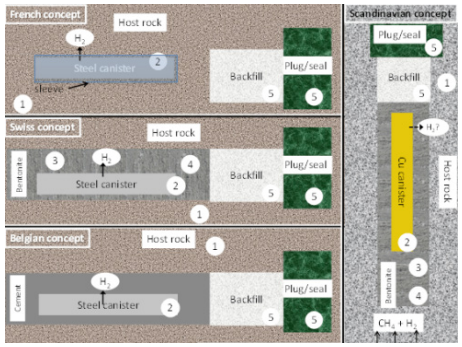
Work Package 2:
HLW: Waste Form Degradation

The metal, concrete and clay barriers in High Level Waste (HLW) disposal concepts are engineered barrier systems (EBS) and are susceptible to deterioration processes. Possible microbial processes are metal corrosion, illitization of smectite clay minerals and degradation of concrete.



http://www.mind15.eu/work-packages/wp-2/

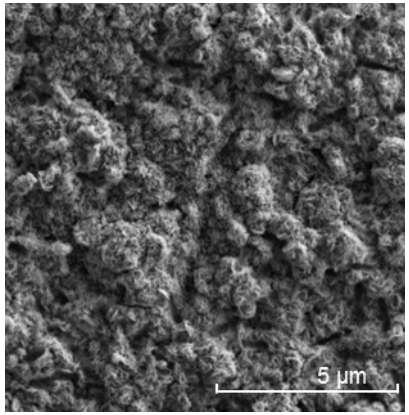
Progress

The partners participating in task 1 has submitted a deliverable in two steps according to plan, deliverable D2.1, on the inventory of reducing gases in host rock and their transport rates to groundwater and microbial ecosystems, and deliverable D2.1-2, Interim report on deep gases and sulphur compounds as biogeochemical energy sources in crystalline rock. For task 2, work is proceeding as planned and deliverable D2-2, Design, set up and operation of experimental equipment has been submitted. Task 3 submitted the deliverable D2.4, on threshold bentonite densities for microbial activity in the end of June. Deliverables for tasks 4 and 5 are scheduled to be submitter after year 3. Work on microbes, concrete and barriers has started in fall 2017 as planned.

Research Highlight

A new publication is available: Bengtsson, A., Pedersen, K., 2017. Microbial sulphide-producing activity in water saturated Wyoming MX-80, Asha and Calcigel bentonites at wet densities from 1500 to 2000 kg m^{-3}. *Applied Clay Science 137:203-212.*

In a study by CV-REZ, Biocorrosion of canister material (carbon steel) was found to be considerably higher (by a factor 2) under anaerobic condition in the environment containing sulphate reducing bacteria comparing to sterile control over 240-days.



SEM of carbon steel surface corrosion after 240 days of exposure to undeground water containing SRB.

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Work Package 3:
Evaluating and Sharing the Knowledge

Results obtained from work package 1 and 2 will be ensured of proper contextualization, while remaining key topics will be extracted by maintaining an active dialogue with stakeholders. The knowledge will be distributed to a broad audience, taking into account conceptualisation and perception issues.

Photo: Birgitta Kalinowski

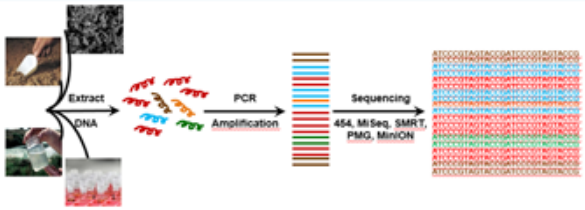
http://www.mind15.eu/work-packages/wp-3/

Progress

The bioinformatics analysis procedure that is used to analyse microbial communities is highly diverse between different MIND partners. To compare the outcome of these pipelines, DNA of a mock community was dispersed among 8 partners and analysed by 5 partners. The results were compared and thoroughly discussed during a pre-workshop organized by SCK-CEN at the PAM-II meeting. The overall conclusion was that the different procedures scored quite well, however, there were some differences in the results which should be taken into account when data are being compared. Drawbacks and pitfalls of different analysis strategies and tips and tricks to analyze the data were examined.

A first draft of the Y2 evaluation report was finished. After contributions from all MIND partners, an overall synthesis and status of the current knowhow and results was performed, and how it is relevant for the performance and safety of the geological disposal facility.

16S rRNA amplicon sequencing



General procedure to prepare 16S rRNA amplicon sequencing.

Comparison of pipelines

Process	Mothur	USEARCH	OCToPUS	QIIME
Data trimming				
Error rate - denoising				
Chimera - detection				
OTU clustering				

Comparison of the different processes used in the analysis of 16S rRNA amplicon sequencing data. A green color means that this process is very accurate, yellow is average and red is less accurate.

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Photo: Birgitta Kalinowski

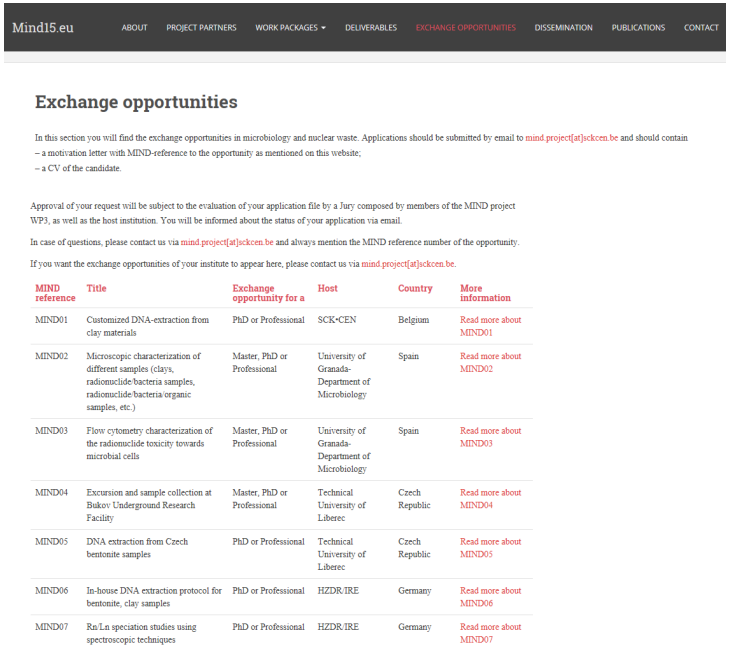
http://www.mind15.eu/work-packages/wp-3/

Progress

To study the impact of the inclusion of microbiology on expert conceptualization and public perception of geological disposal, interviews and group discussions are organized. The PAM-II meeting was used as opportunity to retrieve the implementers' perspectives on the role and place of microbiology in nuclear waste management and to assess how project participants link microbiology research in nuclear waste governance to the safety case.

In 2016, an exchange programme was set up for Master and PhD students, as well as professionals. Carefully selected internship topics are made available by the MIND partners. The first candidate was selected.

Check out the different exchange opportunities on the MIND website and send your students and colleagues abroad to take their knowledge, skills and competences in geomicrobiology to the next level!



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Exchange opportunities

In this section you will find the exchange opportunities in microbiology and nuclear waste. Applications should be submitted by email to mind.project[at]sckcen.be and should contain
– a motivation letter with MIND-reference to the opportunity as mentioned on this website;
– a CV of the candidate.

Approval of your request will be subject to the evaluation of your application file by a Jury composed by members of the MIND project WP3, as well as the host institution. You will be informed about the status of your application via email.

In case of questions, please contact us via mind.project[at]sckcen.be and always mention the MIND reference number of the opportunity.

If you want the exchange opportunities of your institute to appear here, please contact us via mind.project[at]sckcen.be.

MIND reference	Title	Exchange opportunity for a	Host	Country	More information
MIND01	Customized DNA-extraction from clay materials	PhD or Professional	SCK•CEN	Belgium	Read more about MIND01
MIND02	Microscopic characterization of different samples (clays, radionuclide/bacteria samples, radionuclide/bacteria/organic samples, etc.)	Master, PhD or Professional	University of Granada-Department of Microbiology	Spain	Read more about MIND02
MIND03	Flow cytometry characterization of the radionuclide toxicity towards microbial cells	Master, PhD or Professional	University of Granada-Department of Microbiology	Spain	Read more about MIND03
MIND04	Excursion and sample collection at Bukov Underground Research Facility	Master, PhD or Professional	Technical University of Liberec	Czech Republic	Read more about MIND04
MIND05	DNA extraction from Czech bentonite samples	PhD or Professional	Technical University of Liberec	Czech Republic	Read more about MIND05
MIND06	In-house DNA extraction protocol for bentonite, clay samples	PhD or Professional	HZDR/IRE	Germany	Read more about MIND06
MIND07	Rn/Ln speciation studies using spectroscopic techniques	PhD or Professional	HZDR/IRE	Germany	Read more about MIND07

Screenshot of the available MIND exchange opportunities for Master and PhD students, as well as professionals.
http://www.mind15.eu/exchange_table

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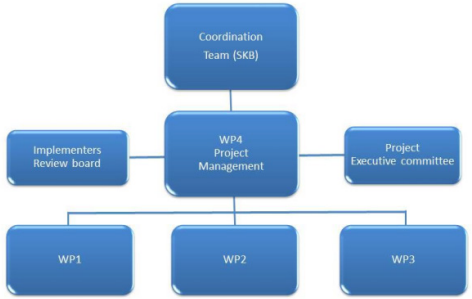
Work Package 4:
Project Management

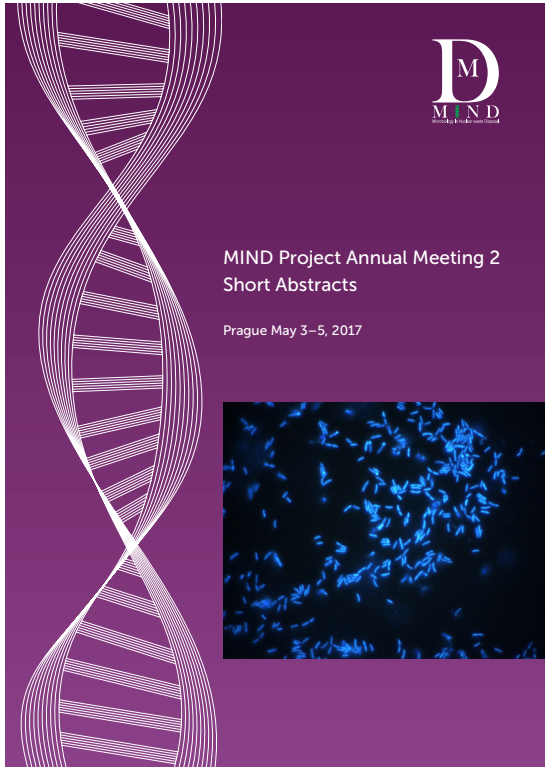
The principal task for this work package is the compliance of the project with the provisions of the European Commission (EC) as defined in the Grant Agreement and the Consortium Agreement by ensuring that the consortium complies with the rules on decision-making as defined in the Consortium Agreement.



http://www.mind15.eu/work-packages/wp-4/

Progress

After the second Project Annual Meeting (PAM), work package 4 has compiled the second abstract book, which is now available at http://www.mind15.eu/wp-content/uploads/2017/07/MIND_Abstract_2017.pdf



Save the date!

The next Project Annual Meeting will be held in Lausanne, Switzerland, from May 7th until 9th 2018.

MIND PAM 3
7-9 May, 2018

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