



## MIND: Microbiology In Nuclear waste Disposal NEWSLETTER 6 – October 2018

*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.*

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### Content of this Newsletter

Project annual meeting

1. Work Package 1: ILW Organic Polymer Degradation
2. Work Package 2: HLW Waste Form Degradation
3. Work Package 3: Evaluating and Sharing the Knowledge
4. Work Package 4: Project Management

For more information please contact: [mind15@skb.se](mailto:mind15@skb.se)  
or visit our webpage: [www.mind15.eu](http://www.mind15.eu)

## 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, NIRAS/ONDRAF, NUMO (members) with IRSN and LANL (Los Alamos National Laboratory) as observers. In addition, CNSC (Canadian Nuclear Safety Commission) participated.



## Pre-meeting workshop

The third Project Annual Meeting was hosted by the EPFL. The meeting started at noon with a brief introductory talk by the coordinators who welcomed all to the meeting. This was followed by a much appreciated plenary talk by Satoru Suzuki from NUMO that initiated the pre-workshop.



The workshop following the talk was organized by IRB and focussed on microbiological-related research topics relevant to radioactive waste disposal. The IRB has created a list with high priority issues that is now being compared with the Grant Agreement.

## Poster session

The workshop ended with a poster session that started with two minutes presentations by all authors. Sixteen posters from TUL, CVREZ, EPFL, UGR, MICANS, SCK•CEN, HZDR, VTT, CNSC and CRIEPI were presented.



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

## Project Annual Meeting (PAM)

The third PAM was held in Lausanne May 7–9 and was hosted by EPFL. About 50 participants including project members, endusers and observers. The meeting included a poster session with oral introduction.



## Project Annual Meeting

The second day was dedicated to the two experimental work packages which were organized and chaired by the WP1-leader Joe Small and the WP2-leader Karsten Pedersen respectively. The last session which was held the last day, was organized and chaired by WP3-leader, Natalie Leys.



Natalie also gave a brief summary of the joint programming.



Valuable input was given by the end users both in the discussion during the meeting and during the summary of the whole meeting the last day. In addition, the interest in the MIND project shown by the regulators IRSN and CNSC and by colleagues from outside the EU such as the US (LANL), Canada (NWMO and CNSC) and Japan (NUMO and CRIEPI) was very much appreciated. The meeting was closed by the Coordinator Birgitta Kalinowski and Petra Christensen.

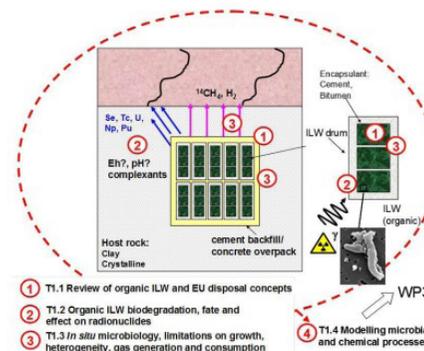


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# 1. Work Package 1

## 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

Five report deliverables have been produced to date, including; a state of the art review at the project outset and reports of experimental work. Studies of degradation of irradiated cellulose, bitumen and PVC materials have been completed and have assessed the ability of microbes to metabolise organic degradation products at pH conditions relevant to ILW disposal. Further studies of ion exchange resin degradation are in progress.

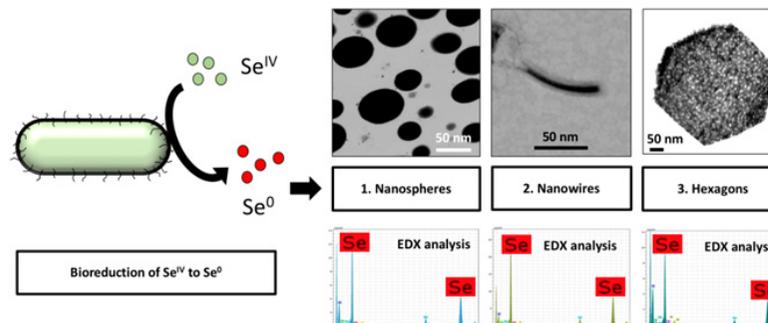
Microbial characterization of an 18 year methane gas generation experiment (TVO, Finland), using genomic techniques has been completed and submitted for publication, complementing a modelling study of the experiment published earlier within the MIND project. <https://doi.org/10.1016/j.apgeochem.2017.07.012>

Further aspects of WP1 consider radionuclide interactions, including the characteristics and behavior of microbes isolated from Spanish bentonites that are capable of reducing Se. In addition, work is nearing completion regarding uranium complexation of cellulose degradation products.

## Research Highlight

Ruiz-Fresneda *et al* (2018) have recently reported the ability of *Stenotrophomonas bentonitica*, isolated from Spanish bentonites, to be capable of reducing the soluble and poorly sorbing chemical forms of selenium (Se(IV)) to Se(0). Using a range of electron microscopy techniques the MIND researchers have shown that the precipitated Se(0) formed by the microbe changes morphology and crystallinity with time which will further lower its solubility. It is revealed that the microbe cells and their extracellular proteins play an important role in this transformation process that could reduce the mobility of selenium from repositories.

<https://doi.org/10.1039/c8en00221e>

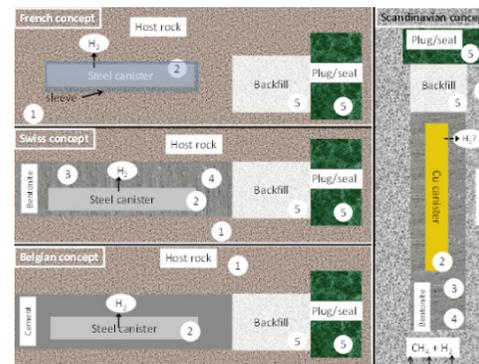


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## 2. Work Package 2

### 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/>

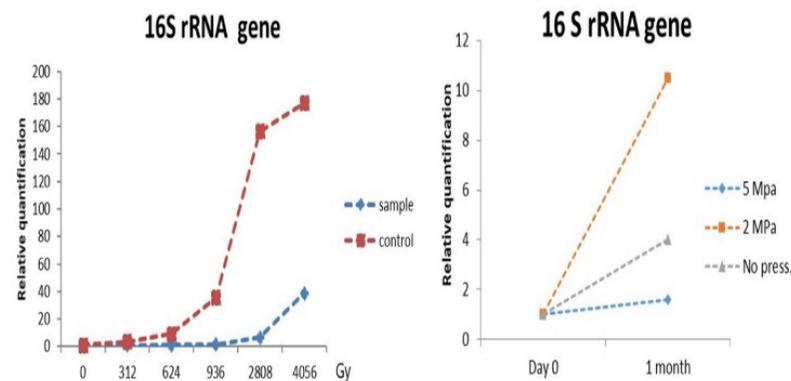
### Progress

Partners have recently delivered 8 reports on various aspects regarding microorganisms, bentonite, corrosion and diversity. Six of these reports are available from the MIND homepage and two will be made open to the public 31 May 2019. Some important observations by WP2 partners are:

- Results on diversity of bacteria in commercial bentonite confirms earlier published data that shows presence of bacteria, spore formers, sulphate reducers and common soil bacteria.
- Bacterial sulphide-producing activity in water saturated bentonite correlates negatively with increasing clay density and the specific swelling pressure generated by the respective clay type.
- Sulphide from sulphide-producing bacteria reacts with ferric iron in bentonite with the formation of elemental sulphur, ferric iron and iron sulphide. This process may reduce the amount of sulphide that can reach a waste container (Pedersen, K. *et al.*, 2017. *Applied Clay Science* 146:495-502).

### Research Highlight

TUL/CV Rez found that bacteria survive and migrate in fully saturated bentonite compacted to the dry densities of 1400 kg/m<sup>3</sup> and 1600 kg/m<sup>3</sup>. In their experiments testing the limiting effect of pressure and gamma irradiation on survival of bacteria in bentonite suspension, the bacteria survived even at the cumulative radiation doses as high as 4056 Gy (with the dose rate 13 Gy/h) (left graph). On the other hand, a significant decrease in bacterial presence in bentonite suspension was detected under the 5 MPa pressure for 1 months compared to the suspension under 2 MPa and no pressure control (right graph).



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### 3. 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.



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

#### Progress

Twelve participants are registered to follow the advanced training course: “Geomicrobiology in radioactive waste disposal” that will be organized from October 8–11, 2018 at SCK•CEN (Mol, Belgium). Several project partners contributed to give a lecture in the course. The full program can be found on the website: [http://academy.sckcen.be/en/Customised\\_trainings/Calendar](http://academy.sckcen.be/en/Customised_trainings/Calendar)

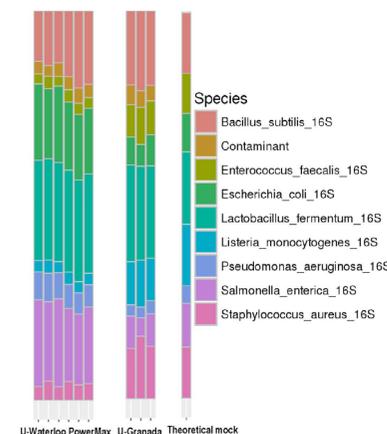
In the framework of a broader risk perception and communication research, an interactive workshop “Open up your MIND” will be organized by the Social Science team of SCK•CEN on October 23. Scientists and informed civilians will take part in this workshop.

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!

#### Research Highlight

EPFL initiated an experiment to compare different DNA extraction protocols to recover DNA from a clay-rich environment. To this end, they distributed Opalinus Clay spiked with a cell mock community provided by SCK•CEN to the different partners. Extracted DNA samples were sent back to EPFL, who amplified the 16S RNA amplicon and sent it for sequencing. Finally, SCK•CEN analysed the sequencing data.

Seven distinct DNA extraction protocols were compared and diverse results were obtained. One method had a strikingly higher yield compared to other method, while another method was outstanding in reassembling the mock community.



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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/>

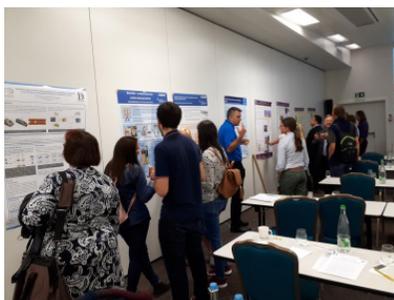
### Progress

The third yearly project meeting was held in Lausanne, Switzerland, on May 7–9th, 2018. Invited to the meeting were project members as well as the Implementers Review Board (IRB).

The MIND-project currently have 10 accepted and published articles in various high impact journals. For more information visit the MIND [website](#).

### Reporting

The second reporting period has been finalized and submitted to the Commission. No alerts have been identified apart from short delays. All deliverables planned for the period is at hand.



### Amendment to Grant Agreement

The project members have agreed not to publish all deliverables publicly on the Commission "Participant Portal" due to journal restrictions, thus all planned deliverables can be found on internal channels for the Commission and for internal project use.

- MIND - Deliverable 1.1 Review-of-anthropogenic-organic-wastes
- MIND - Deliverable 1.2>NNL\_Con
- MIND - Deliverable 1.3 Radiation and microbial degradation of bitumen\_Con
- MIND - Deliverable 1.4 HZDR\_Con
- MIND - Deliverable 1.5 Microscopy and element mapping characterization studies of radionuclide\_Con
- MIND - Deliverable 1.6 Relevant metabolic processes and limits on chemical conditions leading to methane g
- MIND - Deliverable 1.7 Methanogenesis deliverable report
- MIND - Deliverable 2.1 Inventory of reducing gases
- MIND - Deliverable 2.2 Design, set up and operation of..
- MIND - Deliverable 2.3 Interim report on deep gases and sulphur compounds
- MIND - Deliverable 2.4 Bacterial activity in compacted bentonites
- MIND - Deliverable 2.5 Microbial activation due to addition of electron donors-acceptors in deep groundwat
- MIND - Deliverable 2.6 VTT
- MIND - Deliverable 2.7 Microbial diversity in aged bentonites
- MIND - Deliverable 2.8 Final
- MIND - Deliverable 2.9 Evolution of stress in biotic and abiotic clay flow cells FINAL
- MIND - Deliverable 2.10 TUL CRC
- MIND - Deliverable 2.11 Microbial cement deterioration boundaries
- MIND - Deliverable 2.12 Microbial activity in a concrete-bentonite clay interface
- MIND - Deliverable 3.1 Y1 Evaluation
- MIND - Deliverable 3.2 Risk communication
- MIND - Deliverable 3.3 Modular microbiology education and training
- MIND - Deliverable 3.4 Y2 evaluation report
- MIND - Deliverable 4.1 Project homepage
- MIND - Deliverable 4.2 Project Presentation (PP)
- MIND - Deliverable 4.3 Dissemination and Exploitation Plan (DEP)\_151215
- MIND - Deliverable 4.4 Data Management Plan (DMP)
- MIND - Deliverable 4.5 Publication Plan

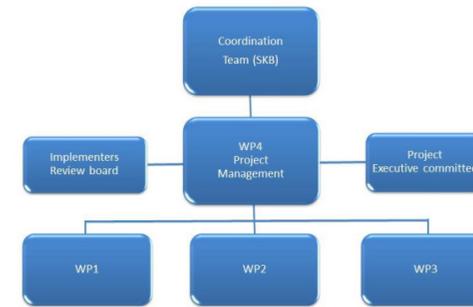


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## Work Package 4

### Project Management

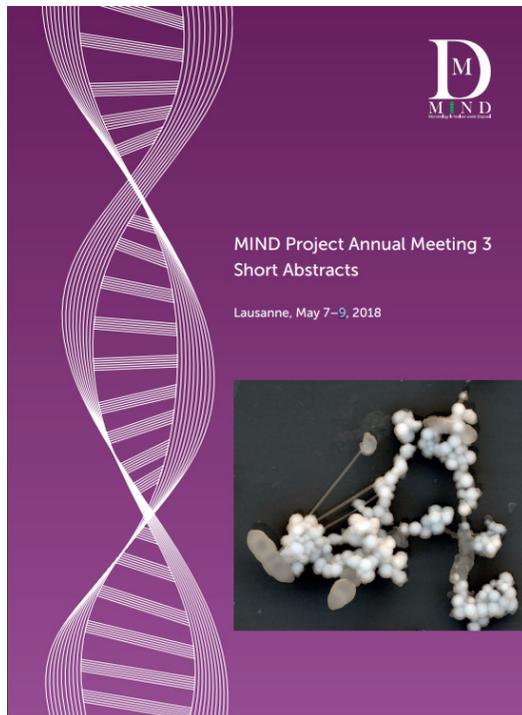
The principal task for this work package is the compliance of the project with the provisions of the European Commission (EC) as defined in the Grant Agreement and the Consortium Agreement by ensuring that the consortium complies with the rules on decision-making as defined in the Consortium Agreement.



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

### Progress

After the third Project Annual Meeting (PAM), work package 4 has compiled the third abstract book, which is now available at: [http://www.mind15.eu/wp-content/uploads/2018/06/MIND\\_Abstract\\_2018\\_webb-1.pdf](http://www.mind15.eu/wp-content/uploads/2018/06/MIND_Abstract_2018_webb-1.pdf)



### Save the date!

The next Project Annual Meeting will be held in Stockholm, Sweden, from May 7<sup>th</sup> until 9<sup>th</sup> 2019



**MIND PAM 4**  
**7-9 MAY 2019**



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