Restriction of microbial growth and activity in a geological repository for radioactive waste

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Expectations on the outcome of WG5

- **Destination**
  - Define scientific and technological priorities
  - Identify common interests

- **Companions**
  - Building a strong international network
  - Complementing competences

- **Travel**
  - Set the basis for a strong TSWG and subsequent EC-proposal

- **Paradise**
  - Joint ‘Microbiology’ project
  - Sharing of expertise and data
SCK•CEN Microbiology Team

7 Scientists

Natalie Leys
Paul Janssen
Rob Van Houdt
Felice Mastroleo
Pieter Monsieurs
Hugo Moors
Katinka Wouters

6 Doctorandi

Kristel Mijnendonckx (UCL)
Hanène Badri (Umons)
Sandra Condori Catachura (Umons)
Jozef Dingemans (VUB)
Joachim Vandecraen (KUL)
Mohamed Ahmed Mysara (VUB)

= 19 pers

5 Technicians

Ann Provoost
Ilse Coninx
Wietse Heylen
Patrick Boven
Liselotte Leysen

1 Consultant
Mergeay Max

Ca. 1-5
scientific visitors/trainees/students

+ Collaboration and interactions with the SCK•CEN Waste & Disposal Unit and Euridice-ESV
Expertise: research fields

Space

Nuclear Installations

MIC @ SCK•CEN
Towards better understanding of microbial behaviour when exposed to radiation, (radio)toxic compounds, and challenging environmental conditions

By detailed analysis of

- Bioprocess
- Community biodiversity
- Cell physiology
- Genetics & gene transfer
- Gene expression & regulation
- Bio-informatics

To exploit the full benefits of microbes in biotechnologies
To manage microbial hazard and environmental safety

Environment

Human body
Expertise: Microbial Community Typing

Piezometer sampling

PCR-DGGE

SEM

Targeted cultivation

Morpheus pore water sample

Metagenomics

Contribution to Competent Safety Case

Microbes will be present and active, and will interact with waste, repository and host rock environment, during excavation, exploitation, and storage.

Need to reduce uncertainties about:

- the microbial communities present in waste, repository and host rock
- the microbial bioprocesses that can occur at in situ conditions
- the impact of those processes on the water & surface geochemistry
- the impact of those geochemical changes on the waste, repository and clay environment
Physical conditions SHAPING microbial communities and processes

\[ \rightarrow \text{inhibiting or promoting} \]

- Water activity
  - clay, borehole, granite
- Pressure/consolidation
  - nanopores, fractures, voids
- Temperature
  - 16°C \( \rightarrow \) 80°C
- Radiation
  - background \( \rightarrow \) 25Gy/h
- Alkalinity, pH
  - pH 8 \( \rightarrow \) pH 13
- Salinity
  - nitrate plume
- Surfaces
  - engineered interfaces, equipment
Restrictions versus Opportunities

Environmental factors SHAPING microbial communities and processes

- Water activity
- Pressure/consolidation
- Temperature
- Radiation
- Alkalinity, pH
- Salinity
- Surfaces

→ inhibiting or promoting

**Working Hypothesis**

“Microbial communities of different origin converge towards similar community functions when subjected to a defined set of restrictions.”

- Need to validate
  - for safety functions
  - in situ
  - on long term
  - through modeling

- In which way is this converging behavior reversible when restriction diminishes?

- How to deal with heterogeneity and uncertainty when this hypothesis is rejected?