

# BEACON

Bentonite Mechanical Evolution

This project receives funding from the Euratom research and training programme 2014-2018 under grant agreement No 745942



# Background

The assessment of long-term safety of a geological repository has to rely on a robust model of a spatial and temporal distribution of the safety relevant properties of bentonite.

Thus developing predictive capabilities of the mechanical behaviour of bentonite buffers, seals and backfills are a common need for all radioactive waste management programs that use bentonite in one or more engineered barrier system (EBS) components.

Because of the complexity of the objectives networking at European level is key for the development of an integrated system understanding, skills, training and capabilities.



# Bentonite Mechanical Evolution

The project will address key technical issues that must be tackled to support the implementation of planned geological disposal projects for the high level radioactive wastes across EU.

The overall objective of the Beacon project is to develop and test the tools necessary for the assessment of the hydro-mechanical evolution of an installed inhomogeneous bentonite barrier and its resulting performance.



In short:

Focus is on developing and testing numerical models with data mainly from already performed experiments to assess the mechanical behaviour of the bentonite buffer and backfill.

One of the challenges is to take into account initial heterogeneities introduced in the system by conception with a combination of block and pellets or due to the size of the bentonite component, several 100 m<sup>3</sup>.

Some supplementary experiments will be performed.



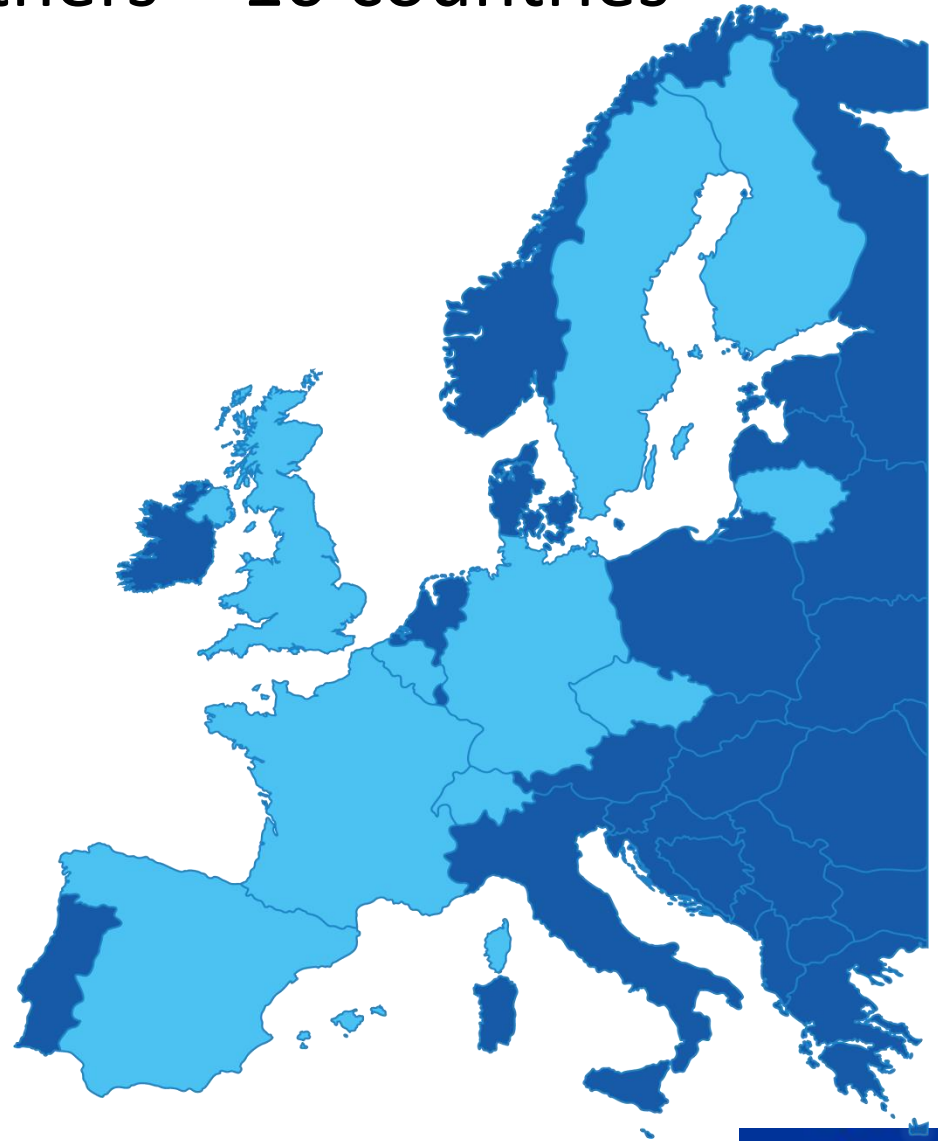
# 25 partners – 10 countries

<b>SURAO</b>	Czech Republic	<b>ULg</b>	Belgium
<b>Posiva</b>	Finland	<b>BGR</b>	Germany
<b>Andra</b>	France	<b>KIT INE</b>	Germany
<b>Nagra</b>	Switzerland	<b>LEI</b>	Lithuania
<b>ENRESA</b>	Spain	<b>CIEMAT</b>	Spain
<b>RWM</b>	United Kingdom	<b>Clay</b>	Sweden
<b>MKG</b>	Sweden	<b>EPFL</b>	Switzerland
<b>UPC</b>	Spain	<b>ICL</b>	United Kingdom
<b>GRS</b>	Germany	<b>Quintessa</b>	United Kingdom
<b>CTU</b>	Czech Republic	<b>NERC/BGS</b>	United Kingdom
<b>CUNI</b>	Czech Republic	<b>JYU</b>	Finland
<b>CEA</b>	France		
<b>VTT</b>	Finland	Coordinator <b>SKB</b>	Sweden



## 25 partners – 10 countries

- Belgium
- Czech Republic
- Finland
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- Germany
- Lithuania
- Spain
- Sweden
- Switzerland
- United Kingdom



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## Start – End – Events

- Project Start: 1 June 2017
- Project End: 31 May 2021 (length 48 months)
- Training Course , Barcelona, 15-19 January 2018
- 1st Annual meeting, Milos, Greece, 29-31 May, 2018
- 2nd Annual meeting, Charles University, Prague, Czech Republic, M24, 21-22 May 2019
- 3rd Annual meeting , Université de Liege, Belgium, M36, 13-14 May 2020
- Final Workshop, M46, 13-15 April 2021 , Imperial College London, Britain



# Work packages

- WP1- Definition of assessment case/Application to the assessment case
- WP2 - Collection and compilation of existing data and available models
- WP3 - Model development
- WP4 - Laboratory testing
- WP5 - Testing, verification and validation of the models
- WP6 - Civil Society interaction
- WP7 - Training and dissemination
- WP8 - Management and coordination
- WP9 - Ethics requirements





WP leader: Nagra, Olivier Leupin  
Participating partners: ANDRA, ENRESA, GRS, Posiva, RWM, SURAO and SKB

## Objectives

- derive the degree of disorder (homogeneity or heterogeneity) that results from specific bentonite applications such as the ANDRA tunnel plug, the Nagra disposal cell and the KBS-3 deposition tunnel backfill based on experimental evidence and numerical simulations
- integrate a term of property variability in the safety assessment of the nearfield and
- formulate requirements in respect to the emplacement density of bentonite that includes property variability and that allows to fulfil specific safety functions.



WP leader: RWM, Simon Norris

Participating partners: ANDRA, BGR, BGS, CEA, CIEMAT, Clay, CTU, CUNI, ENRESA, EPFL, GRS, ICL, JYU, KIT INE, LEI, NAGRA, Posiva, Quintessa, SKB, SURAO, ULg, UPC, VTT

## **Objectives:**

To collect relevant information as produced from past and ongoing projects that provide knowledge relevant to understanding bentonite mechanical evolution in a repository context, and to process it to a level where it can be useful as input to the other Beacon work packages.



WP leader:

UPC, Antonio Gens

Participating partners:

BGR, CIEMAT, Clay, CTU, CUNI, EPFL,  
GRS, ICL, KIT INE, LEI, Posiva,  
Quintessa, ULg

### **Objectives:**

To develop enhanced, robust and practical numerical tools, firmly grounded on a good understanding of the phenomena involved.

The numerical tools should have the required predictive capabilities concerning the behaviour of engineered barriers and seals especially in relation to their final state.



WP leader: RWM, Simon Norris

Participating partners: BGS, CEA, CIEMAT, CTU, CUNI, EPFL, GRS, JYU, KIT INE, Posiva, SKB

### **Objectives:**

- provide input data and parameters for development and validation of models (WP3, WP5)
- reduce uncertainties about conditions and phenomena influencing bentonite homogenization, through experimental studies



## WP5 - Testing, verification and validation of the models

WP leader:

Andra, Jean Talandier

Participating partners:

BGR, Clay, CTU, CUNI, EPFL, ICL, JYU, LEI, Posiva, Quintessa, ULg, UPC, VTT

### **Objective:**

To test, verify and validate the models developed in WP3 with support from the information gathered in WP2 before they are used for the safety case modelling in WP1

The strategy proposed is to select several tests at different scales and with several levels of complexity. The idea is to start with simple tests and progressively increase the complexity in terms of scale, coupled processes and initial/boundary conditions.



WP leader: MKG, Johan Swahn  
Participants: Representatives of the civil society

### **Objectives:**

To give civil society the opportunity to follow, discuss and give feedback on the research conducted in the project by the development, using previous experience, of a relevant interaction framework.

Facilitate the translation of scientific results and other output from WP1-5 to the public and creating the conditions for civil society local and national representatives to interpret, discuss and give feedback on the research result and other information made available by the project. Enhance the possibilities for civil society participation in future situations where there are consultation processes as a part of safety case review.



WP6 - Civil Society interaction (dissemination)

WP7 - Training and dissemination

WP8 - Management and coordination

WP9 - Ethics requirements



## Regulators:

- FANC, Belgium
- IRSN, France
- SSM, Sweden
- (possibly also ENSI, Switzerland)

## Other:

- Paul Scherrer Institute
- Technical University Clausthal

Representatives of experts in the field from organisations outside of the project

Advise the Technical Coordinator, the Executive Board and the Commission with critical evaluation concerning research quality and significance of outputs.





# Calendar

M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
June 2017	July 2017	Aug 2017	Sept 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	March 2018	April 2018	May 2018
Kick off, WP2 WS, Kaunas, D7.1, D2.1			D8.3	D8.13	D2.2	D1.1, D7.2, Consortium Plan, D6.1, D9.1, D7.4 (vers1), D8.12, D7.3, D8.1, D8.2	D7.5 Training Course	D3.2 WP3 report			1st Annual Meeting D5.1.1 D8.8
M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
June 2018	July 2018	Aug 2018	Sept 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	March 2019	April 2019	May 2019
Preliminary reporting for second payment of pre-financing D8.4		D6.2			D5.3	1st periodic report	1st periodic report				2nd Annual Meeting D5.2 D8.9
M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
June 2019	July 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	March 2020	April 2020	May 2020
D8.5		D4.1 D3.3 D4.2 D6.2			D5.5						3rd Annual Meeting D5.4 D4.3 D8.10
M37	M38	M39	M40	M41	M42	M43	M44	M45	M46	M47	M48
June 2020	July 2020	Aug 2020	Sept 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	March 2021	April 2021	May 2021
2nd periodic report D8.6	2nd periodic report	D6.4			D5.6		D3.1		D1.2 Beacon Final Conf D2.3 D8.11	D4.4 D8.7	END of Beacon D6.5, D6.6 D5.7 D1.1 D7.6, D7.8, D7.9
M49	M50	M51	M52	M53	M54	M55	M56	M57	M58	M59	M60
June 2021	July 2021	Aug 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021	Jan 2021	Feb 2021	March 2021	April 2021	May 2021
3rd periodic, and the final report	3rd periodic, and the final report										

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