



EUROPEAN  
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## PROJECT PRESENTATION (PP)

**SLOW PROCESSES IN CLOSE-TO-EQUILIBRIUM CONDITIONS FOR RADIONUCLIDES  
IN WATER/SOLID SYSTEMS OF RELEVANCE TO NUCLEAR WASTE MANAGEMENT**

**SKIN**

**DELIVERABLE D6.3**

**COLLABORATIVE PROJECT (CP)**

Grant agreement N°269688

Submitting organizations: ARMINES

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Actual submission: Month 4

Start date of the project: 01 January 2011

Duration: 36 months

Project co-funded by the European Commission under the Seventh Framework Programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities (2007 to 2011)

Dissemination Level

<b>PU</b>	Public	X
<b>RE</b>	Restricted to a group specified by the partners of the project	
<b>CO</b>	Confidential, only for partners of the project	



## Introduction

Implementation of geological disposal of radioactive waste requires assessment of relevant processes in the near-field (wasteform and engineered barriers) and far-field (host rock and pathways to the biosphere) to allow for development of robust methodologies for performance and safety assessment. Relevant processes are all those affecting the mobility of radionuclides. Questions need to be answered as to whether the engineered and geological barrier systems can isolate and retain the radionuclides in the waste for hundreds of thousands of years. Due to slow groundwater movement in confined deep geological formations, the system of radionuclides, minerals, engineered barrier materials and water will be close to chemical equilibrium. These systems, controlling radionuclide mobility, have been studied for many years, but only a little attention has been given to the fact that, due to the long disposal time, individual very slow processes can have a significant impact on the mobility of radionuclides, despite achievement of local equilibrium states being achieved.

### 1. Nature and Scope of the project

The project will study slow processes influencing radionuclide mobility in close-to-equilibrium scenarios in a detailed and systematic manner in relation to surface properties, surface site detachment/attachment kinetics, irreversible sorption and surface incorporation, for cases relevant to the assessment of radionuclide mobility in nuclear waste repository sites.

Emphasis is on the temporal evolution of surface detachment and attachment rates on minerals and the coupling of surface equilibrium with slow bulk phase diffusion/ recrystallisation processes of trace element (incorporation or release). This concerns kinetic studies, thermodynamic evaluations of solid solution/aqueous solution equilibrium, trace and principal element relations, structural and morphological observations and molecular modelling.

The project has 10 partners, including national waste management organizations, national research centres, universities/grandes écoles and SMEs, from 5 EU Member States (France, Germany, Sweden, Spain, United Kingdom), one Associated Country (Switzerland) and one Other Country (China).

### 2. Activities

The proposed strategy combines laboratory experiments and model development with analyses of safety implications. The work consists of combining, for relevant time frames, bottom-up approaches with individual mineral/water systems with top-down analyses of performance assessment needs to describe non-linearly coupled exchange processes in geological disposal environments.

The work programme covers various experimental case studies for solubility and sorption equilibria combined with surface incorporation and associated model development of practical relevance for application within performance assessment.

The R&D work programme is structured along two experimentally oriented RTD work packages and a work package for model development as well as for assessing consequences in safety analyses. In addition, there is one RTD work package for synthesis. The main questions to be answered are:

- Identification of the substitution scheme for complex metal ion substitutions ion binding (precipitation, co-precipitation, surface uptake) in complex cement related systems.

- Questions of reversibility of solid/solution interaction with clays.
- Assessment of the kinetics of dissolution of tetravalent oxides under quasi-equilibrium conditions the impact of major systems present in the repository environment on the rate of dissolution of matrix-related material and retention/release of radionuclides.

### 3. Expected results

The project results are expected to impact strongly on; (1) the use/misuse of solubility data for thermodynamics; (2) the understanding of affinity/rate relations close-to-equilibrium; (3) the inclusion of irreversibility in models on the long-term mobility of radionuclides in geological disposal systems; and (4) the coupling of radionuclide chemistry with main element chemistry in the repository environment. The results of the project will probably show that safety margins in geological disposal concepts are larger than anticipated.

The study of **SKIN** will have a strong impact on the development of scientific methodology in assessing the long-term aspects of radionuclide migration in geological disposal.

A number of questions of general relevance will be addressed in the project, which are as well of relevance of performance assessment and with different responses expected for the different solids/water systems studied.

### 4. Societal Impact

The research results expected from the SKIN project have a direct impact on the European nuclear power community, including authorities representing public safety concerns. This impact is related to the environmental, economic and political advantages of continued use of the clean and economic nuclear power, as well as its contribution to political stability through lowered dependency of energy import. This is directly related to long term improvement in European competitiveness, employment, environmental quality and quality of life.

### 5. Information about important public events

Persons with interest in the project may participate in annual workshops, announced on the project website.

## Project information

**Website address:** [http://www.emn.fr/z-subatech/skin/index.php/Main\\_Page](http://www.emn.fr/z-subatech/skin/index.php/Main_Page)

**Project type:** Collaborative Project  
Small or medium-scale focused research project

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**LIST OF PARTNERS**

No	Partner	Beneficiary name	Country
1	<b>ARMINES</b> <a href="http://www.armines.net">www.armines.net</a>	Association pour la Recherche et le Développement des Méthodes et Processus Industriels	FR
2	<b>KIT</b> <a href="http://www.kit.edu/">http://www.kit.edu/</a>	Karlsruher Institut fuer Technologie	DE
3	<b>FZJ</b> <a href="http://www.fz-juelich.de/portal/DE/Home/home_node.html">http://www.fz-juelich.de/portal/DE/Home/home_node.html</a>	Forschungszentrum Juelich GMBH	DE
4	<b>SKB</b> <a href="http://www.skb.se">www.skb.se</a>	Svensk Kärnbränslehantering AB	SE
5	<b>AMPHOS</b> <a href="http://www.amphos21.com">www.amphos21.com</a>	AMPHOS 21 Consulting, S.L.	ES
6	<b>CTH</b> <a href="http://www.chalmers.se">www.chalmers.se</a>	Chalmers University of Technology	SE
7	<b>SU</b> <a href="http://www.su.se/english/">http://www.su.se/english/</a>	Stockholms Universitet	SE
8	<b>PSI</b> <a href="http://www.psi.ch">www.psi.ch</a>	Paul Scherrer Institut	CH
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