



## **Cement based materials, properties, evolution, barrier functions**

Cebama es un proyecto de colaboración financiado por la Comisión Europea bajo el marco de Horizonte 2020 dentro del programa de Energía Atómica (EURATOM) (H2020-NFRP-2014/2015), para Contribuir al desarrollo de soluciones para la gestión de los residuos radiactivos [www.cebama.eu](http://www.cebama.eu).

El consorcio Cebama reúne a 27 organizaciones de investigación de 9 países de la UE, Suiza y Japón. El CSIC es uno de los miembros del proyecto CEBAMA, siendo el IETcc el Centro responsable de los desarrollos tecnológicos (persona de contacto: M<sup>a</sup> Cruz Alonso, [mcalonso@ietcc.csic.es](mailto:mcalonso@ietcc.csic.es)

Los objetivos generales del Cebama es apoyar la puesta en práctica del almacenamiento geológico de residuos radioactivos, mejorando la base del conocimiento para lograr la seguridad de los repositorios europeos.

Los objetivos específicos de Cebama plantean:

- Llevar a cabo estudios experimentales para entender los procesos de interacción entre los materiales a base de cemento y las distintos tipos de rocas del almacenamiento geológico profundo o de relleno de bentonita y evaluar el impacto en las propiedades de transporte. Estos aspectos se investigan mediante ensayos de laboratorio y utilización de ensayos in situ.
- Estudiar los procesos de retención de radionucleidos en entornos de alto pH. Analizar la retención de algunos radionucleidos: Be, C, Cl, Ca, Se, Mo, I, Ra.
- Evaluar el impacto de las alteraciones químicas, como un pH elevado, envejecimiento del hormigón, carbonatación, la transición de oxidante a la reducción en la retención de radionucleidos.
- Mejorar la validez de los modelos numéricos para predecir cambios en el transporte.



# Cement-based materials, properties, evolution, barrier functions



Newsletter Issue 1,

February 2016

## Foreword

Cebama is a research and innovation action granted by the European Atomic Energy Community in support of the implementation of the first-of-the-kind geological repositories. The 4-year project, started 1<sup>st</sup> of June 2015, is carried out by a consortium of 27 partners consisting of large Research Institutions, Universities, one TSO, and one SME (small medium enterprise) from 9 EUR-ATOM Signatory States, Switzerland and Japan. National Waste Management Organizations support Cebama by co-developing the work plan, participating in the End-User Group, granting co-funding to some beneficiaries, and providing for knowledge and information transfer.

The overall strategic objective of Cebama is to support the implementation of geological disposal by significantly improving the knowledge base for the Safety Case for European repository concepts. Scientific/technical research in Cebama is largely independent of specific disposal concepts and addresses different types of host rocks, as well as bentonite. Cebama is not focusing on one specific cementitious material, but is studying a variety of important cement-based materials in order to provide insight on general processes and phenomena which can then be transferred to several different applications.

In February 2016, the experimental program of Cebama is fully operative and the project progressing as scheduled. As the present first newsletter intends to provide a general overview of the aims and structure of the Cebama project, future Newsletters will put strong focus on the new R&D results generated in Cebama. We hope that the Cebama Newsletters will encourage different stakeholders to follow closely the research performed within the Cebama project and contribute to productive interactions and exchange.

**Marcus Altmaier (Cebama Coordinator)**

*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 662147.*

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**Project website:**  
[www.cebama.eu](http://www.cebama.eu)

**Newsletter submitting  
organization :**  
**Amphos 21**  
**Passeig Garcia i Fària 49-51**  
**E08019 Barcelona**  
**Spain**

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## Editorial

Dear Reader,

I have the pleasure to present the first issue of the newsletter of the Horizon 2020 project Cebama which started on June 1<sup>st</sup> 2015.

The main purpose of this newsletter is to inform a wide interested community on the research carried out within Cebama during its first six months. On the following pages, the project organization will be briefly presented and the main objectives of each workpackage, as well as an overview of the ongoing activities and recent achievements described.

A section is also dedicated to the recent and future events of Cebama, where we will come back to the Cebama kick-off meeting in Brussels and announce the project's first Annual Workshop.

This newsletter can be downloaded from the project webpage [www.cebama.eu](http://www.cebama.eu).

Amphos 21

Knowledge management and dissemination office of Cebama

## Project organization

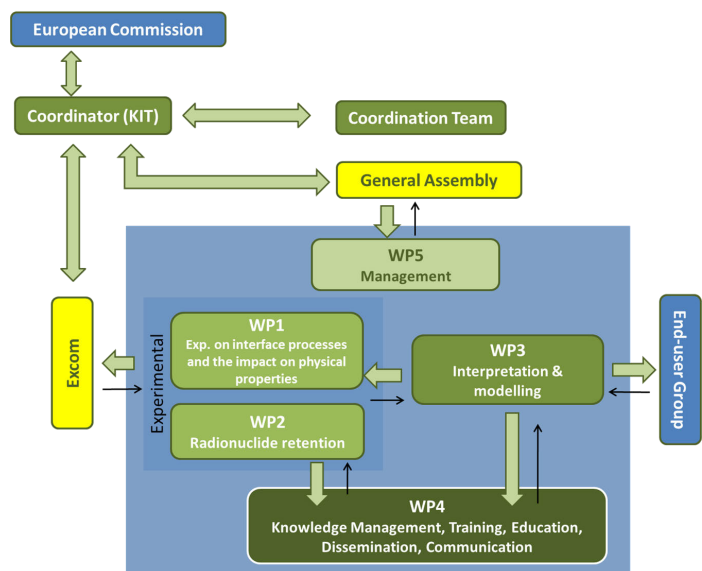
The R&D programme of Cebama is carried out in three specific workpackages (WP1-3) with high level of cross-linkage.

WPs dedicated to knowledge management, dissemination and training (WP4), and project management itself (WP5) are also included in the work programme.

The project is implemented by a consortium of 27 beneficiaries consisting in Research Institutes, Universities and SMEs from EU member countries, Switzerland and Japan, integrating the required skills, competences and resources needed to achieve the objectives of the work programme.

Nine National Waste Management Organizations participate as End Users Group (EUG), offering technical review and guidance with respect to the relevance of the project for the Safety Case. This represent a valuable asset of the project to identify research priorities.

Cebama is also open to additional organizations entering into formal cooperation and participation via Associated Group agreement.



*27 beneficiaries consisting of Research Institutes, Universities and SMEs from 9 EU members countries, Switzerland and Japan contribute to Cebama*

*...  
9 End User Waste Management Organizations*

#### Beneficiaries (27):



#### End-User Group (9):



## WP1 Experiments on interface processes and the impact on physical properties

**WP leaders :** Erika Holt (VTT, Finland), Francis Claret (BRGM, France), Urs Mäder (University of Bern, Switzerland)

The activities of WP 1 during the first few months of Cebama have addressed the synergy between various research methods and experimental studies of cementitious materials used in the repositories. An internal survey of WP1 participants was conducted to gather more details that serve as the basis for the deliverable reports of the first year, mainly addressed at describing the work plans in detail. This has included gathering more information on experimental methods and cementitious materials being studied, to ensure cooperation and implementation by the End Users Group. The first deliverable report, D1.01, was submitted in August with detailed scientific work summary plans from each partner, serving as a basis for future reference.

WP1 participants met again in London on November 2 to further discuss detailed task plans with the work-package. The meeting was attended by 32 participants from 17 of the 19 WP1 partners as well as representatives of WP3 to ensure coordination between experimental and modelling activities of the project. The meeting also included representation from two of the End User Group members (Andra and RWM). The results of the summary were presented by VTT, as well as having some opening presentations of common interest to all partners. These lectures included presentations on:

- Summary of past projects such as EcoClay I-II, etc (Urs Mäder, Univ. Bern);
- Low-pH concretes: Principles, formulations and characterizations (Xavier Bourbon, Andra);
- Relevant methodologies for pH-related interactions (Maria Cruz Alonso, CSIC);
- Lessons learned from sampling and prep in FEBEX dismantling (Maria Turrero, CIEMET);
- Spatiotemporal monitoring of geochemical transport processes with Positron Emission Tomography (PET) - a useful tool for CEBAMA partners (Johannes Kulenkampff, HZDR).

The meeting concluded with a brainstorming session in three smaller groups on the topics of materials, experimental methods and interaction with Workpackage 3 modelling. The outcome was a plan for having a benchmark low-pH concrete made and distributed to partners for comparable test result interpretation and plans for exchange of samples and sharing of methodologies for interpreting material performance.

The survey results and work-package meeting are serving as the inputs to the next Deliverables D1.02 on systems to be studied (publishing December 2015), D1.03 as a state-of-the-art report on WP1 topics to be used as external reference by the general public (publishing February 2016), D1.04 as Experimental method boundary conditions to be used in WP1 (publishing March 2016) and D1.05 on Experimental materials to be used in the WP1 program (publishing May 2016). These deliverables will be achieved during the next 6 months, as well as laboratory preparation and exchange of numerous recipes and samples. Sampling is also being done from existing in-situ field tests with aged samples, in cooperation with the End Users Group members, for further evaluation in WP1.

During the first period, some of the partners have been in the process of hiring students and staff to fulfil the work plans and ensure competence development of the next generation of nuclear waste management experts. Partners have been interacting with end users groups to determine the highest priority for cementitious material recipes and exposure conditions in the experimental studies, which will best serve the quantitative modelling and long-term safety evaluations.

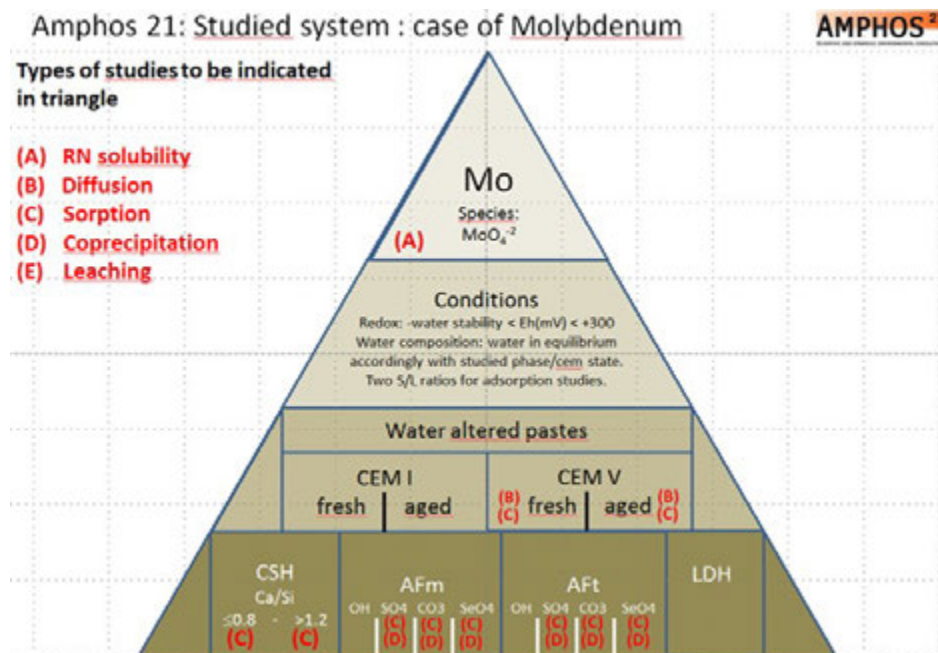
Regarding dissemination plans, many WP1 partners have submitted abstracts to be presented at the “Mechanisms and Modeling of Waste/Cement Interactions” workshop in Murten, Switzerland on May 22-25, 2016 (see [www.empa.ch/cement2016](http://www.empa.ch/cement2016)), thus CEBAMA will have a good level of dissemination already within the first year. Some of the partners are also having papers at the FP7 DOPAS project ending seminar (Turku, Finland on May 25-27, 2016) on “Full-Scale Demonstration of Plugs and Seals”, where concrete-bentonite interaction may also be an issue for long-term safety and performance (see [www.posiva.fi/en/dopas/dopas\\_2016\\_seminar](http://www.posiva.fi/en/dopas/dopas_2016_seminar)).

## WP2 Radionuclide retention

WP leader : Bernd Grambow (Armines, France)

The WP2 activities during the first few months of Cebama concerned the detailed planning of experimental studies on radionuclide interaction on cementitious materials used in the repositories. Following the CEBAMA Kick-off meeting, the first deliverable report, D2.1, was submitted with an overall work plan and detailed plans from each partner, serving as a basis for future reference.

A work-package meeting was held in London on November 5<sup>th</sup> to further discuss detailed task plans with the work-package. All partners of WP2 were represented. The meeting also included representation from the End User Group members (Andra). The goal of the meeting was to create an as much interlinked project as possible. The number of systems to study is large. To allow for compatibility between individual approaches the meeting participants agreed to use as far as possible and feasible similar experimental protocols, boundary conditions or similar solids. Potential transfer of samples between laboratories was also discussed. Other questions concern the exchanges necessary in the interlinkage of the various modelling approaches, how for example to go from individual cement phases to the overall cement pastes or how to take mutual advantage from the analytical capacities in one or the other laboratories. Protocols for preparation of individual cement phases were discussed in great detail. Actually, for each studied radionuclide, each laboratory is preparing a graphical presentation of the systems studied: which individual cement phases, which cement paste, what kind of conditions, what type of studies. A typical example is given below for Mo studies by Amphos21.



## WP3 Interpretation and modelling

**WP leader : Andrés Idiart (Amphos 21, Spain)**

The focus of the modelling work is mainly on physical and chemical processes leading to changes in transport properties both in the cementitious matrix and the cement-host rock interfaces. An essential basis for WP3 is the outcome of the experiments and their characterization performed in WP1. In addition, existing experimental datasets are also used to verify the model developments.

Even though significant advances have been achieved in the coupled process understanding, important gaps still exist on the: (1) interrelation between chemical changes of the cement paste microstructure and its physical properties, (2) relation of classical macroscopic reactive transport models (defined over a representative volume element) to the specific microstructural features of cement and concrete, and (3) confidence in extrapolating numerical models of cementitious systems for long-term conditions.

The main objectives of the work planned in WP3 are the following:

- Improve the validity of existing numerical models to predict changes in transport properties of cementitious systems and the interfaces with different host rocks;
- Give support to the advanced data interpretation and process modelling of WP1 experiments by mechanistic modelling on chemically-induced changes in water and gas flow and transport properties in the cement matrix and at the interface with host rock;
- Contribute to our capacity to extrapolate models of system-level to modelling for Safety Case application (length and time upscaling).

At this stage, the WP3 milestones relate with the definition of the systems to be modelled. During the fall meeting in London, held on November 2, a specific discussion was organised on the interaction between WP1 and WP3, in order to ensure that WP3 participants were informed on experimental plans and the project can be developed in an integrated manner. Each WP3 participant defined an existing experimental dataset to use during the first stages of the project, before WP1 experiments are set up, and will serve to prepare the models and benchmark them prior to the availability of WP1 results. These existing datasets have been chosen by each participant following two criteria: (1) that the type of experiments is similar to those studied in WP1, and (2) that the characterization of the experiments serve the purpose of the modelling approach adopted by each participant.

WP3 models will focus on:

- Cement/concrete matrices and cement/clay interactions;
- Using Reactive Transport as well as Mechanical models;
- Different length scales, mostly at the scale of laboratory experiments, but also from pore-scale to repository (macro) scale;
- Different time scales: mostly covering the duration of lab tests, but also long-term predictions.

The progress foreseen during the next 6 months is related to the review and definition of modelling approaches to be followed in the project (D3.02): scales of analysis, physico-chemical processes considered, software used, or availability of HPC resources.



## WP4 Documentation, knowledge management, dissemination and training

WP leader : Alba Valls (Amphos 21, France)

Within Cebama, WP4 is responsible for carrying out the internal and external communication and training activities. For this purpose, a communication action plan has been established, which is available as deliverable D4.05 on the project webpage.

A web portal ([www.cebama.eu](http://www.cebama.eu)) has been established which provides information of the project that could be of interest for a broader community, e.g., the project description (organization, objectives and workplan, beneficiaries...) as well as the relevant project events. All public deliverables are being and will be uploaded in the *ad hoc* section of the site, and links to other projects with common research areas funded by the EC as well as to public conferences/workshops/events of interest for the partners will be provided. This portal will be updated on a regular basis to provide the latest information on Cebama.

A restricted intranet as well as a forum have also been set up for internal communication purposes.

Presentations and a poster providing a generic description of the project workplan, consortium and organization have been prepared which will be updated and adapted as the project develops and to specifically meet the demands for presentations at specific technical conferences and workshops. This poster was presented at the 15<sup>th</sup> Migration Conference which took place in Santa Fe on September 13-18, 2015.

Cebama was also presented at the 6<sup>th</sup> Exchange Forum of the Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP, [www.igdtp.eu/](http://www.igdtp.eu/)) which took place in London the 3 and 4 November 2015, and the next issue of the IGD-TP newsletter (foreseen in December 2015) includes a short article on Cebama.

**Ce ba ma** CEBAMA – A COLLABORATIVE PROJECT ON CEMENT-BASED MATERIALS, PROPERTIES, EVOLUTION, BARRIER FUNCTIONS, WITHIN THE EUROPEAN COMMISSION / HORIZON2020 FRAME

M. Altmaier (KIT-INE), L. Durr (Amphos<sup>21</sup>), V. Montoya (KIT-INE), B. Kienle (KIT-INE), L. Perrone (Amphos<sup>21</sup>), E. Holt (KIT), E. Claret (BRGM), U. Mäder (Univ. Bern), B. Grambow (AMMRES), A. Idart (Amphos<sup>21</sup>)

**The Cebama project ([www.cebama.eu](http://www.cebama.eu))**

The Collaborative Project Cebama addresses key scientific questions related to the use of cement-based materials in nuclear waste disposal applications. The scientific quality and impact of Cebama builds on joining expertise to tackle these problems within a collaborative approach and emphasizing how the generated knowledge can be applied in the Safety Analysis and Safety Case. Progress beyond the state-of-the-art is achieved by providing basic and trustworthy knowledge, new experimental data, improved modeling and arguments for the Safety Case. Cebama is funded by the European Commission under the Horizon 2020 frame of the European Atomic Energy Community (EURATOM) with the aim to contribute to the development of solutions for the management of ultimate radioactive waste in support of the implementation of the first-of-the-kind geological repositories.

Duration: 4 years starting June 1<sup>st</sup> 2015. **Total Budget ~ 6 M€, (EC contribution ~ 3.9 M€)**

**Project Work Plan**

The R&D is carried out in three R&D Work Packages (WP 1-3), with a high level of iteration between these Workpackages. WP 4 is focusing on dissemination and training. WP5 is related to project management. WP leader are indicated in grey.

**WP1: Experiments on interface processes and the impact on physical properties** (E. Holt / F. Claret / U. Mäder)

Experimental studies are performed to understand the interface processes between cement-based materials and the host rocks (crystalline rock, Boom Clay, Opalinus Clay (OPA), Calivo-Oxfordian (COX)) or bentonite backfill and the impact on physical (transport) properties is assessed.

**WP2: Radionuclide retention** (B. Grambow)

Radionuclide retention processes are studied in high pH concrete environments. Radionuclides which have high priority from the scientific and applied perspective are selected. (Be, C, Cl, Ca, Se, Mo, I, Ra).

**WP3: Interpretation and modelling** (A. Idart)

The validity of numerical models to predict changes in transport processes as a result of chemical degradation is analyzed and improved. Advanced data interpretation and process modelling, covering mainly issues responsible for the changes in transport properties, is supported.

**WP4: Documentation, Knowledge Management, Dissemination and Training** (A. Valls)

**WP5: Management** (M. Altmaier, V. Montoya)

**Consortium**

Distribution of beneficiaries on a member state basis

**Beneficiaries (27):**

**End-User Group (9):**

**Project structure**

**Associated Groups**

Cebama is offering the opportunity of external groups to join the project within the status of Associated Groups (AG). AGs will participate in Cebama at their own costs with specific scientific/technical contributions or particular information exchange functions. The AGs will be invited to the Annual Project Workshops and receive access to the public deliverables and scientific/technical information obtained in the project. (contact: [narcos.altmaier@kit.edu](mailto:narcos.altmaier@kit.edu))

**1<sup>st</sup> Annual Workshop: week from May 8<sup>th</sup> 2016, Barcelona, Spain**

The research leading to these results has received funding from the European Union's Horizon 2020 Programme (NRP-2014/2015) under grant agreement, 662547 - Cebama



## Events

### Project kick-off meeting (July 1<sup>st</sup> and 2<sup>nd</sup> 2015, Brussels)

The project kick-off meeting was held in Brussels on July 1<sup>st</sup> and 2<sup>nd</sup> 2015, and was hosted by the European Commission. In this occasion, all the beneficiaries were represented as well as all the End Users Group organizations. The organizational aspects of the projects were presented, and the programmes of work of the different workpackages were detailed and discussed.



### 1st Annual Workshop

The project's first annual workshop will take place in Barcelona, May 11<sup>th</sup> to 13<sup>th</sup> 2016, at the Hotel Barceló Atenea Mar.

Registration can be done via the Cebama website ([www.cebama.eu](http://www.cebama.eu)).

For more information, please contact [info@cebama.eu](mailto:info@cebama.eu)

**Location**

The 1<sup>st</sup> Annual Workshop of the project will be held on 11<sup>th</sup>-13<sup>th</sup> May 2016 in the **Barceló Atenea Mar**, Sitjès, Barcelona, Spain.

*Plots: Carrer / Park, 37-47, 08019 Barcelona*

**Fees**

The registration fee for the workshop is 250 € and it covers:

- 3 lunches, coffee breaks for three days, finger food at the poster session and the Workshop dinner.

Participation fee does not include accommodation.

**Payment**

Payment is by credit card or by bank transfer. The instructions are given on the registration package. The registration will be complete only after payment.

**Accommodation**

There is a pre-booking of rooms at the **Barceló Atenea Mar** hotel that will be active until **22<sup>nd</sup> April** (after this date the hotel cannot guarantee your accommodation).

- Single room: **138 €/night** (including taxes and breakfast).
- Double room: **133 €/night** (including taxes and breakfast).

Other hotels are available in the surroundings. Occupancy is very high this week in Barcelona. Please book your hotel as soon as possible.

Organized by:

**AMPHOS<sup>21</sup>**

Amphos 21 Consulting S.L.  
[www.amphos21.com](http://www.amphos21.com)



**1<sup>st</sup> Annual Workshop of the Cebama project**

Collaborative Project within the EUROPEAN COMMISSION / HORIZON2020

11<sup>th</sup> – 13<sup>th</sup> May 2016

**Barceló Atenea Mar Hotel**  
Barcelona, Spain



**For more information**

[www.cebama.eu](http://www.cebama.eu)

Or contact the workshop organizers by e-mail: [info@cebama.eu](mailto:info@cebama.eu)

**Ce b a m a**

**General Information**

The 1<sup>st</sup> Annual Workshop of the Collaborative Project Cebama will be held in Barcelona, 11<sup>th</sup> to 13<sup>th</sup> May 2016, hosted by Amphos21.

The CP Cebama addresses key issues of relevance for long term safety and key scientific questions related to the use of cement-based materials in nuclear waste disposal applications.

The project is implemented by a consortium with 27 Beneficiaries from EUROATOM, Signatory States, Japan and Switzerland. National Waste Management Organizations contribute to the running project by participation in the End-User Group, by co-funding Beneficiaries, and provide for knowledge and information transfer.

More info in [www.cebama.eu](http://www.cebama.eu)

**Workshop objectives**

This workshop aims at providing a forum for discussion of scientific and technical project results, preparing for periodic reporting and planning on future project program.

The Project Workshops contribute to integration within the project and communication with a broader interested community.

**Preliminary Agenda (11<sup>th</sup> – 13<sup>th</sup> May 2016)**

Wednesday 11 <sup>th</sup> May 2016	Thursday 12 <sup>th</sup> May 2016
11:00-12:00 ExCom meeting (restricted to ExCom members)	08:30-11:30 Plenary session (WP1, WP2, WP3)
12:00-13:00 EUG meeting (restricted to EUG and ExCom members)	Coffee break
LUNCH	12:00-13:30 Plenary session (WP1, WP2, WP3) (Continuation)
15:00-16:00 Welcome + Presentation by the Coordination Team	LUNCH
16:00-18:00 Individual WP sessions	15:00-17:00 Topical Session
WP1 (room 1): Experiments on interface properties and the impact on physical properties	(Lessons learned from previous and current projects on cementitious barriers)
WP2 (room 2): Radionuclide retention in high pH concrete	– Workshop DINNER –
WP3 (room 3): Interpretation & modeling	
18:00-19:00 Interaction with WP1	
POSTER SESSION (Finger food)	
	<b>Friday 13<sup>th</sup> May 2016</b>
	09:00-11:30 Plenary session (WP1, WP2, WP3) (Continuation)
	Coffee break
	11:30-12:30 General Assembly

**Registration**

The registration deadline is **22<sup>nd</sup> April, 2016**. Registrations can be done via the following link: [www.cebama.eu/Registration/1stAnnualWorkshop](http://www.cebama.eu/Registration/1stAnnualWorkshop)

