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REDOX PHENOMENA CONTROLLING SYSTEMS
ReCosy

COLLABORATIVE PROJECT (CP)

Submitting organizations: AMPHOS
Due date of deliverable: 30 Project Months
Actual submission: 34 Project Months

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Duration: 48 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		
PU	Public	PU
RE	Restricted to a group specified by the partners of the project	
CO	Confidential, only for partners of the project	

NUMBER 5

ReCosy News

Redox Phenomena Controlling Systems

Newsletter, February 2011

In this issue

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http://www.recosy.eu

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Introducing RECOSY

RECOSY is a four year (2008-2012) Collaborative Project under the Seventh Framework Programme of the European Atomic Energy Community (EURATOM) starting on 1st April 2008. To this aim, the project set up a consortium of 32 Contractors and presently 6 Associated Groups. The consortium includes key European Research Institutes, Universities, National Waste Management Agencies and SMEs from 13 EURATOM signatory states, Russia, Japan, Korea, USA and one European Joint Research Centre.

The redox phenomena controlling systems is not a new geochemical problem. There are topics and questions still not resolved and where improved understanding can further contribute to acceptance of the Safety Case. From a top-down approach, the reliability of redox measurements for site characterization, redox disturbances by the near-field materials, changes induced by glaciation scenarios or the redox buffer capacity of host-rocks and the kinetics of response to redox perturbations are addressed. From a bottom-up approach, questions concerning the interpretation of mixed potentials, surface mediated reactions, redox states of actinides and long-lived fission products, the source term of spent nuclear fuel in the presence of corroding steel as well as the role of microbes and biofilms on the evolution of the redox state are tackled.

The key objectives of ReCosy are to provide for (i) a better determination of the system redox conditions, (ii) understanding of relevant redox processes, and (iii) impact of these processes on the disposal Safety Case. For this purpose, scientific and technical objectives cover the understanding of redox buffer capacities, redox kinetics and the long-term redox evolution and the relevance of the redox impact on the radionuclide transport.

Coordinator: Gunnar Buckau (Karlsruhe Institut of Technology).
From 1 January 2011, Marcus Altmaier (Karlsruhe Institut of Technology)

Scientific-Technical Secretariat: Lara Duro (Amphos 21) and Vanessa Montoya (Amphos 21)

5th Semi-Annual Newsletter

The main purpose of the Semi-Annual Newsletter is to inform the broader community on the progress of research carried out within the RECOSY project. The present Newsletter gives a brief overview of the project activities and progress during the project months 26-33 (June 2010- December 2010). It is available at the public project web page (www.ReCosy.eu). It is also distributed by email to a list of recipients. It is furthermore encouraged to use printouts at different events such as workshops, meetings and conferences in order to inform potentially interested persons.

This Semi-Annual Newsletter is less detailed than the 3rd Semi-Annual Project Activity and Management Report, used for thorough information of project partners, the Commission and project reviewers

EDITORIAL

Dear Reader,

I have the pleasure to present the fifth issue of the RECOSY Newsletter. With this Newsletter, we would like to inform a wider audience on RECOSY's activities. The Coordinator of the project is the Karlsruhe Institute of Technology (KIT), Germany. The Coordination Team (CT) consists of two organizations, namely KIT-INE and Amphos 21. In addition to work program planning and project management, the CT is also implementing activities on training and education, and management and dissemination of knowledge. The Executive Committee (ExCom) consists of the WP leaders, ensuring adequate operation of the overall project.

The End-User Consultancy Group (EUCG) is established with three representatives from Waste Management Organizations (ANDRA, SKB, and ENRESA) and three organizations with National Regulatory Functions (GRS, HSK and SWRI). It advises in view of ensuring usefulness of the project work for application to the disposal Safety Case and review of scientific-technical reporting in this respect.

*The project is OPEN for additional organizations entering into formal cooperation and participation via **Associated Group** agreement.*

The project is open for additional organizations entering into formal cooperation and participation via *Associated Group agreement*. By this cooperation form, different groups may participate at different levels of commitment.

The key objectives of ReCosy are to provide an improved interpretation of redox potential in all relevant host-rock systems to be used within European Safety Cases. In this and the coming issues of the RECOSY Newsletter, we will inform you on major research topics and highlights from the project. Key activities on a project level since the last published Newsletter have been the InterComparison Exercise (ICE) finalized in October 2010.

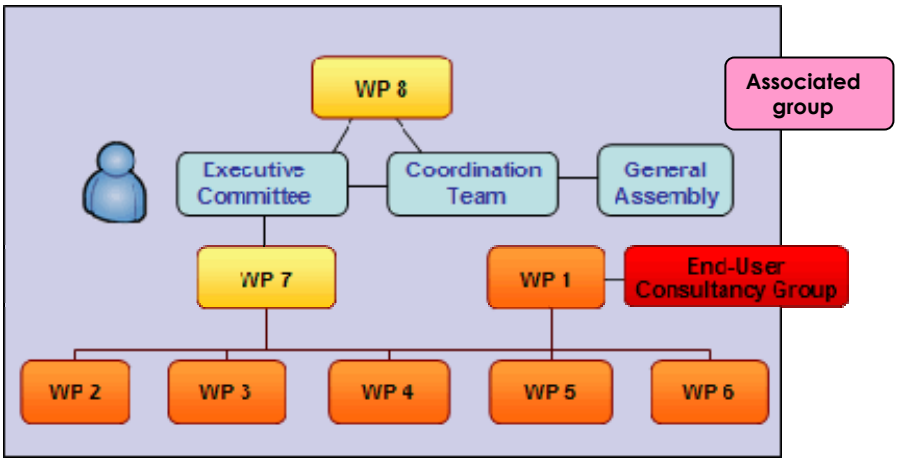
I hope you will enjoy reading and welcome your feedback!

Mireia Grivé (info@recosy.eu)

Knowledge Management and Training RECOSY- Officer

Recosy's main areas of research

The scientific-technical work program is structured along six Research Technological Development workpackages (WP1-6). They cover near-field and far-field aspects as well as relevant host-rocks considered in Europe.



RECOSY organization

WP 1 deals with documentation on the overall project outcome for its implementation in the Safety Case. *WP2* focuses on development of redox determination methods. *WP3* focuses on redox response of defined and near-natural systems. *WP4* studies the redox reactions of radionuclides. *WP5* focuses on redox processes in radionuclide transport and *WP6* deals with the redox reactions affecting the spent fuel source-term. Specific workpackages on knowledge management, education and training (*WP7*) and administrative management issues (*WP8*) are also included in the project.

RESEARCH

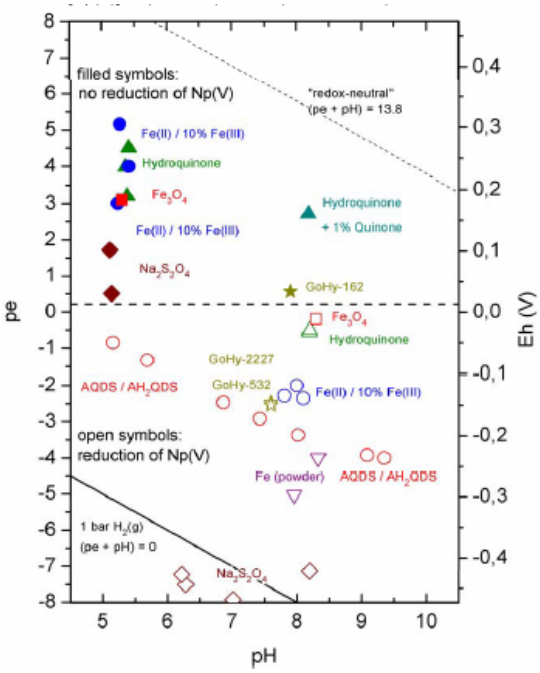
Research on Development of redox determination methods (WP2)

The objective of WP2 is the development and testing of redox determination methods using different type of electrodes as well as optodes (optical sensors) in order to provide a broad and solid scientific-technical basis for the application of such. In combination with chemical analysis and associated thermodynamic modelling the redox state of systems (relevant for nuclear waste repositories) is assessed. The overall goals are (i) to develop redox determination methods specifically designed for environmental applications, and (ii) provide a broader information base for interpretation of system conditions.

The first point reflects the limitations of existing determination methods and models (and new developments) due to poisoning of electrode material, diffusion potentials in electrode bridges, drift through catalytic reactions on electrode material, drift through changes in electrolytes via diffusion, analytical difficulties in determining concentrations of redox sensitive system components or state of involved solids/minerals, and insufficient/inadequate thermodynamic data for calculation of the redox state.

In this context the different participants of this workpackage are working on different issues. KIT-INE continued the investigation of Np(V) reduction at different pH and pe conditions in homogenous and heterogeneous systems with inorganic and organic reductants. Main outcomes from this work have been a better understanding and thermodynamic interpretation of Np(V) state distribution and redox kinetics. ARMINES continued in the development of a methodology for redox determination in hyperalkaline systems based on Se speciation. One of the major objectives in 2009/2010 for BRGM was to carry out robust geochemical (Eh-pH) sensor concepts being able to be devoted (after adaptation or development and/or implementation) to the observation and monitoring of the underground components of a nuclear waste storage. Measurement of redox potential (Eh) and dissolved oxygen (O_2) concentration by microsensors (Clark type) in biofilm samples grown in the laboratory and in acidic waters of a uranium mine where studied by FZD. From these studies, FZD has concluded that data achieved from electrochemical and fiber-optic sensors are directly comparable. In the last year GRS continued the development of two methods for redox potential determination in saline media and tested them on solutions with low and high ionic strength. Examination of the changes of Eh, pH values of the binary (iodine species-kaolinite) and ternary systems (iodine species-kaolinite-humic acid) is studied by TUG. Main work performed by UPPC are a) Further miniaturization of sensing components (optoelectronics, filters, optics, fiber tip etc.) b) Evaluation of fluorescence probes and novel polymer matrices for fiber-based chemical sensing applications, c) Oxygen measurements in real-word biofilm samples d)Improvement of oxygen determination. Finally, contribution of LQC was essentially advisory to various other partners on issues in which the principal investigator in LQC has direct experience.

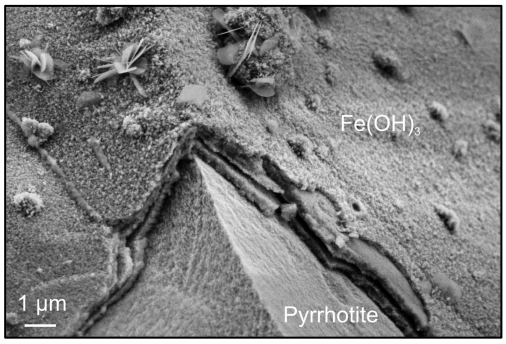
WP leader: Dr. Michael Kumke (University of Postdam, Physical Chemistry)



The investigation of Np(V) reduction at different pH and pe conditions

Cultivation of biofilms in the laboratory, Photography from FZD

Research on Redox response of defined and near-natural systems (WP3)

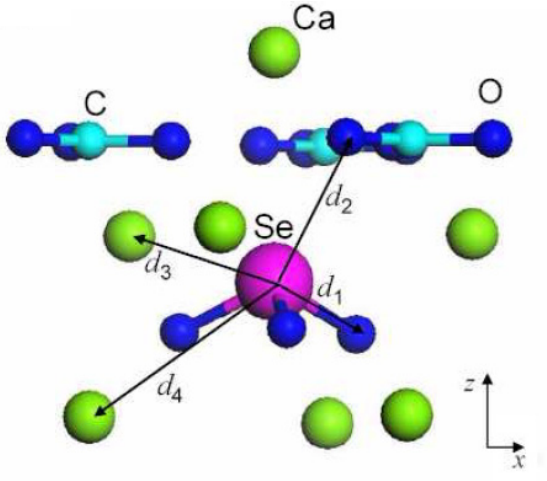


$Fe(OH)_3$ layers precipitated on pyrrhotite surface (Arcos et al., submitted)

The objective of WP3 is to quantify and develop process understanding for redox buffer capacity and kinetics of response to redox perturbations of defined and near-natural systems. This includes, determination of key electrochemical parameters of electrodes as well as redox response of defined and near-natural systems to redox disturbance, namely (i) finely ground Callovo Oxfordian materials, (ii) ions naturally present in the porewater (e.g. H^+, SO_4^{2-}, HS^-, Fe^{2+}), (iii) redox sensitive radionuclides analogues (e.g. Se(VI), Se(IV), I^-, CH_4 for ^{14}C) and (iv) gases (O_2, CO_2, H_2, H_2S) in different situations, both similar to the expected natural situations and to very perturbed conditions.

In the second year of the project, the WP3 work have been focused on (i) Field data, (ii) Field samples, (iii) Microbiology, (iv) Sorption experiments, (v) Redox experiments and (vi) Conceptual Modelling.

KIT-INE has worked on spectroscopic characterization of the natural organic matter from the Callovo- Oxfordian formation and the Opalinus Clay. Other work includes uranium redox speciation by 3D confocal µ-EXAFS, µXRD and µSTXM in clay-rich samples from the Lodève basin (France). Sorptive reduction of U(VI) on magnetite nanoparticles have also been studied by KIT-INE. BRGM have investigated the electrochemical behaviour of the previously made electrodes with the presence of different key redox couple(s) like Fe(II)/Fe(III), S(-II)/S(VI), H(I)/H(0), N(-III)/N(V). CTM and AMPHOS have continued investigating the reducing capacity of natural pyrrhotite through thermodynamic and kinetic experiments observing that no effect on the iron concentration in solution is observed at low sulphate level in thermodynamic studies. TUG works on the analytical measurements of iodine concentration. The immobilization by calcite of Fe(II) (to be released by canister corrosion) and Se(IV) (to be released as ^{79}Se) has been investigated by CNRS. GEOPOINT deliveries of real data from the Swedish site investigation to UNIZAR and UNIZAR investigate the Swedish granite system groundwaters through thermodynamic equilibrium computations. II-HAS investigated the response of Boda Claystone samples to redox disturbances by equilibrating the samples with different redox couples providing stable potential conditions and determining the change of Fe^{2+}/Fe^{3+} ratio in the respective minerals afterwards. During the second year of the project UCYPRUS has collected phosphogypsum samples from different areas of the phosphogypsum stack at a coastal area in Cyprus in order to estimate the redox potential from the [S(II)]/[S(VI)] ratio. MICANS has done 20 boreholes in the underground Aspö laboratory and study the influence sulphate reducing bacteria. UNIUTR Compares the behaviour of hematite with that of lepidocrocite regarding the coupling of redox processes in systems containing Fe(III)/S(-II)/U(VI).



Local structure around a Se(IV) atom in calcite, resulting from the VASP simulations (Aurelio et al., 2009)

WP leader: Dr. Laurent Charlet (Centre National de la Recherche Scientifique)

Research on redox reactions of radionuclides (WP4)

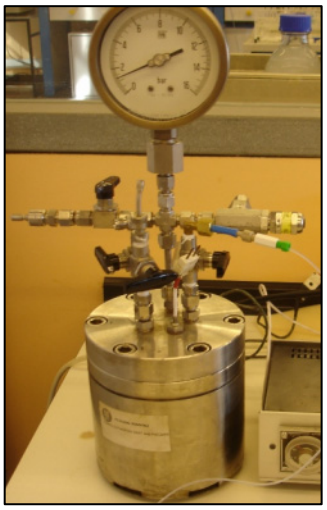
The goal of the activities within this workpackage is to provide fundamental process understanding of the redox behaviour of radionuclides, including the question of equilibrium / disequilibrium with the system redox conditions. The objectives of this work package result from gaps in the knowledge identified from previous projects dealing with redox processes involving radionuclides.

The activities within this workpackage can broadly be divided in four main topics: (1) Interactions of radionuclides with pyrite, (2) Interactions of radionuclides with far-field solids, (3) Redox processes under hyperalkaline conditions, (4) Redox behaviour under microbial processes.

CTH investigate redox reactions and states of selected redox sensitive elements with relevance to a crystalline rock environment (Äspö, Sweden). UMANCH is investigating the interactions between surfaces, humic acids (HA) and redox sensitive radionuclides in ternary systems, with the aim of predicting radionuclide chemistry and solid/solution partition. IPL studies the sorption of Pu to natural clays with naturally present iron oxide coatings. Samples of Triassic clay from a site mined for industrial exploitation known as the Šaltiškiai (North Lithuania) quarry were taken for laboratory investigations. KIT-INE has worked on three different research topics. (a) batch-type experiments with Opalinus clay and Callovo-Oxfordian argillite and Tc(VII), Np(V), Pu(V), (b) sorption/ sorptive reduction kinetics of Np(V), Tc(VII) and U(VI) on fracture filling material (FFM) from the Äspö granite and Grimsel granodiorite (c) following the training activity of Dr. Natalia Shcherbina (MSU), carbon XANES analysis of Mayak sediments and isolated humic colloids from Lake Yrtyash and different hydroquinone enriched humic substances that were investigated at the soft X-ray spectromicroscopic beamline X1A at the National Synchrotron Light Source (NSLS), Brookhaven National Lab. (BNL) has been evaluated. ULOUGH has performed experiments to investigate the complexation of Tc(IV) with 4 anthropogenic ligands, EDTA, NTA, ISA and picolinic acid. AMPHOS aims to provide an understanding of redox behaviour of the uranium system under hyperalkaline conditions. The contribution of PSI to WP4 is focused on the influence of redox conditions on the immobilization of Neptunium in highly alkaline cementitious environments.

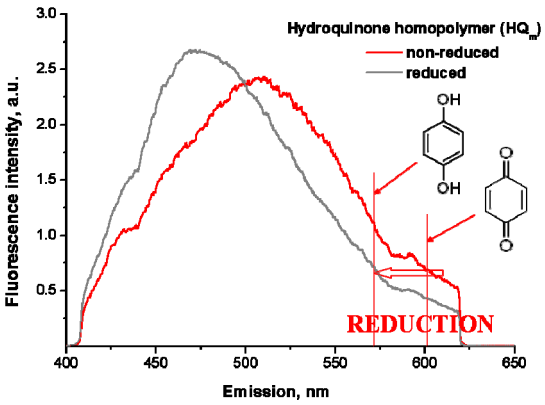
Some of the participating institutes are focusing their work on the study of the microbial impact (IPL) and on the oxygen concentration and uranium redox state in-situ in biofilms with emphasis on biologically mediated redox processes (FZD). The studies are carried out on isolated microorganisms as well as on biofilms. Biofilms are composed of bacteria, fungi, algae, protozoa, exopolymeric substances (EPS), corrosion products and 50–95% water. They are ubiquitous and have to be considered as an important factor in natural biogeochemical processes influencing the redox state of radionuclides. They show a multiplicity of interactions with metals and contribute to metal mobility or immobilization. FZD focus on biologically mediated redox processes of in-situ biofilms growing in a uranium mine in Saxony (Germany), which is currently in the process of being remediated. The scientific activities of IPL comprised the effect of microorganisms on plutonium oxidation states.

WP leader: Dr. Jan Tits (Paul Scherrer Institut)



Autoclave used to perform the batch experiments.

Impact of Microorganisms from clay and groundwater samples will be studied



Fluorescence peak positions for the oxidized and reduced forms of the hydroquinone homopolymer (Shcherbina et al. submitted)

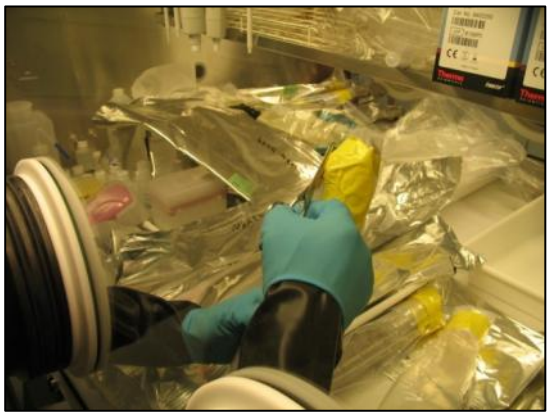
Research on Redox processes in radionuclide transport (WP5)

The goal of the activities within this work package is to study the behavior of redox-active radionuclides Tc, Np, U, Pu, I and Se with the aim to determine the redox impact on their transport through crystalline rocks, clay rocks and contaminated systems.

Core material of the Callovo-Oxfordian (EST30471) observed in anoxic glove box prior conditioning

Investigations are made in different redox media that can be met around planned waste repositories. Radionuclide behaviour is studied in diffusion and sorption experiments, retrospectively using observations of radionuclide retardation under different natural conditions. An important question is "how the redox-reactions play a role in radionuclide retardation?". The problem is approached in this WP by studying the redox-state of retarded or immobilized radionuclides. This work is done with the help of modelling and laboratory experiments, using various spectroscopic techniques and wet chemistry. Complementary to this, investigations in situ at the planned repository site in Finland (Olkiluoto), around a phosphogypsum stack at the Vasilikos site in Cyprus and in a contaminated site in Mayak, Russia are also performed within this workpackage.

KIT-INE continued batch-type experiments on the sorption/sorptive reduction kinetics of Tc(VII), Np(V) and Pu(IV) in the presence of fracture filling material. The Äspö granite and Grimsel granodiorite were used as sample material. KIT-INE has collaborated with MSU in characterizing humic substances isolated from Mayak sediments and Lake Yrtyash humic colloids. CEA continued investigations on the behaviour of U(VI) and long-lived redox active fission products Se(IV,VI) and I(-I,V) in contact with Callovo-Oxfordian (COx) argillite samples. The redox-activity of the sample material was deduced from the presence of FeS_2/FeOOH/$FeCO_3$ buffer. UH continued investigations on in situ behaviour of uranium by examining U series disequilibrium on fracture surfaces in order to identify U retardation or accumulation and developing a wet chemical method to study the redox-state of U accumulated on fracture surfaces. Fracture surface samples are from the groundwater infiltration area at the Olkiluoto study site. II-HAS is investigating the reduction driven retention of I, Tc and U in a redox gradient in clay rock. UCYPRUS continued investigations to assess the impact of redox conditions on the stability of the phosphogypsum stack (e.g sulphate reduction) and U(VI). Samples have been collected directly from the phosphogypsum stack and from fluids from three different sub-areas of the phosphogypsum stack. MSU has investigated actinide speciation in samples collected at contaminated sites in Russia in order to verify the experimental data obtained under well-defined laboratory conditions. The methods included (1) redox speciation of actinides by spectroscopic methods (XPS, XAFS) and membrane extraction, (2) study of possibility for the formation of An(IV) eigencolloids by alpha track analysis, TEM, STEM-HAADF, EELS and XAFS,…and (3) study of preferential binding of actinides to different colloids by nano-SIMS and the actinide redox speciation by membrane extraction.



Opening of the vacuum sealed samples in N_2 glovebox in the laboratory of radiochemistry, University of Helsinki

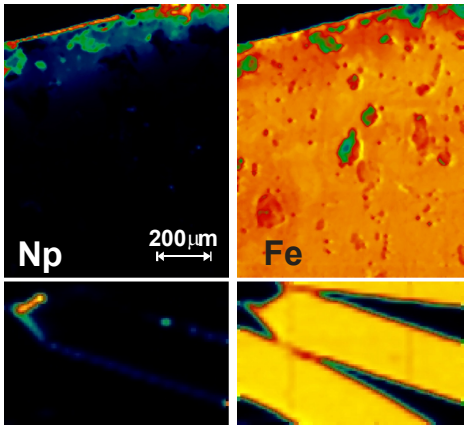
WP leader: Dr. Juhani Suksi (University of Helsinki)

Research on Redox reactions affecting the spent fuel source-term (WP6)

The source term from spent fuel dissolution is subject to considerable uncertainties, both with respect to the presence and extent of oxidative dissolution processes of the spent fuel itself and the coupling with processes associated with the iron canister. Related problems to be examined in this work package are the representativeness and reliability of laboratory data with respect to the impact of unavoidable minor concentrations of oxygen present in inert-gas boxes used, the potential reactivity and impact of hydrogen from container corrosion in combination with high burn-up spent fuel, possible galvanic coupling of spent fuel and container material and the retention of redox sensitive radionuclides by relevant secondary minerals, especially by steel container corrosion products.

A set of investigations has been conducted with the aim of getting better insight into redox processes determining spent fuel and iron canister corrosion. JRC-ITU is reporting on studies on spent fuel in presence of corroding Fe and on thin film model systems, and on corrosion of spent fuel in presence of H_2 and on fuel corrosion studies on thin film model systems. Effects of Y_2O_3 doping on the redox reactivity of UO_2 have been studied at KTH. The reductive trapping of actinides in container corrosion products during spent fuel corrosion is investigated by KIT-INE. Studsvik reports on advances in the reductive immobilization of ^{237}Np on iron canister material under repository conditions. Emphasis is presently given to investigations on the hydrogen catalytic effect of SIMFUEL by D/H isotope exchange method. The effect of iron corrosion on redox potential was studied by NRI.

WP leader: Dr. Detlef Wegen (Joint Research Centre- Institute for Transuranium elements)



Results of µ-XRF analysis of a representative polished iron sample

Y_2O_3 doped UO_2 pellets are significantly less reactive towards H_2O_2 than pure UO_2 pellets

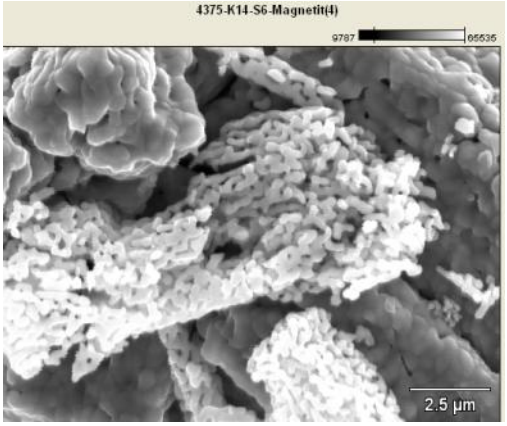
HARMONIZATION OF WORK PROGRAM AND IMPLICATIONS OF REDOX FOR THE SAFETY CASE (WP1)

One of the objectives of this workpackage is the harmonization of the work program and to show the relevance of the redox processes in the Safety Case. To this aim, the safety case that was selected from the beginning of the project was that for the ANDRA B2 cell. The medium activity long lived waste at ANDRA is the B2 waste, which is a result of the treatment of radionuclides with compounds such as nitrate and sulphate and high content of bitumen. The outcome of this treatment is a waste presenting nitric acid and generally oxidising conditions. This can affect the mobility of radionuclides.

One of the main issues of concern is how the oxidising conditions developed within this type of cells might affect the mobility of radionuclides.

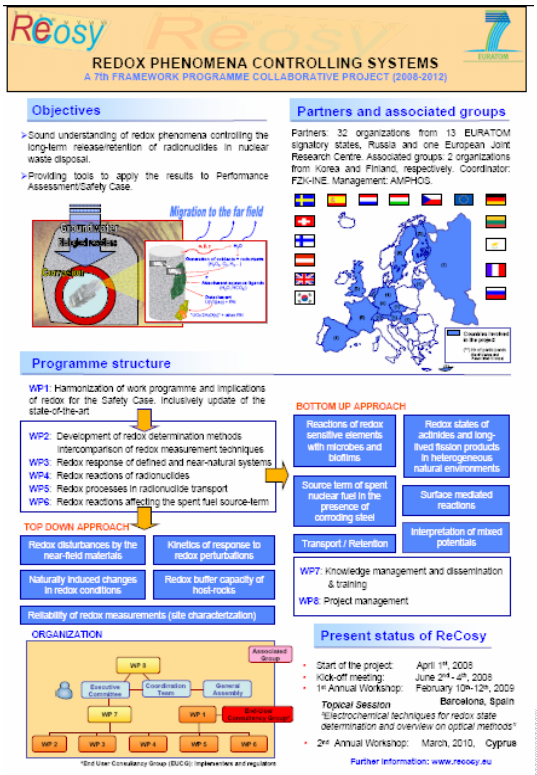
Hence, redox processes play an important role in the safety case of B-type wastes. According to the modelling results of the release of nitrate from this type of cells, very high nitrate concentrations can build up in the vicinity of the wastes. H_2 gas generation is also predicted to occur. Redox processes are, thus, very relevant for the understanding of the evolution of these materials.

WP leader: Dr. Lara Duro (Amphos 21)



SEM micrographs of magnetite agglomerations recovered after termination of the experiment with U contents around 0.5 at%.

KNOWLEDGE MANAGEMENT AND TRAINING (WP7)



The WP 7 addresses the internal and external training as well as knowledge management for the RECOSY project.

A public web site was established within the project (www.recosy.eu). At this site, information about the project and the project activities are made available to the broad community. A project internal Intranet site has been established where non-public documents and reports are kept.

The generic poster has been presented at different occasions, including Euradwaste'08, 20-23 October 2008 in Luxembourg, Migration'09 and ICEM 2009.

The Annual Project Workshops are important elements in the documentation and dissemination of the project outcome. The Annual Project Workshop Proceedings are comprehensive public reports with the key scientific-technical outcome. Proceedings with the scientific-technical outcome of the first project year are published as report FZKA 7466 and the second annual proceedings as KIT-SR 7557 report.

Dissemination of more detailed results are done through peer reviewed scientific journal papers, books, reports, proceedings of various conferences and workshops, PhD thesis, etc. Presentations at different occasions of detailed project work meetings and results or the overall project is also a key contributor to dissemination. The dissemination of the project is effective (19 scientific journal papers, 2 technical reports, oral presentations and posters at 35 international occasions in Europe, Japan, USA, Canada and Russia).

5 training mobility measures have been agreed upon and are presently under implementation or in preparation

TRAINING resources are used for training-on-the-job of young researchers by project internal mobility measures. The measures are aiming for a maximum period of about three months where travel costs for the stay at another organization (or organizations) are covered. Partners or Associated groups applied through the Coordination Team for such training measures.

Natalia Shcherbina, MSU, implemented the first training and mobility measure finalized 30 September 2009. Within the measure, she was visiting KIT-INE, UPPC and Brookhaven National Lab. Ms. Shcherbina is now working with partitioning ligands at PSI. The contact for this work was established within the training and mobility measure.

Additional 5 training mobility measures have been agreed upon and are presently under implementation or in preparation.

WP leader: Dr. Mireia Grivé (Amphos 21)

RECOSY WEBPAGE: www.recosy.eu

EVENTS

RECOSY 2nd Annual Workshop (16th-19th March 2010, Larnaca)

The 2nd Annual Project Workshop was held in Larnaca, Cyprus (16th to 19th March 2010) hosted by Cyprus University. In association with this event, meetings of the different project consortium bodies (Executive Committee, General Assembly, End-User Consultancy Group) also took place.

In total 65 persons attended, including: beneficiary partners (27 out of 32 partners involved in the project), associated groups (BGS, STUK and LANL), EUCG's members, external participants (NIS and NDA from Italy and UK, respectively) and the European Commission project officer, Christophe Davies.

The main purpose of the Workshop was to communicate and discuss the scientific-technical outcome of the first project year in the form of oral presentations around the project, two poster sessions, and the topical session. Next to an overview of the achievements within the respective WP, scientific highlights were presented (30).

During the workshop a specific Topical Session focused on Redox determination by thermodynamic methods and associated Thermodynamic Databases and the application to Performance Assessment/Safety Case was organized by KIT-INE and AMPHOS.

The scientific-technical outcome of the second project year is documented, reviewed by the EUCG and disseminated in the form of workshop proceedings (KIT report, KIT-SR 7557).

RECOSY 2nd Annual Workshop (16th-19th March 2010), Larnaca

RECOSY 3rd Annual Workshop (to be held 21st -24th March 2011, France)

The 3rd Annual Project Workshop (AWS) is under preparation. It will be held in Balaruc-les-Bains (Sète, Languedoc-Roussillon, France) 21st to 24th March 2011, organized by SUBATECH. Registration to the Workshop was open until January the 31st, 2011. Registration was done through the webpage http://www-subatech.in2p3.fr/RecosyWorkshop2011.html

This third annual workshop, like the former ones, gives the project internal and external participants an insight into the project, its activities, status and achievements. It also provides decisions and communication of the planning for the fourth and final project year. Meetings of the Executive Committee, the General Assembly and the End-User Consultancy Group will be held within the context of the Workshop. This third Workshop will have dedicated panel presentations and discussions across the different project workpackages.

This reflects that the administrative, agreement and planning issues that have been very important at the first annual workshops, now is giving way for more in-depth R&D work and developments. The Topical Session will be entitled "Electrochemistry and Redox Processes". Poster sessions will be held where the progress in work by individual partners is presented and joint project activities can be reflected in multi-partner presentations. The flyer with the main information on the workshop have been distributed among the project partners and uploaded to the internet website, accessible for any interested party (www. ReCosy.eu).

Electronic brochure informing on the 3rd Annual Workshop is available in the RECOSY WEB page

RECOSY 3rd Annual Workshop (21st-24th March 2011), Balaruc-les-Bains (France)

RECOSY InterComparison Exercise on redox determination methods (19th-20th October 2010, Karlsruhe)

The RECOSY InterComparison Exercise (ICE) took place in Karlsruhe 16th -20th November 2009, hosted by KIT-INE, Karlsruhe, Germany and finalized after an additional meeting in Karlsruhe 19th-20th October 2010. More than 40 scientists from 20 ReCosy partner organisations and associated groups contributed to the ICE, thus providing a broad scientific basis for the study. The overall outcome is published through a KIT report, to be printed and distributed at the 3rd Project Workshop in March 2011(also to be downloaded at the RECOSY webpage). RECOSY ICE was considered a great success, not necessarily solving all associated problems, but helping in defining the present state-of-art, creating the required problem awareness and in defining next steps.

The aim of RECOSY ICE was the assessment and comparison of redox determination methods with different existing and newly developed methods for redox determination, including comparison of different protocols used by different research groups. A wide set of samples was used with three different types of origin and properties, namely (i) simple samples with well-defined composition, (ii) natural samples kept under near-natural conditions, and (iii) samples with microbial cultures. The main conclusion of ReCosy ICE is that the redox state of an aqueous system can be determined by the existing experimental techniques, although the degree of confidence strongly depends of the kind of aqueous system investigated and the degree of optimisation of the experimental equipment and handling protocols. In how far the available experimental accuracy and precision is sufficient to adequately characterise the sample must be assessed in each single case and cannot be generalised. RECOSY ICE recommends using a combination of several experimental approaches to identify and assess systematic errors as there is no single "best method" to determine the redox state of a given system. This is especially true for the analysis of (intrinsically highly complex) real systems.

The concluding RECOSY ICE report contains detailed recommendations on redox measurements and data interpretation and further proposes topics for future research activities in view of the remaining open issues.

Key event schedule

Below are given key events of RECOSY project that are open to external participation.

3rd Annual Project Workshop

21st-24th March 2011, France

Final Annual Project Workshop

Last week of January 2012, Karlsruhe, Germany

MARCH 2011

Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

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