Caesium Workshop: Fukushima recovery – understanding, modelling and managing radiocaesium decontamination

CORASSE, Fukushima/Japan

September 30th - October 3rd, 2013

(Organized by JAEA in cooperation with SUERC with support by Obayashi/MCM)

Background and objectives

Off-site decontamination work following the Fukushima accident will include 11 municipalities with calculated external gamma dose rates > 20 mSv/y and 104 in the range of 1 to 20 mSv/y. Contamination is predominantly now Cs-134/-137 and work will progress according to guidelines issued by the Japanese Ministry of the Environment. Local dose rates generally decrease as decontamination proceeds, but reservoirs of radiocaesium remain in un-remediated environments (particularly forests) and stored waste, which must be assured not to cause a risk of re-contamination. Hence major concerns arising now are how to treat or reduce mountains of decontamination waste and when, where and how much contamination may in the future be transported into living areas. Further studies are needed to address these concerns, which must be based on a sound understanding of Cs behaviour, as captured within quantitative models & databases.

The objectives of the workshop are to summarise current understanding of the movement of caesium in relevant environments and remedial actions that are effective in constraining it, to identify potential improvements that may result from better mechanistic understanding of the key environmental properties of Cs (e.g. sorption-desorption mechanisms, biosphere transfer) and potential for developing and testing predictive models based on the long baseline provided by multi-decade experience from similar contamination events in the past.

Brief agenda - main items:

Monday 30th September - 9:00-17:20

Welcome addresses:

9:00~9:30 Welcome and introduction (JAEA: J. Ishida)
Welcome in cooperation with JAEA (SUERC: R. Ellam)
Welcome address (MEXT: R. Nishida)
Welcome address (Fukushima Office for Environmental Remediation, MOE: T. Sekiya)
Welcome address (Fukushima Pref. government; K. Suzuki)

9:30~9:40
Short break to allow equipment changeover

Session 1: Objectives and related talks
(Chair, M. Yui, Facilitator, I. McKinley)

Goals: In order to allow evacuated residents to return to their homes as quickly as possible the Japanese government and municipalities are carrying out decontamination work within the Fukushima prefecture, following JAEA decontamination R & D activities. It is estimated that there will be between approximately 15 - 30 M m^3 of waste produced during the decontamination activities and the vast volumes of waste being produced is becoming a problem. The main radionuclide of concern as regards the decontamination work is radiocaesium (134 & 137) and developing methods for waste volume reduction will be essential. In this regard it will be useful to examine international experience to take forward lessons learned. In addition, there is concern that Cs mobilised during storm events will re-contaminate areas that have already been decontaminated. It is therefore important, not only to monitor the redistribution of Cs but also to predict future movement using models based on a sound knowledge of the behaviour of Cs in the environment. Finally, there is particular concern from the public regarding forest decontamination, and therefore it is important to rationalise decontamination activities in this important ecosystem, as it covers ~70% of the Fukushima prefecture.

(Objectives)

9:40~10:20 Objectives of the workshop and difficulties encountered for remedial actions and waste management in Fukushima (M. Yui, JAEA)

- Background and status of off-site Fukushima contamination / remediation
- Overall goals of workshop
- How to decontaminate and how to treat produced wastes for volume reduction?
- How will the contamination develop in the future?
- How will public acceptance be gained?
- What can scientists do to address these concerns?
- Format, approach and tools used in the workshop

(International experiences related to above difficulties)

10:20~11:00 Remediation activities (L. Fellingham, Nuvia)

- Relevant Cs contamination cases
- Approaches to remediation / decontamination
- Current status
- Lessons learned for Fukushima

11:00~11:20 Break

11:20~12:00 Project integration (I. McKinley, MCM)

- Coordination of complex, multidisciplinary projects
- The special challenge of QA
- Benefits from advanced knowledge management systems

12:00~12:40 Communication and confidence-building (J. West, BGS)

- Experience from past contamination incidents
- Successes and failures
- Lessons learned for Fukushima

12:40~13:40 Lunch (bento)

13:40~14:20 Discussions on approaches to resolve difficulties (using AM)

- Priorities and strategies
- Knowledge management and transfer
- Communication with stakeholders

Session 2: Fundamental approaches toward development of radiocaesium removal methods from soil and other related materials, waste reduction and management optimization
(Chair, T. Yaita, Facilitator, I. McKinley)

Goals: to provide a mechanistic understanding of the behaviour of Cs on relevant environmental materials that will be of direct use in dealing with the problems encountered during the decontamination activities (in particular that of waste volume reduction). Background will be provided in other 2 sessions will highlight processes / model parameters to allow the output of such studies to be assessed for relevance. Advanced Cs removal techniques/methodologies will need to be developed for future decontamination / waste volume reduction activities.

14:20~15:00 Introduction of study on the Cs adsorption-desorption on clay minerals for waste reduction and adsorption mechanism from the standpoint of materials science
(T. Yaita, JAEA)

- Structural and chemical bond information for caesium adsorbed on soil
- Adsorption/desorption kinetics of caesium on soil
- Microscope observation and imaging
- Theoretical simulations, e.g. molecular dynamics/ orbital calculations
- Experimental database on chemical treatment of soil & wet classification

15:00~15:20 Break

15:20~16:00 Validation of uptake processes of radionuclides such as Cs on clay minerals by EXAFS (R. Dähn, PSI)

- Characterization of solid phases
- Uptake mechanisms as function of aqueous chemistry
- Potential for quantitative modelling
- Potential role to support Fukushima challenges

16:00~16:40 Molecular mechanisms and selectivity of Cs binding to phyllosilicate minerals with implications for fate and transport in the environment (K.M. Rosso, PNNL)

- Definition of modelled system
- Output from model
- Testing against lab and field experience
- Relevance to Fukushima challenges & further work required

16:40~17:20 Caesium and other radionuclide retention by geochemical and engineered barriers (S.N. Kalmykov, MSU)

- Characterization of solid phases
- Uptake mechanisms as function of aqueous chemistry
- Potential for quantitative modelling
- Potential role to support Fukushima challenges

Tuesday October 1st - 9:00-17:20

9:00~9:40

1) **Cs Adsorption and related reactive dynamics in frayed edges of micaceous minerals (M. Machida, JAEA)**
2) **Molecular dynamics simulation for Cs adsorption behaviour under various kinds of conditions (T. Ikeda, JAEA)**

- Definition of modelled system
- Output from model
- Testing against lab and field experience
- Relevance to Fukushima challenges & further work required

9:40~10:20

1) **Finding and analyses of soil particles adsorbing radioactive cesium in Fukushima (T. Kogure, Tokyo University)**
2) **Interpretation of Cs behaviour in waste reduction process by X-ray imaging and position sensitive XAFS methods (Y. Okamoto, JAEA)**

- Characterization of solid phases
- Uptake mechanisms as function of aqueous chemistry
- Potential for quantitative modelling
- Potential role to support Fukushima challenges

10:20~10:40 Break

10:40~11:20 Sorption-desorption behavior of Cs in subsurface materials: observations and modelling approaches (M. Ochs, BMG)

- Experimental, field and analogue database
- Required assumptions and simplifications
- Current state of the art
- Transfer to Fukushima challenges & further work required

11:20~12:00 Overview of chemical treatments for radioactive waste (S. Yokoyama, CRIEPI, S. Suzuki, JAEA)

- Characterisation of contaminated materials
- Cs extraction experience
- Volume reduction experience
- Relevance to Fukushima challenges & further work required

12:00~13:00 Lunch (bento)

13:00~13:40 Importance of understanding clay-Cs association for reduction, storage and disposal of waste from decontamination activities in Fukushima (T. Sato, Hokkaido University / K. Ito, Miyazaki University)

- Overview of relevant experience
- Strategy – waste reduction
- Strategy – storage & disposal
- Additional challenges for Fukushima

13:40~14:20 Discussion / brainstorming (T. Yaita, JAEA)

- optimization of decontamination
- minimization of waste
- optimization of waste management

Session 3: Prediction of future distribution of Cs, with emphasis on non-decontaminated forest
(Chair, S. Nakayama, Facilitator, I. McKinley)

Goals: The general background from session 1 provides background for an outline of a project to build understanding of radio-Cs mobility in the Fukushima area (F-TRACE). This is complemented by an assessment of the international databases to support it and expansion on the model requirements to extrapolate results in space and time and determine impacts on local communities. Additionally, it is likely that radiocaesium hot spots will form in the future (e.g. lake and dam sediments, river bends) due to remobilisation, therefore strategies for managing these will need to be developed, in particular for sensitive areas, such as agricultural land (which is often irrigated directly from rivers). Examples would include particulate collection/filtration devices installed directly at dam outlets.

14:20~15:00 Overview of the project on Long-term assessment of Transport of Radioactive Contaminant in the Environment of Fukushima *(F-TRACE)* (K. Iijima, JAEA)

- Goals
- Study areas
- Approach
- Data management (incl. QA)
- Modelling & model testing
- Future challenges

15:00~15:20 Break

15:20~16:00 Dynamic behavior of cesium concentration through the river basin (S. Hayashi, NIES)

- Goals & study areas
- Approach & results
- Modelling & capture of understanding
- Future challenges

16:00~16:40 Long-term dynamics of Cs in forest (M. Takahashi, FFPRI)

- Goals & study areas
- Approach & results
- Modelling & capture of understanding
- Future challenges

16:40~17:20 Long-term dynamics of Cs in farmland (S. Eguchi, NIAES)

- Goals & study areas
- Approach & results
- Modelling & capture of understanding
- Future challenges

Wednesday October 2nd - 9:00-17:30

(International context)

9:00~9:40 Technology for measuring regional-scale distribution of radio-Cs (D. Sanderson, SUERC)

- Monitoring technology
- Assuring data quality / database management
- Lessons learned for Fukushima

9:40~10:20 UK experience from the long-term assessment of fallout radionuclide mobility and operational releases (G. MacKinnon, SUERC)

- Overview of relevant sources - fallout from nuclear weapons testing, the Windscale fire and Chernobyl, operational releases from the Sellafield reprocessing plant
- Water - fresh and marine
- Soils & peat
- Sediments & saltmarshes
- Biota
- Varying requirements for understanding natural mobilisation and optimising remediation/waste management - tracers of environmental processes

10:20~10:40 Break

10:40~11:20 Cs and Sr transfers in Chernobyl Pilot Site soils (Chernobyl Exclusion Zone) (Caroline Simonucci, IRSN)

- Site characterisation
- Derivation of Cs database
- Modelling and system understanding
- Transfer to F-TRACE & further work required

11:20~12:00 Sampling and analysis of environmental materials: QA and uncertainty analysis (R. Ellam, SUERC / S. Hardie, MCM)

- Sources of experience
- In-situ measurements
- Sampling, sample handling & laboratory measurements
- Data management, QA and uncertainty analysis
- Transfer to Fukushima challenges & further work required

12:00~13:00 Lunch (bento)

13:00~13:40 Complicating factors (J. West, BGS)

- Factors requiring to be considered to transfer theoretical knowledge to real life applications
- Microbial activity
- Organic complexation
- Colloids
- Others
- Requirements for Fukushima remediation and waste management activities

13:40~14:20 Quantitative modelling of Cs transfer processes and assessing doses to populations (I. McKinley, MCM)

- Historical overview
- Advantages & disadvantages of different approaches
- Model verification & validation
- Fundamentals of biosphere modelling
- Integrated assessment of population doses
- Concept for tailoring to Fukushima

14:20~14:40 Break

14:40~16:20 Discussion / focused brainstorming

- Regional model structure and key components
- Required data
- QA and verification / validation

Session 4 Final discussions and wrap-up (all) (Chair, M. Yui)

16:20~17:20 General discussion and Wrap-up

17:20~17:30 Closing Remarks

Thursday October 3rd 8:00-16:00

Field trip to Ogi-dam of the F-TRACE program

8:00 Departure from Fukushima Station by bus
11:00 Ogi-dam and surrounding forest
12:30 Lunch
16:00 Farewell at Koriyama Station of Shinkansen