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**NUCLEAR ENERGY AGENCY  
RADIOACTIVE WASTE MANAGEMENT COMMITTEE**

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### **Integration Group for the Safety Case (IGSC)**

**An IGSC "Geosphere Stability" Workshop on:**

**STABILITY AND BUFFERING CAPACITY OF THE GEOSPHERE FOR LONG-TERM ISOLATION  
OF RADIOACTIVE WASTE:**

**APPLICATION TO CRYSTALLINE ROCK**

**13-15 November 2007  
Manchester, United Kingdom**

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**English - Or. English**





The University of Manchester  
Dalton Nuclear  
Institute

STABILITY AND BUFFERING CAPACITY OF THE  
GEOSPHERE FOR LONG-TERM ISOLATION OF  
RADIOACTIVE WASTE:

APPLICATION TO CRYSTALLINE ROCK

*An IGSC "Geosphere Stability" Workshop*

MANCHESTER, UNITED KINGDOM  
13-15 November 2007

A workshop organised by the  
OECD Nuclear Energy Agency  
and hosted by  
The UK Nuclear Decommissioning Authority  
And the  
University of Manchester Dalton Nuclear Institute

PRELIMINARY PROGRAMME  
Pre-Registration  
CALL FOR POSTER PRESENTATIONS

Deadline for Pre-Registration and Abstracts for Poster Presentations:  
\*\*\* 29 JUNE 2007 \*\*\*



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<b>KEY DEADLINES</b>	
Pre-registration ends	29 June 2007
Final programme	31 June 2007
Registration opens	31 July 2007
Poster abstracts due	10 August 2007
Author notification	14 September 2007
Registration due	15 October 2007
Final papers due	15 October 2007
Slide presentations due for speakers	1 November 2007



## 1. BACKGROUND AND CONTEXT

A safety case for a geological repository for high-level and/or long-lived radioactive waste aims at conveying reasoned and complementary arguments to illustrate and instill confidence in the performance and safety of the disposal system.

Potential geological host formations (and their surroundings) are chosen in particular for their long-term stability, their ability to accommodate the waste disposal facility, their ability to prevent or attenuate potential release of radioactivity (e.g. through retention capacities), and their buffering capacity *vis-à-vis* external and internal perturbations. Siting of potential disposal facilities is also carried out with an awareness of natural hazards. Honest recognition is required that no natural system is in equilibrium; the concept of “geosphere stability” does not therefore imply that steady state conditions are prevailing in the geosphere over (very) long periods of time. However, changes occur in many systems to an extent and at a rate such that their effects would not compromise deep disposal safety.

In building a safety case, it is therefore important to assess:

- the features, events and processes that could impact the evolution of the geosphere;
- the long-term stability of the favourable conditions displayed by the host formation;
- the buffering capacity of the formation *vis-à-vis* perturbations.

**The key issue is to evaluate the resilience of the main safety functions of the geosphere (including flow and transport properties) to natural perturbations. Thus, phenomenological evidence of persistence of those functions in past episodes of, e.g. climatic changes, seismic activity, diagenetic evolution, burial/uplift should enhance confidence in geosphere stability.** The relevance of various naturally-occurring processes and events will depend upon the timeframe to be considered. Following the conclusions of a previous NEA initiative<sup>1</sup>, the main focus is on features, events and processes over a period of about one million years—the order of magnitude of the time needed for HLW radioactivity to decay to levels comparable to uranium ores is indeed about a few hundred thousand years.

The NEA Integration Group for the Safety Case (IGSC) initiated the “geosphere stability” project in 2002 to address the role and importance of geosphere stability, and to better understand the scientific evidence and arguments that contribute to confidence in geological stability.

## 2. SCOPE OF THE WORKSHOP

This workshop will be the second of a series dealing with geosphere stability for various host rocks types (i.e. crystalline rocks, argillaceous media and evaporites). An important objective of the overall “geosphere stability” initiative under the NEA IGSC is to ensure the views of the broader scientific community inform the understanding of geosphere stability in radioactive waste management.

The first workshop, held in 2003, focused on argillaceous settings and was organised under the auspices of the NEA IGSC Working Group on the Characterisation, the Understanding and the Performance of Argillaceous Rocks as Repository Host Formations (the “Clay Club”). This

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1. NEA 2002, The handling of timescales in assessing post-closure safety of deep geological repositories, Workshop proceedings, Paris, 16-18 April 2001.

second workshop is focused on the application of this project to the context of crystalline, or hard fractured, rocks. In the context of this project, the term “crystalline rock” is meant to include all types of hard, fractured rock – i.e. those not otherwise covered by the other workshops envisioned in the series concerning clay and salt environments. In particular, this workshop is meant to cover various hard rocks being investigated by the U.S. and Japan as potential host environments for geological disposal.

Among the favourable properties often quoted to support the choice of crystalline rocks as host formations for disposing of long-lived radioactive waste are:

- Low permeability;
- Resistance to deformation and erosion;
- Geomechanical properties that afford long-term protection of engineered barrier systems;
- Geochemical conditions that favour low radionuclide solubilities and low degradation of engineered barrier systems;
- Good engineering properties.

The workshop will focus on issues related to crystalline rock in the context of host formations for geological disposal and in particular on:

- The multiple lines of evidences to support the stability/buffering/robustness of crystalline rock over long timescales;
- The resilience of the favourable properties of crystalline rock to natural perturbations.

A further important objective is to evaluate the extent to which we may be confident about the required level of stability whether we know what we are looking for, and if we have the necessary tools to carry out the investigations (predictability). Repository-induced effects (e.g. thermal loading, radiolysis, and migration of alkaline plumes) are excluded from the remit of this workshop.

The workshop will consider the whole spectrum of crystalline and other hard, fractured rocks envisaged as host formations (e.g. tuffaceous rocks).



### 3. PRELIMINARY AGENDA

<b>DAY 1</b>	<b>13 November 2007</b>
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13:00 – 14:00     **Registration + poster set up**

14:00             **Welcome addresses**

*NDA, NEA, Workshop Organisers*

14:30

**SESSION I:**

**GENERAL FRAMEWORK:  
CRYSTALLINE ROCKS AS HOST FORMATIONS**

**Questions to be addressed**

- What are the main functions/roles of the geosphere for disposal at different time scales (especially for crystalline and other hard, fractured rocks)?
- What assumptions relating to such geosphere settings are commonly made in safety cases (uncertainties, time scales, etc.)?
- What are the regulatory expectations concerning the confidence in geosphere stability?

**Oral presentations** (30 min each, including 10 min for discussion)

14:40             **Functions of crystalline rock formations in deep geological disposal and their handling in a safety case**

*Allan Hedin (SKB, Sweden)*

15:10             **Regulatory expectations concerning the confidence in geosphere stability and its handling in safety case**

*To be determined*

15:40

*Coffee break*

16:00

**SESSION II:           EXAMPLES OF KEY PROCESSES AFFECTING THE  
  GEOSPHERE FOR CRYSTALLINE ROCK**

**The session will focus on the processes, their potential consequences on host formations and their predictability**

**Questions to be addressed**

- What are the predominant processes for natural evolution that are relevant for geological disposal?
- What is the predictability of these processes over different time frames: up to 10 000 years, up to 100 000 years, and beyond?
- What are the potential consequences of these processes on the barrier function of the geosphere, including sustaining the integrity of the engineered barrier system?

**SESSION II:   Presentations**

(30 min each, including 10 min for discussion)

16:10

**Observations of Long-Term Evolution for Prediction of Near-Future Behavior of Crystalline Rock: A Geological Perspective**  
*To be determined*

16:40

**Tectonic Activities Affecting Different Types of Crystalline Rocks: Findings of the International Tectonics Meeting**  
*Neil Chapman (MCM Consulting, Switzerland)*

17:10

**Climate Change and Its Potential Impact on Mechanical Hydraulic and Chemical Conditions**  
*Jens-Ove Näslund (SKB, Sweden)*

17:40

**Uplift and Erosion: Potential Impact on Mechanical, Hydraulic, and Chemical Conditions in the Geological Environment**  
*Haruo Yamakazi (Tokyo Metropolitan University, Japan)*

18:15

**End of Day 1**

**DAY 2****14 November 2007**

09:00

**SESSION II: continued**

(30 min each, including 10 min for discussion)

9:00

**Rock Mechanics Impacts: Fracturing, Faulting, Creep and Shearing Driven by Changes in the External Environment***John Hudson (Rock Engineering Consultants, UK)*

9:30

**Predictability of the Evolution of Ground Water Flow Systems and Hydrochemistry***To be determined*

10:00

**Discussion**

10:30

*Coffee break*

11:00

**SESSION III: ARGUMENTS TO SUPPORT CONFIDENCE IN THE STABILITY OF CRYSTALLINE ROCKS AS POTENTIAL HOST FORMATIONS****Questions to be addressed:**

Each presentation will focus on the arguments in support of the confidence in geosphere stability, such as:

- The long-term stability of the favourable conditions displayed by host formations,
- The buffering capacity of the formation vis-à-vis perturbations,
- The predictability and ability to bound the effects of perturbations.

**Oral presentations** (30 min each, including 10 min for discussion)

11:10

**Lithological History and Ductile Deformation: The Lessons for Long-Term Stability of Large-Scale Structures in the Olkiluoto***Liisa Wikström (Posiva, Finland)*

11:40

**Evolution of the Fracture System in the Fino-Scandian Shield and Evidence for its Stability Over Repository Timeframes***To be determined*

12:10

*Lunch break*



DAY 3

15 November 2007

8:30

**SESSION IV: RESPONSE AND RESILIENCE OF CRYSTALLINE  
ROCK TO NATURAL PERTURBATIONS AND  
GEOSPHERE EVOLUTION (BUFFERING)**

**Questions to be addressed:**

- What is the stability of key transport processes and parameters (fracture networks, mineralogy, rock-matrix diffusion)?
- What kind of analogues should be used to support confidence (e.g. other types of formations and coming from other industry, e.g. mining or tunneling/hydroelectric power)?
- What kind of arguments could support the THMC buffering or absence of buffering? (N.B. repository-induced effects are excluded)

**Oral presentations (30 min each, including 10 min for discussion)**

8:40

**Fracture Re-Activation in Response to Seismic Events**

*Harald Hökmark (Clay Technology AB, Sweden)*

9:10

**Buffering Against Intrusion of Ground Water of Undesirable Composition**

*Petteri Pitkänen (VTT Finland)*

9:40

**Evolution of Ground-Water Flow and Mass Transport in Shield Flow  
Domains**

*To be determined*

10:10

**Understanding the Evolution of the Ground-Water Flow System Since Last  
Glaciation as a Means to Enhance Confidence in the Hydrogeological  
Description**

*Sven Follin (SF Geologic AB, Sweden)*

10:40

*Coffee Break*

11:00

**Hydromechanical Effects: Coping with Uncertainties in Transport and  
Flow Paths**

*To be determined*

11:30

**Hydraulic and Hydrochemical Response to Seismic Events**

*Tsuyoshi Nohara (Japan Atomic Energy Agency)*

12:00

**Stability of Flow Paths Considering the Evolution of Chemical Conditions:  
Precipitation and Dissolution**

*To be determined*

12:30

*Lunch break*

**SESSION V:**

**ROUND UP SESSION**

14:30

**Discussion**

15:30

**Key concluding messages**

*Workshop Programme Committee*

Around 16:00

**Closing of the workshop**

**DAY 4**

**16 November 2007**

**An optional technical field trip may be arranged to a UK site; if so, details will be provided during summer 2007.**

## **4. LOGISTICS AND PRACTICAL INFORMATION**

### **4.1 Workshop Structure**

The workshop will be organised into four main sessions, plus a poster session:

- The first and second plenary session will concern the fundamental requirements and basis for deep disposal regarding the stability and buffering capacity of the geosphere;
- The third and fourth plenary sessions will consist of more detailed presentations focusing on crystalline rocks in more detail, including the arguments in favor of geosphere stability in such settings as well as the response and resilience to perturbing events;
- A poster session is organised during the workshop.

The workshop is structured to ensure open discussion between participants and in particular between the waste management organisations and the scientific community. A concluding session should help define the key outcomes and messages of the workshop.

### **4.2 Participation**

In order to ensure a workable size, no more than 120 participants will be accepted. The workshop is open to the scientific community (university, research centres), industry, waste management organisations and regulatory bodies in order to provide a practical forum for fruitful exchanges. It would be of value to scientists, performance assessment specialists, and decision-makers.

### **4.3 Poster Session**

Abstracts for poster presentations are solicited. The posters can address any of the workshop topics. An abstract of ½ page should be submitted with the pre-registration form by 29 June 2007. Authors will be notified of decisions by 14 September 2007. Final papers (6-10 pages) supporting the posters (to be included in the proceedings) are due with official registration by 15 October 2007. Formatting instructions for posters and papers will be provided when authors are notified of acceptance.

### **4.4 Oral Presentations**

Oral presentations are by invitation. Supporting papers to be included in the proceedings will be due with final registration by 15 October 2007; formatting instructions will be provided to authors. Slides in PowerPoint format will be needed for presentations during workshop sessions.

### **4.5 Proceedings**

The NEA will publish full proceedings of the Workshop. The proceedings will include a synthesis of workshop discussions and outcomes, a compilation of supporting papers and the list of participants. A copy of the proceedings is included in the fee to be paid by each registered participant.

#### 4.6 The Workshop Programme Committee

The **Programme Committee** defines the topic and workshop agenda, and takes responsibility for inviting speakers and chairpersons, and takes decisions regarding poster presentations. The committee also reviews the workshop proceedings. The workshop Programme Committee members are Alan Hooper (UK Decommissioning Authority), Johan Andersson (Streamflow, S.A., on behalf of Posiva), Betsy Forinash (NEA), Raymond Munier (SKB), and Koji Umeda (JAEA).

#### 4.7 Location and Practical Arrangements for the Workshop

The workshop will be held on 13-15 November 2007 at the University of Manchester, UK. Further details on logistical arrangements and travel requirements will be available during summer 2007.

#### 4.8 Working Language

English will be the working language of the workshop and of the proceedings.

#### 4.9 Registration and Participation

Please return the attached pre-registration form to the NEA Secretariat by **29 June 2007** to indicate your interest in attending the workshop. The workshop registration will be capped at 120 participants. Official registration to confirm your participation in the workshop will be opened during summer 2007 when the final programme is available; the registration deadline will be 28 September 2007.

The workshop fee will be payable at the time of registration. The fee will be specified with the registration form and is expected to be approximately 350 euro. Fees are to be paid preferably by bank transfer; all bank details will be provided with the final workshop programme and registration form.

#### 4.10 Summary of Deadlines

<b>KEY DEADLINES</b>	
Pre-registration ends	29 June 2007
Final programme	31 June 2007
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## ANNEX A

**GEOSPHERE STABILITY WORKSHOP** on

**“STABILITY AND BUFFERING CAPACITY OF THE GEOSPHERE FOR LONG-TERM ISOLATION OF RADIOACTIVE WASTE: APPLICATION TO CRYSTALLINE ROCK”**

**PRE-REGISTRATION FORM: Due 29 JUNE 2007**

**Yes**, I am interested in the Geosphere Stability Workshop and I hope to attend. Please keep me informed as practical information and the final programme are made available.

(Please fill in using block capitals)

Family and Given Name:		
Organisation:		
Address:		
Phone:		Fax:
E-mail:		

I also would be interested to participate in: (please circle the appropriate response)

- The workshop dinner on the evening of Wednesday 14 Nov Yes / No
  - The technical field trip (if one is arranged) on Friday 16 Nov Yes / No
- (further details will be provided on these events with the final programme)*

I propose the following paper for a poster presentation at the workshop:

*A ½ page abstract is due with the pre-registration form by **29 June 2007**; authors will be notified by 31 August*

Author(s):	
Affiliation(s):	
Title:	

**This form must be returned by 29 JUNE 2007 to Mrs. Katia-Karina Le Bot**  
**e-mail: [katia-karina.lebot@oecd.org](mailto:katia-karina.lebot@oecd.org), telephone: +33 (0)1 45 24 10 87**