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# Use of natural analogues for public communication

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#### **Overview - the past**

Natural analogue information has been used extensively in the past to provide materials for public communications applications:

- provides a valuable method for developing arguments for more technical stakeholders
- impact on the general public has been significantly less than would be desired

## **Analogue technical documentation**

Key background resource for all communication efforts:

- general reviews
- detailed project reports
- technical papers
- conference proceedings
- text books

• .

 ⇒ Hard copies are OK, but more effort is needed to get material onto the internet
⇒ Great care is needed due to poor quality of technical reviewing in some cases



Examples of overinterpretation / incorrect system understanding from technical publications on Oklo ...often from those who should really know better!

"We also argue that the Oklo reactors serve as a natural analogue and provide a rough bound on probability of criticality given favorable hydrologic or geochemical conditions on the scale of the repository that is less than 0.10" (Rechard & Tierney, 2005).

"... criticality in a natural setting is difficult to achieve and, if it occurs at all, it is a self-limiting process" (Oversby, 2000).

Classic example of a logical error: Absence of evidence does not equal evidence of absence

## Material for general technical audiences

- Publications in industry press
  - Radwaste solutions
  - Nuclear Engineering International
  - ...

#### • Articles in general science publications

- New Scientist
- Scientific American
- ..

#### • Technical brochures / magazines

- Nagra Bulletin
- Enresa publications
- .

#### $\Rightarrow$ Generally attractive

 $\Rightarrow$  Feedback positive



## Material for non-technical audiences

高レベル放射性座変物対策の合がわかる広報調

- Advertisements in newspapers & magazines
- Information brochures
- Special media events
- TV & Radio

高レベル放射性廃棄物対策の今がわかる広報誌

NUMO

- Video
- Internet

廃棄物対策の歴史とを超えるガラスの力

Den svenska metoden för förvaring av använt kärnbränsle är inte ny.



Den har funnits i Kanada i 1300 miljoner år.

i tar hand om Su

紀元前1世紀に

それは古代人の

地位の象徴であった

つくられたガラスの管玉

期にわたり安定した性質をもつガラス。

HOW HADRIAN'S WALL IS HELPING NIREX TO CONTAIN RADIOACTIVE WASTE SAFELY.



Concrete and other cement-based materials are known to survive for millennia in the right conditions. They were used in ancient China, Egypt and Greece. In fact the condition of concrete recently excavated from the foundations of Hadrian's Wall shows how well it can withstand the centuries.

It is this quality which makes cement-based grout and concrete so suitable for use in the proposed Sellafield Repository.

Even when they break down they form an efficient chemical barrier which prevents many of the wastes dissolving in water. In fact, this is one of their main purposes in the repository.

The Sellafield Repository, if built, will be an impressive feat of engineering, dedicated to the safe and permanent disposal of medium and low-level radioactive waste. As far as the eye is concerned it will barely be noticeable.

degree of care which will be in evidence

series of huge caverns will be excavated n be emplaced.

ives and shoes, will be packed into steel level waste will be grouted into stainless

l needs for 50 years and it will safeguard years after that.

rmation Officer, UK Nirex Ltd., Curie X11 0RH, or telephone Peter Curd on Sellifield Registion Project is a point venture of UK Nirex Ltd and British Nuclear Fuels PLC.

Nirex Limited

NUMO

Used by many organisations -NUMO particularly prominent recently

#### A problem with material for the general public overinterpretation to the point that the message is incorrect...

"The Oklo reactors ran gently at the kilowattpower level for millions of years. They never blew up. The radiation and waste from them did not deter surrounding life forms. Over immense timescales, the waste has barely moved away from the reactor site. As a result, scientists today are confident that waste in man-made stores and repositories is likely to move even less..."

British Nuclear Forum (1991)

# ...which seems to be a particular problem in the case of Oklo...

(http://www.ocrwm.doe.gov/ymp/science/oklo.shtml) "Most of the Oklo reactor zones were found in environments" without access to oxygen. One site, however, was found in an oxygen rich environment, making it of particular interest as an analogue for processes at Yucca Mountain. This site provides scientists an opportunity to examine the results of a natural two billion-year experiment, one that cannot be duplicated in a laboratory. By analyzing the remnants at Oklo, scientists can understand how underground rock formations contained the radioactive particles and can apply their findings to how a repository at Yucca Mountain would work to isolate waste."

#### Setting an analogue in context



#### ...another example using same format



## **Increasing impact - video & animation**

 Original video "Traces of the Future" was based on an original proposal discussed by NAWG and implemented as an international collaboration

- Video incorporates film clips and a limited amount of animation for clarification of arguments
- Produced for ease of translation
  - E master
  - Versions D, F, I, E, S, J, ...
- Recently formated as DVD by Nagra
- Produced a decade ago:
  - $\Rightarrow$  so somewhat dated
  - $\Rightarrow$  an update would be useful
  - $\Rightarrow$  better focus on audience needed



A proposal for such work has been developed with funding from the US DoE and presented to EDRAM

## **Communication / confidence-building**

- Even well prepared materials reach only a limited audience
- Methods for getting messages over to technical stakeholders are well established

#### however

 The general public especially younger generations - are key audiences that are not being reached by conventional methods



#### The future

#### **Problems identified from the past:**

- Over-simplification (on occasions to the point that delivered messages are factually incorrect)
- Lack of context (attempting to make arguments using analogues alone)
- Conservatism in approach to the mass media (focusing very much on magazines and brochures, with little use of advanced audiovisual and internet materials)

 $\Rightarrow$ So how can we improve this situation?

## **Establishing credibility**

- For public acceptance, both the programme and the organisations involved need to be credible (NB general lack of trust of "nuclear")
- NA projects help to show:
  - technical capabilities of expert staff in multidisciplinary projects
  - abilities to synthesise and document complex systems in a manner understandable to all key stakeholders
  - openness to show potential limitations and flexibility to rapidly correct these
  - operation of international technical collaboration
- $\Rightarrow$  This is all part of "communication"



## Training

- Essential to put NA in the multidisciplinary context of radioactive waste management
- Specialist training centre already established (ITC:

http://www.itc-school.org/index.html

- General NA training course run in April
- Further tailored courses planned (e.g. Nagoya in November)







#### ...lectures are not enough

- A valuable spin-off from early NA projects was the opportunity for relatively young staff to participate in (or even run) complex, international projects
- As such experienced staff are aging, analogues can provide a method for transfer of experience to the next generation
- NA studies have proven suitable for the basis of Ph.D. projects: improves credibility and links to Academia



### **Direct experience transfer**

- Prioritise explicitly during project planning
- Allocate technical / project responsibility to young staff
- Encourage teams to provide support networks
- Complement with experienced mentors

Works best for complex, multidisciplinary, international projects

#### **Need for new projects**

- Involvement of new generation of PR (and PA) staff
- Production of materials suitable for audio-visual and web-based applications
- New projects attract attention of media (much less interest in work carried out in the past)
  - Examples selected to cover a range of cost / complexity: many others are possible

#### **Example 1: standalone PA analogue**

Bukkabrany, Hungary: preserved trees similar (but older - c.a. 8 Ma) to Dunarobba Isolated in sand lenses within an open-cast coal mine

- . proposal being developed (input appreciated!)
- . could be implemented as a collaboration
- . could be used for staff training
- . could produce new PR material (NB highlighted recently in many news websites)



#### **Example 2: an integrated PR approach**

• Aim: test applicability of NA arguments to convince key stakeholder groups:

- Professional societies
- University teachers and students
- School teachers and students
- General public
- **Procedure: identification of messages:** 
  - develop a range of different presentation materials focused on concerns of stakeholders
  - test on representative target groups
  - monitor responses and propose improvements
  - refine materials and retest
- Output #1: base materials for presentations & lectures

#### **Example 2: integrated PR approach (2)**

- Develop video storyboard:
  - rework key messages and analogue support
  - place in the context of national programme(s)
  - if appropriate, formulate variants for different audiences
- Video production
  - specify format / variants (DVD, website, broadcast etc.)
  - select experienced production team
  - produce & edit required video sequence
  - produce variants and test on selected audiences
  - analyse audience comments, revise as required
  - final production
- Output
  - video materials for communication to stakeholders
  - tailored information blocks for web-based applications

#### **Example 2: integrated PR approach (3)**

- Possible implementation approach / teams:
  - Direct involvement of partner technical and PR groups (ideally younger staff)
  - Practical project support / liaison / translation by contractor(s)
  - International technical support by experts with experience in natural analogues, communication and relevant national programmes
  - Production team with experience in broadcast-standard technical video production
  - Technical support by IT experts (internal or external) with experience in web-based applications

#### **Example 3 - an integrated NA approach**



## **Project example – low pH NA**

#### **Opportunity to:**

- Place safety case concerns in context
- Define and prioritise goals
- Carry out site selection / characterisation
- Develop and test models
- Iteratively develop project
- Provide feedback to national programme (HLW / TRU / L1)
- Produce communication materials for key stakeholders

Training & Experience Transfer

#### Background to the concrete / bentonite NA - HLW

- Conventional designs exclude consideration of concrete in the vicinity of the EBS
- Sites may have geological conditions that would exclude any concept without extensive support structures in emplacement tunnels / drifts
- Current technology would focus on concrete – but this is known to cause problems for bentonite stability
- To minimise problems, "low pH" cements are being developed – but it is not certain that these would avoid bentonite alteration



## Background to the concrete / bentonite NA – TRU / ILW

- For both ILW / TRU designs, concreted waste are often surrounded by a bentonite barrier
- Inventory of concrete is huge compared to that of bentonite
- Bentonite barrier properties assumed for ka timescales – and play a major role in the safety case



#### **Bentonite/concrete interaction**



## Study topics at the NA site



# Philippines selected by MAA

- Known hyperalkaline hot springs associated with ophiolites
- Widespread bentonite, including large deposits in the vicinity of ophiolites
- Indications of past alteration of bentonite by hyperalkaline fluids
- Challenge is to find site where such alteration is ongoing
- Check hyperalkaline springs for local bentonite
- Check bentonites for hyperalkaline waters

## **Philippine ophiolites and bentonite**





#### Conceptual model of site



## Goals for the new project

- #1 Ongoing and / or dateable past bentonite alteration by high pH waters
- #2 High pH plume host rock interaction
- #3 RN behaviour under high pH conditions with spin-offs
- Indicators of geological / hydrogeological stability (particularly for coastal sites)
- Training:
  - Involvement of younger staff from waste management / R&D organisations & universities > soft
  - Joint teams with experienced "mentors" and Philippine researchers
  - Involvement of a range of international partners
- PR: exotic and interesting locations

hard

### "Mentors" for experience transfer

Mentor	Direct analogue experience	Radwaste experience
Ian McKinley	<ul><li>&gt; 25 years, wide diversity of analogues</li><li>L.Lomond, Oman, Poços, video,</li><li>reviews</li></ul>	>30 years, esp. CH, J & UK Lab., PA, URLs, tech.coordination
Russell Alexander	>15 years, wide diversity of analogues Grimsel ,Maqarin, TAP, video, reviews	>15 years, esp. CH & J Geochemistry, URLs ,PA,
John Smellie	>20 years, wide diversity of analogues Pocos, Oklo, Maqarin, video, reviews	>20 years, esp. S & SF Geology, site characterisation, URLs
Julie West	>20 years, range of analogues L.Lomond, Oman, Poços, Maqarin,	>20 years, esp. UK,CH & J Microbiology, communication
Fiona Neall	Application of analogues	>15 years, esp. CH & J Cement chem., PA, geochemistry
Hideki Kawamura	Application of analogues	>15 years, esp. J & CH Engineering, PA, URLs, coordination
"Dora" Yoshida	>15 years, wide range of J analogues TAP,	>15 years, J Geology, geochemistry.





# ...finally, an idea for other material for communication

Aim is to communicate the huge extent of geological timescales

- Base on Nagra fold-out "time trip": make longer if possible (form of measuring tape?)
- Set up double-sided:
  - 2 billion year scale (showing age of Oklo and Cigar Lake)
  - 10 Ma scale analogues and future performance of repository / decay of radioactivity (Pu-239?)
- Larger scale variants could be set up in meeting rooms, exhibitions, etc.