Development of an optimised natural analogue programme: a novel methodology

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TOP DOWN PLANNING

Natural analogue (NA) studies have long been an integral part of national radioactive waste management programmes (see Miller et al, 2000, for examples). However, due to the general bottom-up approach taken (*i.e.* projects initiated by the specialists involved in the technical aspects of a specific NA study), few data have been used within any repository safety assessment (SA; see JNC, 2000, 2005 for examples). Here, instead of the 'normal' bottom-up approach, a strictly structured methodology been developed for a national radioactive waste programme, which involves:

- A bottom-up critical assessment of openly available NA literature, with particular emphasis of its relevance to national deep geological disposal programmes. Concentrating on technical aspects, focus is placed on the requirements to provide input to the development of safety cases for specific repository programmes.
- At the top level, a formal assessment of the weightings given to the wider aims of a NA programme, taking account of secondary aims associated with the "safety strategy" and other national programme constraints (*eg* a 5-year R&D plan)
- Specification of an optimised NA project in a top-down manner, representing main goals in terms of individual work packages (WP) and bearing in mind that there can be synergies involved in combining such WP at a suitable location.
- Selection of sites for new analogue projects to meet identified requirements.

As an example, the top down process will be shown, identifying key analogue requirements to support the safety case for high-level radwaste (HLW) disposal and determining if such needs can be met:

1) Directly from the existing international NA database
2) By reworking existing information
3) Only by new, focussed studies

For case 1, a few key references will be highlighted. For case 2, the reworking procedures will be identified and some representative examples illustrated. For case 3, specific goals will be clearly described and used as a basis for developing an optimised programme in a structured manner:
a) Break down goals above in terms of specific site requirements
b) Map such requirements against existing information bases for the sites
c) Evaluate the extent to which missing information could be obtained from each site
d) Outline provisional work programs for each site, along with costs, risks and uncertainties
e) Compare and prioritise sites using a multi-attribute analysis (MAA) approach

KEY NA REQUIREMENTS

Although the process of 'data mining' from existing studies (for Cases 1 & 2 above) appears to be relatively straightforward, this is not the case as evidenced from the numerous published "NA reviews", which are actually no more than data dumps of everything written on the topic – *regardless of relevance or quality*. Data mining needs to be carried out by experienced staff, who understand both the inherent constraints of NA studies and the needs of the users of NA information – and are thus capable of *critical* evaluation of the very extensive, but variable quality, literature in this area.

Effective data mining requires:

- Fully documented reports, which include as much of the raw data as possible, as well as the original interpretation. Where possible, the raw data should include an assessment of uncertainties[1]
- If not available in the reports, a fully quality assured raw data set should be accessible
- Clear indication of the status of any models used (*eg* have they been tested previously)
- It is an advantage if the original project team can still be contacted and questioned, either formally or informally
- A sample depository is also of use, allowing re-analysis of material if necessary
- Where possible, any new information should be compared with relevant laboratory or *in situ* data to produce an integrated whole. This has been proposed several times but has rarely been done within a SA
- Where possible, any re-analysis should be integrated into an ongoing safety case or, at least, the new information should be placed in the context of an existing SA

Using a couple of examples, safety case requirements that can be directly met by existing literature will be indicated. Additionally, existing studies that require re-interpretation in order to be useful will be noted, with an indication of how data may be derived that is applicable to a national programme.

Finally, where requirements cannot be met from the existing NA database, new studies need to be initiated. By setting up a "wish-list" of output from such studies and weighting potential goals, the ideal specifications for sites can be derived and mapped against potential locations in any particular country (and surrounding regions). This forms the basis to establish an optimised NA work programme, as will be illustrated.

REFERENCES
JNC (2000) H12: Second progress report on R&D for the geological disposal of HLW in Japan. JNC TN1410 2000-001, JAEA, Tokai, Japan.

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[1] Astonishingly, this is frequently not the case and is the clear sign of poor quality management.

JNC (2005) H17: Development and management of the technical knowledge base for the geological disposal of HLW - Knowledge Management Report JNC TN1400 2005-022, JAEA, Tokai, Japan.

Miller, W.M., Alexander, W.R., Chapman, N.A., McKinley, I.G. & Smellie, J.A.T. (2000): The geological disposal of radioactive waste and natural analogues: lessons from nature and archaeology. Waste management series, vol. 2, Pergamon, Amsterdam, The Netherlands.