Concepts for bottom-up QA

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Background

- As the national programme moves closer to realisation, it is necessary for the URL programme to develop and support the standards and practices which will be expected by the stakeholders of an actual repository site in Japan
- Clearly, quality assurance programmes are among the first such tools required and here the approach in the Horonobe hydrochemistry programme is presented as an example of likely future methods

Background

- Environmental samples have to be taken where appropriate - hence conditions may not be as well constrained as in the laboratory
- Natural systems are commonly heterogeneous over a wide range of physical and temporal scales
  - a carefully designed sampling programme is a critical first step in any study
  - in general, take as wide a range of samples as possible to determine inherent variability
- → Single measurements are usually of very limited value (NB Maqarin.....)

Background

- Why `bottom-up`?
  - because we at the work face also care passionately about `quality`, certainly enough to do something about it ourselves
  - to prove this, I'll quickly introduce you to a QA system which was invoked by the guys at the bottom, those producing the data

Background

- the aim of this work was to attain added-value in any new boreholes when compared to the older HDB programme
- this is a polite way of saying that we learn from our mistakes....
- the short-term aim is to introduce a QA system for on-site hydrochemistry sampling
- laboratory analysis and data interpretation will follow....

Background

- such formalised *field manuals* have been used in other national programmes (e.g. Sweden, Switzerland, Finland...) and have been very useful in minimising wasted effort
- through this, the medium-term aim is to increase the value of our data
- the long-term aim is to develop a system for use in the national programme *before* it begins in earnest
- to date, we have had feedback from AIST and JNES and will have future input from CRIEPI and RWMC (along with JAEA), so this is/will remain a 'living' document which is constantly updated following comment

Background

- **such a field manual should include:**
  - ***protocols for sampling (why, when and how)***
  - ***explanation of use of appropriate sampling equipment for the required task***
    - ***when downhole***
    - ***when on the surface***
  - ***information on the types of field measurements and analysis (when are they necessary?)***

Background

- ***sample handling (what to be aware of, when to manipulate samples before storage, what not to do....), storage and transport***
- ***definition of analytical programmes – how much do I need to measure, when and on what samples***
- ***make sure that your staff understand uncertainties, error propagation and statistical significance – not directly part of a field manual, but it leads into this.....***

Influences on QA include....

The quality of hydrochemical data can be influenced by several processes, including

- contamination of the groundwater by drilling fluids or additives and by the material of the drilling equipment
  - additives, such as bentonite, will change the major element chemistry (due to exchange reactions, in this case)
  - metals from the drill bit and lines can change the perceived redox state
  - oxidants/reductants in the drilling fluid can change the perceived redox state
  - drilling fluid will dilute the groundwater solutes

Influences on QA include....

- damage to the host rock by the physical and chemical process of drilling
  - this can produce large colloid populations, for example, when weak rock is badly damaged by the drill bit
  - can dissolve highly soluble phases such as calcite, gypsum etc
- introduction of surface microbes or additional nutrients
  - either will change the *in situ* microbial populations and, as a consequence, the redox state of the groundwater
- contamination during analysis
  - by the introduction of atmospheric gases or other contaminants from the equipment or staff (e.g. trace levels of strontium from sweat can be transferred to equipment from hands if gloves are not worn)

Influences on QA include....

- by imprecise or inaccurate analysis
  - caused by equipment drift during analysis
  - or by the use of inappropriate standards (e.g. with a significantly different matrix from that of the groundwater)
  - or by 'non-standard' groundwater matrices (e.g. brines etc)
  - or by operator variability
  - by mixing different methods to analyse for the same parameter

Influences on QA – biggest problem

- contamination during sample handling and transport
  - by the introduction of contaminants such as oxygen and other oxidants (trapped in or on sampling equipment) which changes the *in situ* redox conditions
  - by degassing groundwater samples as they are brought to the surface, so changing pH and Eh values
  - by oxidising reduced species (in the porewater and the rock) during rock matrix sample handling and squeezing
  - by pumping at too great a rate for the local groundwater 'reservoir' in the vicinity of the sampling point. This can induce draw-in of groundwater from further afield and mixing with the *in situ* groundwater to produce a sample which in non-representative of that horizon in the borehole

Solution – review and formalise

- to minimise such problems, a decision was taken to review and correct our *on site* procedures
- decision was taken to formalise the procedure in writing
- aim was one sheet of instructions – i.e. no bulky manual which will be placed on a shelf, *rather something which will fit in a pocket and be used*
- this is supported by a larger set of Background Notes which set out the steps in detail – i.e. we explain our actions to the staff so they appreciate why they are doing what they do
- further supported by quick look tables to save time

Final word

We want to do our best to improve our data quality, but to put this in perspective.....

SKB

- **currently, the vast majority of SKB's site characterisation data are Category 3-5 (1=best, 5=worse)**
- **indeed, for redox calculations, less than 10% of the data are Category 1 or 2**
- **and several of these boreholes are 3 or more years old.....**

Posiva

- **when Posiva carried out a similar exercise on their Olkiluoto data last year, only just over 20% were assessed as Category 1 or 2 (equivalent)**

Final final word

- This work will be presented in detail (in Japanese) at the Annual Meeting of the Atomic Energy Society of Japan (Tokyo Institute of Technology, 23rd – 25th March 2009)
- JNES have requested that it be promulgated as a JIS (Japan Industrial Standard) as soon as possible
- With many thanks to my colleagues at JAEA Horonobe (GIRDD-SERG)