Relevance of model complexity for assessing contaminant leaching from a fractured degrading concrete structure

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Cementitious materials such as concrete, used in near-surface disposal facilities for radioactive waste, play a crucial role in ensuring the waste retention capabilities within the repository. During the lifetime of the facility, the concrete is in permanent contact with infiltrating rain or soil water, which is not in the equilibrium with the cement pore water. Chemical degradation of concrete affects several properties and consequently could accelerate the leaching of contaminants from the disposal system. One important degradation process is leaching of calcium. The effect of calcium leaching encompasses loss of material's mechanical strength, change of physical properties such as porosity, permeability and change of retention capacity for contaminants.

A small-scale representation of a concrete waste container wall with a fracture going through the middle is modeled in a simplified 2D geometry. The geochemical degradation reactions are solved using iPhreeqc, which is then linked to the finite element software COMSOL Multiphysics. By taking advantage of COMSOL's unique capability of treating fracture flow and transport as an implicit 1D-boundary, the computational burden of the problem is drastically reduced.

In a stepwise manner, both the chemical and physical complexity of the model are increased. Along the way, different concrete minerals are added to the geochemical system, starting from system based solely on portlandite and ending up with a state-of-the-art description with inclusion of different C-S-H minerals. By then linking the chemical degradation to the hydraulic and diffusive properties of the concrete, several levels of complexity are again added. It is then evaluated which additions add enough safety-relevant information in order to justify the increase in computational demands. This is done by comparing Ca leaching rates and the evolution of safety relevant properties such as the total water flux through the system or the pH (which influences the mobility of contaminants). On the basis of these analyses, recommendations are made for the safety assessment modelling of large-scale disposal facilities.

Geochemical baseline mapping in India using top and bottom soil samples for environmental management

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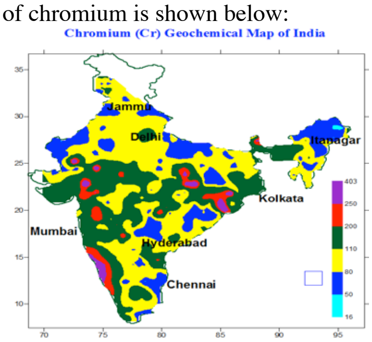
As a part of IUGS/IAGC Global Baselines Program, National Geophysical Research Institute (NGRI), Hyderabad has carried out studies leading to the preparation of geochemical maps of India for top and bottom soil for 25 elements. India is devided into 122 GRNs, out of which 118 cells of 160 x 160 sq. Km have been sampled and analysed by using X-ray fluorescence spectrometer at NGRI, Hyderabad.

Samples were collected by using the field manual (Green Book) prepared by Geological Survey of Finland. All the data is compiled and plotted by using a software SURFER to prepare the baseline maps. The data was interpreted with the underlying geology of the area. Baseline studies are useful to define the natural abundance and the spatial distribution of chemical elements in the earth's surface to which changes caused by human activities can be compared.

Geochemical maps have been interpreted and spatial correlation was found between the underlying geology and elemental abundances in the sampled media. The hot spots for the toxic metals can be seen at a glance for the whole country, which will help in taking suitable remedial measures. Mean, median, maximum, minimum and average concentrations were calculated and presented in this paper for chromium, copper, nickel, arsenic, cobalt, strontium, rubidium along with some major oxides like aluminium, iron, titanium, manganese, sulphur, calcium, magnesium, sodium, potassium and silica. Geochemical map of chromium is shown below:



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