How to use hydrochemical data to improve long-term groundwater flow simulations?

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Understanding long-term groundwater flow regimes (i.e. palaeohydrogeology) has been a challenging task because of few field data and complex interactions between natural events and processes. These problems tend to be greater at deeper depths and at older times so this can increase uncertainty in subsurface characterizations for geological disposal of high-level radioactive wastes (HLW).

Standard approaches are to incorporate hydrochemical data (including isotopes) into hydrogeological analyses that consists of groundwater flow modelling and integrative interpretations. Although many examples from around the world are available in the literature, they are of little help in Japan as the subsurface groundwaters of coastal area in tectonically active zones can be affected simultaneously by various natural events and processes such as sea-level changes, earthquakes, uplift, erosion and sedimentation.

To enable simulation of such complex hydrogeologcal systems, integrated modelling methods combining data from geology, hydrogeology, hydrochemistry and site tectonics, (including uplift and erosion processes) have been developed. Here, discussions are presented on how hydrochemical data are fundamental to reduce uncertainty in long-term groundwater flow simulations by using actual field data obtained from the deep borehole investigations in Horonobe Town, northern Hokkaido, Japan.

Results of a wide-ranging site characterisation for JAEA's Horonobe URL (underground rock laboratory) will be presented with an explanation of how the data were then used to develop initially a site conceptual model and then a 4-D model of the temporal evolution of this complex coatsal site. The methodology developed by JAEA can be used for any site characterisation a coastal repository for radioactive waste in tectonically complex zones worldwide, not just in Japan.