Palaeohydrogeology in coastal site characterisation: a case study at Horonobe, Japan

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Designs for radioactive waste repositories consist of multiple safety barriers which include the waste form, the canister, the engineered barriers and the geosphere. The three most important safety features provided by the geosphere are mechanical stability, favourable geochemical conditions and low groundwater flux. Consequently, any repository site characterisation has to not only define if these features are currently appropriate, but also assess if they will remain adequate up to several hundred thousand years into the future. To this end, palaeohydrogeology has been used as a powerful tool in site characterisation. Here, the temporal changes of various characteristics of a site are studied to build up a conceptual model for the overall site evolution over geological time, up to the present. These characteristics and processes may include tectonics, geology, groundwater flow characteristics, groundwater chemistry and topography including uplift and erosion processes. Multidisciplinary expertise is employed to describe these key aspects.

Traditionally, the data produced are then synthesised into a conceptual model of the site evolution over the last several hundred thousand to a million years and this is used to define the likely future evolution of the site and to assess if the main safety features will continue to function adequately. Here, the concept and approach of this programme are presented, which is focussed on the palaeohydrogeology of the coastal site at Horonobe in northern Hokkaido, Japan, with the integration of input from the ongoing Horonobe Underground Research Laboratory Project. In the first phase, a conceptual model of the site will be developed, which takes into account the geological evolution of the Horonobe area, with focus very much on the impact of glacial/post-glacial related changes in the Japan Sea on the site. This will be tested against data currently being produced at new deep boreholes in the area and amended as necessary. This new conceptual model will then be expanded to cover other sites on Japan's western seaboard, with the final aim of producing a regional understanding of the palaeohydrogeological evolution of all coastal sites on the Japan Sea since the last glacial termination.