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Geomorphic evolution in the Horonobe area, Hokkaido, northern Japan

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A critical issue to assess the long-term safety of the geological disposal system is to demonstrate the stability of the geosphere, taking into account its likely future evolution. The geosphere is gradually and constantly evolving over geological time, and then the stability, in this case, does not imply that steady-state conditions exist. The stability is broadly defined as the persistence of Thermal-Hydrological-Mechanical-Chemical conditions considered favourable for the long-term safety of a geological disposal system. What is important is that we understand the evolution.

The present state of the geosphere results from the interplay of many natural events and processes that have occurred in the past, which include sub-surface processes (e.g. crustal movement, diagenesis, etc.) and earth-surface processes (e.g. climatic and sea-level changes, geomorphic processes, etc.). An explanation of the geosphere evolution which is given in the context of geological history provides the firm foundation to describe the likely future evolution of the geosphere.

In this study, we provide the conceptual model of the geomorphic history as one of the earth-surface processes in the Horonobe area, Hokkaido, northern Japan, based on the results of an air-photo interpretation, geomorphic and geological surveys, AMS C-14 dating of landform materials, and pollen analysis of peat layers. The landforms in the area are classified into 7 categories according to their present form, geomorphic processes responsible for their development, and formation age of landforms. Those are as follows: alluvial terrace, periglacial gentle-slope and terrace, fluvial terrace, marine terrace, rounded and sharp-crested hills, sand dune, and landslide.

The marine terraces can be subdivided into MIS5.5 MIS7, and MIS9 terraces mainly based on the altitude, degree of dissection, and thickness of aeolian deposits on the terrace surface. The uplift rate of the Horonobe area is estimated at 0.3m/ky in the past 210,000 years by using the age and altitude of the marine terraces, and the global-scale sea-level curve [1]. The AMS C-14 ages of the wood fragments occurred at the bottom of the alluvial terraces and the peat occurred in the periglacial terraces indicate ca. 5,000 yrsBP and 14,000 to 12,000 yrsBP [2], respectively. In addition, the reconstructed palaeovegetation in the late Last Glacial indicates a sub-arctic coniferous forest based on the pollen analysis of peat layers occurred in the periglacial terrace [2].

The chronological conceptual model of the geomorphic history in the Horonobe area has been constructed by integration of the information for the palaeoclimate, the geomorphology, and the crustal movement in the area. The model suggests that the geomorphic history in the area has been evolving under the influence of not only a climate change and crustal movement but also surface geology where the landforms have been developed.

[1]Ota et al. (2007) JAEA-Research 2007-044, Japan Atomic Energy Agency.
[2]Niizato et al. (2009) Japan Geoscience Meeting 2009, Abstracts, G122-P007.

Keywords: climatic geomorphology, periglacial environment, rock control