Geosphere Stability Project (3) Provenance analysis techniques

*Kayoko Tokuyasu[1], Kenichi Yasue[1], Tetsuya Komatsu[1], Itoko Tamura[1], Yasuharu Horiuchi[1]

1.Japan Atomic Energy Agency

An uplift rate of mountains attains to a dynamic equilibrium with an erosion rate in the later stage of mountain-building, then the uplift does not cause the change of groundwater flow. However, the uplift can influence the groundwater flow in the early stage of mountain-building that the dynamic equilibrium is not established. Understanding the stage of mountain building is crucial to the stability assessment of geological environments in geological disposal system. In this context, we have carried out the research and development of provenance analysis techniques to elucidate the mountain-building stage. This study presents the results focusing on the R&D using the Electron Spin Resonance (ESR) signals from quartz in sediments.
The R&D was carried out using the Miocene to Pleistocene Tokai Formation distributed over the Tono area, Central Japan. The Tokai Formation is composed of the Tokiguchi-Toudo Formation and the Toki Sand and Gravel Formation. In the northern part of the area, bedrocks consist of Mesozoic sedimentary rocks, the Nohi Rhyolite and the Sanyo Granite, whereas consist of the Ryoke Granites in the southern part. Many studies were performed in the area to clarify the landform developing process (e.g., Moriyama, 1990).
Samples of sediments were taken from the quarry located between the Tsukechi River, a tributary of the Kiso, and the Atera fault. Samples of basement rocks were also taken in and around the quarry. Sediments have a thickness of about 30m, overlying the Nohi Rhyolite. The lower part of sediments contains gravels derived from the Nohi Rhyolite, whereas the upper part contains several different kinds of gravels originated from the Nohi Rhyolite, granites and basalts. The lithology of gravels indicates that the provenance of sediments are different in the lower and upper parts.
ESR signals of quartz grains extracted from the samples were measured. As a result of the measurements, ESR signal intensities of the lower part of the sediments are similar to that of the Nohi Rhyolite, and the intensities of the upper part are similar to the granitic rocks of the Sanyo granite. On the basis of the results and previous studies, the Sanyo granite were not exposed to the drainage basin during the deposition of the lower part between 3.9 and 2.0 Ma, then the granitic rocks were exposed during the deposition of upper part after about 2.0 Ma. We conclude that the ESR properties are effective to estimate the sediment provenance.
This study was conducted under a contract with METI (Ministry of Economy, Trade and Industry) as part of its R&D supporting program for developing geological disposal technology.

Keywords: Geosphere stability, Provenance analysis techniques, Electron Spin Resonance method, High-level radioactive waste, Geological disposal

