Horonobe URL Project - lithological and mineralogical characteristics of the Neogene sedimentary rock (No. 2)

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Japan Nuclear Cycle Development Institute (JNC) is developing an underground research laboratory (URL) project for the Neogene sedimentary rock in Horonobe, Hokkaido. The project was commenced in March 2001 to conduct systematic research and development in the actual deep underground in order to better assess the deep underground environment. The research area is located in the Teshio sedimentary basin of the Neogene period. Sedimentary rock formations from the mid Miocene to the Pleistocene periods known as the Soya coal bearing, Masuporo, Wakkanai, Koetoi, Yuchi, and Sarabetu Formations overlie on the bedrock dating from the Cretaceous and Paleogene systems. There are many folds and faults running in the north-south direction, and in the central part of the town are eastward inclined reverse faults called the Omagari fault and Nukanan faults at a displacement of more than several hundred meters.

This report gives the results obtained from borehole and other investigations on the lithological and mineralogical characteristics of the Neogene sedimentary rock (in the Wakkanai, Koetoi, and Yuchi Formations) around the research area.

*Wakkanai Formation

The Wakkanai Formation is of a marine deposit, at times containing a thin layer of fine sandstone. It contains small amounts of rock fragments, mineral fragments, organic matter and pyrites, but due to the diagenesis, the inclination to shift toward Opal CT characteristics is witnessed and there is a small formation of smectite. In the Wakkanai Formation, rind burrows and trace fossils similar to those found in the Koetoi Formation are observed, producing numerous fossils and nodules. Lamina is found throughout, with greater number of mineral fragments and micro fossil of foraminifers than in the Koetoi Formation. Due to the diagenesis and compaction, shells of siliceous organic remains are compacted (solution, redeposition, compaction). Throughout the Wakkanai Formation, the data obtained are uniform with the rate of crevice formation around 35-40 %, the unit volume weight approximately 18-20 kN/m3, the uni-axial strength about 10-22 MPa, the hardness about 500, and the darkness under 30. The boundary between Wakkanai Formation and Koetoi Formation has traditionally been considered to be between the Opal A and Opal CT zones. However, for the present research area, the boundary for the diagenesis is considered gradually, and thus no clear boundary is defined between the formations. Near the boundary of the hard shale, diatomaceous mudstones and hard shale form indistinct layers, gradually blending into the Opal CT zone. Along with this phenomena, gradually diminishing the rate of crevice formation porosity from approximately 60 % to some 40 %, and slowly raising the unit volume weight from about 15 kN/m3 up to 18 kN/m3. At the same time, tridymite is found to form in a typical manner, the uni-axial strength shows a high record ranging between 20-35 MPa, and the hardness about 350 up to 500.

*Koetoi Formation

A marine deposit consisting mainly of diatomaceous mudstones overlies conformably the Wakkanai Formation. Occasionally, a thin layer of sandstone and tuff is found within this formation. Similar to the Wakkanai Formation, siliceous organic remains (Opal A) made up of diatoms and siliceous sponge spicules, along with small amounts of rock fragments and mineral fragments. In between siliceous organic remains, within the fossils and shells are numerous apertures. With the rate of crevice formation porocity at approximately 60-65 %, unit volume weight measuring approximately 14-16 kN/m3, uni-axial strength at approximately 1.5-6.0 MPa, the hardness about 300-400, and the darkness over 30.

*Yuchi Formation

A marine deposit consisting mainly of sandstones overlies conformably the Koetoi Formation. Occasionally, a mudstone is found within this formation. This formation indicates the hardness about 200-300 and the darkness about 30-40.