Groundwater colloid properties in sedimentary rocks: preliminary results from the Horonobe URL

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The Horonobe Underground Research Laboratory (URL) project has been conducted for the generic purposes of geoscientific research and R&D on geological disposal technology for sedimentary rocks. As a part of development of techniques for characterizing the deep geological environment, an estimation procedure of colloid properties in groundwater has been tested in the Horonobe URL.

In the present study, a non-destructive technique using Particle Tracking Analysis (PTA) (*i.e.*, PTA operated in the "*ZetaView*" made by MicrotracBEL Corp.) has been tested to determine size distribution and concentration of colloids in groundwater. The groundwaters were sampled from water-rings (4 samples) located in the vertical shafts and boreholes (6 samples) drilled in the drifts of the Horonobe URL. Results suggest that colloid particle concentrations range from 9.1×10^{6} to 7.8×10^{8} particle/mL (pt/mL) and the estimated colloid mass concentrations range from 3.4×10^{-2} to 4.2 mg/L for the diameter of 1 to 1000 nm. Particle and mass concentrations of groundwater sampled from water-rings are generally higher than those sampled from boreholes due to differences in groundwater sampling conditions. For sizes > 100 nm of particles, colloid stability was evaluated on the basis of DLVO theory [1,2]. DLVO theory predicts that particle sizes > 100 nm would be unstable (*i.e.*, coagulation could occur) except for samples of low ionic strength (IS) of groundwater obtained from boreholes. Particle and mass colloid concentrations in the groundwater were therefore reevaluated. The reevaluated reliable colloid particle concentrations range from 5.8×10^{6} to 3.0×10^{8} pt/mL and colloid mass concentrations range from 2.0×10^{-3} to 1.3×10^{-1} mg/L for the diameter range < 100 nm. Furthermore, the reevaluated results indicate a negative correlation between colloid concentrations and IS of groundwater (IS ranges from 34 to 200 mM).

[1] Derjaguin and Landau (1948) *Acta Physicochim URSS*, **14**, 633-662. [2] Verywey and Oberbeek (1943) *Theory of the stability of lyphobic colloids*, Elsevier, Amsterdam.