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Characterization of Aquatic Groundwater Colloids Sampled from Yuseong Area, Daejeon by Laser-Induced Breakdown Detection (LIBD) Combined with Asymmetric Flow-Field Flow Fractionation (Asym-FFFF)

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ABSTRACT

The characterization of groundwater and its aquatic colloids is prerequisite for better understanding and evaluation of the chemical behavior of metal ions and also of the colloid-facilitated contaminant migration in aquifer systems. A new sensitive method for the direct detection of aquatic colloids recently been developed, which is capable of determining colloids small in size (< 50 nm) and in very low concentration, i.e., in the ppt range. This method called as laser-induced breakdown detection (LIBD) is based on the generation of breakdown events on individual colloidal particles by a laser pulse and the detection of the resulting acoustic wave. Compared with the PCS (Photon Correlation Spectroscopy), the detection sensitivity of the LIBD method for a particle diameter of about 20 nm is over a million-time superior (Bundschuh et al., 2001). LIBD is thus a very sensitive method for the direct detection of colloids based upon the plasma generation on single particles by a focused, pulsed laser beam.

Groundwater sampled from different geological depths from 30 to 460 m were characterized in terms of the physico-chemical parameters, major metal ions and dissolved organic carbon (DOC) content and so on. All of groundwater samples were in-filtered with a pore size of 450 nm and then injected into AsymFFFF (Asymmetric Flow-Field Flow Fractionation) before the colloid detection and the element analysis, by LIBD and ICP-MS, respectively. The used system is one of the typical LIBD and

Asym-FFFF systems now available in INE/FZK (Institut für Nukleare Entsorgung, Forschungszentrum Karlsruhe GmbH) in Germany (Bouby et al., 2004).

The combination of AsymFFFF and LIBD revealed heterogeneous size fraction with a relatively broad size distribution. The one fraction comprised about 20 nm up to smaller than 100 nm, the other fraction larger than 100 nm. The combination of AsymFFFF and ICP-MS gives us information about the elemental composition of fractionated colloids. The colloid of smaller fraction was mainly calcite saturated with Sr whereas the colloid of larger fraction was mainly aluminosilicates, Fe-oxides, and clay minerals. The findings of the observation of all groundwater samples indicate a similar pattern of colloid fraction in size (about 400 nm) and in element composition with an exception of concentration (about 0.290 ppm).

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