

Colloids and Heavy Metals in Groundwaters: Tangential Flow Filtration Method for Study of Metal Distribution on Different Sizes of Colloids

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Abstract : When metals are released into water from mining activities, they undergo changes chemically, physically and biologically and then may become more mobile and transportable along the waterway from their original sites. Natural colloids, including both organic and inorganic entities, are naturally occurring in any aquatic environment with sizes in the nanometer range. Natural colloids in a water system play an important role, quite often a key role, in binding and transporting compounds. When assessing and evaluating metals in natural waters, their sources, mobility, fate, and distribution patterns in the system are the major concerns from the point of view of assessing environmental contamination and pollution during resource development. There are a few ways to quantify colloids and accordingly study how metals distribute on different sizes of colloids. Current research results show that the presence of colloids can enhance the transport of some heavy metals in water, while heavy metals may also have an influence on the transport of colloids when cations in the water system change colloids and/or the ion strength of the water system changes. Therefore, studies into the relationship between different sizes of colloids and different metals in a water system are necessary and needed as natural colloids in water systems are complex mixtures of both organic and inorganic as well as biological materials. Their stability could be sensitive to changes in their shapes, phases, hardness and functionalities due to coagulation and deposition et al. and chemical, physical, and biological reactions. Because metal contaminants' adsorption on surfaces of colloids is closely related to colloid properties, it is desired to fraction water samples as soon as possible after a sample is taken in the natural environment in order to avoid changes to water samples during transportation and storage. For this reason, this study carried out groundwater sample processing in the field, using Prep/Scale tangential flow filtration systems with 3-level cartridges (1 kDa, 10 kDa and 100 kDa). Groundwater samples from seven sites at Fort MacMurray, Alberta, Canada, were fractionated during the 2015 field sampling season. All samples were processed within 3 hours after samples were taken. Preliminary results show that although the distribution pattern of metals on colloids may vary with different samples taken from different sites, some elements often tend to larger colloids (such as Fe and Re), some to finer colloids (such as Sb and Zn), while some of them mainly in the dissolved form (such as Mo and Be). This information is useful to evaluate and project the fate and mobility of different metals in the groundwaters and possibly in environmental water systems.

Keywords : metal, colloid, groundwater, mobility, fractionation, sorption

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