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Building the foundation for the environmental nanobiogeochemistry of soil solutions

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Environmental nanobiogeochemistry is an emerging research area focusing on the environmental geochemistry of colloidal and nano phases. It seeks to connect the properties of systems of natural nanoparticles and colloids to their environmental function and determine the impacts of disturbances thereupon. Key to this approach is the use of complementary tools to characterize the properties of natural nanosystems. This presentation reports on the application and comparison of AF4-ICPMS and single particle (sp) ICP-time-of-flight-(TOF)MS for the analysis of soil solutions.

Using tension lysimeters, soil solutions were extracted from an agricultural boreal podzol from Newfoundland, and from peat-mineral mixture and overburden soils associated with reclamation following the mining of bituminous sands. Results will be reviewed from combined analysis using AF4-ICPMS and spICP-TOFMS, providing highly resolved and complementary information about the multi-elemental composition of tens of thousands of individual particles in each soil solution, and the distribution of these elements and trace elements amongst three size-fractionated groups with varying lability and mobility: 1) small, simple complexes and molecules passing through the AF4 membrane; 2) elements associated with organic colloids, and; 3) elements associated with larger primarily inorganic particles. The colloidal systems in soil solutions were highly differentiable with distinct particle populations characteristic of soil properties, readily visualized by applying k-means meta-clustering to converged self-organizing maps.