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Extraction and Advanced ICP-MS Characterization of HgS Nanoparticles in Soils

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Mercury contamination is widespread in terrestrial and aquatic ecosystems. It can affect wildlife and human health, due to the persistence and toxicity of its various forms and especially monomethylmercury (MMHg) [1]. Among Hg species, HgS nanoparticles have been suggested to be ubiquitous and particularly important, especially the smaller ones as their properties strongly influence Hg transport and bioavailability, including to methylating organisms, in turn regulating the production of MMHg [2]. Despite their importance, the characterization and quantification of HgS nanoparticles in complex environmental matrices, such as soils and sediments, remains a major analytical challenge, due to the lack of standards and methods [3].

This study aims to overcome these limitations by synthesizing various standards, developing and intercomparing ICP-MS techniques as well as evaluating extraction and preconcentration methods. HgS nanoparticles were first synthesized under controlled anoxic conditions in the presence of 4 different types of humic acids (HA) (Suwannee River, Pahokee Peat, Elliott Soil and Leonardite), producing environmentally relevant nanoparticles with sizes ranging from 3 to 10 nm. These nanoparticles were characterized with a range of techniques including TEM, XRD and DLS, and then used to optimize and intercompare two ICP-MS based techniques, i.e. single particle Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS/MS) and Size Exclusion Chromatography coupled with ICP-MS/MS. Following method optimization, various extraction reagents and sonication conditions were assessed for nanoparticle recovery and stability from a soil spiked with synthetic HgS nanoparticles. These results represent an important step towards a better characterization of small Hg nanoparticles in natural and polluted systems.

[1] Beckers & Rinklebe (2017), Critical Reviews in Environmental Science and Technology, 47 (9), 693–794.

[2] Lead, Batley, Alvarez, Croteau, Handy, McLaughlin, Judy, and Schirmer (2018), Environmental Toxicology and Chemistry, 37 (8), 2029–2063.

[3] Chen, Yin, Shi, Liu, Hu, Liu, Cai, Jiang (2017), Critical Reviews in Environmental Science and Technology, 47 (24), 2415–2447.