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Evaluation of Analytical Methodologies to Differentiate Biogenic Organic Carbon (BOCs) from Heavy Petroleum Hydrocarbons (PHCs) in Tropical Rainforest Organic Soils

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Background/Objectives. Crude oil petroleum hydrocarbon (PHC) releases in tropical rainforests can pose significant risks to human health and the environment. Environmental impact assessments rely on standard soil chemistry analysis techniques for quantifying PHC concentrations and delineating soil remediation zones. Standard laboratory methods use organic solvents to indiscriminately extract all carbon based molecules from soil samples. Although these solvents effectively extract PHCs, they also inadvertently extract biogenic organic compounds (BOCs) as well. BOCs, such as plant waxes and sterols, are natural components of all healthy environments. Highly organic tropical rainforest peat soils (“turba” in Spanish) are naturally enriched with BOCs. For this study, 31 background peat samples were collected from a Peruvian rainforest and analyzed for PHCs in the F2 (C10-C28) and F3 (C28-C40) carbon ranges. None of the F2 concentrations exceeded the 1,200 mg/kg regulatory limit. However, 29 samples exceeded the 3,000 mg/kg F3 regulatory limit, with concentrations ranging from 3,491 mg/kg to 10,377 mg/kg. False PHC detections such as these can interfere with the correct quantification of crude oil concentrations and identification of impact risks. The development of a reliable analytical approach to differentiating BOCs from heavy PHCs is essential to the rigorous evaluation of risks posed by soil impacts from oil production activities and appropriate comparisons of analytical results to regulatory clean-up criteria.

Approach/Activities. This presentation summarizes the method developed to differentiate BOCs from PHCs in crude oil impacted soils and sediments present at sites in the Amazon Basin. Various techniques were evaluated to create a procedure that allowed for the semi-automated subtraction of BOC concentrations from PHC concentrations in individual soil samples. This multi-step process included: a numerical screening for BOCs; visual inspection of chromatograms; calculation of estimated PHC concentrations; screening against regulatory limits; and graphical evaluation of chromatograms utilizing Geographic Information System (GIS) software. The end result of this process was a calculated concentration that estimated the PHC contribution for individual samples.

Results/Lessons Learned. This presentation summarizes the results of the laboratory tests, background studies, and the process developed to discriminate between BOC and PHC concentrations from modified SW846-8015 analyses. The process was applied to more than 17,000 samples, resulting in modified concentrations for more than 5,500 samples. This process subtracted BOC concentrations from samples that would have falsely exceeded the regulatory limit.