100. Microbial Interactions with Native Natural Organic Matter in Groundwater and Sediment from the Oak Ridge FRC

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Project Goal: Natural organic matter (NOM) is central to microbial food webs; however, little is known about the interplay between physical and chemical characteristics of NOM and it's turnover by microbial communities in groundwater and sediments of Oak Ridge Field Research Center (FRC). Microbe mediated molecular and geochemical mechanisms control the flow of carbon that support evolution and maintenance of a community within a given environment. To gain insight into the cycling of carbon, and how the turnover of NOM regulates the development of indigenous microbial community at the FRC, it is critical to extract NOM, identify its characteristics, and correlate this to the structure and composition of microbial communities and to the metabolic potential of that community.

In this FY15 Discovery project, we focused on NOM from the background well, FW305. Preliminary experiment initiated with FW305 sediment enriched with 10ppm fulvic acid (as part of the Microparticles Campaign), showed rapid evolution of CO2. Isolations from this fulvic acid enriched samples yielded strains belong to Sphingomonas, Pseudomonas, Undibacterium, Rugamonas, Rhodococcus genera. The same sediment sample (FW305) was tested for NOM extraction methods using three mild solvents, e.g., phosphate buffered saline (PBS), pyrophosphate, and warm de-ionized water with shaking or mild agitation. The pH was kept close to in-situ conditions, 6.5–7.0. We also tested the efficacy of glass beads as a physical abrasive to aid in extraction. The dissolved organic carbon (DOC) in the extracted NOM was in the range of 8.8–28 mg/L. Sonication with PBS extracted higher levels of DOC, while shaking with pyrophosphate extracted higher levels of metals such as iron, zinc, cobalt and manganese when compared with other tested methods. A spectrophotometric scan of the sample with highest DOC content showed high absorbance between 300-380nm, indicative of presence of functional groups with high aromaticity such as carboxylic and phenolic groups. The extracted NOM was fractionated using molecular weight cut-off filters (100 kDa). In ongoing experiments, we are testing existing isolates from FW 305 for their ability to transform the NOM, and identify the transformation product. In addition, we will add this fractionated NOM to feed native microbes present in the groundwater of well FW305 to identify the microbial isolates/community that preferentially grew with this NOM.

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