LIPID BIOMARKERS AND THEIR USE IN THE ASSESSMENT OF SUBSURFACE SHALE GEOLOGIC FORMATIONS

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ABSTRACT

This abstract summarizes the recent advances towards understanding the non-viable microbial biomass, bioactivity, and biodiversity of the deep surface environment in sediments from the Marcellus Shale Energy and Environment Laboratory (MSEEL). In the current context of global interest in deep surface microbial ecology, it is necessary to understand the paleo-microbial ecology and its relationship to total organic carbon, porosity, permeability, and paleo-environmental conditions. Our analyses were done using the fatty acid methyl esters (FAMEs) and diglyceride fatty acid approaches (DGFAs). Some of the DG-FAMEs are associated with different microbial taxonomic and functional groups, and as a result they are used to distinguish specific groups of microbes (non-viable) as well as physiological stress. We also used the DG-FAME analyses, to investigate shifts in microbial diversity within the Mahantango, Marcellus Top, and Upper Marcellus formations of the MSEEL well. Our samples were collected aseptically from the MSEEL scientific well site in Morgantown, West Virginia, and the DG-FAME biomarkers were extracted from the crushed sediments and the resulting fatty acids were methylated to fatty acid methyl esters (FAMEs) and analyzed using GC-MS. The DG-FAME profiles consisted of normal saturated, monounsaturated, polyunsaturated, branched, epoxy, terminally branched, hydroxyl, and dimethyl esters. The total biomass yield and variety of DG-FAME profiles were higher in the Mahantango compared to the samples from the Upper Marcellus formation and Marcellus Top formation. The Mahantango formation showed higher diversity of microbial lipid profiles than the Upper Marcellus and Marcellus Top for all the FAME profiles present. In some cases some of the FAME profiles were only found in the Mahantango formation and absent in the other formations. For example, the terminally branched, acetylenic, and hydroxyl fatty acids were only found in the Mahantango formation. This suggest that more paleo-microbial activity in the Mahantango compared to the Marcellus Top and Upper Marcellus. This difference could be related to paleo-environmental conditions, nutrient availability, higher porosity, and permeability in the Mahantango compared to the other formations.

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