# Potential Effect of Soil Microbes on Soil Gas Levels and Flux Rate Calculations

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In any consideration of gas migration to the near surface, it is important to understand the potential impact soil microbes can have on soil gas measurements and calculation of flux rates. Additionally, it may be possible to use microbial based calculations to estimate hydrocarbon flux rates. The objective of this presentation will be to indicate the metabolic potential that soil microorganisms, primarily bacterial and yeast cultures, have for the metabolism of migrating alkane and aromatic hydrocarbons from oil and gas reservoirs and present this information in a geological framework.

When hydrocarbon gases enter the near surface zone where atmospheric oxygen can penetrate into the soil column, a situation is created where the natural soil microbes will be supplied with the two primary nutrients required for their growth, carbon and oxygen. When oxygen is present, natural microbes can effectively convert a unit weight of hydrocarbon into a unit weight of biomass. When proper conditions exist, this conversion can be very rapid, with bacteria and yeast capable of growth rates measured in minutes to hours. With hydrocarbon degrading bacteria detected at times up to 10 million bacteria per gram of soil, there exists in the near surface soil a very significant capability to metabolize migrating hydrocarbon gases. Thus, near surface measurements of hydrocarbon gases, either as free soil gas or interstitial gases, can be significantly effected by microbial metabolism. Conversely, we can potentially estimate the flux rate of hydrocarbons to the surface by using microbial based calculations to determine how much gas per unit of time is required to support the level of hydrocarbon degrading cultures present in the soil.

In this presentation, we will establish the theoretical boundaries in regard to how much hydrocarbon gases can be metabolized per acre in a unit of time. The calculations will be based on the starting assumptions that the yield of biomass from hydrocarbon gases (methane, ethane, propane) is approximately 1 gram biomass per 1 gram hydrocarbon metabolized in the presence of oxygen. Secondly, we will assume that 1 gram of bacterial biomass is equivalent to one trillion individual bacterial cells. Based on Environmental BioTechnologies, Inc. experience in conducting oil and gas exploration based on detecting levels of microbial populations in soil which can grow on hydrocarbon gases, we will provide to the basic assumptions the range of hydrocarbon degraders present in near surface soils associated vertically with oil and gas reservoirs. From our laboratory studies on the rate of growth in soil of these hydrocarbon degrading microbes, we then have the basic parameters of bacterial growth rate, microbial yield conversion, and inherent levels of microbes in soil which are needed to support the calculations presented in this paper.

Once the primary calculations have been completed, we will then be able to present the microbiological based information in more conventional geological and petroleum based considerations. Efforts will be focused on indicating the minimum sensitivity of microbial based oil and gas exploration techniques to detect truly microseepages. At issue is whether we can detect true seepage through the overburden instead of seepage which occurs primarily via microfaults or faults. It is our belief that microbial based survey processes are detecting microseepages at significantly lover levels than chemical based survey processes and thus may be impacted differently by geological parameters. We will also attempt to correlate flux rates as detected by microbial populations with rates of reservoir formation and turnover in turns of geological time. We will also examine the potential impact that microbial metabolism has on surface prospecting techniques that are based on detecting actual hydrocarbon concentrations in soil.