THE EFFECTS OF LAND USE ON AQUATIC METHANOGENESIS THROUGH A COMBINATION OF MOLECULAR METHODS AND THE DEVELOPMENT OF A NOVEL *IN SITU* METHANE SENSOR

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Introduction:

- Methane (CH_4) is a potent greenhouse gas with 72× the global warming potential of CO_2 over a 20-year period (1). As CH_4 contributes to atmospheric ozone production, reduction in CH_4 emissions could potentially slow anthropogenically induced climate change, making CH_4 a greenhouse gas of considerable ecological importance.
- Anthropogenically derived CH_4 dominates annual contributions to the atmospheric CH_4 pool (~60%), biogenic CH_4 production, *i.e.* methanogenesis, occurs as the result of anaerobic metabolism of simple organic molecules by methanogenic archaea (Fig. 1).
- Land use can dramatically affect microbial populations at the landscape scale (2); how this could potentially contribute to methanogenesis is of great concern.
- The transience and heterogeneity of CH_4 production (3) in aquatic systems makes it difficult to quantify with precision or ease, thereby the need for a cost-effective, highly mobile *in situ* CH_4 sensor would greatly increase the ability of researchers to monitor aquatic contributions to global methane production.

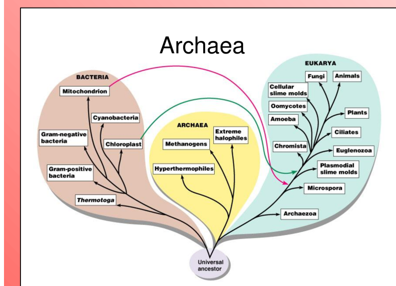

Fig. 1: Phylogenetic tree identifying the methanogenic Archaea within the context of the three domains of life.

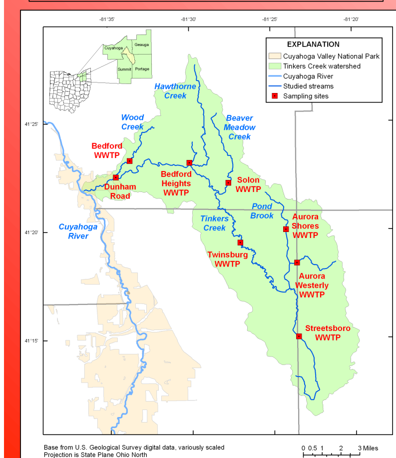

Fig. 3: Tinker's Creek Watershed map

Objectives:

- To examine the effects of land use on biological methane production from aquatic ecosystems and wetlands within a watershed experiencing several land-uses types
- Development of a novel *in situ* methane sensor that is cost effective, portable, and capable of meeting the detection limits and accuracy necessary to compete with currently used detection methods (Fig. 2)

Methods:

- Samples will be collected from Tinker's Creek watershed (Fig. 3) in NE Ohio, the site of numerous land-uses, including including urban, agricultural, wetland/park, and contains several point-source inputs of nutrients due to wastewater treatment plants
- Sediment, water, and gas sample collection will begin Spring 2013 at sites within each land-use type. DNA will be extracted for quantification of methanogens and methanotrophs at each site
- Gas samples will be analyzed using a mass spectrometer for baseline methane concentrations

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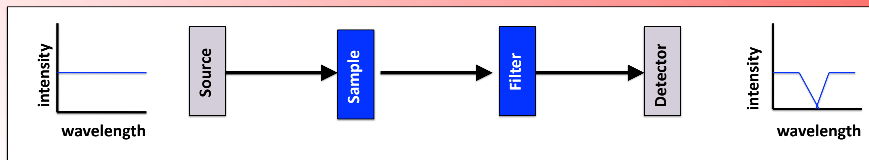

Fig. 2: Basic elements required for portable IR spectroscopy. A light beam interacts with the compound of interest, is scattered by a tunable wavelength filter, and this change in intensity is detected, allowing for quantification of the substance of interest.

Sensor Design:

- Broadband IR source propagates light into fiber optics.
- Methane absorbes into hydrophobic coating on fiber, but water is excluded allowing IR detection of methane without interference from water.
- Resulting transmittance spectrum is separated into component wavelengths via interfereometer and fourier transform.
- Comparison of transmittance spectrum to standard methane spectrum gives concentration of methane in water.

Future Research:

- Complete sensor design and manufacture a prototype for field tests; once calibrated, perform comparative tests between sensor and other methods currently employed in gas detection. If successful, produce multiple sensors to be incorporated into 2013-2014 sampling plan.

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