George Platt: Chemical & Biological Engineering
Mentor: Robin Gerlach -- Chemical & Biological Engineering
Attempting to identify the sources of microbial methane production from coal

As the world begins to transition away from high-emissions fossil fuels, natural gas has become increasingly relevant. One natural gas reserve is found in subsurface coal seams, known as coalbed methane (CBM). Biogenic methane production occurs in anoxic environments where microorganisms catalyze the conversion of coal to methane through fermentation and methanogenesis. This study focuses on the upstream biogeochemical processes that promote the degradation of the coal matrix into bioavailable organic intermediates. A series of solid-liquid extractions were performed with coal from the Powder River Basin (PRB) using methanol, dichloromethane, and water in various treatments and sequences. The residual coal from the extractions was used in anaerobic bioreactors inoculated with a native microbial consortium from the PRB to assess and quantify the variation in methane production via Gas Chromatography (GC). Additionally, the liquid fraction of the extracts were analyzed using Gas Chromatography–Mass Spectrometry (GC-MS) and the bioreactor contents were analyzed using Fluorescence Excitation-Emission Matrix Spectroscopy (EEMS) to assess their chemical composition and fluorescent signatures. While the bioreactors produced limited amounts of methane compared to previous CBM studies, the EEMS analysis showed that the bioreactor contents experienced a shift in fluorescent signatures indicating potential biotic and abiotic chemical conversion of the coal. Dissolved inorganic and organic carbon measurements showed significant differences between treatments, indicating that the coal pre-treatment affected the biogeochemical processes necessary for coal conversion. Ultimately, this study provided insight into the organic intermediates that are bioavailable for coal conversion.

Acknowledgements: Katie Davis (MSU Graduate Student) - Chemical & Biological Engineering, Heidi Smith (MSU Postdoc/Research Scientist) - Center for Biofilm Engineering