Microbial methanogenesis from a consortium enriched from the Powder River Basin, WY

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Evidence for microbial methanogenesis from petroleum hydrocarbons in oil reservoirs [1, 2], organic-rich shale [3, 4], and coalbed reservoirs] is growing. The goal of this project is to better understand the factors controlling microbial methanogenesis from coal in order to potentially stimulate this process *in situ*. A methanogenic microbial consortium was enriched from coal collected during drilling of a coalbed methane well in the Powder River Basin, WY. The consortium produces methane under anaerobic conditions in inorganic nutrient medium with coal as the sole carbon source. This consortium has been characterized by phospholipid fatty acid (PLFA), phospholipid ether lipid (PLEL), and 16S rDNA sequencing. Stable carbon isotopic analysis of the microbial phospholipids is planned in order to determine the carbon sources and dominant pathway of methanogenesis used by this consortium. Experiments are ongoing to determine factors that may affect methanogenesis from coal, such as pH, organic carbon sources, and variable pCO_2 in headspace gases.

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Element cycling and the evolution of the Earth System

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Since the early work by Walker and co-authors in 1981, continental weathering is thought to be a key process of the Earth system evolution at the geological timescales. By balancing the release of CO_2 by the solid Earth outgassing through a climatic negative feedback loop, weathering of continental silicate rocks and sediments controls the long term relative stability of the climate at the multimillion year timescale. However, several recent field studies have shown the high sensitivity of the weathering processes to anthropogenic forcings (climate and land use change) at the decadal scale, for both small and continental-scale rivers. These rivers display up to a 30% increase in their alkalinity flux over the last four decades. This high sensitivity points at a possible rapid evolution of the chemical composition of the large rivers in response to human activities, impacting on the discharge of elements into the coastal area and eventually into the ocean. This observation challenges our ability to model the weathering reactions at the continental and global scale. Indeed, although a simplified description of the weathering can be generally assumed when worrying about the multimillion year evolution of the Earth (except for some rapid transitions), a process-based method is needed at the decadal to centenial scale. The climate, the lithology, the soil characteristics, the vegetation dynamics, the erosion processes must be accounted for at the highest spatial resolution possible. In this talk, we present an overview of the recent advances in the process-based modelling of the weathering processes from the geological down to the anthropic timescales. Through the coupling of numerical models of climate, vegetation dynamics, and weathering (based on kinetics laws derived from laboratory experiments), we explore the role of tectonics in the Earth climatic evolution, and of important thermodynamic and kinetic (like clay mineral stability and near-equilibrium rate laws) on the budget of monitored watersheds.