Microbial community changes in the production of secondary biogenic coalbed methane with bioaugmentation coupled with H_2O_2 pretreatment to Australian lignite

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Coalbed methane is an important unconventional source of natural gas that is found in coal deposits all over the world. Studies have shown that enhanced production of biogenic coalbed methane can be achieved in several ways, mainly including biostimulation, bioaugmentation, and chemical pretreatments. In this study, H_2O_2 with concentrations ranging from 1% to 20% was used to depolymerize and solubilize Australian lignite. A microbial consortium derived from Wyoming's Powder River Basin (USA), the most active coalbed natural gas production field in the world, was bioaugmented to the soluble fractions of the pretreated samples to produce methane. The results show that the pretreatments can effectively solubilize coal carbons into the aqueous phase, resulting in the production of a suite of short-chain fatty acids (C1-C6). These solubilized coal carbons can be decomposed by the microbial consortium to produce methane for up to 1,350 μmol CH_4/g coal (1,070 scf/ton coal). The study also shows that the microbes prefer to utilize organic molecules with smaller molecular weight, as demonstrated by size-exclusion chromatography analyses. The DNA in all the pretreatments was extracted for microbial community analyses. The preliminary analyses have shown that the microbial compositions in all the pretreatments were fundamentally different from the original consortium, particularly for the bacteria communities. Furthermore, the differences were also observed among pretreatments with different H_2O_2 concentrations. The correlations of these differences to the composition of the soluble fractions will be further analyzed and discussed.