Comparison of Methane Emissions from Abandoned Coal Mine Sites versus Ecological Wetlands

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The problem of methane gas arising from abandoned coal mines is not limited to mine sites. The water level in a coal mine naturally increases after abandonment. Although the amount of methane directly released into the atmosphere is reduced, the methane from the coal bed dissolves into the mine drainage and can affect surface water and groundwater.

The solubility of methane is very low, and dissolved methane in the mine drainage is not released directly into the atmosphere upon contact, but is slowly released as the drainage moves through the catchment area. This allows the catchment area of the moving mine drainage to be a source of methane release. Therefore, a possible passive treatment system in a coal mine area could be a catchment area for dissolved methane. Methane flux is easily affected by various environmental factors. Therefore, to evaluate the methanogenic potential of wetlands, a controlled anaerobic environment was created and laboratory experiments were conducted using sediment samples from wetlands. The potential amount of methane generated in the substrate was estimated by selecting a region where a large amount of methane is emitted into the atmosphere. More methane was generated by the abandoned coal mine substrate. The presence of bacteria and archaea was confirmed by identification of the microorganisms in the matrix and growth of methanogenic archaea. It was found that the carbon removal rate before and after methane generation was the result of substrate decomposition by microorganisms. Sulfate-reducing bacteria increase in anaerobic conditions. Methane production was suppressed when sulfate concentration was high.

In this study, the natural remediation facilities in the mine area maintained anaerobic conditions and contained a substrate material with high biodegradability. The amount of methane and potential methane, emitted from natural remediation facilities at abandoned coal mine sites, was higher than that of ecological wetlands, as estimated from field and laboratory tests.