ISOTOPIC AND MICROBIOLOGICAL EVIDENCE OF MICROBIAL METHANE AND CO₂ IN THE UPPER SILESIAN COAL BASIN, CZECH REPUBLIC

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Introduction

Czech part of the Upper Silesian Coal Basin (USCB) is an outstanding natural laboratory with examples of both thermogenic and microbial methane associated with bituminous coal seams. Current research is aimed at providing geochemical and biochemical evidence of past and present activity of methanogenic and methanotrophic archea in the USCB basin.

Chemical isotopic and microbiological composition

The thermogenic methane occurs in the USCB in the areas covered by the impermeable sediments of the Carpathian Flysch Belt protecting Carboniferous strata from descendent pore waters and act as a barrier for the migration of methane gas to the surface. In addition to previous data (e.g. by Weniger et al. 2012), new measurements of coal-seam gases in the Namurian and Westphalian contain 40-96 % of methane with the δ¹³C value ranging from -33 to -53 ‰. Microbial methane occurs in Namurian A and B strata in the northern segments of the Czech and mainly Polish part of the USCB (Kotarba 2001), outside the Carpathian fold-and-thrust belt. Its δ¹³C values range from -55 to -88 ‰.

Ample sampling revealed details in coal-bed gas composition with respect to fault tectonics and geological position. CO₂ δ¹³C ranges from -5 to -27 ‰, but in some places from -30 to -50 ‰, pointing to microbial oxidation of methane. Application of PCR provided deeper insight into methanogen and methanotrophic consortia dynamics in coal-bed methane related environment.

PCR (polymerase chain reaction) was used for sample screening followed by qPCR (quantitative polymerase chain reaction) determination of abundances of bacteria, archaea and methanogenes. Positive signal of mcrA gene presence was confirmed, though clear relationship to methanotrophs needs more investigation.

Conclusions

Isotopic, chemical and microbiological data suggest presence of active microbial methanogenesis in the NE part of the Upper Silesian Coal Basin in the Czech Republic.
Figure 1 Carbon isotopic composition of methane ($\delta^{13}C_{CH_4}$‰) and C1/(C2+C3) “dryness” ratio of microbial and thermogenic gases in the Czech part of the Upper Silesian Coal Basin. Colours show different partial areas.

References
