Occurrence and origin of coal-seam gas in the Upper Silesian Basin (Poland): isotopic, hydrous pyrolysis and geological approach

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In Poland, major resources of bituminous coals and coal-bed methane occur in Serpukhovian and Pennsylvanian strata in the Upper Silesian coal basin (USCB), one of the major coal basins in the world [1]. The study area covers about 1000 km^2 in the southern part of USCB.

Samples and Methods

64 coal-bed gas samples were analyzed. To provide a better characterization of origin of thermogenic gas, hydrous pyrolysis (HP) experiments were performed on five coal samples at 330 and 360^oC for 72 h and compared with results of nine HP experiments previously conducted at 360^oC for 72 h [2, 3]. Coal-bed and HP gases were analyzed for molecular and carbon [$\delta^{13}C(C_1, C_2, C_3, iC_4, nC_4, iC_5, nC_5)$] and hydrogen [$\delta^{2}H(C_1, C_2, C_3)$] isotope compositions. Initial and after HP coals were analyzed for vitrinite reflectance, $\delta^{13}C$, Rock-Eval, maceral and elemental compositions.

Discussion of Results

Geochemical and geological studies reveal that thermogenic methane and microbial methane are present within the Pennsylvanian coal-bearing strata. Thermogenic methane was generated during the bituminous stage of coalification. This process was completed at the end of the Variscan orogeny. Since that time the uplifted coal-bearing strata had been subjected to erosion, denudation and degassing for about 270 Ma. The degassing process lasted until the deposition of the impermeable, clay-rich, Upper Miocene strata. Meteoric waters infiltrated the Pennsylvanian coal-bearing strata before Paleogene, mainly in eroded slopes, transporting both methanogenic archaebacteria and nutrients [4]. The depletion of ^{13}C in thermogenic CH_4 could have resulted also from the diffusion and adsorption-desorption processes during migration through the microporous coal structure [5].

[1] Kotarba *et al.* (2002) *Chem. Geol.* **184,** 11-35. [2] Kotarba & Lewan (2004) *Org. Geochem.* **35,** 615-646. [3] Lewan & Kotarba (2014) *AAPG Bull.* **98,** 2581-2610. [4] Kotarba & Pluta (2009) *Appl. Geochem.* **24,** 876-889. [5] Kotarba (2001) Org. Geochem. 32, 163-180.

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