

# Geochemical and isotopic characterization of coalbed gases in active excavation fields at Preloge and Pesje (Velenje Basin) mining areas

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The geochemical ( $\text{CH}_4$ ,  $\text{CO}_2$ ,  $\text{N}_2$ ) and isotopic composition ( $\delta^{13}\text{C}_{\text{CO}_2}$ ,  $\delta^{13}\text{C}_{\text{CH}_4}$ ,  $\delta\text{D}_{\text{CH}_4}$ ) of coalbed gases in the Velenje Basin vary and depend on the composition of the source of coalbed gas before excavation, advancement of the working face, depth of the longwall face, pre-mining activity and newly mined activity [1]. High correlation ( $R^2 = 0.99$ ) was obtained between methane and  $\text{CO}_2$  concentrations in a lignite seam within boreholes. It was found that the highest concentrations of methane gas are found at longwall panels located under fresh overburden. This occurrence is connected with the more rapid migration of  $\text{CH}_4$  up through the seam due to its smaller molecular size than that of  $\text{CO}_2$ . Geochemical indices, CDMI ( $((\text{CO}_2/(\text{CO}_2+\text{CH}_4)) \times 100 \text{ \%})$ ) varied from 36.1% to 98.2% and stable isotope ratios varied in following ranges:  $\delta^{13}\text{C}_{\text{CO}_2}$  from -11.0‰ to 1.9‰,  $\delta^{13}\text{C}_{\text{CH}_4}$  from -71.8‰ to -43.4‰,  $\delta\text{D}_{\text{CH}_4}$  from -343.9 to -223.1‰ and  $\alpha_{\text{CO}_2-\text{CH}_4}$  from 1.040 to 1.070. The calculated gas dryness index ( $\text{C}_1/\text{C}_2+\text{C}_3$ ) ranged from 339.7 to 23272.7 ppm and coalbed gas is considered to be dry. From the results, it can be concluded that coalbed  $\text{CO}_2$  from working faces is endogenic and of bacterial origin. Measurements of  $\delta^{13}\text{C}_{\text{CH}_4}$  and  $\delta\text{D}_{\text{CH}_4}$  have led to the conclusion that methane from Velenje Basin has a microbial origin, formed through microbial fermentation and/or  $\text{CO}_2$  reduction, and of mixed origin, both thermogenic and biogenic, since some  $\delta^{13}\text{C}_{\text{CH}_4}$  values are enriched with  $^{13}\text{C}$  isotope. Such investigations are relevant to the development of clean coal technologies (CBM), which could have great potential when cessation of underground coal excavation is being considered.

[1] Kanduč T., Žula J., Zavšek S. (2011): Tracing coalbed gas dynamics and origin of gases in advancement of the working faces at mining areas Preloge and Pesje, Velenje basin. *RMZ-Mater. Geoenvironment* **58**, 273-288.