Mgr inż. Anna Twaróg

Analysis of results of surface geochemical surveys conducted in the Rabka - Mszana Dolna - Limanowa area to evaluate the processes of dispersion of light hydrocarbons from deep sources.

Surface geochemical surveys were carried out in the central part of the Polish Outer Carpathians (Rabka – Mszana Dolna – Limanowa). Geochemical profiles were mostly located within the area of the Magura Unit and Fore-Magura Unit exposed in the Mszana Dolna tectonic window. The research was also carried out within the depleted Słopnice - Limanowa crude oil and natural gas field. Surface geochemical studies included: collection of 770 soil gas samples using "free gas" method and measurements of greenhouse gas emission (CH_4 and CO_2) released from the soil to the atmosphere, using static chamber method in the 126 research stations.

The purpose of this study was: (i) determination of the relationship between concentration values registered in the near surface zone and methane emission from the soil to the atmosphere; (ii) determination of the current migration activity of light hydrocarbon migrating from the deep sources to the near surface zone; (iii) establishment of current losses of the hydrocarbon potential in a selected area of the Polish Outer Carpathians; (iv) estimation of the optimal measurement depth of the emission where the influence of methanotrophic bacteria is minimal; (v) estimation of the current greenhouse gas emissions from the selected part of the Carpathian Petroleum Basin and (vi) determining the impact of the oil industry activity on CH_4 emissions to the atmosphere.

Maximum concentration values recorded in soil gas samples in the area of Rabka - Mszana Dolna - Limanowa for CH_4, total alkanes C_2-C_5, total alkenes C_2-C_4, CO_2 and H_2 are respectively: 0.57 vol. %, 83.9 ppm, 7.4 ppm, 6.9 vol. %, 1195 ppm, while the maximum concentration values recorded in the area of depleted Słopnice - Limanowa field are: for CH_4 – 15.3 vol. %, total alkanes C_2-C_5 - 1800 ppm, total alkenes C_2-C_4 -53.6 ppm, CO_2 – 6.8 vol. % and for H_2 - 267 ppm. Within the area of Mszana Dolna tectonic window, mean values of natural CH_4 and CO_2 flux are 0,4 mg m^{-2} d^{-1} and 22,8 g m^{-2} d^{-1}, respectively. Simultaneously, mean values of forced emission are: for CH_4 1,8 mg m^{-2} d^{-1} and for CO_2 26,3 g m^{-2} d^{-1}. The maximum CH_4 flux, registered around one of the boreholes, is 151 g m^{-2} d^{-1}.

The obtained results show presence of the active routes for the migration of light hydrocarbons from the deep sources to the near surface zone in the selected part of the Carpathian Petroleum Basin. The distribution of anomalous zones of occurrence of total alkanes C_2-C_5 detected in the soil samples, indicates a significant differentiation of registered micro-

concentrations of hydrocarbons in the individual tectonic units of the Outer Carpathians. Furthermore, conducted methane emission measurements show that the largest increase in the value of the CH_4 flux in relation to the natural emission of CH_4, is recorded at a depth of 0.4 to 0.6 m. On the other hand, no mutual correlation is found between individual geochemical indicators determined in soil gas samples and measured values of CH_4 and CO_2 fluxes. The estimated values of CH_4 and CO_2 emissions from the area of the Mszana Dolna tectonic window are 10,8 Mg CH_4 $year^{-1}$ (± 2,7 Mg) and 0,6 Tg CO_2 $year^{-1}$ (± 0,06 Tg). Simultaneously, total greenhouse gas emission from the area of depleted Słopnice – Limanowa field is 25 Mg CH_4 $year^{-1}$ (± 0,25 Mg) and 122 Mg CO_2 $year^{-1}$ (± 1,2 Mg). Contemporary losses of the hydrocarbon potential caused by leaking of micro-concentration of gaseous alkanes into the near surface zone and atmosphere from the area of Mszana Dolna tectonic window is estimated at 49 Mg CH_4 $year^{-1}$ (± 12,2 Mg).