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Variability of hydrogen, methane and carbon dioxide concentrations in soil gases along a geochemical profile across the Podhale Basin (Southern Poland)

This study presents preliminary results of hydrogen (H_2), methane (CH_4), carbon dioxide (CO_2), and helium (He) concentrations in soil gases collected along a geochemical profile running from Szaflary to Zakopane, within the Podhale Basin. The Podhale Basin is a geologically complex area in the Carpathians, known for active faults and geothermal waters used for heating and recreational purposes. Currently, 110 soil gas samples have been collected over a distance of 11 km, and the sampling and analysis of the final section of the profile are still in progress. Soil gas samples were collected from a depth of approximately 1.2 meters using a patented geochemical probe. Concentrations of individual gases were determined using gas chromatography. The maximum detected concentrations of hydrogen, helium, methane, and carbon dioxide were 455 ppm, 64 ppm, 21 ppm, 3.5 vol.% respectively. The median concentrations of hydrogen, methane, and carbon dioxide were 27 ppm, 2.5 ppm, and 0.4 vol.%. Based on the data, seven anomalous zones were identified, characterized by significantly elevated gas concentrations relative to background levels. These preliminary results on hydrogen, carbon dioxide, methane, and helium concentrations in soil gas represent the first study of this kind conducted in the Podhale Basin. The findings indicate that active gas migration occurs in this area. This regional, north-to-south transect across the basin provides a foundation for future, more detailed investigations, which should focus particularly on the zones with recorded hydrogen and helium anomalies. In particular, we plan to perform additional sampling and carry out isotopic analyses in the helium-enriched anomalous zone.

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Keywords: natural hydrogen, soil gas, helium, Podhale Basin

Biography

I hold a B.Sc. in Applied Geology from the University of Warsaw and am currently pursuing an M.Sc. in Applied Geology at AGH University Krakow. My academic focus includes hydrogeology, engineering geology, and petroleum geology. I am particularly interested in unconventional energy resources and subsurface fluid dynamics. Currently, I serve as the coordinator of the "Search for Natural Hydrogen" project, conducted by the student scientific circles of Hydrogeology ‘Hydro’ and Petroleum Geology ‘Kiwon’.

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