

Analysis of the results of surface geochemical survey against the background of the seismic interpretation of a selected area of the Outer Carpathians in the context of the location of deep hydrocarbon accumulation

Abstract

Currently, discovering new hydrocarbon deposits is a significant problem in the Polish part of the Outer Carpathian Mountains. It is related to shallow and easily accessible sources having been depleted as well as to difficulties in interpreting the results of geological and geophysical surveys which are targeted to search for potential accumulations that are located deeper. Interpretation problems also arise with regard to research findings obtained with the use of seismic reflection, currently the leading method employed when searching for hydrocarbon deposits. The problems stem mainly from the complicated geological structure of the Outer Carpathians. Hence, integrating seismic research findings with surface geochemical survey results seems worthwhile; even more so, since internationally such solutions bring tangible benefits in the form of a reduced number of negative boreholes.

This paper aims to analyse the results of surface geochemical survey conducted in the Krosno–Besko region as regards prospective prioritization of interpreted areas with anomalous seismic record. Moreover, the paper intends to assess the influence that tectonic conditions and lithological variations in outcrops of flysch formations have on surface geochemical results; it also aims to assess the relations and interdependence between gas-phase alkanes and alkenes to determine the extent of hydrocarbon microseepage activity from deep sources to the near-surface area.

The surface geochemical surveys were conducted in the Krosno–Besko region, located in the eastern part of the Outer Carpathians within the central synclinorium. The molecular composition of 985 soil gas samples was examined and calcite concentration, pH values and magnetic susceptibility of 96 soil samples were measured. The isotopic composition of 6 selected samples as well as methane emissions were analysed. Then the research findings were integrated with a geological-seismic model.

The analysis of research results shows that light hydrocarbons vary widely in their microconcentration measured in soil-gas samples. The values of geochemical indices point to a variable profile of hydrocarbon seepage from oil sources and oil-condensate sources

deposited at various depths. The interpretation of relationship between gas-phase alkanes and alkenes suggests that, in general, strong alkene anomalies are confirmed by strong alkane anomalies, which implies a strong link between the presence of alkenes and of alkanes. The distribution of measured geochemical indices, especially the sum of C₂–C₅ alkanes against the backdrop of the geological map and seismic-geological cross-sections, indicates a variable hydrocarbon potential within different tectonic blocks. The locations of geochemical anomalies are related to regional tectonics: the fold-and-nappe structure of the area and the lithological variation in outcrops of flysch formations determine the near-surface geochemical composition. Calcite concentration, pH values and magnetic susceptibility were analysed and prove there exists a correlation between the distribution of intermediate geochemical indices and the concentrations of light hydrocarbons detected in soil gas. At present, hydrocarbon migration from greater depths to the near-surface area can be influenced by secondary mineralization caused by changes which occur within migration paths of gas-phase hydrocarbons.

Having taken the character of geochemically anomalous areas, their extent, amplitude and location with reference to the zones of seismic record anomalies and to hypothesized traps, the best sites in terms of hydrocarbon potential were indicated.