The CO_2-rich fluids from the Eastern Carpathians: constraints on the origin of fluids and quantification of fluxes

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The Eastern Carpathians host numerous gas emissions associated with Neogene–Quaternary volcanic areas and the adjacent flysch belts. These emissions are predominantly CO_2-rich, with variable amounts of CH_4, N_2, and H_2S, occurring as free gases, mofettes, or CO_2-rich mineral springs. By integrating new and existing gas-geochemical data, we constrain the spatial distributions of these gases that reflect underlying lithological and structural controls. Isotopic analyses of carbon and noble gases indicate a mixed CO_2 origin, involving (i) mantle or magmatic sources (R/R_a up to 3.2), (ii) metamorphic decarbonation reactions, and (iii) minor organic-derived components. The Ciomadul volcanic area in the Eastern Carpathians shows the highest R/R_a values, confirming an active magmatic contribution. A progressive decrease in R/R_a towards the flysch belt highlights the role of fault systems as conduits for volatile migration. The $\delta^{13}C$–CO_2 and $CO_2/^3He$ ratios further support a combination of mantle and crustal sources, modified by shallow-level interactions.

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Dr. Boglárka-Mercedesz Kis is a lecturer and researcher in the field of fluid geochemistry at the Department of Geology, Faculty of Biology and Geology, Babeș-Bolyai University, Cluj-Napoca, Romania. During her PhD at Babeș-Bolyai University, she focused on the hydrogeochemistry of mineral waters from the Eastern Carpathians. Following her doctoral studies, she held postdoctoral and research positions at Eötvös Loránd University (ELTE), Budapest, and at the Isotope Climatology and Environmental Research Centre in Debrecen, Hungary. During this period, she specialized in noble gas geochemistry and volcanic gas emissions, contributing to international collaborations on diffuse degassing and mantle-derived and crustal derived volatile fluxes in volcanic and non-volcanic environments. Her research integrates geochemical, isotopic, and field-based methods to investigate the interaction between geological structures, fluids, and gases, with a focus on the geologic and environmental significance of CO_2 emissions and mineral water systems in the Carpathian–Pannonian region.