



Real time and in-situ analysis of the gas-emissions of the Eastern Carpathians: results and perspectives

Roland Szalay¹, Boglárka-Mercédesz Kis^{1,2,3}, Szabolcs Harangi², László Palcsu³, Marcello Bitetto⁴, Alessandro Aiuppa⁴, and Zoltán Imecs⁵

¹Babes-Bolyai, Biology and Geology, of Geology, Cluj-Napoca, Romania (szalay.j.roland@gmail.com, kis.boglarka@ubbcluj.ro)

²MTA-ELTE Volcanology Research Group, Eötvös University, Budapest, Hungary (kis.boglarka@ubbcluj.ro, szabolcs.harangi@geology.elte.hu)

³Isotope Climatology and Environmental Research Centre (ICER), Hungarian Academy of Sciences (ATOMKI), Debrecen, Hungary (kis.boglarka@ubbcluj.ro, palcsu.laszlo@atomki.mta.hu)

⁴DiSTeM Department, University of Palermo, Palermo, Italy (alessandro.aiuppa@unipa.it, marcellobitetto@gmail.com)

⁵Babes-Bolyai, Hungarian Department of geography, Cluj-Napoca, Romania (zoltan.imecs@ubbcluj.ro)

The Carpathian-Pannonian region was dominated by diverse volcanic activity for the last 20 million years, and even 1 million years ago there was precedent for active zones. Although volcanic eruptions are very uncommon in the region today, however the frequent earthquakes in the Carpathian-bend, the numerous appearance and intense manifestation of gas-emissions in the southeastern areas of the region and many petrochemical and geochemical volcanologic studies as well, indicate that the area is likely not completely inactive. The gas emissions investigated by us may be directly related to these geodynamic processes [1].

In Romania, the Eastern Carpathian Neogene-Quaternary volcanic chain and its neighbouring zones contain most of the carbon dioxide rich gas emissions, which also occur in the form of natural mofettes, bubbling pools and springs. They can appear in frequently populated settlements more often in cellars, which puts the inhabitants in direct danger due the lack of information in the public knowledge.

The motivation of our work is to gather real time and in-situ information with the help of Multi-Gas instrument about the composition of the gas-emissions across the Eastern Carpathians and to create a high resolution geological map from the measured sites in the mentioned area above. Furthermore, we would like to clarify if there is any relation between the tectonic characteristics of the study area and the manifestation, concentration of gas-emissions.

In total, 205 gas emissions were investigated for their CO₂ (0-100%), CH₄ (0-7%) and H₂S (0-200 ppm) concentrations. The composition of the different gas-species varied according to the geological context. The CO₂ concentrations varied between 0.96 and 98.08 %. The highest values were measured in the the Quaternary volcanic area of Ciomad, and also in the neighbouring thrust and folded area of the Carpathian Flysch which suggests a tectonic control over the

appearance of the gas emissions.

The **CH₄** concentrations ranged between 0.21 and 6.76% and were higher at hydrocarbon-prone areas, such as the sedimentary deposits of the Transylvanian Basin and Carpathian Flysch. In these cases the CO₂ concentrations were low (up to 4.6%).

The **H₂S** concentrations varied between 0.21 and 200 ppm, according to our knowledge, these are the first H₂S in-situ measurements in the gas emissions of the study area. The concentrations of H₂S were higher at the volcanic area of Ciomad, reaching values above the detection limit (~200 ppm) which are related to volcanic degassing.

In conclusion, based on the investigated sites, there is a spatial correlation between the appearance of mineral water springs, gas emissions on surface and the neighbouring tectonic structures. The Multi-Gas proved to be a useful tool in the in-situ investigation of gas emissions of the Eastern Carpathians, being efficient especially for the measurement of the H₂S concentrations that are very sensitive for oxidation processes.

Bibliography:

1. Kis B.M., Caracusi, A., Palcsu, L., Baci, C., Ionescu, A., Futó, I., Sciarra, A., Harangi, Sz., Noble Gas and Carbon Isotope Systematics at the Seemingly Inactive Ciomadul Volcano (Eastern€Central Europe, Romania): Evidence for Volcanic Degassing, *Geochemistry, Geophysics, Geosystems*, vol.20, issue 6, 2019, 3019-3043.