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## Geochemical features of the geothermal and mineral waters from Apuseni Mountains, Romania

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The Apuseni Mountains are located in the western part of Romania and separate the Pannonian Basin from the Transylvanian Basin. These mountains are famous and intensely studied for their important non-ferrous metal resources. Few data were published about the geothermal potential of this area. More works have been dedicated to mineral waters, while the geothermal waters are only briefly described, without sufficient emphasis on them. The current research is focusing on the two categories, cold mineral and geothermal water in the Apuseni Mountains, compared to

the surrounding areas, in order to better understand their genesis and the general context of the geothermalism in the study region. A preliminary survey of these waters was done in 2019 taking water and gas samples from 41 sources.

The pH varies between 6.00 and 9.02 and, the lowest values have been measured in the CO<sub>2</sub>-rich waters of the Southern Apuseni Mountains. Water temperatures vary between 11.1 °C and 81 °C. In the southern part of the Apuseni Mountains, the geothermal waters are of the calcium bicarbonate type (Ca-HCO<sub>3</sub>), while in the north-western part, the sodium bicarbonate type (Na-HCO<sub>3</sub>) is more common. The water sources from the north-western part are close to the Pannonian Basin and show features comparable to the thermal waters of this basin. Conductivity values show significant variations between 142 and 2040 µS/cm, but regional homogeneities were observed. The highest concentration of bicarbonate was measured in one of the localities of the northern study area (Beiuş Depression - 3318.4 mg/L). The dissolved heavy metal concentrations (Zn, Pb, Cd, Cr, Ni, Cu, Fe) in the water samples were also measured. For all the investigated waters, the heavy metal content was low. The highest concentrations were recorded for Fe 342.90 µg/L and Zn 86.14 µg/L. The isotopic data (δ<sup>18</sup>O and δ<sup>2</sup>H) demonstrate the meteoric origin of the thermal waters.

Some springs and wells release free gases. The gas chromatographic analyses show the prevalence of N<sub>2</sub> and CO<sub>2</sub>, with minor amounts of CH<sub>4</sub> in the water sources close to the Pannonian Basin. The isotope composition of Helium shows values between 0.9 and 2.18 R/Ra indicating a prevailing crustal source with a significant mantle component. In the case of δ<sup>13</sup>C-CO<sub>2</sub> the values range between -12.7 and -6.1 ‰ vs.V-PDB, indicating that the CO<sub>2</sub> originates possibly from a limestone source.