Profile gamma-ray spectrometry measurements in the Malé Karpaty Mts.

Andrej Mojzeš
Department of Applied & Environmental Geophysics[1]

Silvia Kellerová[2]

A b s t r a c t: Field gamma-ray spectrometry measurements were carried out in the southern part of the Pezinské Karpaty Mts. (part of the Malé Karpaty Mts.) during summer and autumn 2010. The profile survey was aimed at in situ natural radioactivity of rock and soil environment determination, at rock blocks mapping based on their different radioactivity and at correlation and confrontation of surveyed radioactivity boundaries with known geological and geochemical rock lithotypes distribution.

The measurements were performed by portable gamma-ray spectrometer GS256 (Geofyzika Brno, Czechoslovakia) in surface 2π geometry. It is an instrument well established in geological practice with 256 channel spectrum analyzer and NaI (Tl) scintillation detector of 76x76 mm dimensions. The number of accumulated impulses per 120 seconds at each measured station were converted to mass concentrations of ^{40}K (%K), ^{238}U (ppm eU) and ^{232}Th (ppm eTh) while total (gross) gamma-ray activity is presented in concentration of equivalent uranium (ppm eU ~ Ur).

Four profiles were measured crossing the mountain range from NW to SE in the rectangular among Stupava, Rača, Modra and Kuchyňa villages (Fig. 1): the 1st profile (P1) between Rača and Stupava, the 2nd profile (P2) between Svätý Jur and Lozorno, the 3rd profile (P3) between Pezinok and Pernek and the 4th one (P4) between Modra (Harmónia) and Kuchyňa villages. Totally 1039 stations were measured what covers, with the step of measurement of 40/50 m, the length of approx. 40 km (approx. 10 km per line). Every station was fixed by GPS WGS84 coordinates.

Geological structure is various in the study area (Fig. 1). Generally the SE halves of all profiles (except of P3 that nearly whole) lay on the Paleozoic

[1] Comenius University in Bratislava, Faculty of Natural Sciences, Mlynská dolina, 84215 Bratislava, Slovak Republic, mojzes@fns.uniba.sk
[2] Vígľašská 3, 85107 Bratislava, Slovak Republic, kellerova@centrum.sk

crystalline basement built by magmatic (granites, granodiorites and tonalites) or metamorphic (slates, phylites, gneisses, mica schists) rocks. The SW parts of profiles lay mostly on Mesozoic, Neogene and Quaternary rocks.

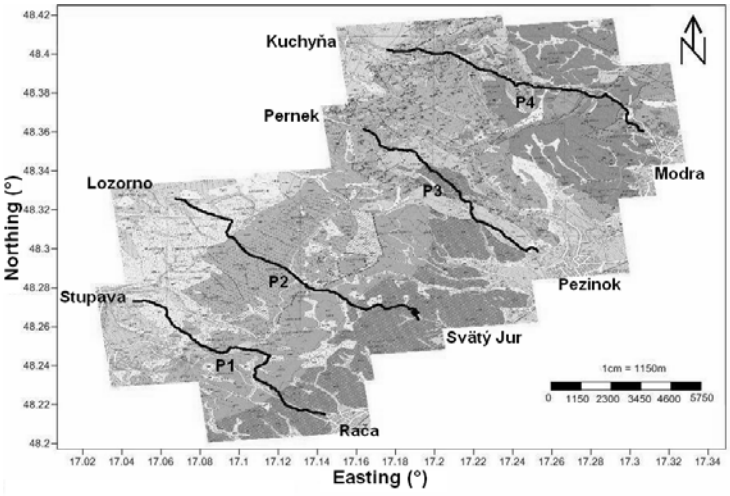

Fig. 1. Geological map of the study area (Káčer et al., 2005) with survey profiles.

The survey confirmed that rocks of the study area have middle and low radioactivity level (Matolín, 1976; Daniel et al., 1996) (Fig. 2). The highest values of radioactivity belong to the coarse grained granites and granodiorites of the Bratislava massif with lower thorium content (2.7 %K, 3.5 ppm eU, 7.4 ppm eTh and 16.5 Ur). The medium grained muscovite granites and granodiorites have similar or little lower values with higher thorium content (2.6 %K, 2.9 ppm eU, 10.1 ppm eTh and 17.0 Ur). The lowest values among the crystalline granites have the granodiorites and tonalites of the Modra massif (1.7 %K, 2.3 ppm eU, 6.1 ppm eTh and 11.2 Ur). Very high values of radioactivity belong to phylites and slates (2.2 %K, 2.9 ppm eU, 7.9 ppm eTh and 14.6 Ur), the lower ones to gneisses and paragneisses (1.6 %K, 3 ppm eU, 7 ppm eTh and 12.1 Ur). Schists and metaquartzites show mainly higher U and Th contents (2.2 %K, 2.7 ppm eU, 8.6 ppm eTh and 14.7 Ur). The lowest values among all crystalline rocks have fine and medium grained amphibolite bodies (1.7 %K, 2.2 ppm eU, 5.4 ppm eTh and 10.8 Ur). Mesozoic rocks are presented by low radioactivity level. The Jurassic limestones (1.4 %K, 2.3 ppm eU, 5.8 ppm eTh and 9.8 Ur) show lower values than the Triassic ones (1.9 %K, 2.8 ppm eU, 8.9 ppm eTh and 13.5 Ur). The Neogene sandstones, conglomerates and gravels show very

low values (1.6 %K, 2 ppm eU, 5.4 ppm eTh and 10.5 Ur) while the Quaternary deluvial sediments show higher values (2.1 %K, 2.7 ppm eU, 7.6 ppm eTh and 13.6 Ur) in comparison with the fluvial ones (1.9 %K, 2.4 ppm eU, 6.3 ppm eTh and 11.9 Ur).

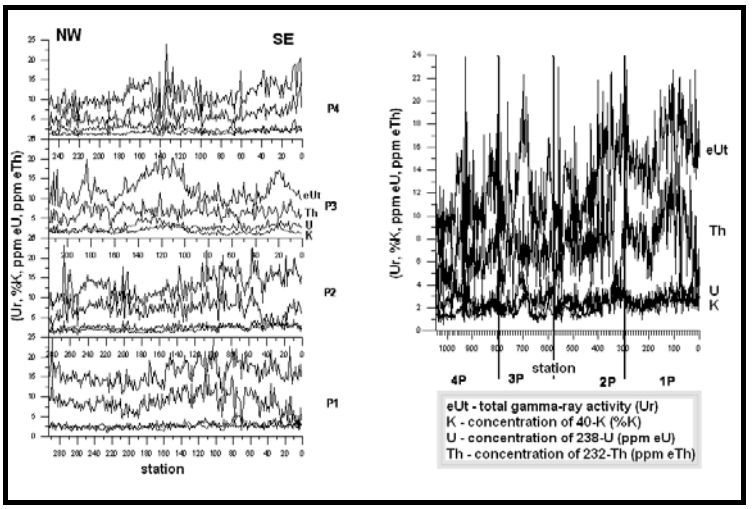

Fig. 2. Results of rock radioactivity measurements.

Key words: geophysical survey, profile gamma-ray spectrometry, natural radioactivity of rock environment, concentration of ^{40}K, ^{238}U and ^{232}Th in rocks

Acknowledgements: This contribution was prepared within the ambit of the project VEGA No. 1/0468/10 "Spatial and time demonstration of the unsaturated zone in geophysical fields".

References

Daniel J., Lučivjanský L. & Stercz M., 1996: Geochemical atlas of Slovakia, part IV.- Natural radioactivity of rocks. Ministry of Environment, Bratislava, 88 pp.

Káčer Š., Antalík M., Lexa J., Zvara I., Fritzman R., Vlachovič J., Bystrická G., Brodianska M., Potfaj M., Madarás J., Nagy A., Maglay J., Ivanička J., Gross P., Rakús M., Vozárová A., Buček S., Boorová D., Šimon L., Mello J., Polák M., Bezák V., Hók J., Teťák F., Konečný V., Kučera M., Žec B., Elečko M., Hraško Ľ., Kováčik M. & Pristáš J., 2005: Slovak Republic – digital geological map 1:50 000 and 1:500 000. Final report. Geofond, Bratislava (in Slovak)

Matolín M., 1976: The radioactivity of rocks of the Western Carpathians. Charles University, Prague (in Czech)