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Hydrogeochemical characteristics of mineral and thermal waters

title: **Natural radioactivity of thermal waters of Podhale trough
– preliminary results**

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The Podhale Trough is situated between the Tatras in the south and the Pieniny Klippen Belt in the north, both geological units belonging to the Polish Inner Carpathians. The Trough consists of the Paleogen flysch (sandstones and shales) overlain by conglomerates, and mudstones. The flysch strata rest on the Eocene and Mesozoic carbonate rocks of the Tatra units. Thermal water with the temperature 20.4°C was discovered for the first time by Zejszner (1844) in Jaszczyrówka. Currently, thermal water has been reported in 14 boreholes (Sokołowski, 1992; Kępińska, 1997; Chowanec, 2003; Małecka, 2003). The rocks of the Tatra massif affect most the hydrological conditions of the Podhale Trough. The thermal waters of Podhale are associated with meteoric waters recharging in the Tatra Mts the fractured and karstified Mesozoic carbonate rocks, and as a result come into contact with the Palaeozoic crystalline basement of the Tatras. These rocks dip to the north under impermeable and weakly permeable sediments of the Podhale flysch. The Pieniny Klippen Belt rocks form an impermeable barrier that closes the Podhale Trough waters from the north.

Physical and chemical analyses of water and measurements of their natural radioactivity were carried out on samples collected from selected boreholes: PIG/PNiG-1 in Bukowina Tatrzańska, IG-1 and Szymoszkowa GT-1 in Zakopane and PGP-1 in Bańska Niżna. The temperature of the thermal waters in question ranges from 25.9 to 83°C and their mineralization (TDS) from 0.3 to 2.4 g/L (Tab. 1). They are currently used for heating purposes and in recreation.

The specific activities of radionuclides are as follows: 1–81 Bq/L for ^{222}Rn ; 23–686 mBq/L for ^{226}Ra ; 10–401 mBq/L for ^{228}Ra ; 0.4–1050 mBq/L for ^{238}U and 2.6–1000 mBq/L for ^{234}U . They are the highest in the water from the borehole Szymoszkowa GT-1. The maximum activities of radium, uranium and radon contained in the mineral waters of the similar mineralization from the Outer Carpathians are lower and amount to 170 mBq/L, 56 mBq/L and 32 Bq/L, respectively (Chau et al., 2009). The significantly higher level of natural radioactivity of the thermal waters from the Podhale Trough must be associated with their contact during migration with the crystalline, igneous and metamorphic rocks of the Tatra Mts.

Table 1. The data concerning to the analyzed thermal waters.

Code of the borehole and its localization	Borehole depth [m]	Temperature [°C]	Type of water	TDS [g/L]	Radon [Bq/L]	Radium [mBq/L]		Uranium [mBq/L]	
						^{226}Ra	^{228}Ra	^{234}U	^{238}U
PIG/PNiG-1 Bukowina Tatrzańska	3780.0	44.3	SO ₄ -Ca-Na	1.4	2.7	480	170	2.6	0.4
IG-1 Zakopane	3073.2	31.0	HCO ₃ -Ca-Mg	0.3	1.0	23	≤10	6.1	2.9
Szymoszkowa GT-1 Zakopane	1737.0	25.9	HCO ₃ -Mg-Ca	0.4	81	686	401	1000	1050
PGP-1 Bańska Niżna	3242.0	83.0	Cl-SO ₄ -Na-Ca	2.4	1.3	522	395	148	205

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REFERENCES

- Chau N.D., Rajchel L., Nowak J., 2009: *Natural radioactive elements and chemical composition of some mineral waters of Poland (Polish Carpathians, Carpathian foredeep)*. Proceeding of the 2008 International Liquid Scintillation Conference, Davos, Switzerland. Radiocarbon.
- Chowaniec J., 2003: *Wody podziemne niecki podhalańskiej (Groundwaters of the Podhale Trough)*. Współczesne problemy hydrogeologii, t. 11, cz. 1: 45–53. Uniw. Gdański, Gdańsk.
- Kępińska B., 1997: *Model geologiczno-geotermalny niecki podhalańskiej (Geological and geothermal model of the Podhale Trough)*. Studia, Rozprawy, Monografie, 48. Wyd. CPPGS-MiE PAN, Kraków.
- Małecka D., 2003: *The thermal waters of Podhale, southern Poland: historic of research, genesis and utility*. Geol. Quart., 47, 2: 195–209.
- Zejszner L., 1844: *O temperaturze źródeł Tatrowych i pasm przyległych (On the temperature of the springs in the Tatras and adjacent ranges)*. Bibl. Warsz. t. 2, Warszawa, 257–281.



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