Ryszard HABRYN, Marcin ŁOJEK, Magdalena PAŃCZYK-NAWROCKA, Dominika SIERADZ, Adam WÓJCICKI, Marta WRÓBLEWSKA

SUMMARY

The results of the Czerwony Potok PIG 1 drilling indicate that the well has achieved its intended objectives. A continuous, approximately 200 m profile of granitoid rocks was obtained, with good core yields in excess of 95%, and the planned wireline logging and temperature tests were completed.

According to the geological workplan, cores were profiled and a very wide range of laboratory tests were performed on selected rock samples. A full photographic documentation of the cores was also made. The drill cores transported to the core warehouse of the Central Geological Archive in Kielniki near Częstochowa, and the results of the tests included in this documentation can be used as comparative material for further regional geological studies of the Karkonosze pluton.

The profile of the borehole includes 4.5 m of granitoid debris, with the remainder (4.5–201.0 m b.t.s.) drilling the Karkonosze pluton, with a highly lithologically diverse complex including a fault zone in the interval 82.4–106.6 m b.s.l.

This complex is also found by magnetotelluric soundings in the area of the borehole, as a zone of significantly reduced resistivity.

Similarly, interpretation of the petrographic-mineralogical results suggests that at a depth of 82.4–106.6 m b.t.s., there is a tectonic zone where the originally coarse-crystalline granitoids have undergone fracturing and intense metasomatic processes. On the other hand, in the interval covering several meters below the tectonic zone, granitoids have undergone intense chloritization, albitization and sericitization.

The total porosity in the studied core samples from the Czerwony Potok PIG 1 borehole ranges from 0.36 to 3.94%. These are values that characterize very poorly porous rocks. Permeability ranges from 0.001 to 2.934 mD, so they generally belong to impermeable rocks (samples of lower to medium part of the borehole profile) or low/medium permeable rocks (samples of depth range 30.3–73.3 m b.t.s.). Threshold diameter values in the analyzed samples range from 0.5 to 20.0 μm, mostly around 1 μm. This proves the poor filtration properties of the rocks. The values of the hysteresis effect indicate the relatively homogeneous formation of the pore space of the studied rocks. The analyzed samples show a microporous character of the pore space. The percentage of pores with diameters larger than 1 μm is generally low, averaging about 46%, although in some samples it exceeds 60%.

The results of thermal conductivity measurements indicate that the average value of this parameter for the borehole is 2.64 W/m*K. The study showed that fine- and medium-grained granites can have higher values of this parameter compared to coarse-grained granites. Thermal conductivity increases gradually with depth obtaining a maximum value of 4.435 W/m*K. A clear deviation is shown by sample No. 13 (tab. 4) described as cataclasite, taken from a depth of 91.45–91.60, which has a value (average) of 1.9525 W/m*K. On the other hand, the heat capacity of granitoid samples varies from 0.842 J/(g*K) for temperatures of 80°C to 0.953 J/(g*K) for 160°C. As for the determination of radiogenic heat production for the granitoids samples under consideration, 4 samples out of 10 reached very high values of this parameter, amounting to more than 6 [$\mu W/m^3$], which is also correlated with the high uranium and thorium contents of these samples determined by physicochemical tests.

The results of chemical analyses suggest that granitoids from the Czerwony Potok PIG 1 borehole are characterized by high SiO_2 contents (74.7–77.5 wt%) except for a sample of transformed medium-crystalline biotite granite from the immediate vicinity of the fault zone (about 68 wt%), as well as high K_2O (4.26–5.46 wt%) and varied Al_2O_3 (9.77–17.15 wt%).

The results of the interpretation of the wileline logging curves indicate that in the interval 84–106 m there is a change in lithology resulting from the strong tectonic involvement of this zone of the occurrence of a tectonic melange zone and cataclasite subjected to metasomatism manifested in the caliper-meter curves. In this interval, the curves also show increased porosity (from 0–2 to 19–24%) and reduced density (from 2.45–2.5 to 2.2–2.4 g/cm^3). Analysis of the resistivity curves shows the water saturated zone with increased porosity.

The first series of temperature measurements taken under steady-state conditions (January 2012) yielded a geothermal gradient of 3.90°C/100 m (geothermal degree of 25.64 m/°C) in the 50–150 m interval, while the geothermal gradient in the 100–200 m interval was 3.82°C/100 m (geothermal degree of 26.17 m/°C), indicating favorable geothermal conditions. In contrast, the second series of measurements (February 2012), taken due to technical conditions only to a depth of 104 m, also under steady-state conditions, yielded significantly lower geothermal gradient values of 2.3–2.4°C/100 m (geothermal degree of 41.6–43.5 m/°C). Such a low geothermal gradient is probably related to groundwater circulation in the measured depth interval, including within the tectonic zone occurring at a depth of 82.4–106.6 m b.t.s. On the other hand, the geothermal gradient and geothermal degree, obtained from temperature measurements taken in January 2012, are probably also representative of deeper parts of the Karkonosze pluton.