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title: **The impact of old mine shafts on the accumulation of water in mined excavations and terrain surface based on the example of the Górsko shaft in the "Wieliczka" Salt Mine**

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The issue of water inflow to the Górsko shaft and the problems arising due to the accumulation of waters in the nearby excavations of the mine as well as the geological and engineering phenomena occurring on the surface in the surroundings of the shaft is most interesting. The waters migrating in this shaft and around it were not considered as a direct hazard to the existence of the Wieliczka undergrounds, however, their movement and the changes of volume and NaCl saturation caused a necessity to capture and pump them to the surface. The waters migrating for centuries washing out the soil (the phenomena of suffusion) and leaching saline formations together with the process of tightening of post-exploitation excavations caused mining subsidence and the destruction of the building at the fore-shaft.

The Górsko shaft was dredged to the depth of Level I, in the first half of the 17th century, and completed during the administration of the salt-works administrator, Andrzej Górski, probably in 1622. The excavations located nearby at Level I were established in the 17th and 18th centuries. The shaft was dredged in the 19th century, at first to the Level II lower, and then, in the period to 1836, to Level IV (Charkot, 2003).

In the 1890s and first decade of the 20th century the shaft housing was reconstructed. In 1899 the wooden *kleta* (housing) was changed to a brick structure in the shaft building. The cable railway constructed in 1902 was extended to the shaft in the years 1912 – 1914 from the nearby Psia Górka sand pit and from 1914 sand was lowered into the mine and used for filling the excavations. This process was continued after the break caused by World War I until the outbreak of World War II (Müller, 1935; Charkot, 2003).

In 1954 the Górsko shaft was filled in to the depth of ca 6 metres below ground level (Charkot, 2003). The geological profile of the shaft indicates the existence of Quaternary formations forming as clay dust and loam dust, and then the following successive formations of loam and gypsum zone, boulder deposit with loam-and-saline rock (called *zubry*) and blocks of green salt, and from the height of the Level II lower into the depth of the orogen–stratiform deposits (Fig. 1), (The book of water hazard control in inactive shafts at the Wieliczka Salt Mine, Hrebenda 2005).

The hydrogeological conditions of the orogen, in the area of the shaft, and the phenomenon which occurred on the surface impact on the creation of Quaternary formations, including the existence of soils susceptible to suffusion. It was difficult to pass this layer during the process of dredging the excavation in the 17th century. The inflow at that time was defined as significant. Therefore, it became necessary to drill a drainage well in the vicinity of the shaft connected with it to the underground corridor, so-called *stuła* (Charkot 2003). Also, accumulating water in the region and the geological and engineering process taking place in the orogen may have had their impact on the stream flowing by the shaft and the surface affecting subsidence of the Słaboszów chamber, established in 1698, located a few dozen metres to the west from it (Kolasa, Kubik 1983).

The water outflows of from the Górsko shaft where first observed at the shaft bottom of Level III (Fig. 1). On the map „The Inflow of Ferocious Waters" (this was the name of mine outflows) of Level III at the shaft bottom leak no. 63 is noted of a flow rate equal 1.59 l/dm^3. The map, which is not dated, depicts the situation of the excavation in the 1930s. According to the observations made between the years 1943–1944 there was an existing inflow at the flow rate of 0.66–2.0 dm^3/min. at the shaft bottom of Level III , which in the years 1948–49 was registered at a flow rate of 1,5 dm^3/min. (Ferocious inflows in the Wieliczka mine).

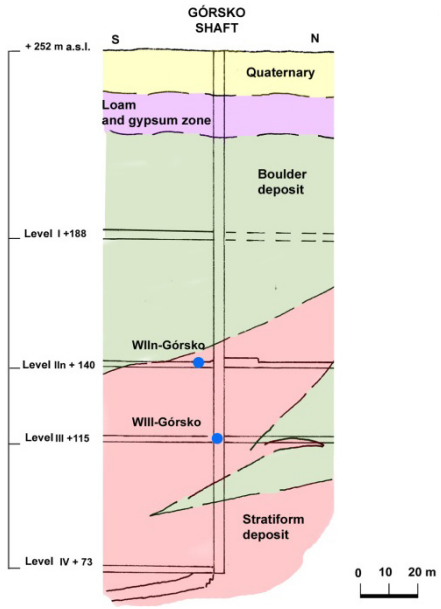

Figure 1. Geological profile of the Górsko shaft. Prep. by J. Przybyło, 2010.

After filling in the shaft in 1954 the registered inflows at the shaft bottoms were characteristic for their different flow rates from droplets to ca 2 dm^3/min. as well as changes in the flow route. The leaks associated with the shaft were observed in the area of the shaft bottom in the Level II lower and III. The shaft bottoms at Levels I and IV are not accessible.

At present no significant hydrogeological phenomenon at Level III is noticed in the spot where the inflow was noted in the 1940s. The brines are received in the lower section of Level III known as WIIn-Górsko in the area of the shaft bottom (Fig. 1), (The book of water hazard control in inactive shafts at the Wieliczka Salt Mine). It is also possible, that the brine from the shaft migrates along the ceiling of the bedded deposits to the Fryderyk August chamber (leak WIIn-8) located to the south from it. In both these areas the condensation of fully saturated brine is observed (Leak register of the mine).

The building of the shaft bottom, in respect to the surrounding area, is located in a basin, what causes the flow of precipitation waters towards it. The terrain surrounding the shaft is systematically settling, as registered, on average 13 mm/year. A slight subsidence of the terrain was noted in the shaft area at the end of the 1970s, and, in the 1980s, a subsidence of the level of the material filling the shaft pipe was noticed.

Cracks were noticed on the fore-shaft building in December 2002, and at the beginning of 2003 – intensified settlement. These phenomenon caused the execution of protecting works in January and February 2003, which included the liquidation of the empty space around the shaft to the depth of 3 metres, and the empty 16-metre space in the shaft pipe which was performed to limit the inflow of water to the shaft. In effect, the execution of these works resulted in slowing the motion of terrain settlement in the area of the shaft (Stawarczyk, 2003).

The work plans aimed at protecting the Wieliczka Salt Mine include further sealing of the orogen in the close vicinity of the Górsko shaft, which is conditioned by preserving the historic infrastructure of the shaft, the fore-shaft building and shaft tower.

REFERENCES

Charkot J., 2003: *The Górsko shaft – a witness to the mining history of the town (Szyb Górsko – świadek górniczej historii miasta). Żupy.* Kwartalnik Muzeum Żup Krakowskich Wieliczka. No. 14.

Dziwik K., 1984: *Protecting the Salt Mine in Wieliczka with filling in the years 1832–1939 – A historic outline (Zabezpieczenie Kopalni Soli w Wieliczce podsadzką w latach 1832–1939, zarys historyczny).* Studia i materiały do dziejów Żup Solnych w Polsce. T. XIII, Wieliczka.

Ferocious water inflows into the mine in Wieliczka for the years 1943–1944, 1948–1959 (Dzikie dopływy w kopalni w Wieliczce za lata 1943–1944, 1948–1959). Archiwum Działu Geologicznego KS Wieliczka.

Hrebenda M., 2005: *Geological and engineering documentation for the region of the Górsko shaft in Wieliczka (Dokumentacja geologiczno-inżynierska dla rejonu szybu Górsko w Wieliczce).* Krakowskie Przedsiębiorstwo Geologiczne „ProGeo" Sp. z o.o. Maszynopis. Archiwum Działu Geologicznego KS Wieliczka.

Kolasa K., Kubik K., 1983: *Post-exploitation Wieliczka collapse sinks (Poeksploatacyjne zapadliska wielickie).* Studia i materiały do dziejów Żup Solnych w Polsce. T. XII, Wieliczka.

Leak register of the mine at Level IIn. The Wieliczka Salt Mine for the years 1983–2003 (Rejestr wycieków kopalnianych poziom IIn. Kopalnia Soli Wieliczka za lata 1983–2003). Archiwum Działu Geologicznego KS Wieliczka.

Leak register of the mine. Leak control register at the Level IIn for the years 2004–2009 (Rejestr wycieków kopalnianych. Książka kontroli wycieków na poziomie IIn za lata 2004–2009). Archiwum Działu Geologicznego KS Wieliczka.

Müller A., 1935: *The history of the Wieliczka saline (Historia saliny wielickiej).* Maszynopis. Archiwum Działu Geologicznego KS Wieliczka.

Stawarczyk Z., 2003: *The analysis of the present deformations of the building at 12a Górsko Street based on observations (Analiza dotychczasowych deformacji budynku przy ul Górsko 12a na podstawie prowadzonych obserwacji).* Maszynopis. Archiwum Działu Mierniczego KS Wieliczka.

The book of water hazard control in inactive shafts at the Wieliczka Salt Mine for the years 1981–2009 (Książka kontroli zagrożenia wodnego w nieczynnych szybach w Kopalni Wieliczka za lata 1981–2009). Archiwum Działu Geologicznego KS Wieliczka.

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