

The development of tourism in the Historical Silver Mine and the groundwater management system in Tarnowskie Góry – a case study of mining heritage tourism

Udostępnianie turystyczne Zabytkowej Kopalni Srebra wraz z systemem gospodarowania wodami podziemnymi w Tarnowskich Górach – przykład rozwoju turystyki górniczej

Małgorzata Polak

Primary School No. 32, al. Szymały 124, Bytom, Poland
geomailmp@gmail.com



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Abstract: This article presents the values of the Silesian mining heritage in the context of accessibility of the Zabytkowa Kopalnia Srebra (Historical Silver Mine) in the Tarnowskie Góry. Simultaneously, this is the largest, best-preserved and accessible historical lead-silver mine in Poland with its unique, integrated historical groundwater management system of drainage adits and a potable water supply network. In this area, industrial heritage is now becoming a precious touristic and cultural value in and of itself. The scope of the article includes the characterization of all objects added to the UNESCO World Heritage List, the description of ground and underground tourist trails and the history of their accessibility. Not all underground workings have been included into the tourist trail, due to their preservation conditions, accessibility and mine safety measures. The paper also presents a multi-faceted evaluation of the accessibility to all objects of mining heritage, including sites that are currently inaccessible, but still have the potential for tourism development.

Keywords: industrial mining tourism, Tarnowskie Góry Lead-Silver-Zinc Mine, underground water management system, underground and surface tourist trails

Treść: W artykule omówiono udostępnianie obiektów Zabytkowej Kopalni Srebra w Tarnowskich Górach będącej częścią śląskiego dziedzictwa górniczego. To największa, najlepiej zachowana zabytkowa kopalnia rud srebra i ołowiu w Polsce, z unikatowym zintegrowanym systemem sztolni odwadniających i zaopatrzenia w wodę. Dziedzictwo tarnogórskie jest obecnie na nowo odkrywane przez turystów. W artykule przedstawiono charakterystykę wszystkich obiektów wpisanych na Światową Listę Dziedzictwa Kulturowego UNESCO, opis podziemnych i naziemnych tras turystycznych oraz historię ich udostępniania. Nie wszystkie obiekty Zabytkowej Kopalni Srebra są częścią tras turystycznych ze względu na ich stan zachowania oraz dostępność i bezpieczeństwo zwiedzających. Zaprezentowana została wieloaspektowa ocena dostępności turystycznej wszystkich obiektów dziedzictwa. Wskazano także obiekty i miejsca, które są niedostępne, a mają potencjał turystyczny.

Słowa kluczowe: turystyka górnicza, Zabytkowa Kopalnia Srebra Tarnowskie Góry, system gospodarowania wodami podziemnymi, podziemne i naziemne szlaki turystyczne

Introduction

‘Cultural heritage’ is a tangible and intangible concept of human activity in the past. It is “a meaningful collective

value imprinted on social space as a civilization memory” (Lamparska, 2013). Cognition of the elements of cultural heritage proceeds comprehensively and holistically by visiting the sites and objects. Cultural tourism includes, among

others, visits to post-industrial regions and objects, which are the principal tourist attractions, motivating people to explore (Rohrscheidt, 2016). Recently, travels to the sites of technical monuments and post-industrial facilities are breaking popularity records worldwide. In Poland, this branch of the tourism industry is relatively new, due to the quite short time, which elapsed from the closure of particular industrial objects to their development for tourism (Lamparska, 2013). Industrial heritage tourism, related to the resources of the Earth (particularly the post-mining objects), is a part of geotourism. Słomka & Kicińska-Świdarska (2004) were among others, one of the first in Polish literature to provide a definition of geotourism, considered as: “getting to know geological objects and processes”. According to Kowalczyk (2010), “when the geotourism includes also the specialized problems, as e.g. the use of construction and decorative stones in architecture, the history of the Earth or the museology it will involve the elements of cultural tourism, hence, it will no longer be solely a branch of nature tourism” (Migoń, 2012). This author suggests that geotourism should be recognized as a branch of tourism positioned at the border between nature and cultural tourism. Newsome *et al.* (2005, *vide* Migoń, 2012) define ecotourism as “a form of nature tourism focused on geology and landscape”. Geotourism promotes visits to sites important from the point of view of the Earth sciences, but it also bolsters the concern for preservation of geodiversity and cognition of the Earths’ heritage by admiration and education. Such goals are achieved by self-contained visits to geological objects, by walks on educational trails and to scenic outlooks, by organized tours, by geo-activity and visiting the tourist information centers at the sites of the Earths’ heritage (Newsome *et al.*, 2005). Similar definition of geotourism was proposed by Gray (2004). In practice, geotourism generally considers the human relations to the Earths’ heritage and resources (Migoń, 2012).

According to the international *Charter for the Protection and Management of Archaeological Heritage (1990)* (ICOMOS, 1990), archaeological heritage is defined as a part of tangible heritage for which basic information is provided by archaeological methodology. Hence, it comprises all traces of human existence, in which all the sites evidencing the human activity (including the mining operations), abandoned constructions and any other remnants (in which the underground workings) along with any associated movable cultural heritage. Definition of archaeological heritage merges with that of cultural heritage in its part focused on geology and landscape. Therefore, it becomes a coherent part of geotourism, in accordance with the idea proposed by Newsome *et al.* (2005).

Industrial mining tourism is a part of cultural tourism focused on industrial facilities, architectural structures and cultural landscapes. However, it also embraces the events, traditions and artistic creations, which are testimonies to or refer to both the technical and industrial developments in the past and today (Burzyński *et al.*, 2008; Rohrscheidt, 2016). The most important part of industrial mining tourism is the cognition of geological and mining conditions at the surface and

underground. Rybár & Hronček (2017) defined mining tourism as a phenomenon describing unique objects and mining machinery, and providing an opportunity to explore the underground spaces, in which both the abiotic and biotic nature components can be recognized, as well as cultural heritage related to past mining activity can be admired by both the amateurs and the professionals. The term “mining tourism” was applied and defined by several other authors (e.g., Conlin & Jolliffe, 2011; Kobyłańska, 2013; Pérez-Álvarez *et al.*, 2016). Thematic trips to mining centers help the visitors to understand the specific character of such sites and to recognize the customs and tradition of local communities. On the other hand, development of mining tourism is a chance for many industrial centers affected by decommissioning of industrial plants, including mine closures, which resulted in unemployment and decline of living standards of local communities. Mining tourism may become a separate part of mass tourism; a principal branch of the tourism industry in the former industrial centers, where post-industrial facilities are clustered. Mining tourism includes two separate problems directly related to past mining operations and to recent development of selected mines as tourist attractions (Rybár & Hronček, 2017). If integrated, both problems would result in the creation of a new branch of the tourism industry focused on cultural objects, based upon the past extraction of mineral raw-materials as tourist destinations. Upper Silesia is a region particularly rich in industrial heritage sites and objects. Hence, a specific tourism product can be created there, based upon the relics of historical mining activity (Lamparska, 2013).

The paper provides discussion on the Silesian mining heritage exemplified by the development of the Zabytkowa Kopalnia Srebra in Tarnowskie Góry town. The unique value of this object was recognized by joining the UNESCO World List of Cultural Heritage in 2017. All the elements of mining heritage are characterized and categorized according to their accessibility for visitors. The term “accessible” means suitable, available or at the disposal of. Therefore, the condition of accessibility must be met if the object can be not only visited physically, but also information about it is easily available together with its intellectual value, sensory features and property measures.

Description of the Zabytkowa Kopalnia Srebra

The lead and silver ore mine, together with its groundwater management system, in Tarnowskie Góry town are located in Southern Poland, at the border between two important physiographic units: the Silesian Lowland and the Silesian Upland, more precisely between the Opole Plain and the Tarnowskie Góry Ridge (Książkiewicz, 1936). This is one of the “classic” European metallogenic provinces (UNESCO World Heritage Nomination, Poland, 2016). Simultaneously, this is the largest, best-preserved and accessible historical lead-silver mine in Poland with its unique, integrated

historical groundwater management system of drainage adits and a potable water supply network. Both represent one of the largest, pioneering technical solutions of mine drainage in the world (Gamble, 2013).

The mine comprises a number of connected works, with in a total area of about 50 km², and is the most exceptional part of a much larger (150 km²) lead-silver ore mining

district operating since the 12th century. The historical system of drainage adits was developed under the flatland, built of highly permeable rocks, having high groundwater circulation rates; three times higher than average inflows to the other mines in Central Europe. Additionally, only two small rivers exist there, located somewhat higher above the sea level, to which the mine waters could be discharged (Fig. 1).

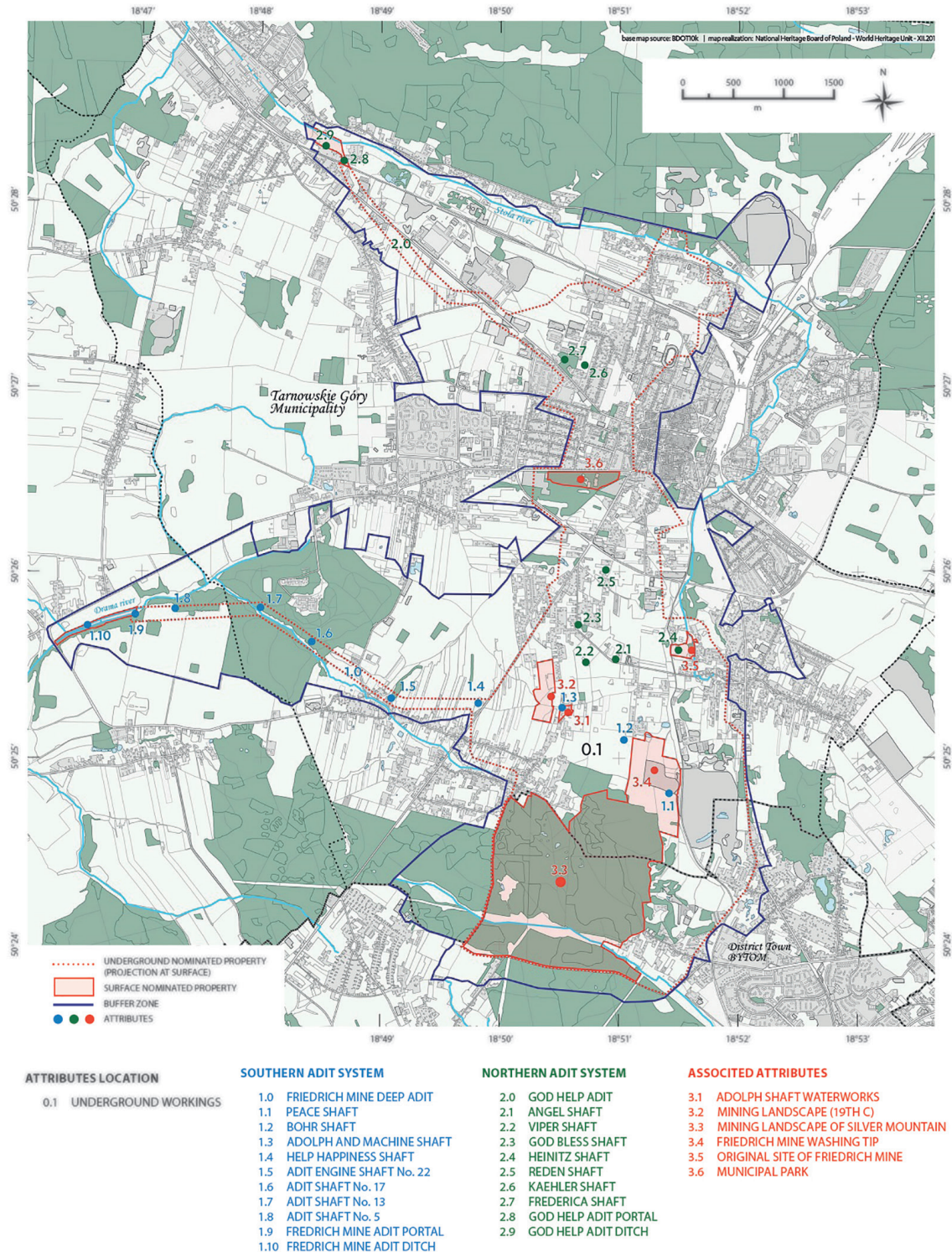


Fig. 1. Tarnowskie Góry Lead-Silver-Zinc Mine and its Underground Water Management System (base map from UNESCO, www2)

Silver ore mining started in the medieval ages, initially with the open-pit techniques and/or with small, shallow shafts. As late as in the 18th century, the progressing industrialization of the Upper Silesia made it possible to effectively carry out underground operations in lead-silver, followed by zinc mining districts (e.g. the Królewska Kopalnia Fryderyk (Royal Friedrich Mine)) (Żeglicki, 1996, 2003).

Brief characterization of facilities located at the historical mine

Below is a description of all facilities located on the site of the historic silver mine.

The Zabytkowa Kopalnia Srebra is a cluster of facilities with three shafts: Anioł (Angel), Żmija (Viper) and Szczęść Boże (God Bless) (Fig. 2A). The Anioł Shaft with headframe is the entrance to the underground workings. The underground tourist trail includes numerous galleries, chambers and adits (UNESCO World Heritage Nomination, Poland, 2016) (Fig. 2B–D).

The Żmija Shaft – its sinking started in 1811. The oval-shaped shaft barrel is 43 m deep and has a brick lining. Currently, this is a downcast shaft (Piernikarczyk, 1937). Ventilators located in the shaft collar provide airflow to the workings of the tourist trail.

The Czarny Pstrąg (Black Trout) Adit with the Ewa (Eve) and the Sylwester (Sylvester) shafts were a fragment of the Kopalnia Fryderyk (Friedrich Mine) Deep Adit (Fig. 3A, B)

connecting both shafts. The Ewa Shaft (Fig. 3C) descended in 1827 down to 20 m depth and worked as a skylight for No. 13 Drainage Adit, and as downcast and hoist shaft. The Sylwester Shaft, completed in 1829 in-depth and dropped down to 30 m depth, was the skylight for No. 17 Drainage Adit. The Czarny Pstrąg Adit was developed for visitors in 1957 as the first underground tourist trail, covered by boats along some 600 m distance (Potempa, 2015).

The Municipal Park was located in the center of the Tarnowskie Góry town, on the site of historical silver ore mining operations. Numerous hollows occur there, left after old shafts and small dumps and are now vegetated with trees and shrubs. In the park, visitors can inspect some objects of garden architecture, including a characteristic gazebo with stone stairs (Fig. 4A).

The Washing Tip was built by dumping the barren rocks left after washing the lead, silver and zinc ores at the old Fryderyk (Friedrich) Mine (Fig. 4B). It is 17 m high and has some foxholes at the top surface, left after World War II. It is vegetated with a valuable calamine grassland community with plants resistant to high concentrations of heavy metals (UNESCO World Heritage Nomination, Poland, 2016). Simultaneously, the dump is a great outlook point for Tarnowskie Góry town.

The mining landscape of Srebrna Góra (Silver Mountain) is located within the Segiet Nature Reserve, directly south of the ore washery dump, on the border between Tarnowskie Góry and Bytom towns. Characteristic mounds and hollows occur there, left after long-lasting (12th–14th century) mining activity, now covered with a beech forest (Fig. 4C).

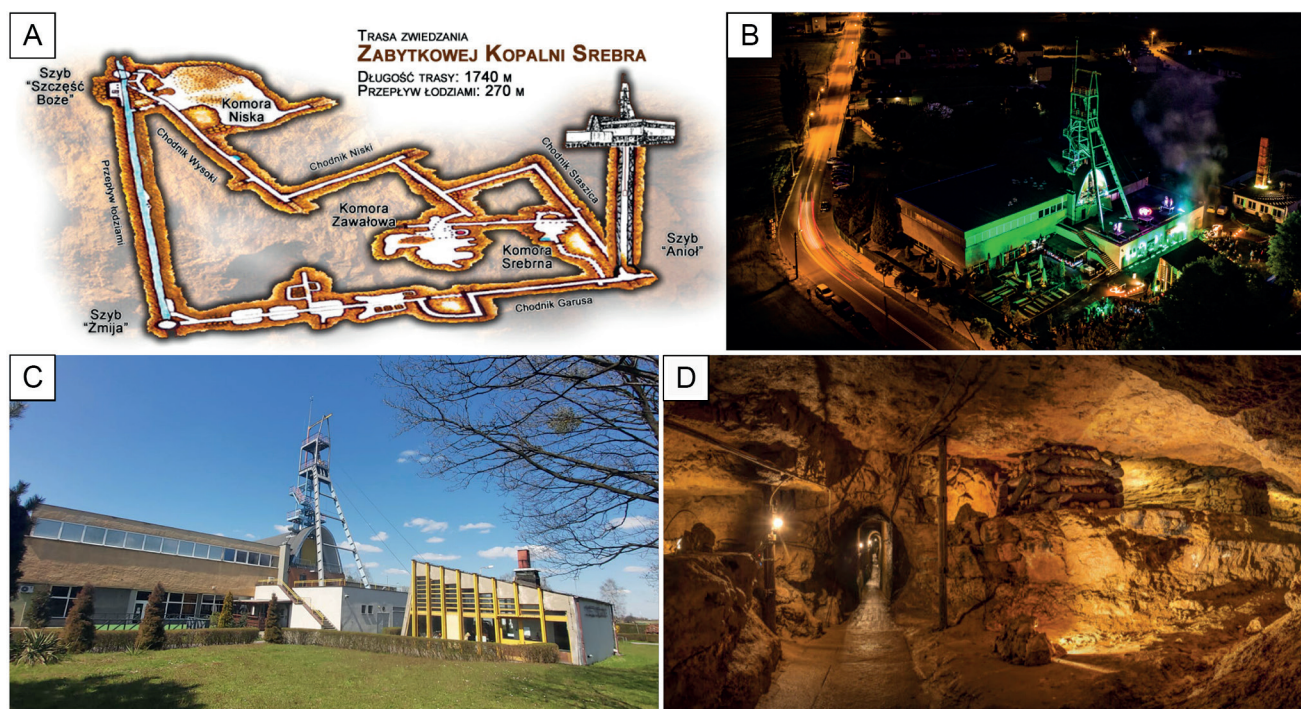


Fig. 2. Geotouristic objects described in the text: A – the Zabytkowa Kopalnia Srebra – the underground tourist route (UNESCO World Heritage Nomination, Poland, 2016); B – the Anioł Shaft, collar shaft and haulage machine, view from above; C – the Anioł Shaft, collar shaft and haulage machine; D – the Zabytkowa Kopalnia Srebra – Niska (Low) Chamber. Photos M. Polak unless otherwise noted

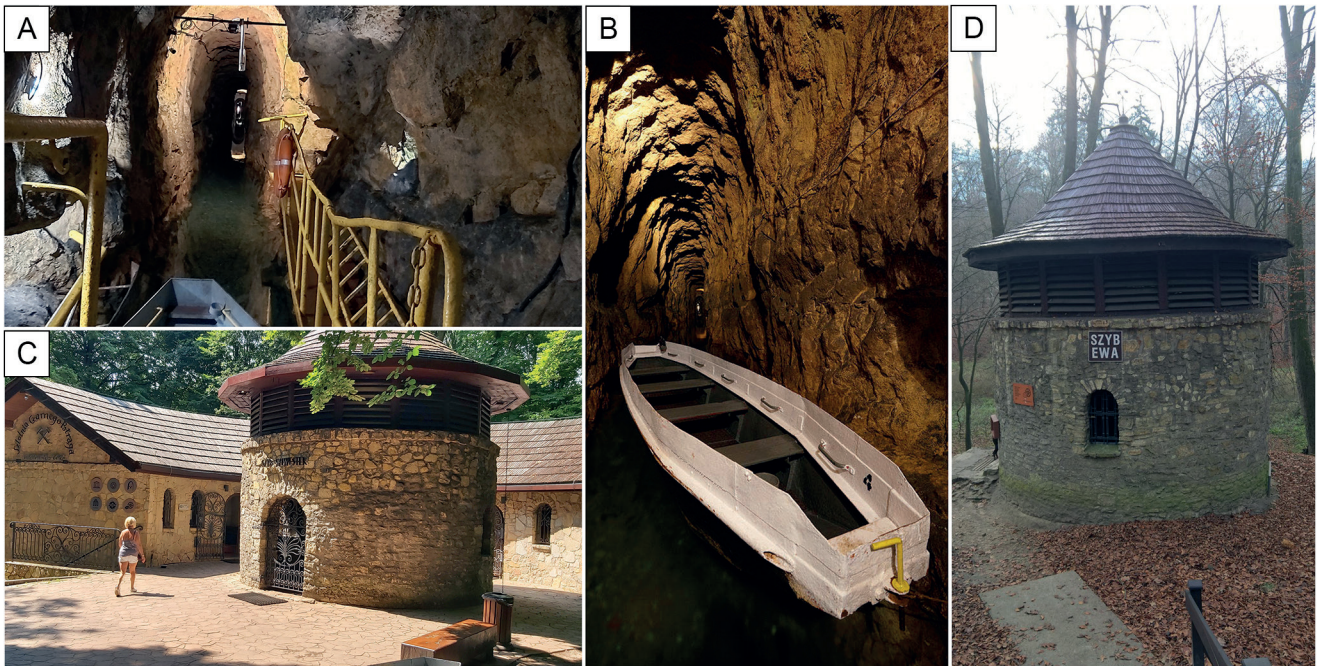


Fig. 3. Geotouristic objects described in the text: A – the Czarny Pstrąg Adit (UNESCO World Heritage Nomination, Poland 2016); B – the Czarny Pstrąg Adit, boat for transporting tourists (UNESCO World Heritage Nomination, Poland, 2016); C – collar of the Sylwester Shaft; D – collar of the Ewa Shaft

The original site of Kopalnia Fryderyk is the initial mining field of the Królewska Kopalnia Fryderyk. Recently, it belongs to the Kunszt Park, with a characteristic mound

raised in 1920 to commemorate the discovery of the first, high-grade silver ore deposit in 1784 (Piernikarczyk, 1937) (Fig. 4D).

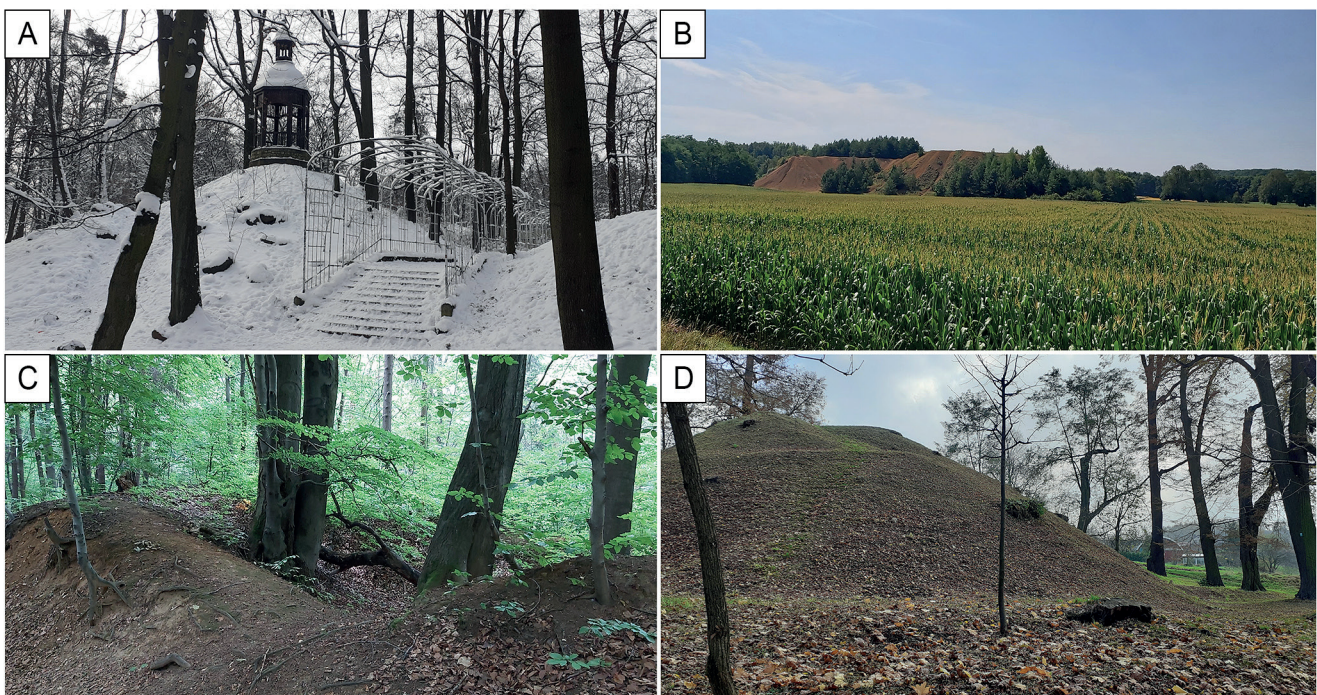


Fig. 4. Geotouristic objects described in the text: A – central part of the Municipal Park with characteristic mound, gazebo and metal pergola, the latter imitating a mine gallery; B – view of ore Washing Tip composed of barren dolomite with an admixture of iron ore responsible for orange color; C – the Kopalnia Segiet (Segiet Mine) with typical craters, hollows and mounds; D – memorial mound in Kunszt Park

The descent of the Szczęść Boże Shaft commenced in 1815, down to the final depth of 43 m. Recently, the shaft is closed and backfilled (Lubos, 1995). However, its fragment can be seen from the underground tourist trail of the Zabytkowa Kopalnia Srebra (Fig. 5A). A characteristic dump left after shaft sinking is located on private property.

The Staszic (Adolph) Shaft Waterworks comprises two brick hoist rooms of the Staszic and the Maszynowy (Engine) shafts, as well as the boiler house with the last-existing, historical drum boiler (Fig. 5B). In the basement, there are three huge halls, in which the machinery of a water intake system was installed (initially steam-powered, now electric) (Fig. 5C). In the past, this was the main potable water source for Tarnowskie Góry town, but now it is only of minor importance. Additionally, the water was also supplied through the pipeline system to the historical Huta Królewska (Royal Iron Works) in Chorzów town (UNESCO World Heritage Nomination, Poland, 2016). The object is well-preserved but, unfortunately, it is inaccessible to visitors due to issues with its ownership.

The post-mining landscape from the 19th century is a rolling terrain with numerous hollows and mounds originating from lead and silver ore mining operations in the 19th century (UNESCO World Heritage Nomination, Poland, 2016). These are randomly distributed, rounded open-pits and dumps left after the sinking/submergence of the shafts (Fig. 6A), now vegetated by xerothermic grassland. This area is adjacent to the Staszic Shaft Waterworks.

The Kopalnia Fryderyk Adid Ditch includes a neoclassical portal built of sandstone, with a carved date of construction (1821), named the Brama Gwarków (Miners' Gate), and the ditch draining groundwater from the mine to the Drama River (Wyciszak & Moszny, 2003) (Fig. 6B).

The Boże Wspomóż (God Help) Adit Ditch originates from 1672. The sandstone portal was restored in 2000. The draining ditch is about 500 m long and 6 m wide, and discharges the mine waters to the Stoła River (UNESCO World Heritage Nomination, Poland, 2016) (Fig. 6C, D).



Fig. 5. Geotouristic objects described in the text: A – the Szczęść Boże Shaft sunk down to the level of the Heinitz and the Reden galleries; B – collar and hoist buildings of the Staszic Shaft; C – steam engine of groundwater pumping system built in 1921 at 50 m depth level (UNESCO World Heritage Nomination, Poland, 2016)

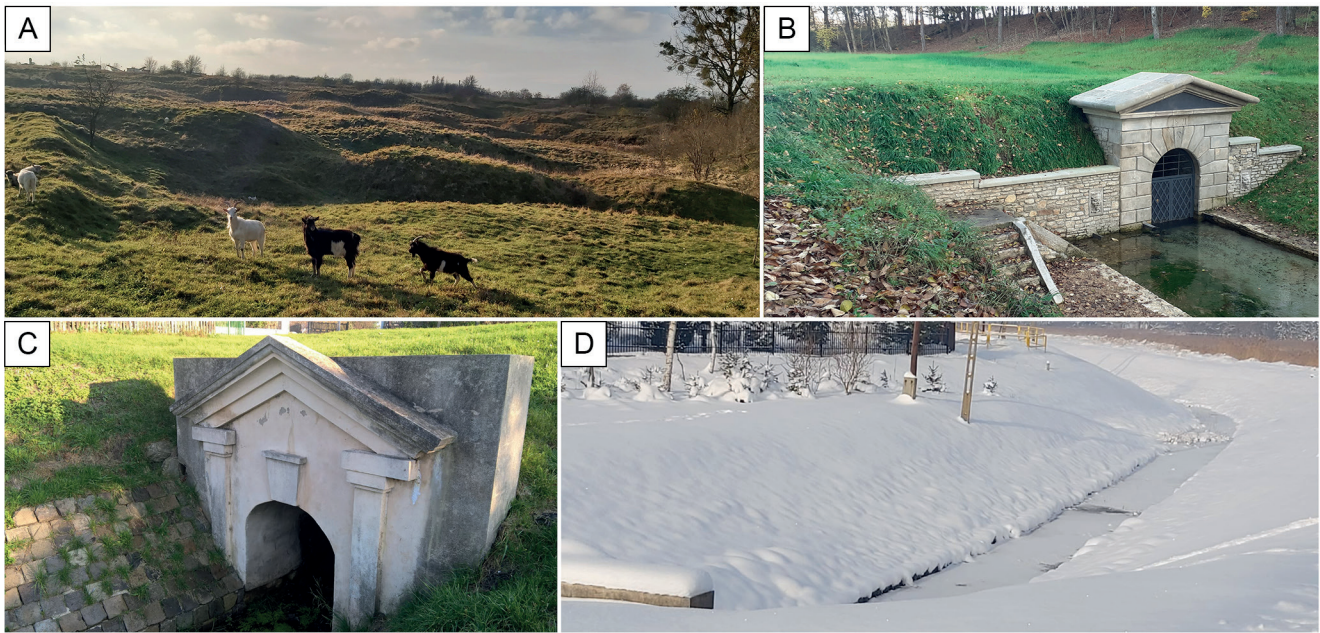


Fig. 6. Geotouristic objects described in the text: A – characteristic post-mining landscape, photo UNESCO World Heritage Nomination, Poland, 2016; B – portal of the Fryderyk Deep Adit – the Brama Gwarków (Miners Gate); C – the Boże Wspomóż Adit mouth with portal and ditch; D – the Boże Wspomóż Adit mouth with portal and ditch – winter view

The Pomóc Szczęściu (Help Happiness) Shaft sunk in 1832 down to 67 m depth. It is the deepest shaft located along the Kopalnia Fryderyk Deep Adit (Piernikarczyk, 2003). It has a brick lining, and its mouth is closed with concrete slab,

with noticeable ventilation holes (Fig. 7A). Around the shaft are remnants of a foundation of a non-existent hoist room. Nearby, an artesian well was drilled down to 203 m depth, now closed and backfilled.

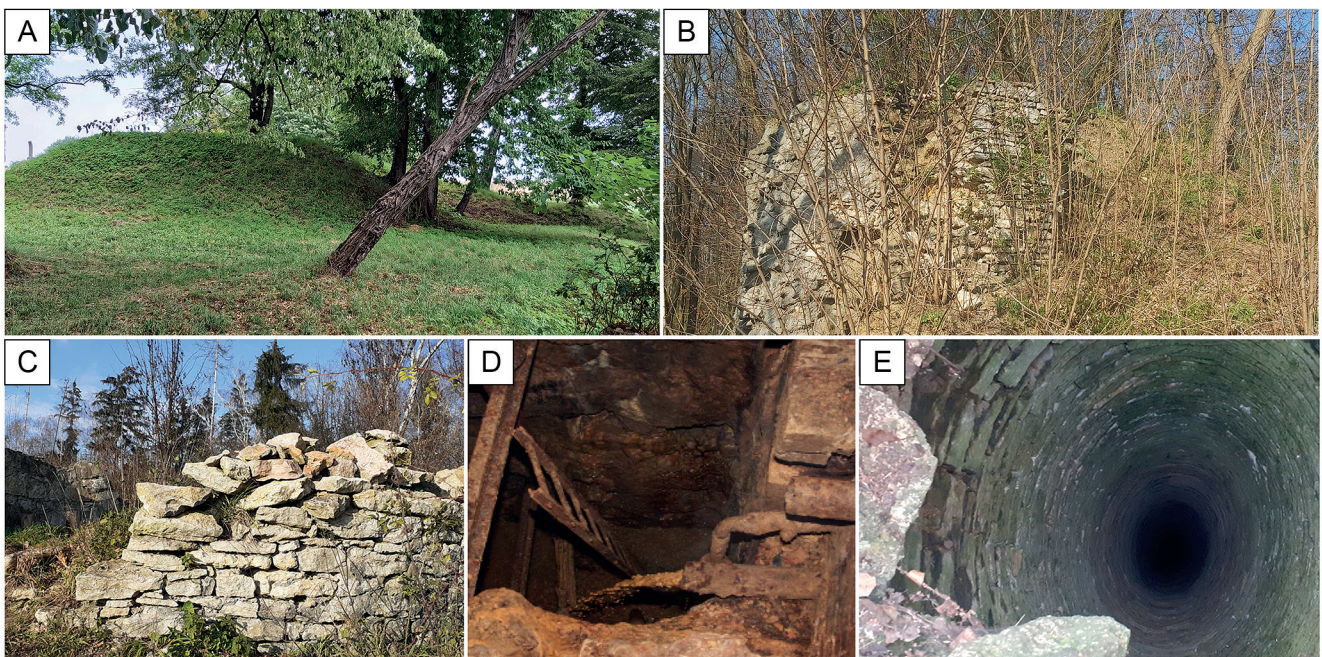


Fig. 7. Geotouristic objects described in the text: A – mound of the Pomóc Szczęściu Shaft with mouth protected by concrete slab with ventilation holes; B – oval-shaped No. 22 Shaft with brick lining; C – relics of stone-lined collar of the Adam Shaft; D – sump of the Pokój (Peace) Shaft at 53 m depth, photo UNESCO World Heritage Nomination, Poland, 2016; E – lining of the Bohr Shaft

The Maszynowy (Adit Engine) Shaft No. 22 is an oval-shaped, stone-lined shaft sunk in 1824 down to 39.7 m depth (Fig. 7B). It hosted the drainage pumps and the ladderway. Recently, the shaft is on private land.

The Adam Shaft No. 5 Adit was sunk in 1823 as a skylight and ventilation shaft for the Kopalnia Fryderyk (Friedrich Mine) Deep Adit, distant by 472 m from the adit mouth. Recently, only the rounded stone lining is preserved at the border between the forest and the farmland (Fig. 7C) (UNESCO World Heritage Nomination, Poland, 2016).

The Pokój Shaft is a rectangular shaft with brick lining, which was sunk in 1806 down to 53 m depth (Fig. 7D). It hosted a steam-powered pump, which supplied the water to the first ore washer located close to the washery dump (UNESCO World Heritage Nomination, Poland, 2016).

The Bohr Shaft was sunk in 1837, down to 64.1 m depth, for ventilation purposes (Fig. 7E), contemporaneously with the development of the Kopalnia Fryderyk Deep Adit. Now only a low mound is visible in the forest. The shaft mouth is protected by a concrete slab with steel bars, as it is now a bat

hibernation shelter (UNESCO World Heritage Nomination, Poland, 2016).

The Reden Shaft's submergence started in 1794, about 1.5 km southwest of the Tarnowskie Góry market square (Fig. 8A). The shaft was 40 m deep and hosted the first steam engine driving the water pump, which supplied the first municipal waterworks system carrying the potable water to the market square (UNESCO World Heritage Nomination, Poland, 2016).

The Kaehler Shaft's sinking started in September, 1808, at the Reden Hill, about 1 km northwest of Tarnowskie Góry downtown. The oval, stone-lined shaft is 55 m deep and has a hoist compartment, and a ladderway (Fig. 8B). In the years 1835–2000, the shaft supplied potable water for the local community. In 2015, water intake was reinstalled (UNESCO World Heritage Nomination, Poland, 2016). Near the shaft, there is a water tower built in 1926. Recently, it is owned by the Municipal Water and Sewerage Co., which is responsible for its maintenance and for water supply to Tarnowskie Góry.



Fig. 8. Geotouristic objects described in the text: A – mound left after the Reden Shaft; B – lining and machinery of the Kaehler Shaft; C – mound left after the Frederica Shaft; D – hollows and mounds left after the Heinitz Shaft

The Frederica Shaft's sinking started in 1801, together with the Maszynowy Shaft located at the exit of the Boże Wspomóż Adit. The initial depth of 43 m was deepened by another 6 m, in order to connect it to the Reden winze through which the water was raised by a steam-powered pump to the Boże Wspomóż Adit (Koch, 2020). The oval, stone-lined shaft is well-preserved. Its mouth is protected and inaccessible from the surface (Fig. 8C). Unfortunately, it is located on private property.

The Heinitz Shaft was sunk in 1787, within the first mining field of the old Friderich Mine (Fig. 8D). It was the deepest (39 m) shaft in the whole Bobrowniki mining district.

The shaft was connected through the Heinitz Gallery to the Maszynowy Shaft of the Staszic Shaft Waterworks. Recently, it is located in a shallow depression and is complemented by a memorial mound, surrounded by the recreational Kunszt Park. The shaft mouth is protected and inaccessible from the surface (Koch, 2020).

History of development

The mining tourism to the Kopalnia Srebra Fryderyk began in the late 18th century, when the first steam engines

were imported and installed. Hence, visitors started to arrive at the mine in order to admire the work of that early steam-powered machinery. The tourists documented their impressions with entries in the so-called Golden Book of Tarnowskie Góry, which now contains almost 900 names of visitors representing various professions and social groups.

The first attempts to develop tourism in a part of the mine workings in the Tarnowskie Góry district took place in the 1930s. A concept was proposed to open an underground tourist trail between the Pokój and the Spess shafts. Some small tourist flow was also initiated in the vicinity of the Staszic Shaft Waterworks. In 1937, the municipal authorities joined the Association of Tourism Propaganda of the Silesian District, which opened an office in the town. This initiative increased the number of visitors to the town. In 1938, the Polish Travel Agency ORBIS opened a branch in Tarnowskie Góry. In the same year, the municipal authorities were granted a mining lease from the State Treasury for the development of the “demonstration mine” named after the king Bolesław the Brave. The 208-hectares lease was located in the vicinity of the Anioł Shaft. Unfortunately, the outbreak of World War II terminated this project (www1).

Further attempts to develop the Tarnowskie Góry mining heritage sites for tourism were resumed after World War II. Professor J. Piernikarczyk, discoverer of the famous mining act dated in 1528, the so-called *Ordunek Gorny* (Piernikarczyk, 1928), was a widely respected figure who wanted the Czarny Pstrąg Adit and Zabytkowa Kopalnia Srebra to become available for tourists. Since 1956, as a result of huge social efforts, attempts have been made to start the route traveled by boats from shaft Sylwester to shaft Ewa, which is a part of the Kopalnia Fryderyk Deep Adit located under Repecki Park. Development of the Czarny Pstrąg Adit for tourism started on July 15, 1957. First, rubble had to be removed from the works, then installations and mine safety measures had to be set up. In September 1957, first groups of visitors went down to the bottom of the Ewa Shaft, then covered by boats the distance of 300 m towards the Sylwester Shaft and returned to the Ewa one. After installation of stairs in the Sylwester Shaft, the boats were moving alternately in the adit (Piernikarczyk, 2002). Much later, in 1976, the underground tourist trail of the Zabytkowa Kopalnia Srebra was completed and opened to the public.

Underground tourist trails

Centuries of mining activity in the Tarnowskie Góry region resulted in the development of a unique, multi-level system of underground workings. Recently, the only available for tourists one is a small, but attractive fragment of that system with two main tourist trails:

- The Zabytkowa Kopalnia Srebra: the trail is 1,740 m long, visiting time is about 90 min.;
- The Czarny Pstrąg Adit: the trail is 600 m long, visiting time is about 40 min.

Both trails are accessible to pedestrians and quite long segments are operated by boats. There are also special trails prepared for disabled visitors.

The tourist trail at the Zabytkowa Kopalnia Srebra starts in the Anioł Shaft, where tourists descend in a cage/lift down to 40 m depth. Then, they walked along the Staszic Gallery to the Srebrna (Silver) Chamber (500 m²) preserved in its original condition, with a reconstructed workplace of the miners. Deeper inside the chamber, there is a unique, small pond and the relics of galena ore. From the Srebrna Chamber, tourists walk to the large (1,500 m²) Zawałowa (Collapse) Chamber, worked in the 18th century. Here, huge dolomite blocks can be seen, detached from the roof, due to the movements of rock formation and accumulated at the chamber's bottom. In the central part of that chamber, visitors can examine wooden mining cars from the 18th century, loaded with lead-silver ore. In the frontal wall, a fragment of karst sinkhole typical bell-like shape is exposed, about 9 m in diameter. Its vertical extent remains unknown. When leaving the Zawałowa Chamber, tourists pass by the statue of St. Barbara, the patron saint of miners. Further, the trail continues through the old gunpowder storage chamber to the Niska Chamber (area of 2,000 m² but only 1 m high) and then to the Szczęść Boże Shaft station, which is preserved in its original condition. Nearby, is the flooded part of the adit, with the wharf where tourists board the boats and go to the next wharf located close to the station of the ventilation Żmija Shaft. This waterway is 270 m long and the water depth is 80 cm. From there, visitors walk back to the Anioł Shaft station and are taken to the surface in the cage/lift (Wycizak & Moszny, 2003) (Fig. 2A).

The Czarny Pstrąg Adit, also “underground Venice”, is a unique mining heritage monument in Poland, as it offers a 600-m-long underground boat cruise, along a small fragment of the 19th-century Kopalnia Fryderyk Deep Adit of total length 4,568 m (Dzięgiel, 2008). The adit provided gravitational drainage of mine waters to the surface. Its construction started in 1821 and was completed in 1834. Currently, the adit belongs to the natural scenic area named the Repty Park and the Drama River Valley. Formerly, it was located in the park surrounding the palace of the Donnersmarck family, destroyed after World War II. The adit is accessible from both the Ewa and the Sylwester shafts. The adit mouth is decorated with the neoclassical portal carved in limestone. Tourists enter the trail by walking down the spiral staircase within the shaft and then to the underground wharfs located close to the Ewa and Sylwester shaft stations. They board boats and sail a 600-m-long segment of the adit in a mysterious atmosphere of flickering carbide lamps (Fig. 3A, B). While hand paddling the boats, the guides tell the history of silver ore mining in Tarnowskie Góry and the mine legends. The visitors can observe the audit walls, in which vertical grooves are visible. These are the relics of hand-drilled blast-holes. The 20-m-deep Ewa Shaft and the similar Sylwester Shaft (30 m deep) belong to the system of 26 shafts sunk for

ventilation and hoist along the Kopalnia Fryderyk Deep Adit during its operation. The adit is from 1.20 m to 2.50 m wide and from 2.20 m to 2.50 m high (locally, up to 4.00 m). Water depth varies from 0.70 m to 1.00 m (Piernikarczyk, 2003; Dzięgiel, 2020). A trail is available for groups and individual tourists, but only with the assistance of professional guides who speak foreign languages including English, German, French, Spanish or Russian.

The organization of visits to underground tourist trails is in the responsibility of the Stowarzyszenie Miłośników Ziemi Tarnogórskiej (Association of Tarnowskie Góry Land Lovers). Only visits to developed tourist trails are available. In the past, specialized tours were organized for scientists, explorers and/or speleologists. However, since the underground trails have been subjected to the Geological and Mining Law, such activities have become impossible. It must be emphasized that not all accessible underground objects are available for tourists, due to poor preservation conditions and resulting safety hazards.

Surface tourist trails presenting the mining heritage

In the Tarnowskie Góry region, several surface tourist trails run through the objects of mining heritage, as for example, the Miners' Trail. It starts in Repty Śląskie village and continues for 27 km, to Kolonia Woźnicka village, through Stare Tarnowice, Tarnowskie Góry, Lasowice and Chechło, which are the sites of historical silver ore mining operations. The northeastern segment of the trail runs through vast forests, in which two mining heritage objects are located: the flooded Bibiela iron ore mine and the zinc, lead and silver ore mine named "Floras' Luck".

Another tourist attraction is the Trail of Nature Lovers. The trailhead is located in the Municipal Park of Tarnowskie Góry, which was developed at the site of the mining waste dumps left after the submergence of the small shafts. Close to Kunszt Park, which covers the original site of the Kopalnia Fryderyk, the historical Fryderyk Mound is erected near the Rudolfinia (Rudolphine) Shaft on the occasion of the 100th anniversary of the founding of the mine. Recently, this area has become covered by valued calamine grasslands, inhabited by special plants resistant to high concentrations of heavy metals in the soil (particularly zinc and lead). The remnants of shafts are easily recognized by their characteristic rounded dumps and shallow depressions, up to 10 m in diameter.

The Zabytkowa Kopalnia Srebra is included into the Industrial Monuments Route of the Silesian Voivodeship, together with other mining heritage sites in Tarnowskie Góry including: the ore washery dump, the Segiet Nature Reserve on the Srebrna Góra, the Staszic and Maszynowy (Machine) shafts, mining landscape of the 19th century, the Czarny

Pstrąg Adit and the Fryderyk Deep Adit with its portal and ditch, as well as the Blachówka Dolomite Quarry, where unique geological features can be examined, with Triassic sediments found on the Devonian and Permian layers.

The Segiet Educational Forest Trail runs through the mining heritage areas in Tarnowskie Góry and Bytom. It includes the post-mining landscape of the Srebrna Góra and the Nature 2000 area. The trailhead is located in the suburb of Bytom town, at the entrance to the Segiet Nature Reserve. Afterwards, the trail runs through a 150-years-old beech forest covering the old post-mining landscape, transformed again in the industrialization epoch of 18th–19th centuries, during the extraction of lead, silver and zinc ores. The mouth of one of the galleries belonging to the old Kopalnia Srebra Fryderyk is located in the area of the Blachówka Dolomite Quarry. Recently, that gallery has become a bat hibernation shelter (UNESCO World Heritage Nomination, Poland, 2016).

Accessibility of tourism attractions of the Zabytkowa Kopalnia Srebra

Evaluation of accessibility of the Zabytkowa Kopalnia Srebra includes four criteria (Tab. 1):

1. physical accessibility – an equal opportunity to enter an object and to circulate within it for an average tourist;
2. information accessibility – includes the proper marking of the object in the terrain and its relevant description on site, and in any information sources, particularly, the Internet;
3. intellectual and sensory accessibility – access for visitors with all kinds of disabilities;
4. ownership accessibility – concerns mainly the objects located on private lands, access to which is forbidden or limited for example by fences.

Based upon the data presented in Table 1, facilities of the Zabytkowa Kopalnia Srebra can be ascribed into three categories of accessibility: I – accessible object; II – limited accessibility; III – inaccessible object. The category "accessible objects" indicates these facilities which meet all four criteria specified in Table 1.

Further development of objects belonging to the Kopalnia Srebra Fryderyk is a prerequisite for recognition of it as a distinguished tourism space. However, both the physical and/or the intellectual/sensory accessibility of these objects can become limited or even terminated due to e.g. mine safety measures or conservation requirements for historical monuments. That is why the removal of accessibility barriers may sometimes be undesirable.

Table 1. Accessibility of tourist objects, Kopalnia Srebra Fryderyk added to the UNESCO World Heritage List, depending on the criteria (www2)

Number of the object (see Fig. 1)	Name of the object	Geographic coordinates	Physical accessibility	Information accessibility	Intellectual and sensory accessibility	Ownership accessibility	Category of accessibility
0.1	Underground workings of the Zabytkowa Kopalnia Srebra (Historical Silver Mine)	50°42'54.9"N 18°84'94.1"E	+	+	+	+	I
1.0	Fryderyk (Friedrich) Mine Deep Adit	–	+	+	–	+	II
1.1	Pokój (Peace) Shaft	50°41'41.2"N 18°85'77.8"E	–	–	–	–	III
1.2	Bohr Shaft	50°41'85.2"N 18°85'06.4"E	+	–	–	–	II
1.3	Staszic (Adolph) and Maszynowy (Machine) Shafts	50°42'11.5"N 18°84'26.7"E 50°42'10.3"N 18°84'23.7"E	–	+	–	–	III
1.4	Pomóc Szczęściu (Help Happiness) Shaft	50°42'14.7"N 18°83'05.5"E	–	+	–	+	II
1.5	Maszynowy (Adit Engine) Shaft No. 22	50°42'18.7"N 18°81'82.2"E	–	–	–	–	III
1.6	Sylwester (Sylvester) Adit Shaft	50°42'69.0"N 18°80'72.1"E	+	+	–	+	II
1.7	Ewa (Eve) Adit Shaft	50°42'99.5"N 18°79'99.4"E	+	+	–	+	II
1.8	Adam Adit Shaft	50°42'98.0"N 18°78'88.4"E	–	–	–	+	II
1.9	Portal of Fryderyk (Friedrich) Mine Adit	50°42'95.3"N 18°78'18.1"E	+	+	–	+	II
1.10	Fryderyk (Friedrich) Mine Adit Ditch	50°42'95.3"N 18°78'18.1"E	+	+	–	–	II
2.0	Boże Wspomóż (God Help) Adit	–	–	–	–	+	II
2.1	Anioł (Angel) Shaft	50°42'55.7"N 18°84'97.6"E	+	+	+	+	I
2.2	Żmija (Viper) Shaft	50°42'50.8"N 18°84'58.6"E	+	+	–	+	II
2.3	Szczęście Boże (God Bless) Shaft	50°42'81.6"N 18°84'50.9"E	+	+	–	–	II
2.4	Heinitz Shaft	50°42'69.8"N 18°85'65.7"E	–	–	–	–	III
2.5	Reden Shaft	50°43'32.7"N 18°84'81.8"E	–	–	–	–	III

Table 1 cont.

Number of the object (see Fig. 1)	Name of the object	Geographic coordinates	Physical accessibility	Information accessibility	Intellectual and sensory accessibility	Ownership accessibility	Category of accessibility
2.6	Kaehler Shaft	50°45'08.8"N 18°84'46.2"E	–	+	–	+	II
2.7	Fryderyka (Frederica) Shaft	50°45'21.3"N 18°84'22.7"E	–	–	–	–	III
2.8	Portal of Boże Wspomóż (God Help) Adit	50°47'01.8"N 18°81'16.0"E	+	+	–	+	II
2.9	Boże Wspomóż (God Help) Adit Ditch	50°47'01.8"N 18°81'16.0"E	+	+	–	+	II
3.1	Staszic (Adolph) Shaft Waterworks	50°42'13.2"N 18°84'29.5"E	–	+	–	–	II
3.2	Post-mining landscape from 19th century	50°42'07.3"N 18°83'94.6"E	+	–	–	–	II
3.3	Post-mining landscape of Srebrna Góra (Silver Mountain)	50°40'92.6"N 18°84'67.0"E	+	+	+	+	I
3.4	Fryderyk (Friedrich) Mine Washing Tip	50°41'58.4"N 18°85'47.5"E	+	+	–	+	II
3.5	Original site of Fryderyk (Friedrich) Mine	50°42'69.9"N 18°86'00.1"E	+	+	+	+	I
3.6	Municipal Park	50°44'05.8"N 18°84'15.3"E	+	+	+	+	I

I – accessible object; II – limited accessibility; III – inaccessible object

Summary

The beginning of mining tourism is not very distant in time, as it took place shortly after the closure of industrial plants (including mines), in many European industrial centers. Initially, the number of visitors was rather limited to small groups of special-interest tourists. However, the increasing cultural awareness of citizens resulted in protection and revitalization of post-mining facilities, which, in turn, led to the creation of a tourism product. Mining tourism is a branch of general tourism, which promotes objects and areas of unique cognitive, educational and historical values. Moreover, it is a part of geotourism, due to its links to the resources of the Earth.

The Kopalnia Srebra Fryderyk in Tarnowskie Góry together with its exceptional system of groundwater management is a perfect example of successful development of geotourism attractions. A vast post-mining area (about 50 km²), together with about 150-km-long system of various types of underground workings, being the remnants of the old Kopalnia Srebra Fryderyk is a unique example of preservation of historical industrial objects. Tourism development of these treasures was an initiative of a small group of local enthusiasts who aimed to protect and preserve the mining heritage for future generations. Protection included properly exposed mine workings, some elements of geological structure (craters and hollows) at depths, karst features, as well as partly original, partly reconstructed mining equipment used for winning and haulage of the ore.

The Kopalnia Srebra Fryderyk was opened to the public September 5th, 1976. Its exceptional tourism potential was strengthened by being recognized in the UNESCO List of World Heritage on July 9, 2017. This entry on the list increased its attractiveness and resulted in great interest among tourists, not only those already engaged in cultural tourism, but also those who unexpectedly learned about the existence of world-class mining heritage objects.

Further development of future facilities of the Kopalnia Srebra Fryderyk is necessary, in order to preserve their

unique values. Obviously, not all underground workings have been included into the tourist trail, due to their preservation conditions, accessibility and mine safety measures. Additionally, there exist several surface thematic and hiking trails running through the old mining area in Tarnowskie Góry, which contribute to the promotion and progress of mining tourism related to exploitation of silver ores. Development of the Kopalnia Srebra Fryderyk in Tarnowskie Góry has become a perfect example of the growth of mining tourism on regional, national and international scales.

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