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New Geo- and Mining Heritage-Based Tourist Destinations in the Sudetes (SW Poland)—Towards More Effective Resilience of Local Communities

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Abstract: This paper explores several geotourist destinations in the mountainous area of SW Poland, either recently created or being developed right now, where the unifying theme is the emergence of a new site of interest in a place formerly inaccessible due to mining operations. We focus on five sites, including three in the territory of Land of the Extinct Volcanoes UNESCO Global Geopark, connected with the legacy of mining (coal, ores) and quarrying (solid rock, aggregates). For each locality, the history of mining is briefly outlined, followed by the presentation of its conversion into a tourist object and current use. The localities illustrate, at the same time, (a) various aspects of geoheritage and its connection with human activities, thus in line with the ABC concept promoted for geoparks and similar initiatives; (b) attempts to alleviate problems of abandoned mining grounds and their management; (c) different ways towards conversion of formerly inaccessible localities into tourist destinations; (d) ideas to increase the portfolio of (geo)tourist products at the regional scale, striving to achieve greater balance in the geographical distribution of sites of potential interest; and (e) a variety of current management challenges. Overall, it is argued that in each case, the emergence of a new site of interest is beneficial for the local community, as the visibility of the place is increasing, tourist visits grow, local identity is strengthened, and new employment opportunities arise, both directly and indirectly.

Keywords: geoheritage; sustainable tourism; geoeducation; adaptive reuse; resilience; Land of Extinct Volcanoes UNESCO Global Geopark

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1. Introduction

Geotourism is variously defined in the literature, but the term was coined to emphasize the specific interest of tourists in places and features which constitute Earth heritage, or geoheritage [1,2]. Geoheritage, in turn, includes geological, geomorphological, mineralogical, and soil features, as well as the record of past life (paleontological record), but in the practical context of both tourism and geoconservation, the term is extended to encompass various aspects of human activities, among which exploitation and use of mineral resources play a major role (e.g., [3–6]; for review see [7]). The concept of geotourism development in areas of particularly significant value of geoheritage and high geodiversity, especially within geoparks, links with the model of sustainable tourism [8], which in turn directly stems from the concept of sustainable development [9–11]. This general idea is based on three pillars: economic, environmental, and social. Sustainable development is a holistic approach, within which a balance between economic growth, environmental conservation, and benefits for local communities is sought [12,13].

The phrase "sustainable tourism" gained in popularity in the 1990s, but there is no one universally agreed-upon definition [11,14]. According to the World Tourism Organization (UNWTO) [15], the following requirements should be met for sustainable tourism:

(a) optimal use of natural resources; (b) respect to the sociocultural identity of the region where it takes place; and (c) economic and social benefits to all stakeholders involved in its development. In the documents of UNWTO [15–17] it was emphasized that a complex approach is needed if the development of sustainable tourism is analyzed. It should not be restricted to environmental issues, as economic and social aspects are equally important [14,18]. Local associations, self-governments, broadly defined tourism businesses, and responsible tourists should be among the main actors engaged in the formulation of the strategy for sustainable tourism for any area. Geotourism that is developed with due respect to sustainability principles is capable of stimulating regional growth, generating new work positions, and bringing additional revenues for local inhabitants but also contributes to the maintenance of local traditions and local identity [19,20].

More recently, several researchers emphasized that the concept of sustainable development is highly idealistic [12,21] and the long-term goals are difficult to achieve if sudden changes, crises, and natural disasters occur, and these may indeed be very common in some parts of the world. The proper response to these challenges is offered by the concept of "resilience development", defined as the ability of systems, communities, and infrastructures to regain their inherent characteristics after being subject to disturbance and cataclysmic events [22,23]. At the core of this concept is the provision of persistent sustainable development even in the face of changing external conditions and unexpected events such as natural disasters, changes in the business cycle, economic crisis, climatic changes, or pandemics. Hence, the concept of "resilient development" is not in opposition to the idea of sustainable development but is closely related to it. However, the emphasis is on flexibility and adaptations to change [24–26]. Both concepts are complementary and are aimed at sustained economic growth based on local natural and cultural resources, as well as on local human capital [27]. Actually, the concept of resilience as an ability to adapt to change is not new but emerges from environmental studies and is linked with the name of the Canadian ecologist Crawford Stanley Holling [28]. It soon found its application in other disciplines such as psychology, economy, and sociology and has enjoyed considerable popularity in recent years, typified by extremely fast changes and the growing feeling of an uncertain future.

The concept of "resilience development" is directly applicable to tourism [29]. Resilience in tourism means the ability of tourism destinations, businesses, and local communities to cope with adverse external conditions of whatever origin and to return to the equilibrium state after disturbance [21,30]. In this context, geotourism as one of the manifestations of sustainable tourism [8] may have a special role to play. Being closely associated with the history of human use of natural resources, it may help to redevelop problematic areas, where the termination of mining and mineral processing, with inevitable closure of many industrial operations, means the loss of the economic fundament of local development. This termination may have various reasons such as exhaustion of resources, reduced demand due to technological evolution, competition on the global market, or environmental issues.

Moreover, abandoned mines and quarries, degraded environment, and a high level of unemployment with all related social problems create a negative image of a place (region) as a postindustrial wasteland, hardly appealing to casual tourists. New geotourist attractions, developed in places of previous mineral exploitation and causally linked to them, may alter this perception and act as catalysts of tourism. In line with the principles of sustainable tourism, they offer a good background to develop educational and interpretation programs, which would emphasize the value of geoheritage. Their development also requires human resources, local awareness of geocultural values—not necessarily appreciated before—and new social skills appreciated by tourists; hence, the impact on the development of local human capital is expected to be positive.

This paper aims to address these general issues using several examples from the Sudetes Mountains in SW Poland, an area once widely known for its mining-based economy. It explores a few dissimilar cases of geotourist products (destinations), either recently

created or being currently developed. The unifying theme is an emergence of a new site of interest in a place formerly inaccessible due to mining, accompanied by new tourist provisions in the vicinity. Thus, these localities illustrate, at the same time, (a) various aspects of geoheritage and its connection with human activities, thus in line with the ABC concept promoted for geoparks and similar initiatives [31]; (b) attempts to alleviate problems of abandoned mining grounds and their management; (c) different ways towards conversion of formerly inaccessible localities into tourist destinations; (d) ideas to increase the portfolio of geotourist products at the regional scale, striving to achieve a greater balance in the geographical distribution of sites of potential interest; and (e) a variety of current management challenges. The localities are as follows: (1) the former hard coal underground mine in Wałbrzych; (2) galleries of ancient ore mines in Krobica and adjacent surface remnants; (3) quarries and sand pits in Czaple; (4) a recently closed basalt quarry at Mt. Wilkołak near Złotoryja; and (5) limestone quarries around the town of Wojcieszów. The latter three are located within the territory of the recently (2024) approved Land of Extinct Volcanoes UNESCO Global Geopark (UGGp) (Figure 1).

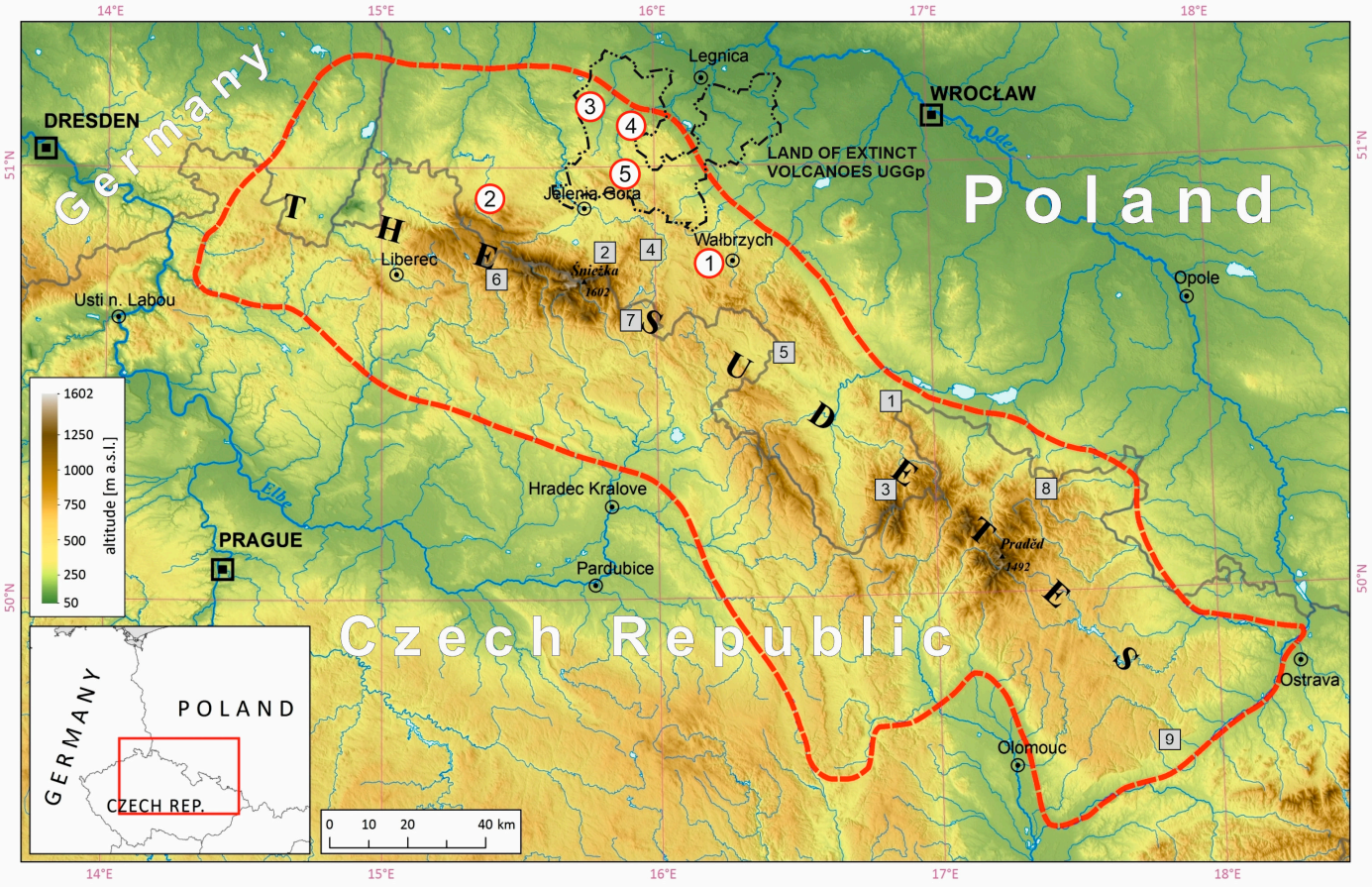

Figure 1. Location map. Red line shows the approximate extent of the Sudetes. Circles—localities presented in this paper: 1—Stara Kopalnia, Wałbrzych; 2—Krobica; 3—Czaple; 4—Mt. Wilkołak; 5—Wojcieszów. Squares—other selected localities of mining heritage in the Sudetes: 1—Złoty Stok; 2—Kowary; 3—Kletno; 4—"Colorful Lakes"; 5—Nowa Ruda; 6—Harrachov; 7—Žacléř; 8—Zlaté Hory; 9—Odry (base map courtesy of Kacper Jancewicz).

Consequently, we intend to address several research questions, with an overarching one asking whether the activities undertaken at these localities are consistent with the principles of sustainable development in tourism and contribute to enhanced resilience at the local scale. More specifically, we examine the following aspects:

- What are common and specific challenges these localities have been facing since the conversion for tourist use was considered and may face in the future?
- What was the role of particular stakeholders in the development of these localities?
- Are the local developments parts of wider regional strategies, and how can the impact possibly be enhanced?
- How are interpretative and educational programs built while developing geo- and mining heritage for tourism?
- Do the sites really contribute to sustainable tourism at the local level or is it too early to provide an answer?

2. Approach, Materials, and Methods

This paper is based on the examination of five localities (case studies), selected to illustrate the diversity of both geo- and mining heritage, from underground mines through open-cast rock and aggregate quarries to surface industrial facilities, as well as different stages and approaches to convert the former mining ground into tourist products. We argue that they all are being developed in line with sustainable practices and help to increase the resilience of local economies. The list does not exhaust the potential of the region and is by no means complete. Several other localities with significant mining heritage have been successfully developed into geotourist products in the last two–three decades, such as the old gold mine in Złoty Stok [32–36], galleries of the former uranium ore mine in Kowary [37], fluorite adit in Kletno [38], "Colorful Lakes"—flooded pits left after pyrite exploitation [37,39], hard coal mine in Nowa Ruda, and various quarries in the Przedgórze Sudeckie local geopark [40]. Analogous cases can be provided from Czechia, across the border (Figure 1).

The approach to the problem is similar to the multiple case study method, widely used in the social sciences, especially in management studies, economics, and interdisciplinary research of a qualitative nature [41–43]. It involves the development of a concept, selection of case studies, data collection at each study site, comparative analysis, and generalization. The multiple case study method allows for the identification of common features and unique aspects of individual cases. The use of different data sources (documents, observations, interviews) increases the credibility and comprehensiveness of the study. This method can facilitate a better understanding of the context in which the phenomena under study occur. In the context of tourism, social, economic, and cultural factors play a key role. Therefore, this research method can be employed to study various forms of tourism, the development of which is of particular importance for the advancement of a specific area [44–46]. Among the envisaged benefits of the method is the possibility to obtain results of significant practical use, important for managers at different hierarchical and territorial levels, from the specific sites of interest to municipalities, regions, and organizations (e.g., geoparks in our case).

Following the requirements set for case studies, each site presented in this paper was visited by us, some many times over the last 10 years or so, which allowed us to trace their development and how emerging problems were addressed. Photographic documentation was collected and inventories of tourist provisions and interpretative facilities were performed and updated, facilitating comparison between localities. Historical materials and the relevant literature were consulted to reconstruct the history of each locality, especially for the transitional period towards the opening to the public. We also received opinions of local people involved in geotourism development, especially in the Land of Extinct Volcanoes UGGp, where three out of the five case study sites are located. The content of social media relevant to the localities was also examined.

3. Results

3.1. Regional Context

3.1.1. The Sudetes as a Tourist Destination

The Sudetes are a medium-high mountain range, which is about 300 km long, up to 80 km wide, and straddles the Polish/Czech border. Altitudes reach 1603 m a.s.l., but the majority of the area is located at much lower elevations, between 400 and 800 m a.s.l., and shows moderate relief, which allowed for significant expansion of settlement patterns and the development of agricultural activities, in addition to forestry and mining. The Sudetes as a whole (i.e., including the Czech and German parts—see Figure 1) are among the most popular tourist regions in Central Europe [47]. This is primarily consequent to the wide range of assets, rooted in both characteristics of the natural environment and human cultural history, whose material legacy can be traced back to prehistory. In addition, the central position of the region, including the proximity of major urban centers (Prague, Wrocław), and an efficient communication network allow for easy access to most parts of the mountain terrain. Thus, the Sudetes host various natural landscapes and impressive sceneries, including high plateaus and former glacial cirques of the Karkonosze, numerous sandstone rock cities and rock labyrinths, mountain ridges dotted with picturesque crags, deeply incised valleys, and karstic caves [48]. Outstanding values of the natural world, from geology to flora and fauna, led to the establishment of three national parks (two in Poland, one in Czechia), more than ten landscape parks, and many tens of nature reserves. They can be visited owing to the good network of waymarked trails, and the region is consistently very popular among hikers, with the history of nature-based tourism going back to the 18th century [49]. The rich and multicultural human history of the Sudetes has resulted in a variety of objects of interest, including medieval towns [50], castles and palaces (or their ruins) [51], pilgrimage centers [52], picturesque examples of traditional rural architecture [53], old mines (see Section 2), military remnants from different periods of warfare not excluding World War II [54,55], and industrial heritage [56]. Thanks to natural conditions, ongoing climate warming notwithstanding, the region is still a popular winter tourism destination, with many ski resorts scattered across its specific parts [57]. Moreover, the dense population of adjacent areas coupled with good access make the Sudetes an ideal destination for day trips and weekend (short) breaks.

However, within an overall very high frequency of tourist visits, there are significant disparities within the region. The Karkonosze National Park is visited by a few million people annually [58,59], and the respective number for the Stołowe Mountains National Park is over one million [60], whereas other subregions, especially at lower elevations, receive much less incoming tourism. Reasons for disparities are complex and significantly rooted in the history of tourism, but certainly limited tourism promotion of specific parts of the Sudetes is a factor. In recent years, numerous attempts to overcome these disparities have been observed. Among them is the development of geotourism and geoparks, using geoheritage and mining heritage as fundamental resources [56]. As of 2024, there is one UNESCO Global Geopark in the Polish part of the Sudetes and two national geoparks in Czechia, and other initiatives are underway. The case studies examined below are parts of these attempts.

3.1.2. Mining History

In the Sudetes, the abundance of mineral resources supported mining industry for centuries [61]. Rock formations ranging in age from the Precambrian to the Quaternary occur in the region and are very diverse in terms of lithology [62]. Therefore, different resources could have been mined in different times and periods, depending on availability until exhaustion and demand [61,63]. Gold prospecting heralded the mining history of the region, followed by exploitation of polymetallic ores (copper, iron, lead, tin) in late medieval and early modern times, peaking in the 16th century. After that, many ore mining areas lost significance, although locally, copper ores were exploited until the 1970s. In the 19th and 20th centuries, coal mining from rock strata of the Carboniferous age was an important

component of the regional economy, with the large city of Wałbrzych (formerly Waldenburg) developed as the industrial center of the region. Coal mining terminated in the 1990s, and most of the industrial facilities were dismantled (see Section 3.2 for further details). In parallel, stone extraction has been developed since medieval times for both local purposes and export further afield. Granites, sandstones, basalts, and limestones were extensively quarried [63], whereas in the least elevated parts of the Sudetes, sand and gravel deposits occur, and these were mined as aggregates. Quarrying and aggregate mining occur until today, with some old quarries recently reopened in response to demand, although there is also growing pressure to reduce this activity for environmental reasons. It is also argued that active quarries have negative impact on tourism, including visual deterioration of the landscape, dust, and noise pollution. This is important given that tourism is considered the main branch of the contemporary regional economy, with perspectives for further growth in the future.

3.2. Case Study 1—Stara Kopalnia ("Old Mine") in Wałbrzych

3.2.1. Location and Mining History

Stara Kopalnia is located in the city of Wałbrzych, central to the region in the Middle Sudetes (Figure 1), where the economy was long based on hard coal mining and related industries. The coal mining history goes back 500 years or so, as the oldest document to mention a coal mine dates to 1561 [64]. The number of mines steadily grew in the 17th and 18th centuries, but massive industrial development occurred in the mid-19th century. Besides coal mining, other industries thrived, including coking, metal, textile, and ceramic production. In 1853, the area was reached by a railway, which catalyzed further growth [65]. In the first half of the 20th century, the entire region was heavily industrialized, and this continued after World War II, notwithstanding a new political situation, border changes, and massive population exchange, with the German population replaced by the Polish one. The area became part of Poland and has remained like that since. The industry did not suffer war damage, nearly all infrastructure survived, and mining was immediately resumed, as were other related industrial activities [66]. The city of Wałbrzych became one of the main industrial centers in southwest Poland. However, the geological conditions of coal mining were difficult and exploitation challenging, technologies were outdated, demand declined, and hence, profitability was limited [67,68]. However, in order not to create social tension and to keep employment, coal mining continued until political and socioeconomic change in Poland commenced in 1989.

The ensuing economic crisis, associated with the transition from state-controlled to free-market economy, affected the mining and textile industries in particular, including Wałbrzych. In the mid-1990s, a decision was made to terminate coal mining and to close all existing mines as unprofitable, even though this caused the massive growth of unemployment, reaching a maximum of 28.1% in 2002 [67]. The decline of industry, coupled with severe environmental issues related to land degradation and soil, water, and air pollution, resulted in an extremely difficult economic situation of the city and its vicinity. Among timely questions raised were those addressing the fate of disused postmining and postindustrial infrastructure and directions of land rehabilitation [69].

3.2.2. Development for Tourism and Current Use

Concurrent with the closure of coal mines, in the early 1990s, an idea to preserve at least part of the city's industrial heritage was born. To this end, a plan was drawn to establish a Museum of Industry and Technology on the grounds of the "Julia" mine (previously named "Fuchs" and "Thorez"), which was the largest and most impressive complex of mining infrastructure. The museum was officially launched in March 1993 as a branch of the Regional Museum in Wałbrzych [64]. Among its purposes were the conservation of surface and underground industrial objects of heritage value, education about regional mining traditions, and technological developments. However, equally important was to use the preserved historical mine complex as a new open public space,

which could host various activities and events. Following this evolution of ideas, going beyond traditional functions of a museum, the city council approved a new, independent institution in 2008, namely, the Old Mine Multicultural Park (Polish "Park Wielokulturowy Stara Kopalnia") [64].

The first phase of conservation and adaptation works was completed in 2014, and on 9 November 2014 the Old Mine Centre of Science and Art was opened in the premises of the previous "Julia" mine [70] (Figure 2a). It is multifunctional and includes a number of separate facilities, such as (a) the Museum of Industry and Technology, focused on coal mining history; (b) a modern art gallery; (c) a center of unique ceramics, also emphasizing one of the leading industries in Wałbrzych; (d) an auditorium, where concerts, performances, and conferences are organized; (e) and the SOWA discovery center for children. The complex also hosts several cultural institutions and a folklore ensemble which sustains local mining, folk, and patriotic traditions. Accommodation and catering facilities are present. The entire complex occupies 4.5 ha. In 2015, Stara Kopalnia was included into the European Route of Industrial Heritage (ERIH).

Figure 2. Stara Kopalnia (Old Mine) in Wałbrzych. (**a**) General view of the postindustrial area after rehabilitation, in adaptive use as a tourist site and education and cultural center; (**b**) part of indoor tourist route—former machinery room; (**c**) underground transportation tunnel; (**d**) outdoor geological exhibition and model of the coal-bearing Wałbrzych Basin (photos by P. Migoń).

The Museum of Industry and Technology (Figure 2b,c), which is the core of the whole complex, includes, among others, a bathhouse, a lamp room, a boiler house, a mechanical workshop, machinery buildings, head frames, shaft towers, an underground tunnel towards the dumping site, and the complete technological line of mechanical coal processing, which consists of a sorting plant, washing plant, and flotation plant. A new observation tower was built, allowing visitors to see the entire mine complex and its wider surroundings. In addition to the mining machinery, further items on display include various mining memorabilia, audio and video recordings, and archival documents. The museum also has

archaeological and geological divisions, the latter moved from the Regional Museum after a change in its profile towards the history of ceramics. Apart from rock and fossil collections, there is an outdoor exhibition with interpretation panels explaining the geological history and the origin of coal-bearing strata, and a model of the geological Wałbrzych Basin (Figure 2d).

The museum can only be visited with a guide. The guides, as well many other people employed in Stara Kopalnia, are former employees of the mines, including the miners themselves. English- and German-speaking guides are available, and audio guides in different languages were prepared. The visit helps the visitors to understand both the geological history and the history of the coal-based industry, as well as to appreciate the challenges of the work of the miners. Besides regular sightseeing, the educational offerings of the museum include workshops, school lessons, educational games, and participation in a miners' feast, with traditional music and food [71].

3.3. Case Study 2—Krobica

3.3.1. Location and Mining History

The village of Krobica is located in the West Sudetes, at the foot of the prominent mountain massif of the Izerskie Mountains, c. 5 km away from one of the most popular summer and winter holiday resorts in SW Poland, also a spa town, Świeradów-Zdrój. Geologically, it is located within a narrow (~2 km) belt of schist rocks of the Late Proterozoic age, long known for polymetallic mineralization, particularly tin [63]. The history of tin mining in Krobica and adjacent villages of Gierczyn and Przecznica, along a 6 km long schist belt, goes back to the 16th century and reached its peak at the turn of the 17th century [72]. The St. Johannes mine, whose underground remnants are now open to the public, was founded at that time, as were many other mining shafts in the vicinity. Mining operations were suspended in the first half of the 17th century (Thirty Years War) but resumed later, albeit at a smaller scale. In the 18th century, a new gallery named St. Leopold was excavated close to the St. Johannes mine, aimed at the exploitation of cobalt ores. Immediately after World War II, a new phase of geological prospecting, this time aimed at uranium ores, occurred, but the results were not promising and industrial mining did not commence [73]. Likewise, further geological reconnaissance works in the 1970s–1990s led to the conclusion that resumption of tin mining would not be profitable and the villages did not turn back into mining settlements.

3.3.2. Development for Tourism and Current Use

Ideas on how to use remnants of ancient mining to support local tourism development emerged in the early 21st century as a side effect of research carried out by specialists in ancient mining [72,73]. They were implemented in 2010–2013, with the support of the local government of Mirsk municipality, using various external funding sources. The project consisted of two components: (1) an underground part in the galleries of the St. Johannes and St. Leopold mines; and (2) a surface educational trail which would link preserved remnants of mining between the three villages mentioned above (Figure 3).

Adaptation of the mine for tourism involved considerable mining engineering work, including the building of a staircase to connect two different levels of galleries (Figure 3a,b). The underground route was opened in autumn 2013, and the place is known as "Kopalnia Św. Jana" (St. Johannes Mine). The underground route is relatively short, c. 350 m, but shows a very valuable object of ancient mining, as the original shape of galleries excavated 200–400 years ago is essentially unchanged [74] (Figure 3c). The exhibition in the entrance room focuses on techniques of tin extraction and history of local mining. The adit walls expose local schists in different variants, as well as garnet concentrations, large milk quartz occurrences, folds, and faults [72]. Visits to the mine are organized throughout the year and last about 50 min. Only guided tours are possible. In addition to the standard sightseeing, special offerings are available targeted at senior visitors and school groups.

Figure 3. Tourist facilities at the Krobica old ore mine and vicinity. (**a**) Entrance to the underground part; (**b**) modern staircase in the shaft connecting two mine levels; (**c**) main mine gallery; (**d**) one of sites along the surface interpretative trail connecting various remnants of mining activity; (**e**) interpretation panel on the trail, evidently designed to provide maximum information for a highly interested visitor (photos by P. Migoń).

The surface trail includes nine stops at old mining works (Figure 3d) and three panoramic viewing points. Elaborate interpretation panels were erected along the route (Figure 3e). Besides comprehensive text, visitors can also see reproduced fragments of old mining maps, drawings, and cross sections. The trail begins at St. Johannes Mine, which is the first stop, and ends in the village of Przecznica after 8 km of hiking. Thus, it is not circular, which complicates trip planning. It may be assumed that its different sections are visited separately, using private cars to move from one section to another (as public transport is nonexistent). In addition, after more than a decade since the opening of the trail, it needs renovation of the panels, signage, and some overgrown sections of the route.

3.4. Case Study 3—Czaple

3.4.1. Location and Mining History

The village of Czaple is located in the western part of the Land of Extinct Volcanoes UGGp, in the transitional area between a more hilly land to the south and a plain to the north. Altitudes are within the 250–300 m a.s.l. range, with the most elevated sandstone hill of Mt. Kopka rising to 343 m a.s.l. The most eye-catching place in the vicinity, but within an adjacent municipality, is the volcanic neck of Mt. Grodziec, which hosts the ruins of a medieval castle, one of the premier sites within the geopark. Nevertheless, considering the geodiversity of the entire UGGp, the surroundings of the village may be considered less attractive than areas farther to the south.

Exploitation of mineral resources has long occurred in Czaple and its vicinity [75]. This industrial activity focused on two types of materials: hard quartz sandstone of the Cretaceous age and unconsolidated sands and gravels of the Quaternary age (Figure 4). The latter are of glacifluvial origin and testify to the presence of the Scandinavian ice sheet in the Pleistocene [76]. Sandstone quarries are located within Mt. Kopka, and several open pits occur there, although only some are still operational and none on a large scale. However, the history of quarrying can be traced back to at least the 18th century, and it certainly flourished between the end of the 19th century and the late 20th century. In contrast to sandstone extraction, aggregate quarrying continues, and a large sand and gravel pit is located to the west of the village, occupying the total area of more than 20 ha.

Figure 4. Tourist facilities and mining grounds in and around the village of Czaple. (**a**) Information board introducing "The Village of Sand and Stone"; (**b**) rock garden—open-air exhibition of sandstone specimens; (**c**) abandoned sandstone quarry at Mt. Kopka and stop along an educational geological trail; (**d**) still operative gravel pit next to the village (photos by P. Migoń).

3.4.2. Development for Tourism and Current Use

The development of tourist infrastructure in Czaple is recent, being evidence of one among various local initiatives in the Land of Extinct Volcanoes UGGp (not yet approved by then) to highlight local attractions based on geoheritage and to increase local participation. The brand name of "The Village of Sand and Stone" was chosen as an identifier and promotional tool (Figure 4a), clearly emphasizing the link with Earth resources. The newly established tourist infrastructure in the village itself includes an open-air exhibition of different sandstone rocks from the vicinity (opened in 2014; Figure 4b), a small exhibition room, and a picnic site suitable for different outdoor activities and events, which are organized on a regular basis by the local association. The outdoor display of sandstone is also a starting point for an educational trail heading to Mt. Kopka and its quarries (Figure 4c), where interpretation panels describe different aspects of the geological history. The path was opened in 2019 as part of a larger project aimed to increase the tourist potential of the village. Another thematic trail leads to seven old stone crosses scattered in the large forest complex to the south of the village, and further interpretation panels were erected next to key geological outcrops around the village, in cooperation with the Polish Geological Institute [75].

3.5. Case Study 4—Former Basalt Quarry at Mt. Wilkołak

3.5.1. Location and Mining History

Mt. Wilkołak (367 m a.s.l.) is a distinctive hill in the vicinity of the town of Złotoryja, in the northern part of the Kaczawskie Foothills, rising above the adjacent rolling countryside by c. 100 m. It is built of basalt of the Miocene age [77] and interpreted as a lava-filled volcanic vent, exposed from the surrounding sandstone in the course of long-term denudation due to the much greater hardness of the former [78–80]. The locality is within the Land of Extinct Volcanoes UGGp and is considered as one of key geosites of the region [81].

The values of Mt. Wilkołak are multiple (scientific, scenic, recreational), but generally they are related to quarrying, which occurred within the hill since the early years of the 20th century until 2019/2020 [81,82]. Industrial activities, whose history is comprehensively presented in [81], resulted in the origin of large quarries, which admittedly altered the natural silhouette of the hill, but they also exposed striking examples of columnar thermal jointing. The scientific importance of jointed basalt outcrops was first realized in the 1950s, and a geological nature reserve was established in 1959 in the disused part of the quarry to protect the outcrop and enhance its scientific value. However, quarrying continued in other sections of the hill, revealing even more impressive jointing patterns and other geological features and formations (large sandstone xenoliths, thick pyroclastic deposits). These were, however, inaccessible to the public, and the continuing deepening and lateral expansion of the quarry generated slope stability problems and put the nature reserve at risk. At the end of the exploitation period, the depth of the quarry pit exceeded 100 m.

Strong local movement against further expansion of the quarry, which could result in the collapse of the hilltop and irreversible loss of all values of Mt. Wilkołak, and then for rehabilitation of the quarry towards recreational use and its development as a geosite coincided with large-scale quarry wall collapses in 2019 and 2020, which prompted the decision to terminate the quarrying for good [82].

3.5.2. Development for Tourism and Current Use

The first phase of rehabilitation of the quarry was completed in May 2023, and the former quarry grounds were opened to the public. Considerable investment was involved to both ensure safety of visitors and facilitate visits to the site, including educational provisions which highlight geoheritage of the locality [81] (Figure 5a,c). These facilities and provisions include the following: (a) railings and fences to clearly demarcate inaccessible parts of the quarry and to prevent approaching quarry edges; (b) grading and strengthening of access routes; (c) an observation platform in the lower part of the quarry pit (Figure 5b,d); (d) a picnic ground on an artificially levelled platform above the quarry pit, with a shelter,

tables, and benches; (e) information panels about the geology, nature, and history of the site, erected at several places; and (f) an open-air exhibition of more than 40 rock specimens from different quarries of the wider region, with relevant explanation (Figure 5). Various recreational facilities are planned next to the quarry pit, and a mountain bike track has already been finished.

Figure 5. Basalt quarry at Mt. Wilkołak. (**a**) General view of the main quarry face, including some interpretation panels; (**b**) rest place on the observation platform deep inside the quarry pit; (**c**) fragment of open-air rock exhibition; (**d**) another view of the quarry pit, with an observation platform in the front; (**e**) nature reserve on the opposite side of the hill, after vegetation clearance in late 2023 (photos by P. Migoń).

In the meantime, the nature reserve, located on the opposite side of Mt. Wilkołak, was subject to vegetation clearance in late 2023 to re-expose the geological structure (Figure 5e). This was an important action since vegetation expansion quickly conceals rock outcrops, rendering the sites invisible and unable to perform their educational role. In fact, in the past, poor management of the reserve and the lack of systematic clearance were used by the industrial lobby to argue that the reserve should be delisted and the entire hill subject to quarrying and complete dismantling. However, currently, no interpretative provisions exist in the reserve and a common interpretation program for the entire hill is lacking.

Even though Mt. Wilkołak has just been opened to the public and is still a "work in progress", it has certainly become a key geoheritage site in the region, and within the Land of Extinct Volcanoes UGGp specifically [81]. The locality is owned and managed by the municipality, with the reserve being supervised by the Regional Directorate of

Environmental Protection. Thus, the current maintenance and further development are among the responsibilities of the municipality, with advice from the Land of Extinct Volcanoes UGGp. At the moment, the site does not generate any jobs directly, but there are plans to convert the former quarry administration building into an information point and a modest visitor center. However, indirect effects are also anticipated as the place is becoming more and more known and promoted also outside the region, which is likely to attract more visitors, including guided tours by certified geopark guides. Various events are also planned in the recreational part of the former quarry, and these will certainly raise the visibility of the site.

3.6. Case Study 5—Wojcieszów

3.6.1. Location and Mining History

The town of Wojcieszów, also located within the territory of the Land of Extinct Volcanoes UGGp, has long based its economic development on limestone quarrying, being surrounded by hills made of limestone of the Cambrian age [83]. Limestone occurrences are rare in the Sudetes in general; hence, quarrying was widespread, and essentially, each larger outcrop was subject to industrial activity. Although the beginnings of limestone exploitation date back to the 16th century, quarrying on a large scale began in the late 19th century in several different localities simultaneously (Figure 6) [84]. Some processing also took place locally, and hence, lime kilns were built next to the quarries. Some quarries were closed in the 1970s–1980s, followed by closures of others after economic transformation in the 1990s, so that only one quarry at Mt. Połom is still in operation and is the main employer in the town, providing around 70 work positions. However, disregarding the early 20th century boom in lime processing, more than 1500 people were employed in mining-related enterprises at the beginning of the 1970s [84].

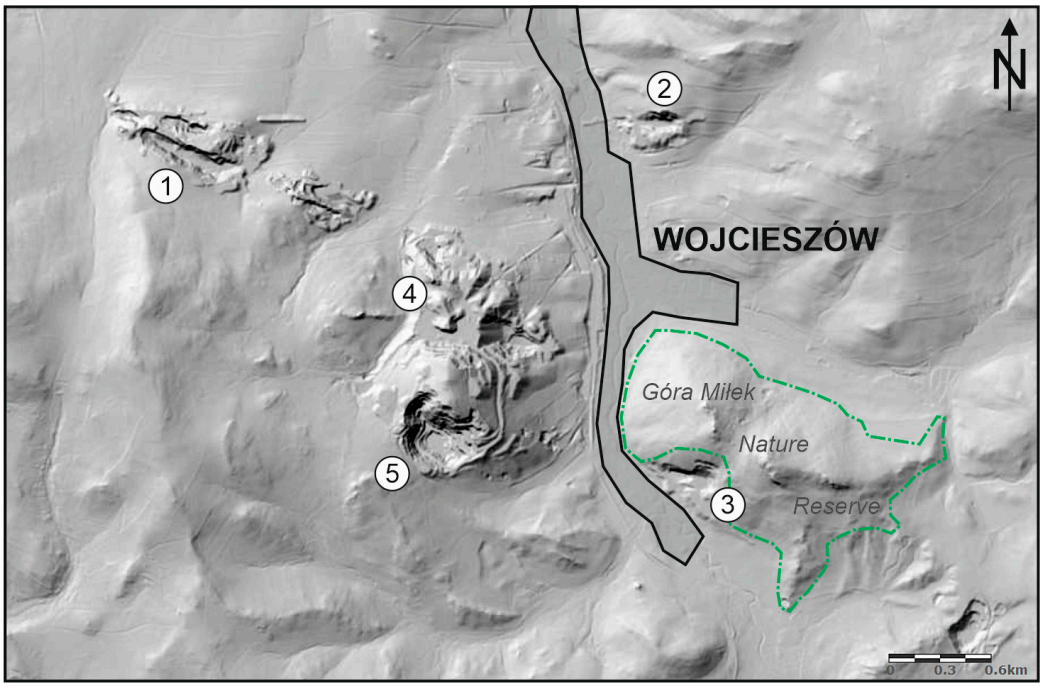

Figure 6. The occurrence of limestone quarries and spoil heaps around the town of Wojcieszów. Numbers 1–5 indicate individual quarries: 1—Silesia, 2—Gruszka, 3—Miłek, 4—Połom: Northern Quarries, 5—Połom: Southern Quarries. Only quarry no. 5 is still in operation. Source of digital terrain model: www.geoportal.gov.pl (accessed on 20 May 2024).

In terms of landscape change, Mt. Połom to the west of the town has been transformed most (Figure 7a). Its original appearance was considerably altered by excavation of two large, multilevel quarries on the northern and southern sides, respectively, the building

of transportation facilities, and the deposition of spoil heaps. Silesia quarries further to the west are a discontinuous string of deep pits along more than 1.5 km of land in total. On the east side of the town, two large quarries existed (Gruszka, Miłek; Figure 7b,c), with industrial operations terminated in both in the 1970s and 1980s. After quarry closures, some buildings and other infrastructural elements were dismantled, such as historical lime kilns, even though by contemporary standards, some can be considered as part of industrial heritage.

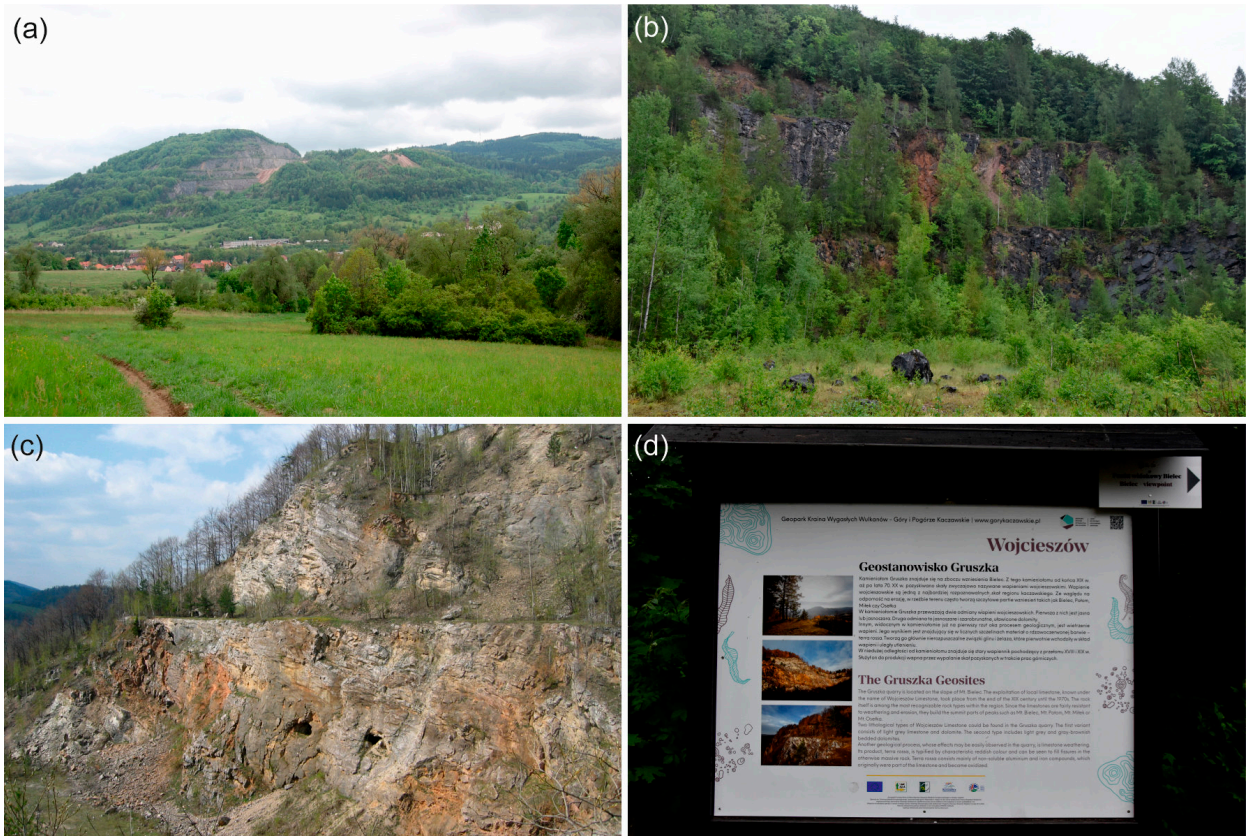

Figure 7. Limestone quarries around the town of Wojcieszów. (**a**) General view, with the disused Northern Quarries at Mt. Połom in the distance; (**b**) Miłek quarry, with vegetation encroaching on quarry walls, concealing rock structures and karst phenomena; (**c**) Gruszka quarry is developed into a geosite; (**d**) information panel at the entrance to the Gruszka quarry (photos by P. Migoń).

3.6.2. Development for Tourism, Current and Possible Future Uses

Nowadays, the town of Wojcieszów is in the transition phase between an industry-based and a tourism-based economy, the latter developed within the framework of the Land of Extinct Volcanoes UGGp. The geotouristic potential of Wojcieszów and its immediate surroundings was realized more than a decade ago [85,86], and the inventory of geosites prepared as part of the application dossier of the geopark included nearly 20 localities within the relatively small Wojcieszów municipality [87]. Besides limestone quarries, it also contained minor quarries of other rock types (phyllite, diabase), one prospective adit for uranium ores, and several natural rock outcrops (crags) built of limestones, trachytes, and greenschists. More sites of geodiversity and geoheritage interest are located in the adjacent municipalities [87]. However, this evident potential is yet to be fully utilized.

Until now, only one former quarry has been adapted for tourism. The Gruszka quarry, with its 50 m high limestone walls (Figure 7c), is used by rock climbers and cavers as a training ground, and various events related to rock climbing are organized. Access is clearly signposted, and the site has basic infrastructure for tourists. Panels at the entrance and in the quarry itself provide succinct explanations about geology (Figure 7d), whereas

more in-depth information is available as online resources [88,89]. Next to the quarry is an old, renovated lime kiln with a viewing terrace on top. The Gruszka quarry is included in a local educational circular trail which connects more than 10 sites of interest.

By contrast, the abandoned multilevel quarry at Mt. Miłek, despite a favorable location and easy access, is hardly developed and suffers from ongoing vegetation growth (Figure 7b). Another local walking trail includes the upper quarry level, but no interpretation facilities focused on geoheritage are present. In turn, impressive limestone crags along the ridge of Mt. Miłek are technically off-limits, as the hill (except the quarry) is a protected nature reserve established mainly to protect beech forest communities (Figure 6). According to the Polish Nature Conservation Law, nature reserves can only be visited using marked trails, and no trail currently goes to the summit part, even though a network exists of roads and paths inherited from the times before conservation was enforced, which could be easily adapted. Likewise, a string of deep quarries under the collective name of "Silesia", to the northwest of the town, is not officially open to the public, despite the termination of industrial activity many years ago. However, their geoeducational potential was evaluated as very high due to large exposures of different rock types and tectonic structures, the occurrence of karst phenomena, and mining heritage [87].

Mt. Połom is currently completely off-limits, being a mining area, although actual quarrying continues only in the southern part of the hill. The multilevel northern quarries are long closed and associated spoil heaps overgrown, although part of the area is still used for technical operations and storage. The current license for mining operations is valid until 2034, which might seem rather distant, but it is nevertheless worth reflecting on how the postmining areas can be used and how the geotouristic products of the town and the region can be enhanced. Specific distinctive features of Mt. Połom are karstic caves [90,91], not present in such an abundance anywhere else in the region, and although many have been irreversibly destroyed during quarry operations, some remain and may become important tourist assets. The upper rim of the quarry may be developed into a panoramic viewing point, playing a role that the forested Mt. Miłek cannot.

A recent development, thematically closely connected with the history of limestone quarrying and processing, is setting up of an exhibition room focused on local geo- and mining heritage, with rock specimens and old photographs of quarries and processing plants on display. It was opened in the town in early 2024. Common rock types from the area, shown outside the building, were supplied by the mining company, exemplifying cooperation.

4. Discussion

4.1. Postmining Sites and Geotourism—Common Themes and Site-Specific Solutions

All sites presented in this paper can be considered as local responses to several inter-related problems inherent to old mining grounds, which are no longer used by the industry. Depending on the size of the site, its characteristics (surface or underground, singular or involving a larger number of similar places), time elapsed since termination of mining, and resources available for functional conversion, various pathways towards geotourism were followed, similar to other cases explored in the literature (e.g., [92–96]). Nevertheless, several common themes may be identified and these are addressed below: (a) how to deal with postmining grounds, as geotourism use is but one option; (b) the role of stakeholders—who and how?; (c) enhancement of tourist products at the regional scale; and (d) educational program—linking geoheritage and cultural history. Examination of these themes allows us to answer research questions asked at the beginning of this paper.

4.1.1. Reuse for Geotourism as but One Option

Conversion of old and abandoned mining grounds into publicly available places and geotourist products in particular is by no means the only available option. In fact, although it might seem otherwise given the geoheritage potential and overall attractiveness of old mines and quarries [94,95,97,98], it is not necessarily the first option because of costs involved (both at the time of rehabilitation and afterwards) and also due to the lack of vision

and awareness. Among the sites presented here, Mt. Wilkołak provides a good case where at one time different options were considered, from further exploitation and destruction of the entire hill, through a landfill site, afforestation, to recreational and educational use, with the latter eventually being implemented. However, at the same time, it is now less likely that other basalt quarries in the close vicinity, especially in the same municipality, will be similarly adapted to recreational use, given potential conversion costs, their less evident values, and competition with a "better" site.

The latter comment introduces an issue of a feasible strategy to deal with areas which were once dominated by mining and where there are many remnants left. In the feasibility study for the Krobica area, it was clearly indicated which underground galleries were suitable to adapt for tourist purposes and which were not [73], and the conversion was organized accordingly. The problem was certainly far more acute in Wałbrzych, where many coal mines existed, occupying large tracts of terrain, and the areal extent of postindustrial wasteland was considerable [99,100]. It was simply not realistic to even think about tourist reuse of all former industrial infrastructure, and the selection of one, possibly the most representative place, was an inevitable solution. Thus, Stara Kopalnia was selected and redeveloped, whereas many other elements of mining and industrial heritage disappeared. It is anticipated that a similar problem will be faced by the town of Wojcieszów, where many limestone quarries occur in the vicinity. Two are already used for (geo)tourism, although rather modestly at present. Of particular significance will be the southern quarry at Mt. Połom, still in operation, as its state at the end of the exploitation period should determine further use. If the quarry walls expose karst phenomena, for which Mt. Połom was once famous at the regional scale [90], in an easy-to-appreciate way, then a new geosite established there will be a valuable addition to the list of geosites in the Land of Extinct Volcanoes UGGp. In this specific example, but in fact in any similar case, strong voices from the scientific community, arguing for considerable values of a locality and ideally supported by the local community, would play an important role in the decision-making process. This line of argument may converge with more local voices, emphasizing the symbolic value of a place for the local community (e.g., place of everyday work of ancestors). At the same time, it needs to be accepted that saving everything for geotourism is hardly possible. Thus, the most significant challenge at an early stage is to have a vision of development of a postmining ground for tourist use and the ability, institutional or otherwise, to convince all relevant stakeholders that the idea is worth implementing.

4.1.2. Stakeholders

Two opposite ends of the spectrum of local engagement are the top-down and bottom-up approaches. The most evident example of a top-down approach is the case of Stara Kopalnia in Wałbrzych, whose revitalization and conversion into tourist and cultural use were part of a wider program to address socioeconomic and environmental problems arising from the simultaneous closure of several coal mines and related industries [69,101,102]. Revitalization of a large industrial complex required considerable financial resources and skills to manage the long-term rehabilitation project, both logistically and financially. It also necessitated an adequate framing of the conversion project within the long-term strategy of revitalization of the city, including the operational model of its cultural institutions. Hence, direct involvement of the city at every stage, from planning through fundraising to the execution of the project, was crucial for the eventual success of the project. Today, Stara Kopalnia is the property of the City of Walbrzych.

By contrast, activities undertaken in the village of Czaple provide a good example of a bottom-up approach, where nearly all developments are the results of work of a group of enthusiasts from a local association, the Heron Foundation, seeking to enliven the place and make it more attractive to both the inhabitants and visitors. Links with the academic community were maintained and were crucial to ensure proper scientific content of the tourist products (explanations in the rock garden, interpretation panels on the educational trail). More recent developments for geotourism, however, were framed within a program

coordinated by the municipality of Pielgrzymka, of which the village of Czaple is a part, which was based on an agreement with the Polish Geological Institute (Geological Survey).

The cases of Krobica and Mt. Wilkołak are examples of a mixed approach, where municipalities eventually played a major part in overseeing the rehabilitation and conversion works towards geotourist use but the ideas came from either scientists (Krobica) or local inhabitants supported by scientists (Wilkołak). Thus, the results of inventories of mining remnants in Krobica and adjacent villages were presented to the Mirsk municipality, indicating geotourist potential for an area poorly developed for tourism until then [73]. Likewise, the concept of an educational trail was conceived by scientists. The municipality, in turn, obtained the necessary funds and supervised actual work. Then, for many years, it operated the underground part of the trail (St. Johannes Mine), but recently a private operator took over the site. At Mt. Wilkołak, the "battle" to save the hill and convert it into an open-air museum of volcanism after the termination of quarrying had a long history [81,103], and it was by no means certain that this bottom-up pressure would be sufficient or that successful conversion would occur, if not for the participation of the Złotoryja rural municipality in the Land of Extinct Volcanoes Geopark project. The project highlighted the significance of Mt. Wilkołak as one of the premier geosites in the region, a unique site at the Central European scale. A similar mixed bottom-up and top-down approach is likely the way forward for the town of Wojcieszów and its limestone quarrying industry. Whereas small-scale investments at abandoned quarries (rest sites, interpretation panels, trails) can be implemented as parts of bottom-up activities, close cooperation of the municipality and the industrial sector will be required to establish a feasible long-term strategy for the rehabilitation and reuse of large quarries, which are still within the mining area and technically off-limits (even without any industrial operations).

Thus, even though only five localities are examined here, it appears clearly that there is a relationship between the size of the project and the stakeholders. For large projects, especially if they are part of a wider strategy, highly committed involvement of local administration is indispensable. By contrast, minor developments can be borne by local NGOs. In addition, in the specific context of geotourism, encouragement from the academic community involved in fundamental research is important, helping to raise local awareness. From a long-term perspective, though, management based on close cooperation between local communities (organizations), local administration, and research and education institutions should prove the most effective.

4.1.3. Increasing Portfolio of Tourist Products at the Regional Scale and Enhancing the Image of a Place

This aspect is perhaps most evident in the case of Stara Kopalnia. The city of Wałbrzych, because of its mining-based industrial past and associated socioeconomic problems, for a long time had not been considered as an attractive tourist destination, despite its interesting architectural heritage from the 19th and early 20th century. In addition, in the close vicinity there are such major highlights as the monumental Książ castle with its underground shelters from World War II, overlooking a picturesque gorge of the Pełcznica River, the Palm House in Lubiechów, spa park in Szczawno-Zdrój, ruins of medieval Grodno castle in Zagórze Śląskie, and good hiking terrain in the Kamienne Mountains, just south of the city. Thus, notwithstanding the poor image of the city itself, Wałbrzych as a tourist destination was certainly overshadowed by these evident attractions located nearby. The opening of Stara Kopalnia to the public, with its diverse program of activities not limited to a standard guided route, clearly contributed to the enhancement of the image of the city, and the old mine has become an important regional tourist spot. This is confirmed by the number of visitors. According to data provided by the management of the Museum of Industry and Technology, operating within the structure of Stara Kopalnia Multicultural Park, in its first full year of operation in 2015, the museum was visited by over 22,000 people. The number of visitors in subsequent years (excluding the COVID-19 pandemic period) increased, reaching nearly 72,000 in 2023. The total number of participants in all events

organized by Stara Kopalnia in 2023 was over 150,000 [104]. In addition, in contrast to sites developing outdoor activities, it is an all-year destination, less affected by the seasonality issues in tourism.

The old mine in Krobica plays a similar but a more modest role for the Mirsk municipality. Prior to the opening of the mine, the municipality lacked evident must-see places and was not considered a tourist destination. Here, the proximity of the popular spa town of Świeradów-Zdrój contributed to the relative neglect of Mirsk. Nowadays, not only has the list of places which tourists can visit increased but also, the mine is a good alternative for periods of adverse weather conditions, when outdoor activities are less feasible. This is true for the winter period in particular, since Świeradów-Zdrój is also a winter skiing resort, but snow conditions are deteriorating due to climate warming and are unpredictable anyway. A surface trail, in turn, expands the offering focused on mining history, even though after 10 years of use, it requires renovation to be attractive. According to data received from the manager of the Krobica Mine, in the first full year of operation in 2015, the mine was visited by more than 5000 tourists. In 2022, the number of visitors reached 17,750 (no data available for later periods). Considering the size of the facility, this is a significant figure.

The developments in and around the village of Czaple should in turn be analyzed in the wider regional context of the Land of Extinct Volcanoes UGGp. It covers a large area of more than 1300 km^2, with a nonuniform distribution of geoheritage and geodiversity resources [105,106]. These are mainly concentrated in the southern part, where lithological and landform diversity is higher. Czaple and the nearby Grodziec castle provide a kind of counterweight and focus attention on the lesser-known corner of the geopark. It also needs to be emphasized that the local portfolio of tourist attractions is on the rise, as shown by new geosites recently developed and equipped with interpretation panels as well as new online resources [75]. In a similar way, the quarry at Mt. Wilkołak enhances the tourist products of the Land of Extinct Volcanoes UGGp, with significant potential to become one of the key localities to visit, even though the adjacent town of Złotoryja was a recognized destination already, mainly due to gold-prospecting associations. Its role as a geotourist site of considerable significance was strongly argued during discussions about the future of the quarry after the termination of industrial activity. It may be anticipated that a strong focus on limestone and all related issues, including mining history, would raise the status of the town of Wojcieszów as a tourist destination.

4.1.4. Geoheritage, Cultural Heritage, and ABC Concept in Geoeducation

The ABC concept, involving exploration of relationships between geoheritage and geodiversity (i.e., the abiotic sphere), biotic elements, and cultural heritage, is now strongly emphasized as a model for effective geoeducation, not only in geoparks but also more generally [31]. Geotourist destinations focused on mining history are particularly suitable to develop educational programs emphasizing connections between rocks, resources, and changing human activities over the years [7,107,108], and the sites presented here are no exception. Moreover, various innovative means to make the educational program more attractive are implemented.

A significant component of the interpretation program at Stara Kopalnia is storytelling about coal mining, including both tangible (equipment) and intangible (customs, traditions) heritage. Old mining techniques and their effects are also presented during a tour in the Krobica Mine. In the exhibition rooms in Krobica and Wojcieszów, visitors can see old photographs, maps, mining tools, etc. The history of quarrying is extensively presented on outdoor panels at Mt. Wilkołak, actually even more elaborately than is the geology of the site, and it is the main focus of the surface trail from Krobica to Przecznica. In Krobica, the story told to visitors goes back to early modern times, covering c. 500 years of mining history. In Wałbrzych and Wojcieszów, various aspects of the further processing of raw materials are explored, using remnants of old industrial facilities where possible. However, some objects which would be now considered industrial heritage were sadly demolished

without a trace, such as different types of lime kilns in Wojcieszów. Finally, the theme of stone use is emphasized in Czaple, as it was part of a thriving "sandstone district", delivering high-quality building stones to various distant places, including monumental buildings in Berlin [109], which is addressed within the open-air exhibition of quarried stones at Mt. Wilkołak [81].

Worth emphasizing is the range of activities, interpretative provisions, and facilities available at each locality. This is the most evident in Wałbrzych, where Stara Kopalnia is not just a museum of past coal mining but also functions as a multicultural center for the entire city, with a diverse program of events all year round. In Krobica, mining heritage is revealed both underground and at the surface by means of an interpretation trail, and this solution partly addresses mine accessibility problems for certain visitors. The interpretative program at Mt. Wilkołak is not restricted to site characteristics but also includes the wider context of the quarrying industry and stone use at the regional scale by means of an open-air stone exhibition. In Czaple, geotourist facilities are part of a broader image of the village as an ecofriendly tourist destination. Finally, many educational activities (guided tours, workshops) follow the ideas of experience-based tourism, learning by playing, and teaching by means of curiosity. This is most evident in Wałbrzych, where an innovative SOWA discovery center aimed at children and teenagers is part of the entire Stara Kopalnia complex.

4.2. Sustainable Practices and Associated Challenges

Even though none of the localities presented in this paper has a long history of use as a geotourist destination, some comments regarding their role as catalysts of sustainable tourism at the local level can already be offered. Figure 8 attempts to summarize the contribution of former mining sites to sustainable development and local resilience in general, providing, therefore, a background to evaluate localities in the Sudetes in this context. In short, we argue that they indeed perform these functions well, even though they face various challenges.

Tourist and educational functions are essential for the "new life" of these places. It is important to emphasize that the educational component is not only directed at tourists but also equally, perhaps even more, at the local people, who may have not necessarily seen the value of a place before. In addition, Stara Kopalnia in Wałbrzych also plays the role of a cultural institution and provides a venue for various cultural events.

Functional conversion towards tourist use proves capable of generating new employment opportunities, both directly (in the case of staffed objects, such as in Stara Kopalnia and Krobica) and indirectly, as well as reducing the phenomenon of the seasonality and weather dependence of tourism in the wider area. This role is likely to increase in the Sudetes, where the sustained warming trend in the last few decades makes the future of skiing-based tourism and holidaymaking uncertain. Thus, the opening of new tourist destinations based on existing resources is considered another tool to bring tourism more in line with the principles and goals of sustainable local development. This function can be enhanced by the implementation of educational and interpretation programs, which emphasize the importance of heritage values and the sustainable management of resources, as is being conducted at all localities presented in this paper. At the same time, new infrastructure should not interfere with the environment and may contribute to its aesthetic qualities. A good example is provided by Stara Kopalnia, where careful revitalization of old mine buildings emphasized their architectural values.

New geotourist destinations, especially if developed by or in close collaboration with the local inhabitants, perform an important social role, helping to build local social capital. Involvement of local communities in tourism development increases their economic resilience, helps them to learn entrepreneurship, and fuels creativity. The activities undertaken in Czaple provide an excellent example. Establishing local associations and partnerships usually proves useful, as such bottom-up organizations are more powerful partners for local governments, industrial entities still involved in resource exploitation,

academic institutions, and regional tourist organizations. Local knowledge and experience is crucial in designing the model of tourism development, which would be optimally adjusted to site-specific conditions.

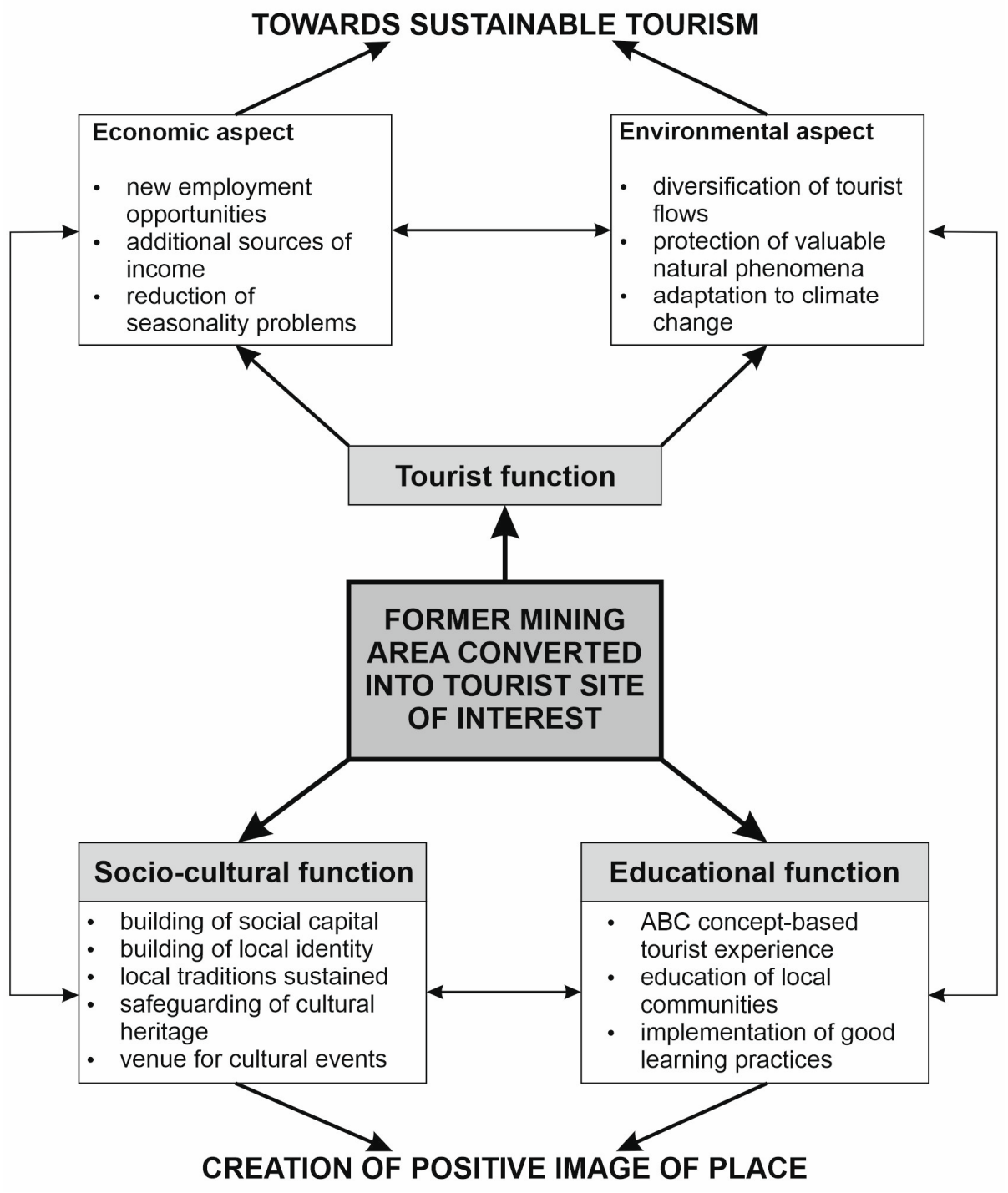

Figure 8. Graphical summary of positive impacts of redevelopment of former mining grounds and quarries towards geotourism for local communities.

New geotourist destinations are also good promotional tools, as clearly demonstrated by Stara Kopalnia, whose role to change the image of the city of Wałbrzych is not to be neglected. Other places, such as Krobica or Czaple, have been made recognizable due to their geoheritage-based attractions.

Old mining grounds and facilities adapted to tourist use are very attractive, but their maintenance in this function requires effective ways to manage multiple challenges. The most important ones, decisive for the future of these localities, are associated with running costs, which may be considerable. Stara Kopalnia in Wałbrzych is now a large institution, responsible for a considerable area, many buildings, and infrastructure. It is also a large employer, with multiple tasks to perform, and it is unlikely that revenues from entrance tickets will be sufficient to maintain it in the long term. In Krobica, an additional task is constant monitoring of underground spaces in terms of visitors' safety. Safety-oriented monitoring should also be implemented at disused quarries, whose steep walls may be unstable. At Mt. Wilkołak, this problem was reduced due to the appropriate design of tourist paths inside the quarry at a sufficient distance from quarry walls, and any plans towards opening the now off-limits quarries in Wojcieszów will need to consider this aspect as well. Maintaining educational facilities (panels, signage, picnic sites) in good condition also requires a solid financial basis. If funding is predominantly project-based, local managers must show skills relevant for project preparation. Management plans for old quarries and other mining works should also consider regular clearance of vegetation, which often conceals features of interest if allowed to grow freely. Visibility of quarry walls and physical access to former quarries may be substantially different within and outside the vegetation season, up to the nearly complete loss of educational value of the site in summer [81,110].

A different set of challenges is associated with interpretation programs at geosites, which should be regularly updated, reflecting the accumulation of knowledge and past experience. Options of how to connect sites in the vicinity are worth exploring, where the main theme might be a rock resource (e.g., basalt, sandstone, or limestone), and different aspects of the story, from the origin of the rock to its final use, can be presented at different places. Thematic trails, supported by either on-site interpretative facilities or online resources, are one possible solution.

4.3. Selected Comparatiuve Examples

Conversion of former mines and mining grounds into geotourist sites is a common phenomenon, and comparative examples may be provided from many countries. In particular, these developments are taking place in geoparks, aligning with their overarching goals to promote geoconservation, foster geotourism, and increase benefits for the local communities [111,112]. In fact, in Europe, there are several geoparks, both UNESCO Global Geoparks and national geoparks, which emphasize local mining history as a key geoheritage characteristic. Among them are Muskau Arch UGGp (Germany/Poland), Copper Coast UGGp (Ireland), Tuscan Mining Park UGGp, and Black Country UGGp (Great Britain). Below, a few examples from three geopark areas in Central Europe are briefly presented to set the localities discussed in this paper in a wider context. These examples also show common practices in bringing geo- and mining heritage to the public and the potential of former mining grounds as tourist sites.

4.3.1. Geopark Landscape Břidlice

Landscape Břidlice is the name of a national geopark in Czechia, in the East Sudetes, and may be translated as "the slate landscape". Geographically, it is located in the Nizký Jeseník upland, which was long neglected as a tourist destination, apparently overshadowed by the much higher mountain range of Hrubý Jeseník farther west. Its territory is mainly built of slightly metamorphosed rocks of the Devonian age, particularly slates, whereas a regional geological curiosity is the occurrence of young volcanic rocks, which testify to significant volcanism in the early Quaternary [113]. Both slates and basalts were extensively used as stone resources, leaving a varied mining heritage, which is now presented as one of the key assets of the geopark and the region in general (Figure 9a). Several old quarries of volcanic materials have been developed into geotourist sites, cleared of debris and vegetation, made accessible via waymarked trails, and equipped with interpretation panels.

They show a variety of volcanic products, including solid lava (e.g., Lava flow near Mezina geosite), coarse pyroclastic deposits at former stratovolcanoes (e.g., Uhlířský vrch geosite), and layered deposits from phreatomagmatic eruptions (e.g., Razov tuffites geosite). All can be visited without restrictions and are protected by law as natural monuments. Slate extraction, in turn, occurred mainly underground [114], although open quarries are also present and these are used as both geosites and recreational grounds, including diving sites. In recent years, two former subterranean slate mines have been developed to accommodate visitors (Flaschar Mine and Raab's adit), offering unique insights into both the geological structure of the area and techniques of stone extraction. Slate mining history is also presented in the municipal museum in the town of Budišov nad Budišovkou, and various mining remnants in the vicinity of the town are connected by a network of educational trails [115].

Figure 9. Selected comparative examples of geosites in Central European geoparks, associated with past mining. (**a**) Slate exposures and heaps in the National Geopark Břidlice (Czechia); (**b**) open-air display of Scandinavian erratic boulders against a contour of Scandinavia in Nochten, Muskau Arch UGGp (Germany); (**c**) former basalt quarry at Hegyestű, with interpretation panel in the foreground, Bakony–Balaton UGGp (Hungary); (**d**) entrance to a karstic doline at Úrkút, Bakony–Balaton UGGp (Hungary), photo taken prior to recent renovation of access facilities (photos by P. Migoń).

4.3.2. Muskau Arch UNESCO Global Geopark

The Muskau Arch UGGp is a transboundary geopark straddling the German/Polish border, a member of the Global Geopark Network since 2011. It is located in a lowland terrain, distinctive because of the presence of a large horseshoe-shaped moraine rampart of the continental ice sheet [116–118]. Processes of glacial tectonics were crucial for the development of the rampart, and among their geological effects was the dismembering and dragging of coal seams of the Miocene age up to the topographic surface. This in turn allowed for easy access to the resource and facilitated lignite mining, which commenced in

the early 19th century and terminated in 1973, leaving the topographic surface considerably transformed [117,118]. However, large-scale open-cast mining still continues to the south of the moraine rampart. Apart from lignite, the area provided other mineral resources such as clays, glass sands, alum, and bog ores.

Mining history is evidently the major asset of the Muskau Arch UGGp and all key geosites made available to the public are related to mining. Among them is the Babina Educational Trail in the Polish section, which connects more than 10 specific localities illustrating mining operations and their consequences for the landscape along a 5 km long circular route. In Germany, there are several shorter trails bringing visitors to flooded former lignite pits. A site of particular interest is the open-air exhibition of glacial erratics in Nochten, close to a working lignite mine (Figure 9b). A few tens of different rock types are on display within artificially molded hilly scenery, which mimics the geography of Northern Europe [117]. In this innovative way, the places of origin of different rock types can be shown in an engaging way. The visitor center of the UGGp in Klein Kölzig uses an old brickyard building and hosts an exhibition focused on multiple mineral resources and their various uses. In addition, the former ring oven for brick making can be visited.

4.3.3. Bakony–Balaton UNESCO Global Geopark

The Bakony–Balaton UGGp is located in the western part of Hungary and covers a varied terrain to the north of Lake Balaton, including a low mountain range of the Bakony Forest. It has been a member of the Global Geopark Network since 2012. The geoheritage of the geopark is very diverse, and the main "selling points" are karst landforms, including showcaves, and volcanic rocks along with spectacular landforms built of volcanic materials, dated mainly to the Pliocene [119–122]. Many geosites are natural rock outcrops, but there are several notable examples of the successful development of former mining grounds as sites of tourist interest. The volcanic hill of Hegyestű is strikingly similar to Mt. Wilkołak (albeit on a smaller scale), exposing an impressive pattern of columnar jointing in a former quarry (Figure 9c). The natural outcrop is accompanied by a rock garden, with typical rocks from the region on display, and a small interpretation center [122]. Next to the village of Úrkút, a former open-cast mine of manganese ores hosted by karstic depressions was developed as a geosite, which required not only the development of educational content (thematic trail, information panels) but also the provision of physical access to the bottom of the karstic dolines by means of stairs and ladders, along with vegetation clearance (Figure 9d). The third example comes from the surroundings of the village of Kővágóörs, once famous as a center of millstone production. Boulders for millstone making were picked up from natural blockfields of sandstone and widely spread across the landscape, and even though the evidence of past use of stone resources is rather subtle, it is explained as an important component of local heritage.

5. Conclusions

Conversion of old mining grounds and associated industrial facilities towards tourist use is a promising tool to avert negative socioeconomic trends and to safeguard valuable natural and cultural heritage. In this respect, the results of this study align with conclusions reached elsewhere. However, there are further benefits for local communities since new mining heritage-based tourist destinations contribute to the positive identity of a place, local sense of pride, nature-friendly rehabilitation of degraded land, more sustainable profile of tourism, and employment opportunities. All in all, the resilience of small communities is expected to increase. After the examination of five recently developed geo- and mining heritage-based tourist localities in the Sudetes, we can provide answers to the overarching question asked at the beginning. However, the answer should be split into two parts. Irrespective of the size of an object and level of investment, the developments at each locality are consistent with the principles of sustainable development in tourism and positively contribute to the image of a place. However, it is probably too early to make a strong claim that they firmly enhanced resilience at the local scale. They clearly have a

potential to do so, and their performance so far allows one to be optimistic. In addition, their role may increase if further developments aimed at enhancing the geotourist products take place (this is especially the case for Mt. Wilkołak and Wojcieszów).

However, one needs to be aware that significant challenges are twinned with any such development, and these have been identified at various stages of conversion and adaptive reuse. They include, but are not limited to the following: (a) the necessity of providing a proper inventory of mining remnants and assessment of their potential to generate tourist visits, which should be executed with due attention given to the characteristics of the wider surroundings; (b) adoption of a long-term feasibility plan, based on a cost/benefit analysis, especially if considerable costs are anticipated; (c) seeking local support, both institutional and noninstitutional, as plans even if drawn elsewhere will have to be implemented locally; (d) securing adequate financial support; (e) development of appropriate educational and interpretative programs, adjusted to site characteristics and not duplicating localities elsewhere ("unique selling points"); (f) monitoring of site conditions; and (g) running costs, which may be considerable and are generally correlated with the level of initial investment.

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