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Geotourist potential of post-mining regions in Poland

Abstract: The current article will attempt to confirm that Polish post-mining areas are characterized by high cognitive and aesthetic values and that they have great geotourism potential, which has been little used so far. Tourism is regarded to be one of the most dynamically growing sectors of the global economy and is a phenomenon that occurs in the landscapes of all ecological and altitudinal zones. Geotourism is among the relatively recent types of tourism. Poland is a highly attractive country for geotourism. The aim of this article is to analyze the distribution and size of post-mining areas in Poland and, based on these analyses, to assess the geotourist potential of selected post-mining regions. Based on the distribution of natural resource mining sites and their potential and actual use in geotourism, the authors selected 20 actual and potential geotourist regions in Poland. These regions were divided into three basic categories based on their attractiveness.

Key words: geotourism, geodiversity, post-mining areas, geotourism regions

Introduction

Tourism is a global phenomenon that takes place in the landscapes of all ecological zones and at all altitudes, and is regarded to be among the most dynamically growing sectors of the global economy. The participation of citizens in broadly understood tourist traffic and various forms of recreation is becoming a determining factor of modernity and a parameter by which standards and quality of life can be measured. Tourism is also an important carrier of innovation. Tourism stimulates social changes by popularizing

new lifestyles and favouring spatial globalization (Muirden and Martin 2004). All of these factors have made contemporary tourism one of the key sources of anthropopressure on the natural environment, leading to rapid, and difficult to control "consumption" of the landscape for tourist destinations and investments.

Tourism is becoming highly diversified, and the industry is seeking new forms of expression. Relatively recent types of tourism include geotourism. Geotourism is a relatively new form of tourism with considerable growth potential (Hose 1994, 2000, 2005, 2008; Alexandrowicz 2006; Gordon 2012; Radwanek-Bąk 2012). This form of cognitive tourism has become increasingly popular in many countries throughout the world in recent years. Poland is a highly attractive country for geotourism because of its diverse geological structure, multitude of genetic types of surface features, numerous mining sites of various resources, the contrasting occurrence of different types of natural landscapes (Richling and Dąbrowski 1995) and the occurrence of minerals, fossils, paleontological objects and traces of geological processes that both took place in the geological past and are taking place in the present. Due to their unique value, many geotourist objects are subject to various forms of environmental protection resulting from the provisions of the Nature Protection Act (2004). There are also objects whose tourist attractiveness consists in the exploitation of resources of an inanimate nature, such as paleontological fossils, precious stones and gemstones. Thus, geotourists are interested in geological entities and processes, which are the core of the tourist product.

The objective of the present article is to analyze the distribution and size of post-mining areas in Poland and, based on these analyses, to assess the geotourist potential of selected post-mining regions. The article will attempt to confirm that Polish post-mining areas are characterized by high cognitive and aesthetic values and that they hold great geotourism potential, which has been little used so far. With the appropriate regional policy and promotion, post-exploitation regions may play an important role in both geoprotection and geotourism, while fostering the economic growth of post-mining areas (Sanfelin and Jordan 2009).

Stone quarries, exploitation hollows and post-exploitation areas in general are of particular geotourist value. These are sites for observing geological activities occurring on the surface, which, when intentionally adapted to

the needs of tourist traffic, may become excellent tourist and educational attractions.

The anthropogenic value of post-mining areas has been the subject of analyses and scientific papers in many countries of the world (especially those with a long history of mining, such as Great Britain, Germany, Czech Republic or the USA). However, the geochemical approach, or one based on ecology and protection, dominates the scientific literature on geotourism because most authors concentrate on the processes leading to the secondary (already occurring or potential) creation of habitats of unique animal and plant species (comp. Brenner et al. 1984; Hüttl and Weber 2001; Morin and Hutt 2001; Sklenicka and Lhota 2002; Hancock et al. 2006; Conesa et al. 2007a, b; Nita and Myga-Piątek 2010).

Methods

The authors based their studies on phenomena in Poland that were created as a result of the exploitation or processing of natural resources with an area of land transformation larger than 0.5 km^2 (Table 1). The basic method was: statistical data analysis of the size of post-mining objects; cartographic analysis and the assessment of the objects' locations; field mapping (consisting of measurements and verification of the statistical data); field observations, and a study of specialist reference books, reports and legal acts concerning post-mining regions.

The official Register of Mining Regions (databases of the Polish Geological Institute (PIG-PIB 2010) lists approximately ten thousand operating sites of resource exploitation in Poland.

Of these exploitation sites and preserved inoperable sites, 255 objects were selected in this paper that meet the size criteria of ≥ 0.5 km^2. The approximate locations of these sites are presented in Figure 1. Apart from post-mining exploitation hollows, the group also includes heaps, dumps and tailing dams (Table 2). The size of the area was assumed to be important, as it determines the type and direction of adaptation and potential tourist availability. Large objects usually raise a lot of interest, e.g., the largest Polish brown coal mine in Bełchatów is the deepest in Europe, being 330 m deep (Ciepiela 2009), making it of great interest to visitors.

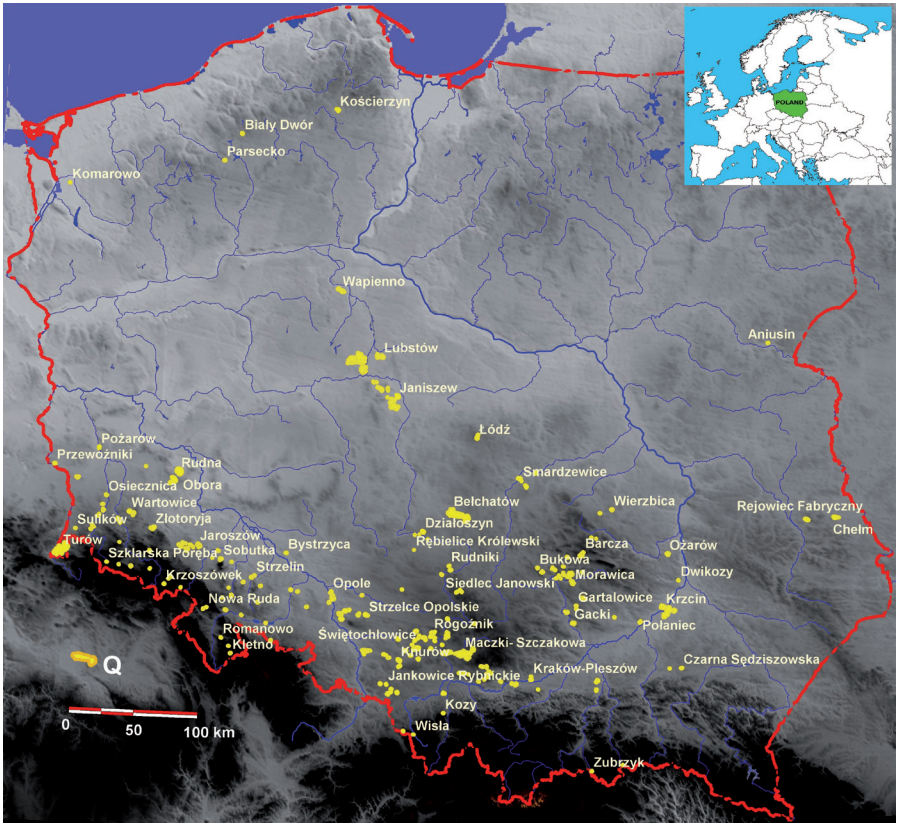

Fig.1. Location of the largest exploitation and post-exploitation [Q] regions in Poland (selection of authors on the basis of database PIG-PIB (2010) access http://old.pgi.gov.pl/surowce_mineralne/), with area > 0.5 km^2 on background of river network and black and white shaded DEMs (The data currently being distributed by NASA/USGS/ CGIAR-CSI http://srtm.csi.cgiar.org)

Geodiversity as the basis for geotourism development

Studies on the geodiversity of Poland began with the work of Kozłowski (1994) and Kostrzewski (1998), and the concept of geodiversity was discussed in general terms by Gray (2004), Cañadas and Flaño (2007) and a number of papers by Zwoliński (2004, 2009, 2010). The definition that is most popular and most often referred to is that formulated by the Australian Natural Heritage Charter (ANHC 2002). The definition of geodiversity included in the document by the ANHC states that geodiversity consists in the environmental diversity (entities features) of geological (bedrock),

geomorphological (formations of surface features) and depositional (soil) entities, along with their collections (complexes) and systems (geoecosystems), as well as environmental (natural) and anthropogenic (human) activities (processes). Geodiversity includes evidence of past and present environments and geoecosystems in the history of the Earth. While assessing geodiversity, it is necessary to include the impact of atmospheric, hydrological, geological, geomorphological and biological processes occurring in the environment. The term "geodiversity" is currently used in a holistic sense to emphasize the relations between the subject matter of the Earth sciences, ecology-related sciences and human-related sciences.

Reference books currently use this holistic notion in various meanings and scopes. Kostrzewski (1998) claims that geodiversity is valuable from the point of view of internal, geological, geoecological and ecological diversity; natural heritage; and scientific, educational, social, cultural and tourist values. For these reasons, geodiversity should be subject to geoprotection in the form of a geolocation or a geopark for contemporary and future generations. Geodiversity includes the whole of the landscape, which should be assessed as a value in geotourism and geoprotection (Kozłowski 1994; Kostrzewski 1998; Zwoliński 2004, 2010; Cañadas and Flaño 2007). In this sense, geotourism should focus on the areas which are a set of elements of the geographical environment (alongside the geological structure of a given region) which, individually or as a whole, may become an object of interest for tourists and may be a destination for tourist traffic.

Geotourism as a new field in cognitive and professional tourism

Geotourism (Brilha et al. 2009) is a relatively new field of sightseeing tourism, which is most generally defined as an alternative to ecotourism. It is a tourism that sustains or enhances the geographical character of the places being visited, such as the environment, culture, aesthetic, heritage and the well-being of the local community.

Most often, geotourism is considered in a narrower aspect, such as exploring geological entities and processes. In this aspect, geotourism originates from a fascination with geological knowledge, especially petrography, mineralogy and paleontology, in combination with the widely understood concept of sightseeing, and its aim is to enhance knowledge of the natural environment. Cognitive motives are often supplemented with aesthetic motives because the mentioned entities are picturesque

and mysterious, monumental and noble and are characterized by unique visual characteristics. These reasons encourage people to visit these places and tourists do not need to have specialized knowledge of geology or geomorphology. Many attractive places from a geological point of view and many geological sites which are very popular tourist destinations don't necessarily require specific skills, and tourists also want to 'experience' their geosite visit e.g. Petra, Cappadocia, Ayers Rock etc. (Allan et al. 2011). At the same time, geotourism is regarded as a type of professional tourism because exploring (reaching) geological objects requires specialist skills (physical fitness, specialist knowledge and qualifications, such as skills in climbing, speleology, diving and yachting).

Geotourism is practised in areas of high geodiversity with a highly natural landscape; in primeval sites that are hardly explored and which preserve fantastic rock formations and geological profiles. However, it can be practised in all kinds of environments, both on and under the surface of the ground or water. Of particular interest are entities that public opinion holds to be monumental, such as the Grand Canyon, Mount Kilimanjaro, Ngorongoro, Mount Fuji, the Colca Canyon, caves and waterfalls. However, geotourist attractions occur not only in the natural environment but also in the anthropogenically transformed environment, and these are related to the products of the material culture of humanity. A detailed typology of geotourist entities, based on various criteria, has been given by Słomka and Kicińska-Świderska (2004) and Słomka et al. (2006), among others.

The primary function of geotourism is to make it easier to understand past and present geological processes and to recognize the necessity of protecting the natural environment related to these processes. Geotourism is practised at selected geological objects that are (or may be, if appropriately promoted and made available) objects of tourist interest (Table 1).

Table 1. Scope and objects of tourist interest

Category of geotourist interest	Examples
Geomorphologic-geological landforms	mountains, cliffs, volcanoes, canyons, valleys, gorges, glaciers, lakes, waterfalls, caves, karst forms, coral reefs, moving dunes, landslides, etc.
Geological and tectonic forms or phenomena	minerals, rocks, horsts, folds, joints, cleavages, magma intrusions, faults, fault troughs, mineral deposits, sedimentation structures, craters, fossils, etc.
Geological processes	volcanic eruptions, geyser explosion, lava and mud flows, coastal zone waves, tides, glacier calving, earthquakes, etc.
Anthropogenic landform and features	post-mining areas: surface and underground mines, stone pits, sand pits, clay pits, quarries, exploitation hollows, cross-cuts, excavations, trial pits, heaps, dumps, former military buildings, etc.
Geological-engineering activity	mining operations, geological drilling, construction of dams, tunneling, operation of oil rigs at sea, intakes of geothermal water
Cultural heritage elements and objects	e.g. rock buildings (pyramids or rock towns), stone tools in archaeological excavations, etc.
Forms of exposition and presentation	museums of geology, mineralogy, paleontology; geological sites (rocky profiles, exposures, geotourist paths, etc.)

Source: Żaba and Gaidzik (2010), partly processed

This science still needs a thorough definition of basic notions, although first attempts have already been made. Therefore, geotourism is situated within interdisciplinary scientific activities, being placed between geology, the protection of geological heritage and tourism. The matter of the protection of geological heritage is becoming particularly important. This issue did not raise international interest or become part of integrated studies until the latter part of the previous century. However, geoprotection (protection of geological heritage) is still largely underdeveloped in comparison with other conventions and programs of biosphere protection, which have been in force for a long time. It needs to be emphasized that well and wisely planned geotourism may be a tool for successful geoprotection and may support protection of the animal and plant world. The important thing are lectures, professional training and courses in the field of geological heritage (geoeducation). One particular form of geotourist attraction is geoparks;

regions that are protected due to the geosite[1] accumulated within their area. These regions are defined as fragments of the lithosphere that carry a clear record of its structure and development and of life on Earth (Bodura et al. 2002; Migaszewski 2002; Kozłowski et al. 2004). Geotourist attractions located along a specifically designed trail could be defined as a geotourist route and it should be emphasized that many geotourist attractions occur in protected natural areas, such as national parks, landscape parks or nature reserves. Thus, it is justifiable to claim the complementary functions of geo- and eco-protection. As can be seen in Table 1, one of the possible types of geotourism is visiting places (still in operation or no longer active) of rock material or mineral resource exploitation.

Potential of post-mining regions

Significant modification of the primary landscape occurs in post-exploitation (post-mining) regions (Nita 2001). Because of the domination of anthropogenic factors, a post-exploitation area is characterized by specific forms and objects (Table 2) typical of a particular type of cultural landscape, called the post-exploitation landscape (Nita and Myga-Piątek 2005, 2006; Myga-Piątek and Nita 2008). Such areas should not, however, be perceived only as a form of degraded space, but as a new kind of landscape which, after necessary adaptations, may be used for the needs of geotourism and recreation (Kalimpakos and Mavrikos 2006; Hose 2007).

When the exploitation of resources ceases, hollows are left in the exploited spaces, which are subject to reclamation processes and multidimensional forms of management. The way post-mining areas are used depends to a large extent on the type of resources that were mined, the local mining laws and social preconditions. In some mining regions in western Europe and the USA, tourism and geotourism are considered ever more popular forms of the use of post-exploitation regions (along with the mining buildings existing within their area). These activities are regarded as a way of stimulating the economic and social growth of areas where the mining industry was the main employer

[1] In Poland, the status of geoparks, such as establishing them as protected areas, is still under discussion. A list of existing European geoparks and suggested Polish geoparks can be found at the following websites: http://mos.gov.pl/kategoria/2372_geologia_dla_turystyki/, http://www.pgi.gov.pl/geoturystyka-mainmenu-606/geoparki, http://www.geosilesia.pl/274,geopolska__geoparki.html, http://www.geosilesia.pl/295, geostanowiska_wojewodztwa_slaskiego.html. Accessed 20 March 2011

up to that point (Porębska 2005; Stryjakiewicz 2010). The Ruhr District example shows that post-mining dumps and other objects remaining from the mining and steel-working industries can be left *in situ* and can be used to increase the attractiveness of recreation, tourism and landscape. Building so-called creative spaces, along with the development of recreation-related services and tourism, may become an important element of the new "life cycle" of the landscape (Stryjakiewicz 2010).

Table 2. Landforms created as a result of exploitation and processing of natural resources in Poland, with the area of anthropogenic deformation exceeding 0.5 km^2

No	Type of object	Number of objects	Area [km^2]	Perimeter [km]
1	Open-pit mines	11	180	220
2	Stone quarries	140	92	487
3	Mine waste dumps, settlement tanks	43	98	260
4	Sand pits	28	70	178
5	Gravel pits	23	12	73
6	Clay pits	10	6	37
7	Total	255	458	1255

Source: PIG-PIB (2010) supplemented with field observation measurements by the authors

The main potential of areas where mining activities, especially those using open-pit methods, have ceased can be described as follows:

- exploited space: environmentally degraded and intended for reclamation and the restoration of its primary functions (most frequently forestry- or agriculture-related objectives);
- areas intended for free use and management: places for free landscape arrangement and creative spaces intended for various functions, e.g., recreation, sports, building, entertainment and culture;
- a region of protected geological heritage: an area recommended for protection because of its exposed geodiversity, including geological and geomorphological values, potentially usable in geotourism, including cognitive, scientific, experimental and educational tourism.

The first solution above has prevailed in Poland until now, being regulated by means of the Act on Geological and Mining Law (Official

Journal of Laws 2005). If we assume that post-mining areas create space that is free for various kinds of management (the second case), the possible landscape arrangements are almost infinite. Post-mining areas can be used as sites for open-air shows and exhibitions, recreational and sports events, amphitheatres, housing estates and recreational-sports facilities, or they can serve as green areas with habitats of unique plant and animal species.

In the third case, post-exploitation areas should be used for arranging geoparks, documentation sites, geotourist-educational paths, field workshops, theme exhibitions and open-air museums of geology, mineralogy or paleontology.

Results

Polish geotourist regions related to post-mining areas

Based on the distribution of natural resources and the sites of their current and potential exploitation, possible geotourist regions were identified on a map of Poland. The analysis also took into consideration the actual and potential uses of those places for recreation, tourism and geotourism. While determining the boundaries, the sizes of the exploitation areas (exploitation pits, infrastructure, technical facilities) were also considered (PIG 2009 a,b,c,d,e; PIG 1997–2007; PIG 2002–2011). The analyses of the sizes of the objects, along with the DEMs, allowed for the identification of zones of potential scenic influence, which was taken into consideration when determining the borders of the region. The analyses also included the occurrence of other related anthropogenic and scenic objects (formations), which, if included in the area of the region, would increase its geotourist attractiveness (e.g., old industrial plants, cement works, lime works, and road building structures).

The regions were selected based on the following:

– the ranking of their existing exploitation and its volume;
– the significance of their geodiversity value;
– the range of their geological, geoecological and cultural heritage values.

Based on these criteria, three classes of geotourist post-mining regions were distinguished in Poland, differing in their levels of attractiveness.

Class one (I, Fig. 2) includes sites of unique scientific, educational and historical value that may be of international interest. Areas and objects with unique and highly diverse values in this class are in most cases already

being adapted for tourist use (due to their complementary values) and can be further managed and made accessible for geotourist use relatively easily.

Class two (II, Fig. 2) covers regions of national and trans-regional importance. The geotourist values in this class are still poorly exposed or dominated by the occurrence of recreational features rather than geotourist features.

Class three (III, Fig. 2) includes other areas of potential importance, often at a regional scale, with typical sites of exploitation of popular minerals. Objects in this category show potential geotourist values, but they are dominated by tourist-recreational values or have not yet been popularized.

Using these criteria, 20 geotourist regions were distinguished in Poland (Fig. 2).

Class one of attractiveness includes the following regions: Lower Silesia, Upper Silesia, Świętokrzyskie, Olkusz-Zawiercie and Krakow (marked in green in Fig. 2). The value of this category was determined by places such as Krasiejów, Lisowice, Czerwionka, Miedzianka, Zachełmie and Śluchowice. The areas and objects with unique and highly diverse geotourist values that exist there are in most cases already being adapted for tourist use.

Class two (yellow color in Fig. 2) covers regions of national and trans-regional importance: Opole, Bełchatów, Konin and Częstochowa. The geotourist values that exist there are still poorly exposed or are dominated by the promotion of recreational features rather than *sensu stricto* geotourist features (examples are the mining dumps in Bełchatów, which were transformed into ski slopes, or the exploitation hollows in Turawa, which were converted into water reservoirs serving recreational purposes).

Class three (brown color in Fig. 2) includes other areas of potential importance and regional rank. Objects in this category show potential geotourist values, but they are dominated by *sensu largo* tourist-recreational values. Cases two and three frequently need substantial adaptation work. This class also includes areas where exploitation activities will be largely intensified in the near future, which is why it is essential to plan the future forms of their tourist and geotourist use as early as possible.

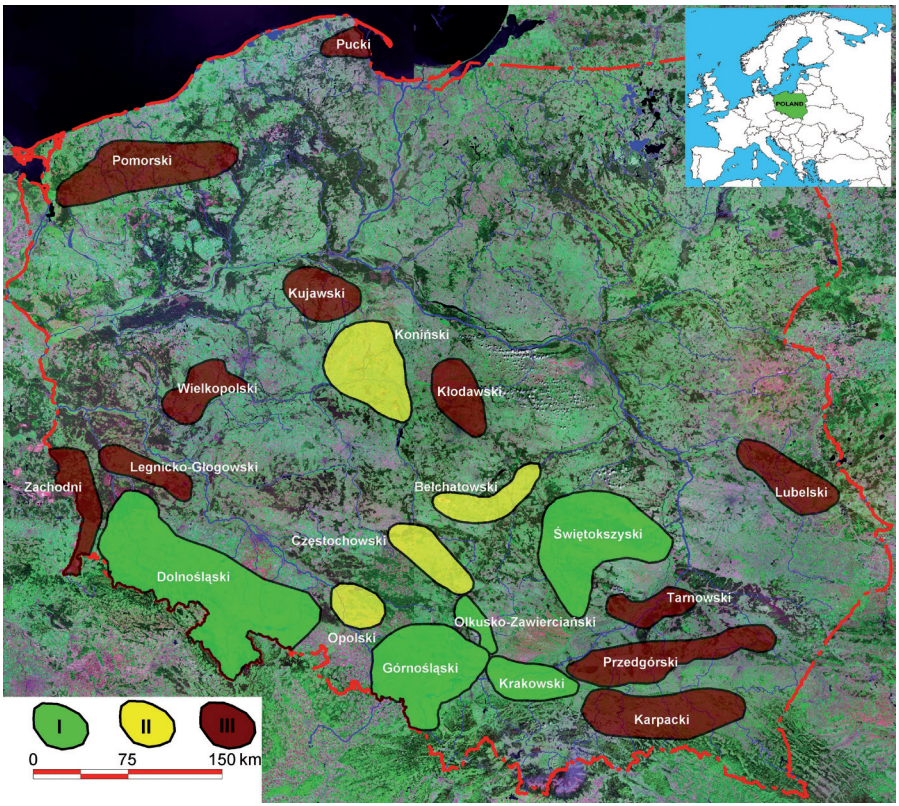

Fig. 2. The main regions of geotourism in Poland, on background of satellite image LandSat-7 (NASA`s data: https://zulu.ssc.nasa.gov/mrsid/). Regions involved in exploitation and post-exploitation process of rock resources divided into three categories: I – areas of international importance (green color); II – areas of nation and cross-regional importance (yellow color); III – other regions with potential importance and region rank (brown color).
Source: Owner compilation based on PIG-PIB (2010)

Summary

Because of their relatively rapid development, new mining entities are commonly referred to as "scars" on the landscape and, in physiognomic terms, are treated as disharmonious formations. Technical facilities accompanying open pits, such as heavy industry technical equipment or mining, industrial and construction machinery, increase the negative impression of these areas. Mining objects also break up the ecological continuities existing

in the environment and change the previous landscape structure (creating so-called engineering landscapes with a large share of anthropogenic energy in the geosystem). Post-mining objects are changing the character of previous landscapes. In the course of time, however, (and usually soon after mining operations cease and burdensome technical infrastructures are removed), a process of peculiar "landscape naturalization" occurs. The newly-created special structure is to some extent unique, and new types of natural-spatial relations appear between elements of the post-mining landscape. Such post-mining areas often resemble their natural counterparts, such as sandy deserts, tundra or dried lakes. Currently, detailed work is required on the evaluation of these areas' geotouristic potential. However, the idea of adapting such areas for geotourist use still faces obstacles. These difficulties result from the regulations of the geological and mining laws that are in force in Poland (Geological and Mining Law Act of April 4, 1994; Official Journal of Laws, No 27, item 96, Official Journal of Laws of 2005, No 228, item 1947). These laws recommend reclamation of these areas, that is, restoration to the state they were before exploitation, which in practice usually amounts to the filling and reforestation of exploitation pits. As a result, the chance to promote "uncovered" values and potential geotourist attractions is irretrievably lost. To take care of post-exploitation areas, clear economic management projects and landscape concepts should be developed, supported by comprehensive analyses, thus keeping such places from uncontrolled and one-dimensional reclamation.

Based on the distribution of current and potential mineral exploitation sites with the actual value of the geological structures (e.g., geoparks, geoposts, geological reserves, geological paths, geotrails, geo-objects, exposed rock outcrops), the authors identified regions of geological attractiveness within Poland. Twenty potential geotourist regions were distinguished.

Well-considered reclamation should not, therefore, aim only at "neutralizing" the aggressive landscape forms by removing them and restoring the landscape to its state before exploitation because, paradoxically, mining operations result in the creation of landforms that contribute to a higher geodiversity of the landscape and attractiveness to tourists. At the same time, these potential geotourist sites challenge architects in terms of new spatial planning (so-called creative spaces). Modern reclamation projects should be based on individually-tailored designs that integrate post-mining objects with the surrounding landscape. These concepts

should emphasize the openness of the post-mining entity in the landscape (e.g., size, uniqueness, picturesque appearance) while simultaneously meeting the ecological criteria (e.g., the restoration of broken ecological processes and continuities).

The use of post-exploitation regions for geotourism is conditioned by a number of economic, social and environmental factors and functions. In heavily industrialized areas, which frequently lack space for investments in new recreational entities, such areas are of high value (so-called areas of investment reserves). At the same time, in places farther from large settlement centres, post-mining areas may become an interesting component of tourist spaces if appropriately developed. Thus, rational and objective-driven reclamation activities may create the potential for geotouristic exploitation. Such adaptations should be planned as early as the stage of investment planning and until the stage of closing down mining operations.

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