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Original Article

The untapped potential of scenic routes for geotourism: case studies of *Lasocki Grzbiet* and *Pasmo Lesistej* (Western and Central Sudeten Mountains, SW Poland)

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Abstract: A view is often more than just a piece of landscape, framed by the gaze and evoking emotion. Without diminishing these obvious 'tourism-important' advantages of a view, it is noteworthy that in itself it might play the role of an interpretative tool, especially for large-scale phenomena, the knowledge and understanding of which is the goal of geotourism. In this paper, we analyze the importance of scenic drives and trails for tourism, particularly geotourism, focusing on their ability to create conditions for experiencing the dynamically changing landscapes in which lies knowledge of the natural processes shaping the Earth's surface and the methods and degree of its resource exploitation. The issues are found in both wider and local contexts. A more detailed insight has been conducted on the basis of two, although in some sense peripheral, tourism regions from the Sudeten Mountains (southwestern Poland): *Lasocki Grzbiet* (a ridge) and *Pasmo Lesistej* (a small range). The subjects of the investigation were complex: the geotourism potential of selected viewpoints located on the most scenic routes (mostly paths and forest tracks) as well as the problems of maintenance, conservation, and protection of their educational value. Our work is based on desk and field research supported by results of GIS visibility analyses (conducted in the QGIS program).

Keywords: Scenic tourist trails; Scenic drives; View-towers; Viewpoints; Geotourism; Sudeten Mountains

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1 Introduction

Landscape, although variously defined (Daniels 1993; Frydryczak 2013; Hose 2010; Robertson and Richards 2003), is a 'whole' and a value in itself regardless of the individual elements that make it up, and it can be used for various forms of tourism (Meyer 2007; Środulska-Wielgus and Wielgus 2007). This is no different in the case of geotourism. The significance of landscapes in the process of interpreting the Earth's heritage in its widest sense seems to be recognized by academic communities interested in geotourism development and can be seen, for example, in the granting of selected landscapes/views the status of 'geosites' (Migoń and Pijet-Migoń 2017). Extensive panoramas have an illustrative value especially where large-scale processes are recorded in the landscape; they also allow characteristic features of these landscapes to be identified that would be difficult to see

on a microscale. The Grand Canyon of the Colorado river, as a testimony to the power and patience of Mother Nature, certainly makes a greater impression viewed from *Grand Canyon Skywalk & Eagle Point* or other viewpoints than from the bottom of the valley. This is even more important in the case of landscapes predominantly covered with taller vegetation where the best visibility is provided by exposed places where the vegetation has been removed (individually or as a group) as a result of natural or anthropogenic processes.

Although it is difficult to put a landscape into a strict frame, it is relatively easy to determine the observation points of a 'certain view', whose extent, as well as interpretative value, is dictated by the specificity of a place and observation conditions. Education plays a leading role in choosing 'views' in geotourism, but aesthetic value is also of great significance (see: Chylińska 2019) – some 'picturesqueness' or drama is desirable and this can be easily transformed into hundreds or even thousands of 'likes' on Instagram or Facebook. Such features also attract geotourists, although it can be suspected that they are more important for the casual than the dedicated (see classification according to: Hose 2000). Many definitions of geotourism highlight the role landscape in appreciating geoheritage. According to Dowling and Newsome (2010, p. 232) geotourism is "a form of natural area tourism that focuses on geology and landscape. It promotes tourism to geosites and the conservation of geodiversity and an understanding of earth sciences through appreciation and learning. This is achieved in independent visits to geological features, use of geotrails and view points, guided tours, geo-activities and patronage of geosite visitors centers." A similar understanding is suggested by Hose (1995, 2000, 2012) and Joyce (2006). Various scientists investigate the role of views and picturesque in geotourism (e.g. Chylińska 2019; Gordon 2016; Gordon and Baker 2016; Hose 2005a, 2010; Katupotha and Sumanarathna 2020; Migoń and Pijet-Migoń 2017).

Not always an observation point of a valuable view is the work of nature itself. Human intervention is often required here, undertaking various infrastructural measures such as – in its simplest form – cutting away a part of the vegetation to reveal the panorama, or building artificial landscape observation sites in the form of viewing towers and platforms. Behind such activities are substantive factors. These structures facilitate observation of a landscape, including both 'deep' and wide panoramas, and through additional information they allow aesthetic experiences to be enriched with knowledge. Safety aspects are important as well concerning both tourists and the natural environment. Although popular among tourists and useful in geotourism, a limitation is the static nature of a view, with variability only due to daily weather conditions or seasons. Therefore, so-called scenic routes have an advantage over static view-towers and platforms in terms of landscape reception. Scenic roads, following a specific route, allow observation of changing landscapes for tourists. Moreover, connections with other linear infrastructural elements in the form of paved roads, forest or field tracks, paths and marked trails allow tourists to experience valuable views while undertaking various forms of tourism, sport or recreation (for example, see: Denstadli and Jacobsen 2011).

2 Aims and Methods

In the article we want to analyze the tourism potential of selected routes with high scenic and geotourism value in chosen mountain massifs of the Western and Central Sudeten Mountains: *Lasocki Grzbiet* (a ridge) and *Pasmo Lesistej* (a small range) (Figs. 1 and 2). We pay attention to the unused interpretative possibilities of both locations and the 'formula' of the scenic route in the Polish Sudeten Mountains in the context of various forms of tourism, including geotourism. The main part of the work will be preceded by an analysis of the problems of using the landscape in tourism (understood as a view) in the form of both natural scenic routes and artificial facilities that enable the landscape to be 'experienced' (view-towers and platforms). The term 'experiencing' the landscape has been deliberately used here, because by this notion we understand not only the emotional perception of a view's aesthetic value, but also its educational value, especially in the context of understanding the natural and anthropogenic processes shaping the Earth's surface (see: Hose 2005a). The reference to scenic roads, including the most famous in the world, aims to show the importance of dynamically changing views in tourism. Indeed, the tracks of *Lasocki Grzbiet* and *Pasmo Lesistej* are not motor roads (they are aimed at active

tourism), but such routes have not been analyzed in more detail in the literature so far, hence the wider theoretical reference to motor roads is presented. The idea behind them is the same, only the means of transport (movement) are different. As it turns out, scenic routes were quite often popularized in older Polish scientific literature which was decided to be discussed in the text. The last element before the

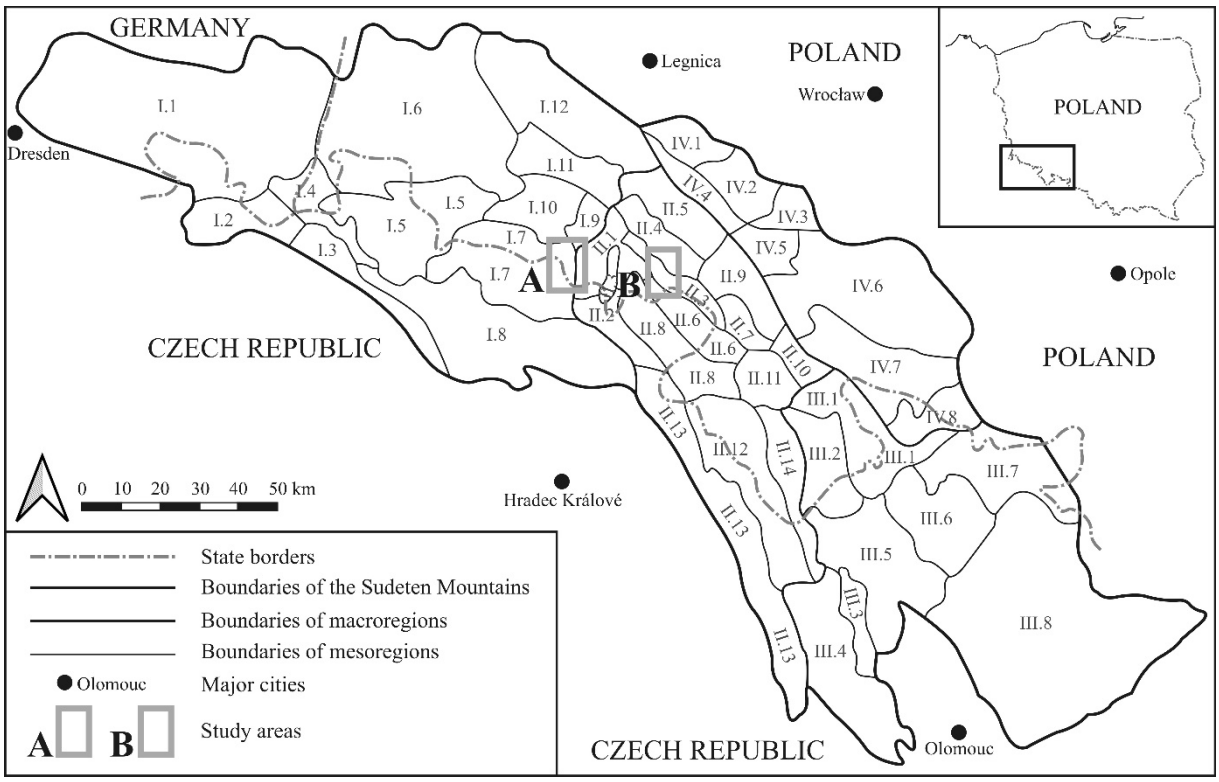

Fig. 1 Study areas at the mesoregion level of the Sudeten Mountains: A. *Lasocki Grzbiet*, B. *Pasmo Lesistej* (southwestern Poland). Source: based on Potocki 2009.

Legend for mesoregion numbering (*Polish*/*Czech*/*German* names depending on location and equivalents in English):

I. *Sudety Zachodnie* – Western Sudeten Mountains: 1. *Pogórze Łużyckie*/*Šluknovská pahorkatina*/*Lausitzer Bergland* – Lusatian Foothills, 2. *Góry Łużyckie*/*Lužické* hory/*Zittauer Gebirge* – Lusatian Mountains, 3. *Ještedsko-kozákovský hřbet* – Ješted-Kozákov Ridge, 4. *Kotlina* Żytawska/*Žitavská pánev* – Zittau Basin, 5. *Góry Izerskie*/*Jizerské hory* – Izerskie Mountains, 6. *Pogórze Izerskie*/Frýdlantská pahorkatina – Izerskie Foothills, 7. *Karkonosze*/Krkonoše – Giant Mountains, 8. *Podgórze Karkonoskie*/*Krkonošské podhůří* – Giant Mountain Foothills, 9. *Rudawy Janowickie*, 10. *Kotlina Jeleniogórska* – Jeleniogórska Basin, 11. *Góry Kaczawskie* – Kaczawskie Mountains, 12. *Pogórze Kaczawskie* – Kaczawa Foothills;

II. *Sudety Środkowe* – Central Sudeten Mountains: 1. *Brama Lubawska* and *Kotlina Kamiennogórska* – Lubawka Gate and Kamienna Góra Basin, 2. *Žacléřská vrchovina* (*Jestřebí hory*) – Žacléř Highlands (Jestřebí Mountains), 3. *Góry Kamienne*/*Vraní hory* and *Javoří hory* – Kamienne Mountains, 4. *Góry Wałbrzyskie* – Wałbrzyskie Mountains, 5. *Pogórze Wałbrzyskie* – Wałbrzych Foothills, 6. *Obniżenie Ścinawki*/*Broumovská kotlina* – Ścinawka Depression, 7. *Obniżenie Noworudzkie* – Nowa Ruda Depression, 8. *Góry Stołowe*/*Broumovská vrchovina* – Stołowe (Table) Mountains, 9. *Góry Sowie* – Sowie Mountains, 10. *Góry Bardzkie* – Bardzkie Mountains, 11. *Kotlina Kłodzka* – Kłodzko Basin, 12. *Góry Orlickie* and *Góry Bystrzyckie*/*Orlické hory* – Orlickie and Bystrzyckie Mountains, 13. *Pogórze Orlickie*/*Podorlická pahorkatina* – Orlickie Foothills, 14. *Rów Górnej Nysy* – Upper Nysa Valley;

III. *Sudety Wschodnie* – Eastern Sudeten Mountains: 1. *Góry Złote*/*Rychlebské hory* – Złote Mountains, 2. *Masyw Śnieżnika*/Králický Sněžník – Śnieżnik Massif, 3. *Mohelnická brázda* – Mohelnice Furrow, 4. Zábřežská vrchovina – Zábřeh Highlands, 5. Hanušovická vrchovina – Hanušovice Highlands, 6. *Wysoki Jesionik*/*Hrubý Jeseník*, 7. *Góry Opawskie*/*Zlatohorská vrchovina* – Opawskie Mountains, 8. *Niski Jesionik*/*Nízký Jeseník*;

IV. *Przedgórze Sudeckie* – Sudeten Foreland: 1. *Wzgórza Strzegomskie* – Strzegom Hills, 2. *Równina Świdnicka* – Świdnica Plain, 3. *Masyw Ślęży* – Ślęża Massif, 4. *Obniżenie Podsudeckie* – Sub-Sudeten Depression, 5. *Kotlina Dzierżoniowska* – Dzierżoniów Basin, 6. *Wzgórza Niemczańsko-Strzelińskie* – Niemcza-Strzelin Hills, 7. *Obniżenie Otmuchowskie*/*Vidnavská nížina* – Otmuchów Depression, 8. *Przedgórze Paczkowskie*/*Žulovská pahorkatina* – Paczków Foreland.

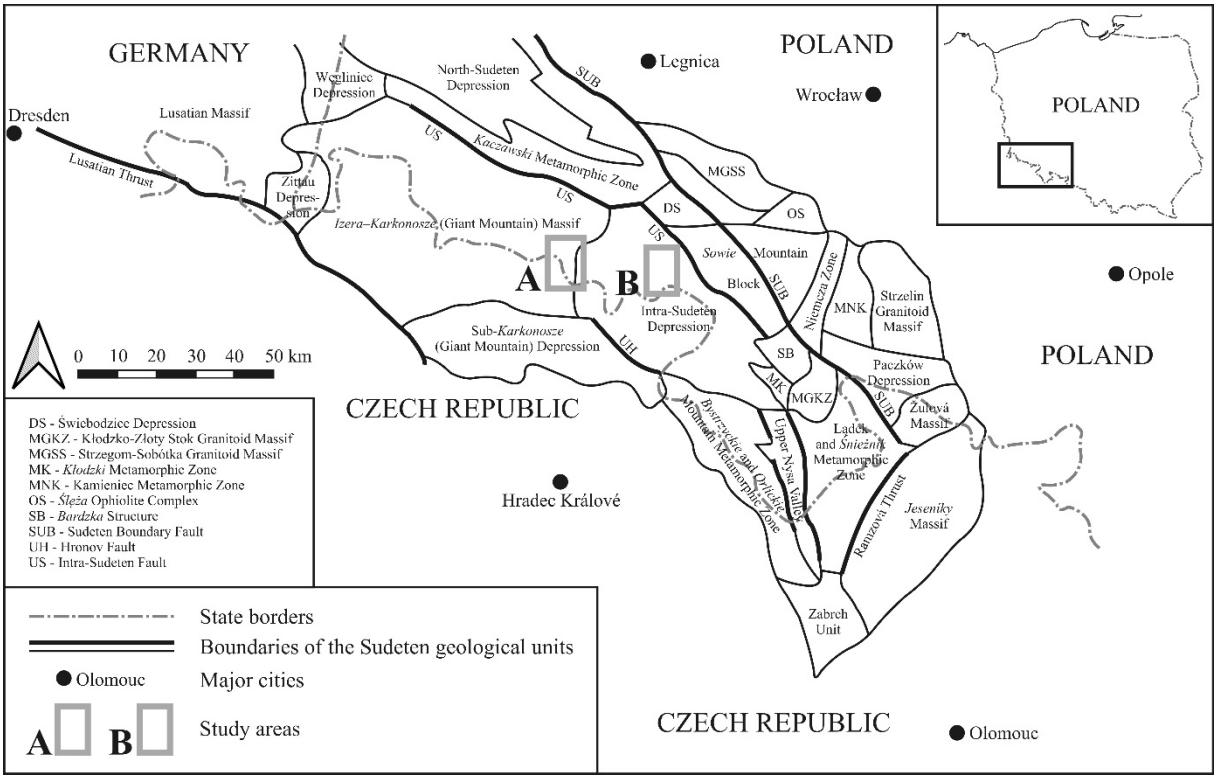

Fig. 2 Simplified sketch of the Sudeten geological units with an indication of the study areas: A. *Lasocki Grzbiet*, B. *Pasmo Lesistej*.

actual analysis is the growing number of view-towers which is noticeable in many mountain ranges in Europe, including the Sudeten. This is evidence of a growing interest in view and landscape perception (and appreciation) in tourism. We will discuss these issues at the theoretical level and referring to the Sudeten Mountains where the 'geotourism' scenic routes analyzed in the article are located. Desk work supplemented with field visits and spatial analyses performed in QGIS software will allow an assessment of the geotourism and scenic potential of the examined routes and regions.

Both studied areas are among the less popular tourist areas in the Sudeten Mountains and at the same time have great potential in terms of e.g. landscape values, including scenic ones, and geoheritage. These factors determined their choice. The proposed solutions, especially the scenic routes, may contribute to their popularization and, at the same time, may help to take over some of the heavy (probably too heavy) tourist traffic in the neighboring regions, e.g. the Giant Mountains (*Karkonosze*) to the west (cf. Potocki 2010), and the *Kamienne* and *Sowie* Mountains to the east (Fig. 1). As a result, tourist flows can be more evenly distributed. Of the two analyzed areas, the *Lasocki Grzbiet* is higher and more compact, with the main ridge being easy to distinguish, while the *Pasmo Lesistej* has a more complicated layout, with few roughly parallel ridges and many valleys cutting into mountain area. Both situations provide suitable conditions for admiring the views. The *Krucze* Mountains (Czech *Vraní Hory*) stretch between the *Lasocki Grzbiet* and the *Pasmo Lesistej*. This mountain range is discussed in the text, but in the context of the areas visible from the two established research areas. Hence, the *Krucze* Mountains are not a formal research area, as they do not have the appropriate scenic values. They are lower than the discussed mountain ranges, to a greater extent covered with forests, and most of all, there are no roads that would provide a suitable scenic experience. The scenic values there are related rather to viewpoints.

Based on field visits in both research areas, we selected routes with special scenic value. We chose wide forest tracks, available to various users for hiking, cycling, skiing, as well as horse riding (in Polish forests this can only take place on marked bridle paths – see: Kacprzyk and Rothert 2013; Krakowska et al. 2014; in the areas analyzed they hardly exist at present but a formal bridle path runs

along the northern edge of *Lasocki Grzbiet* and south of *Pasmo Lesistej*). Indicated scenic routes allow wide landscapes to be admired over a considerable distance, and thanks to a diversified horizontal profile (especially in *Pasmo Lesistej*) they ensure continuous changes of perspective, and thus the 'dynamization' of the landscape. Next, as part of the scenic assessment of the examined routes, analyses were conducted of views from selected points on these tracks, using the Viewshed tool in QGIS software and a digital elevation model for a 10 m² grid. We selected the points based on field visits and a map with an average height for ground cover calculated for the same 10 m² grid. Thanks to this, we were sure that the analyses were carried out for locations that actually have significant visibility, avoiding places where the view is obstructed by vegetation. We set an observer height at 1.6 m. Taller people will be able to see more of the landscape, similarly in the case of building even a low platform (although this applies more to immediate views, especially valleys at the foot of selected scenic routes). In order to assess the geotourism potential of the examined routes we identified sites (geographical districts, ridges, summits, important valleys, other significant geoheritage features, e.g. quarries) visible from selected routes. For chosen points, we have also included photos of the panoramas. All analyses were aimed at showing not only the aesthetic, but also the educational potential of scenic routes and the way they can help tourists to understand and appreciate geological and geomorphological phenomena in a macroscale, as they can be observed in a landscape.

3 Viewpoints and Scenic Routes in Tourism

The landscape has various connections with tourism. Generally speaking, tourism happens in certain landscapes, transforms them, sometimes even creates them. At the same time the landscape and its special attributes can be attractive (usually due to aesthetic value or connections with culture and media) becoming a kind of pull factor for tourists (Kulczyk 2013). Due to this, a separate tourism form has emerged which is landscape tourism (Frydryczak 2013). In addition, as already mentioned, in some tourism types, the landscape can be a handy tool for transmitting, explaining and interpreting various phenomena or processes, both cultural (e.g. industrial tourism) and natural (e.g. geotourism). One tool, with very long traditions in making it easier to view a landscape, is a view-tower (Potocki 2004, 2014). Originally built for other purposes, church towers, town hall towers, defensive towers (or other elements of defensive architecture used for observation) and lighthouses have become, along with tourism development (especially mass tourism), popular landscape observation sites. Gradually, especially designed structures have been erected for this purpose, attractive not only because of their basic function, but also their visionary architecture or form (especially in the United States or Australia, e.g. at the summit of *Black Mountain* over Canberra, the tower has open and closed galleries and a restaurant that performs a full turn within 80 minutes; Duda-Seifert 2010). Tourists are attracted not only by view-towers, but also by Ferris wheels (e.g. London Eye), treetop walkways, glazed footbridges and viewing platforms (e.g. *Grand Canyon Skywalk*).

Fig. 3 A platform allowing the landscape to be admired from the road below *Col de la Schlucht* Pass (1139 m), on the popular scenic road, the *Route des Crêtes*, and a view from it to the eastern slopes of the Vosges, France (photos were taken by the authors in 2019).

Along with the development of the transportation network (road and rail) and the appreciation not only of the aesthetic but the educational value of the landscape, selected transport routes have been given the status of scenic roads, usually along with a proper tourism infrastructure. The latter is to ensure the safety of vehicle parking off the road and for people to admire the view from exposed, and thus possibly dangerous, viewpoints (Fig. 3). As Kent and Elliott (1995) wrote, already by the 1980s in the Scenic Byways publication issued by the US Department of Transportation/Federal Highway Administration, attention was drawn to the fact that the scenic road is a natural transport corridor characterized by the high aesthetic value of the surrounding natural or cultural environment which at the same time gives the traveler an insight into history, nature, geology and the typical landscapes of the area through which the route leads. All this contributes to the significant educational potential of scenic roads. Scenic drives using the

existing road network are of great importance in various forms of road tourism for example by car or motorcycle (e.g. Eby and Molnar 2002; Scuttari 2019). As Cater (2017) wrote, in these forms of tourism, the picturesqueness of a transportation route, understood as the presence of scenic stopping points, is important for 76% of motorized tourists when choosing destinations, and comparable in importance to road conditions and ease of parking. Due to the stimuli provided, scenic routes are indicated as a form of escape from daily routine (Frash et al. 2018), or as an important source of experience (Hallo and Manning 2009; Scuttari 2019; Qiu 2018). The belief that the scenic value of transport routes can be of value for tourists has initiated a number of analyses that have both cognitive and practical value for researchers, enabling the best tourist scenic routes to be chosen, along with approaches to development and promotion (Akbar et al. 2003; Alivand et al. 2015; Clay and Daniel 2000; Clay and Smidt 2004; Eby and Molnar 2002; Hanrahan et al. 2017).

Referring to trails focused on active tourism (hiking, cycling and cross-country skiing), the role of the landscape and views was highlighted by a few authors (e.g. Hose 2018a, 2018b; Rogowski 2009, 2012), however not as often as in case of scenic drives, especially regarding recent years.

4 Important World Scenic Roads

Nowadays, there are many transport routes around the world whose scenic value is appreciated by everyday users and visitors, making these roads themselves an attraction. The most famous are certainly the *Great Ocean Road* in Australia and *Chapman's Peak Drive* in South Africa (between Hout Bay and Noorde Hoek). In addition to the spectacular coastal landscapes, both offer high-class geotourism value. The first, built in 1919 by Australian veterans of the Great War as a commemoration of fallen comrades, allows users to admire the spectacular abrasive landforms and high cliffs of the southeast Australian coast (including formations protected in the Port Campbell National Park). The second – comparably old (1922) – leads along the steep slopes of *Chapman's Peak* massif (593 m), where the sediments (sandstones, siltstones and mudstones) of the Table Mountain Group (490–400 million years old) lie on granites formed as a result of the intrusion (540 million years ago) of a huge batholith within the pre-Cambrian greywacke, phyllite and schist rocks of the so-called Malmesbury Group (Council for Geosites 2014). *Chapman's Peak Drive* is also at risk from mass movements, landslides and rock falls, which has repeatedly been the reason for its temporary closure (Chapman's Peak Drive n.d.), while at the same time having significant educational value.

In the United States, roads with exceptional landscape, natural, cultural, historical, archaeological and recreational value are covered by the *America's Byways* federal program (early 1990s; National Park Service 1990). Among the current 150 certified roads in 46 states, two categories are distinguished: *All-American Roads* classified as the most valuable (42 roads) and *National Scenic Byways* (US Department of Transportation n.d.). The growing understanding of such activities is evidenced by the fact that at the turn of the millennium, the number of roads in both categories was just over 70 from 32 states (Draper and Petty 2001). Many of the certified scenic drives have high geotourism value, showing landscapes resulting from large-scale geological, tectonic and geomorphological processes. These include, among others, the famous *Blue Ridge Parkway* (North Carolina, Virginia), *Grand Mesa Scenic and Historic Byway* (lava-capped plateau, Colorado), *Death Valley Scenic Byway* (California) and *Scenic Byway 12* (Utah).

The legendary *Ruta 40*, located in Argentina's wilderness area parallel to the Andes, is an asphalt or gravel road, comparable to other famous transcontinental routes in North America (*US Route 66*, *Trans-Canada Highway*) or Australia (*Stuart Highway*). Due to its significant length *Ruta 40* runs in the vicinity of various landscapes and close to famous (geo)attractions: *Cueva de las Manos*, known for its ancient cave art, Los Glaciares National Park (*Los Glaciares National Park* 2020), as well as deserts and the green *Calchaquí Valleys*. In Asia, particularly scenic and, at the same time, extremely dangerous drives include *Tianmen Mountain Road* in China with 99 harmoniously-stacked hairpin bends. Breath-taking mountain views can be enjoyed by visitors not only onboard tourist coaches, but also by using trails with glass platforms or hanging footbridges. Documenting the processes of karst decay, the spectacular landscape consists of numerous caves, as well as steep cliffs and precipices falling into deep valleys (*Tianmen Mountain*... 2020).

In Europe, often visited is the Grossglockner *Hochalpenstrasse* (High Alpine Road) in Austria. Built in 1935, with a length of 48 km, this mountain road runs through the harsh landscape of *Hohe Tauern*, offering spectacular views of *Grossglockner* (3798 m) or the *Pasterzen Kees* glacier. The *Route des Crêtes* runs in the slightly lower French Vosges Mountains (Fig. 4). This 73 km road, in addition to landscapes typical of the range, in several places offers 'deep' views into the neighboring Rhine Valley with the German *Schwarzwald* running parallel to it. On clear days tourists can see the Alps. The road also connects places of great cultural and commemorative significance, associated with the battles of World War I. Besides this, the road itself was built as part of war-related activities. Due to the enormous popularity of the *Route des Crêtes* in the summer season, there were attempts to restrict traffic by a speed limit and launching regular bus lines which were supposed to take at least some tourists to the most important vantage points and tourist trails. There were also suggestions to close some sections for the summer (Mounet 2008).

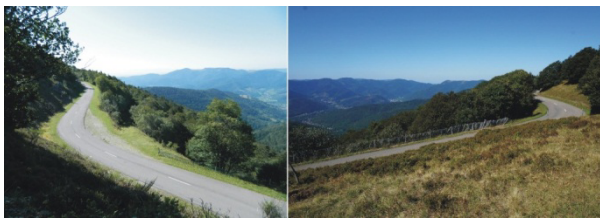

Fig. 4 Sections of the *Route des Crêtes* in the French Vosges (photos were taken by the authors in 2019).

Among European scenic roads other natural landscapes than mountainous can be found. The *Wild Atlantic Way* in Ireland is a scenic drive project currently being implemented (Hanrahan et al. 2017), whose landscape potential evokes the most legitimate associations with the spectacular landscapes of the Australian *Great Ocean Road* or the South African *Garden Route*. It is planned to stretch between Kinsale (County Cork) and Cape Inishowen (County Donegal) and partly would use already existing and touristically certified scenic routes (e.g. with Michelin stars). The choice of the right course is to be based on many criteria, which include view attractiveness. Among the numerous interpretive points for the route, many are associated with the geomorphological processes occurring at the contact of the ocean and the land and their forms in the landscape (cliffs, estuaries, beaches, etc.). If the project is fully implemented, it will be the longest coastal scenic route in the world (Fáilte Ireland n.d.).

Among European countries, however, Norway deserves special attention in terms of scenic roads and their use in tourism. Similar to the United States, the first attempts to create a system of tourist-certified scenic routes (Norwegian Scenic Routes: *Nasjonale Turistveger*) were made in the early 1990s, using experience from the USA, Germany (*Romantische Strasse*) and France (*Route du Vin*). Starting from 1994, Norway has designated, classified and equipped with the necessary infrastructure 18 national scenic routes (250 scenic recreation points, as of 2014), running in all landscapes from the fjord coasts, through island archipelagos to vast mountain plateaus (2151 km in total; Statens vegvesen 2018). Among them are the famous *Geirangen-Trollstigen* road and the *Lofoten Highway*. This unique Norwegian tourism product was created in cooperation with landscape architects and constructors from many prestigious architectural studios and this distinguishes it from other such initiatives. Its importance for Norway's tourism is also evidenced by the fact that by 2024, the government of Norway will allocate a total of NOK 3.4 billion for the construction and development of route networks, while NOK 0.45 billion will be provided by other stakeholders (Forlaget Press 2016).

5 Importance of Scenic Routes in Poland

The area of interest in this article is the Polish part of the Sudeten Mountains, therefore it seems justified to present the importance of views for tourism and scenic routes in the Polish literature. These issues appear mostly in older publications, whereas nowadays landscape value has given way mainly to a tourism product approach. Among the publications from the times when Polish tourism – like the entire economy – was to a large extent centrally controlled, it is worth paying attention to the work by Werner (1980) who placed providing scenic value among the most important tourism functions of roads and – at the same time – a factor affecting their attractiveness. Among several types of tourist road, he listed those that ran through areas of high landscape value, primarily of varied relief, including mountainous landscapes. The route of roads in such terrain depends on morphological conditions; they

are characterized by a varied profile and provide users with diverse visual impressions. According to Werner (1980), the tourist road does not necessarily have to provide fast travel, but should show the value of the area from different places (perspectives). Among features that affect attractiveness and are related to scenic value, the author mentions altitude, differentiation of the road's vertical and horizontal profiles and the range of views. Roads crossing ridges, mountain passes and other relief on their summit and downhill sections are usually characterized by exceptional visibility. The altitude of the road has an impact on view quality, whether it is observed from above or at eye level, while the range of views depends on the terrain: it can be distant both from roads crossing summits as well as from roads leading through large valleys.

Among scenic drives in Poland, the following are mentioned: the so-called 'Sudeten Highway', *Autostrada Sudecka*, also known as the 'Sudeten Road', *Droga Sudecka* (Różycki 1973; Werner 1980, 2010a); and the 'Carpathian Road', *Droga Karpacka* (Czerwiński et al. 1991; Kruczała 1973; Murczyński 1973; Rygielski 1981; Wzorek 1973), both running through the most important mountain ranges of southern Poland, as well as the 'Kashubian Road', *Droga Kaszubska*. The first one, like the *Route des Crêtes*, was built for military needs before World War II (1931–1938). From the plan as a whole (it was supposed to have stretched along the entire Sudeten range, from Zittau through Świeradów-Zdrój, Szklarska Poręba, Lubawka, Broumov, Radków, Kudowa-Zdrój, Międzylesie, Hanušovice and Bruntál to Opava), only two sections were created: from Świeradów-Zdrój to Szklarska Poręba in the *Izerskie* Mountains and a section in the *Orlickie* and *Bystrzyckie* Mountains, i.e. in the western part of the Kłodzko region (Battek et al. 1991; Brygiel and Dudziak 2010; Staffa et al. 1992). After World War II, the road lost its military significance (due to the inclusion of Lower Silesia into Poland and the fact that both Poland and Czechoslovakia became part of the bloc of socialist states) and its tourism function (due to restrictive regulations regarding staying in the border zone). The last, due to outstanding scenic value, regained importance after the changing of border regulations in the communist period as early as the 1970s (this is a period of intensive analysis of scenic routes in Poland). The section in the Kłodzko region is currently poorly maintained on most of its route and has little traffic but tourism clearly dominates. After Poland's accession to the European Union, plans for its revitalization and tourism development came into being, but were not implemented (one positive exception is the viewpoint at *Jedlnik*, 746 m). The 'Carpathian Road' was a concept of connecting several roads with great landscape value, dating back to pre-war times. There were, also unrealized, plans to combine both these routes (Sudeten and Carpathian) and create a single tourist product (Czerwiński et al. 1991; Goetel 1973). Attention was also paid to the landscape value of other roads in the Sudeten Mountains, including the Kłodzko region (Werner 1980). An example of a famous vantage point associated with a roadway is the so-called Death Bend (*Zakręt Śmierci*), from which a great view of the Giant Mountains and the *Jeleniogórska* Basin can be seen. A scenic drive in the Polish lowlands is the 'Kashubian Road' built in 1965–1967 in an attractive and picturesque section of the Kashubian Landscape Park (Rząd-Górnicki and Walicki 1971). In the 1980s and 1990s, attractive landscape and scenic roads were marked on tourist maps at large and medium scales issued by the Polish Cartographic Publishing Company (*Polskie Przedsiębiorstwo Wydawnictw Kartograficznych*).

The role of scenic value is noticed in the Polish literature not only in the case of roads, but also on walking (hiking) trails. Sewerniak (1982) stated that a walking trail is an ordered set of points from which the landscape can be observed. The desired impressions can be controlled through a properly selected route, leading to specific panoramas with landscape dominants giving the impression of a dynamic or static landscape, the first being more desirable. There should be stopping places at locations with interesting view-points, leading to sightlines. Sewerniak also wrote about the importance of views in his earlier works (1980a, 1980b), pointing out, for example, that viewpoints or their surroundings should be well equipped with tourist infrastructure (e.g. resting places) which is consistent with current trends, for instance the Norwegian routes. The appropriate blending of the architecture of newly-created tourist facilities into the landscape was often emphasized in terms of forms, building materials and colors. Unfortunately, this was not necessarily reflected in practice. Similar to Werner (1980; cf. Werner 2010b), scenic value has become one of the key elements for assessing the

attractiveness of tourist trails (Kołodziejczyk 2020a; Kucharska 2006; Rogowski 2008, 2009, 2010, 2011, 2012; Styperek 2002). However, this is not reflected in the appreciation of the role of scenic routes in contemporary Polish academic literature in the field of tourism.

Recently, however, perhaps as a consequence of the renaissance of tourists' interest in view-towers (discussed below), there have been individual infrastructural items in the Sudeten Mountains aimed at facilitating the admiration of views from roads or tourist trails leading along major forest tracks (Figs. 5 and 6).

6 New View-towers as an Expression of the Revival of the Importance of a View to a Tourist

Explicit evidence of the growing importance of a view and its admiration in recent years is the increase in the number of view-towers on various mountain ranges, including the Sudeten, both on the Polish and Czech sides of the border (Fig. 7). Although the oldest view-towers in this area date back to the early 19th century (they were then private buildings, especially popular in the former Prussia in the Sudeten Mountains, most often taking the form of artificial ruins; it was only with time they were made available for tourism – Potocki 2004), the beginning of the 21st century is a period when dozens of new ones have appeared. Moreover, several older ones have been restored and made accessible again, as they had become unavailable or lost their viewing function in the 20th century, usually by neglect soon after World War II. Towers in Fig. 7 were intentionally divided into several categories: those built before World War I, during the interwar period, after World War II, after the fall of communism, after Poland and the Czech Republic joined the European Union, and after the inclusion of these countries into the Schengen area. These were key moments for tourism development, including tourism infrastructure, and more broadly for general economic development in the Sudeten Mountains. The view-towers built in the 21st century levelled out an earlier disproportion in the distribution of such facilities in this mountain range (Fig. 7).

Structures prior to 1919, usually built by tourist organizations or owners of accommodation and catering facilities (Potocki 2004, 2014; Przerwa 2005), occur almost exclusively in the western part of the range, from the Lusatian Mountains to the Giant Mountains along with their Czech foreland, the *Jeleniogórska* Basin and the *Kaczawskie* Mountains (Figs. 1 and 7). Further east, the view-towers which are still accessible today and belonging to the oldest group are found only near spas or larger settlements

Fig. 5 Viewing platforms and the views from them: platform (A) on the Chełmsko Śląskie-Różana road and the view (B) over the *Krucze* Mountains, *Brama Lubawska* with the Giant Mountains in the background; view (C) of the Wałbrzych Basin, *Wałbrzyskie* Mountains, including *Chełmiec* Massif, seen from platform (D) located by the forest track on the slopes of *Dłużyna* (677 m) (photos were taken by the authors in 2019).

Fig. 6 The viewing platform by a forest track and the black-marked Zagórze Śląskie-Walim hiking trail (A) and the view overlooking Lake Bystrzyckie (B). The lake is anthropogenic, created by flooding the gorge of the River Bystrzyca at the beginning of the 20th century for flood control and hydro-energy purposes (photos were taken by the authors in 2019).

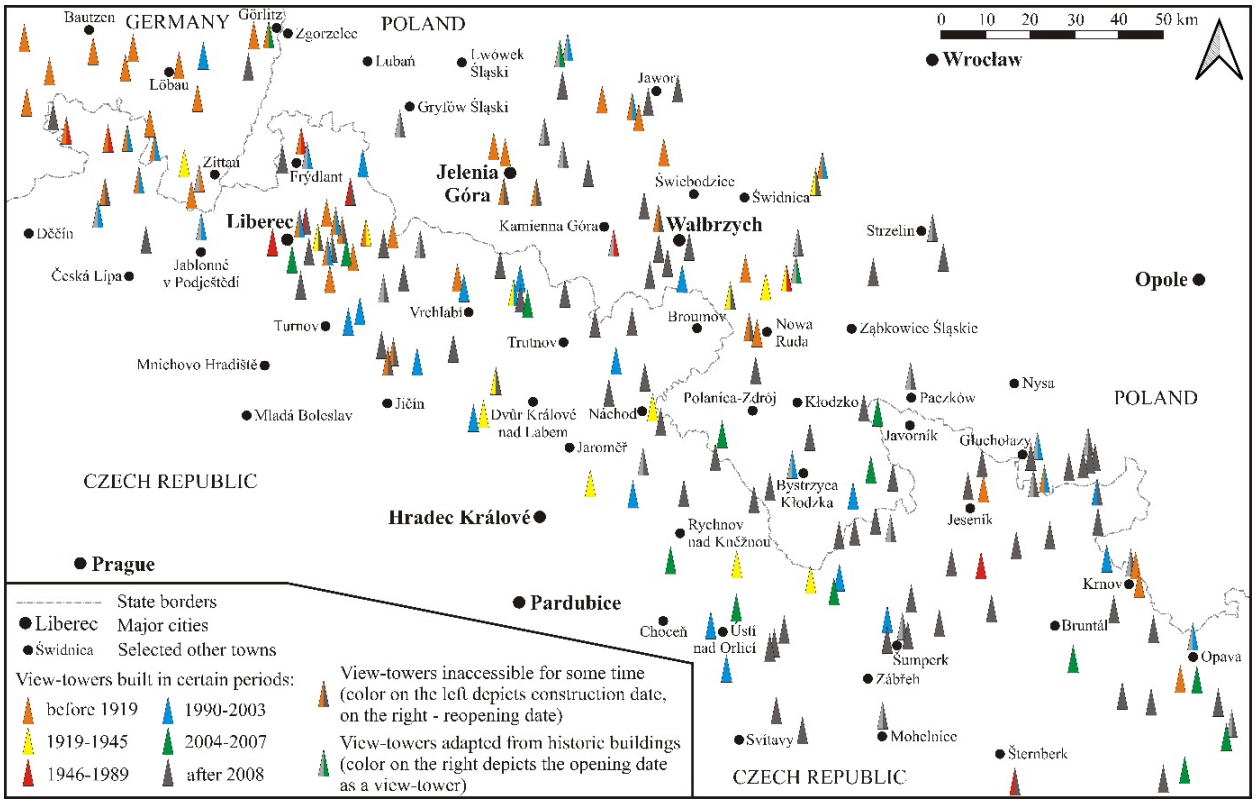

Fig. 7 Sudeten view-towers available for tourists in 2020 according to construction period.

that were the source of recreation or tourism (Wałbrzych, Szczawno-Zdrój, Nowa Ruda, Jeseník, Zlaté Hory, Krnov, Opava) but in regions that lacked natural 'view openings' (Potocki 2004). In the interwar period, only single examples were built, mainly in the Central Sudeten Mountains, but most were still located more to the west (Potocki 2004). Even fewer towers were built during the communist period (and many structures were destroyed on the Polish side of the Sudeten Mountains; in the 1980s, only 10 towers were accessible out of 50 after World War II – Potocki 2014). Only the period of systemic transformation brought some revival in this respect, covering the entire length of the range, but almost exclusively on the Czech side (in the years 1990–2003 only one new tower was built on the Polish side on *Czarna Góra*, 1205 m). Additionally there were two very close to the state border but formally in the Czech Republic. During this period, several towers which had become inaccessible during the communist period were re-opened.

Significantly more towers began to appear after the accession of Poland and the Czech Republic to the European Union whose funds were used to erect a significant number of them, sometimes together with accompanying infrastructure. Most were built in the Czech part of the Eastern Sudeten Mountains, but from 2004 to today, in each mountain range on both sides of the border, at least one structure has been built to enjoy the views. New investments took place even in ranges that were previously well equipped in this aspect, e.g. in the Czech *Izerské* (*Jizera*) Mountains and the Lusatian Mountains and Foothills (Figs. 1 and 7). Thanks to investments in the Central and Eastern Sudeten Mountains view-towers are now distributed quite evenly throughout the entire range, although the Czech side has an advantage especially in the *Izerské* Mountains (this advantage was also noticeable in each of the periods mentioned above – Fig. 7). On the Polish side, Wałbrzych and Nowa Ruda regions have the most view-towers. Throughout history they have taken a variety of forms and have been built from wood, brick or steel (Potocki 2014). This diversity has persisted to this day.

The new towers are generally an expression of the growing importance of scenic value, especially in case of forested peaks, which increases the tourist attractiveness of these places. There are, however, exceptions, examples of towers that do not fully fulfil their intended function or are unnecessary because

they were created in places already very scenic (and those built on treeless peaks are dissonant in the landscape). An example of the first is a tower at Ciechanowice near Jelenia Góra, which stands among trees on a low hill (430 m) within the Bóbr valley, or on *Gromnik* near Strzelin. Both are too low and virtually the entire view is obscured by trees. In turn, examples of the second are the towers on *Ruprechtický Spičák* (881 m) near Broumov, *Val* (790 m) near the town of Králíky and the still unbuilt tower on *Śnieżnik* (1426 m, reconstruction of the structure that was blown up in 1973). The problem from the perspective of landscape perception, including geoheritage content, is that many towers (including those recently opened), as well as other viewpoints, are not equipped with any boards (panels) to give information about what the tourist is looking at (e.g. panoramas with the names of summits, settlements and other important places). In older constructions, such boards are often damaged. As a result, the admired views have become nameless landscapes and for most people, who do not necessarily have the knowledge of local topography, the only attraction is to view a large area, admired from a considerable height. Tourists do not even get basic information about the names of the main topographic locations, let alone interpret the relief and explain it by referring to particular morphological factors (e.g. geological structure, mass movements, erosion).

7 Potential of Lasocki Grzbiet

7.1 General characteristic and geosites

Lasocki Grzbiet (*Łysocina*, 1188 m) is a ridge about 9 km long classified as part of the eastern Giant Mountains in the macroregion of the Western Sudeten Mountains (Figs. 1, 2 and 8) located along the state border (on the Czech side the name *Pomezní hřeben* is used). It declines to the east becoming *Brama Lubawska*, and on the Czech side, the range of *Rýchory*. It is separated from the main ridge of the Giant Mountains by the picturesque *Okraj* Pass (1046 m, the roads leading to it on both sides of the border have high scenic value), while through the *Sulica* Massif (943 m) and the *Kowarska* Pass (728 m) it connects with the *Rudawy Janowickie* range (Staffa et al. 1993). Topographically, *Lasocki Grzbiet* consists of the elongated N-S ridge of *Łysocina* and shorter, transverse ridges leading in the main to the east: *Dzwonkówka* (1004 m), *Borowa* (1056 m), *Bielec* (931 m), *Biała* (915 m) and *Średniak* (849 m). As Kasprzak and Traczyk wrote (2013), *Lasocki Grzbiet* has a great deal of 'geomorphological energy'[1] as relative heights are mostly in a range from 90 to over 120 m, lower differences (30–40 m) are less frequent including the cols between the summits, and in the largest river valleys (*Srebrnik* and *Biała Woda*). Therefore, the terrain and geological structure in some places is conducive to the occurrence of rapid denudation processes, e.g. mass-wasting (Fig. 1 in Sikora and Wojciechowski 2019).

Lasocki Grzbiet consists mostly of the metamorphic rocks that form part of the Giant Mountain batholith shield (Mazur 1995). There are phyllites here, for which the starting material was fine-grained sedimentary rock from a marine environment (mudstone-clay) dated to the Ordovician-Silurian period. Furthermore, the massif is built of amphibolite and greenstone, i.e. metamorphosed undersea volcanic rocks with a composition similar to basalt, and mica slate. Apart from these, small outcrops of quartzites, chlorite schists, silica-graphite and crystalline limestones can be found. Gneisses, which also occur in the region, between the *Biała Woda* and *Złotna* valleys (in the vicinity of *Białe Skały*), belong to a separate geological unit, called Leszczyniec. Among the rocks forming the *Lasocki Grzbiet* foothills are conglomerates and sedimentary breccias of the early Carboniferous, whose sharp-edged boulders or cobbles set in a relatively finer-grained matrix originate from the massif of the *pre-Karkonosze* (pre-Giant Mountains), subject to uplifting and intensively eroded (Migoń 2012a).

In terms of terrain and land cover, *Lasocki Grzbiet* creates many opportunities for various forms of tourism and recreation, and in all seasons. These are primarily hiking, cycling and cross-country skiing.

Due to the fact that, relatively, many slopes have a southern, south eastern and south western exposure (Kasprzak and Traczyk 2013), physical activity can

[1] As Kasprzak and Traczyk (2013) stated, the geomorphological energy is a parameter indicating the differences in height in a given surrounding for each raster of the numeric terrain model. The geomorphological energy parameter for the Giant Mountains area was determined by the authors for a field with a radius of 250 m, i.e. with an area of 6.25 ha. Based on the value of this parameter, susceptibility to the occurrence and types of land denudation can be calculated.

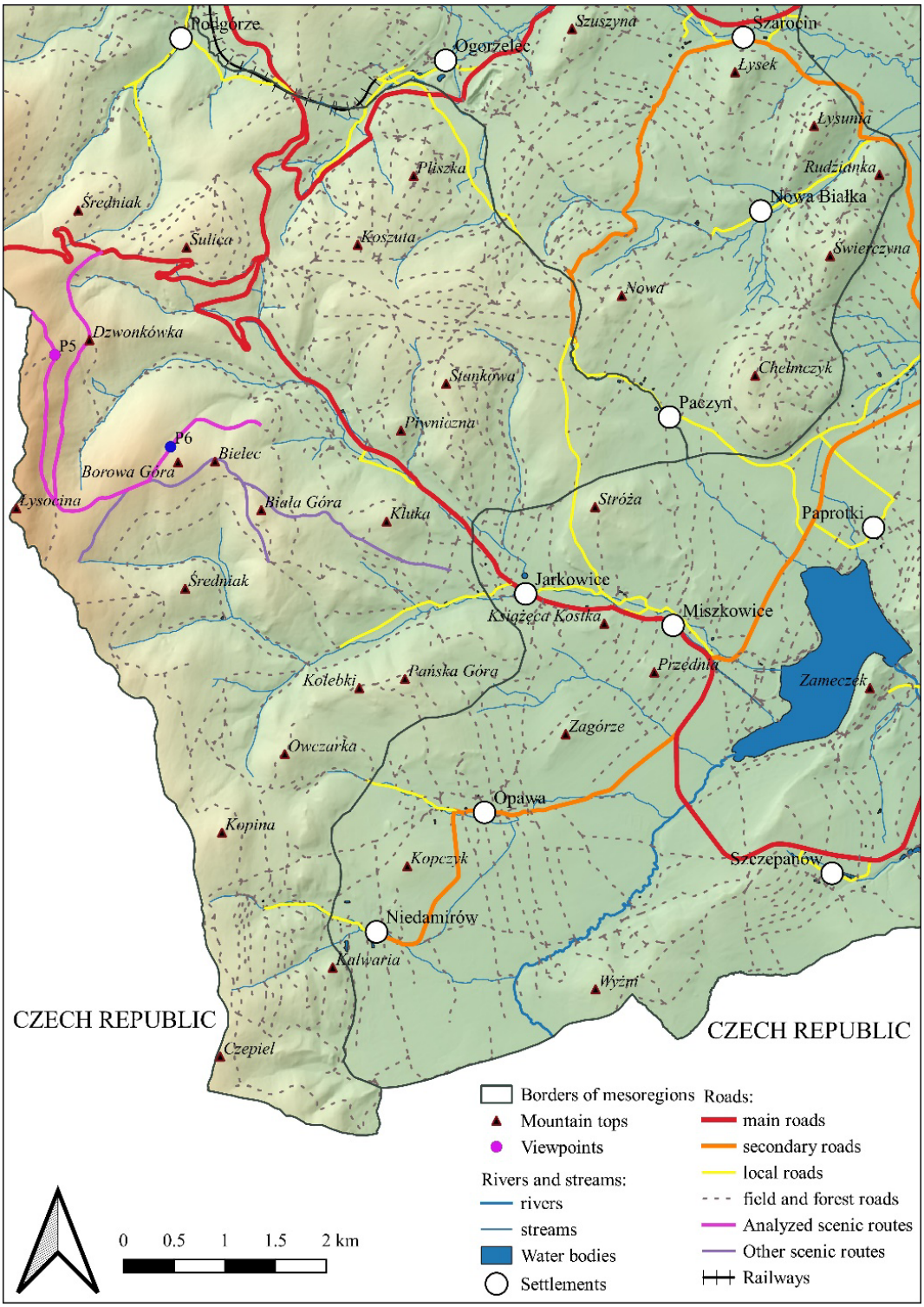

Fig. 8 *Lasocki Grzbiet* and its eastern foreland (western part of *Brama Lubawska*) along with the current road network and scenic routes.

occur here in good sunlight conditions. The geotourism attractiveness of *Lasocki Grzbiet* in terms of rank and concentration of geosites is lower than for the main ridge of the Giant Mountains (Knapik et al. 2011) (Table 1) which, however, is compensated for to some extent by the greater tourist accessibility of the geo-attractions present, understood as the opportunity to explore the area on foot, by bike or on skis. *Lasocki*

Table 1 Potential geoheritage sites on *Lasocki Grzbiet*

Geo-attraction	Characteristic	Tourism and geotourism infrastructure	Literature
Białe Skały	A group of amphibolite and gneiss rocks on the slopes of *Bielec* (931 m). At an altitude of 919 m the border between the southern Giant Mountains (phyllites) and the Leszczyniec Unit (gneisses, amphibolite and greenstone) can be observed.	Yellow hiking trail, educational trail, red and green bicycle trails	Knapik and Migoń 2011; Staffa et al. 1993; Vlček 2014
Lime kilns in Jarkowice	Dating from the 18th century, two partially preserved lime kilns being evidence of the extraction and processing of crystalline limestones (Cambrian, Silurian): 1. in the *Srebrnik* Valley, below the mouth of its right tributary, *Biała Woda*; 2. on the left bank of the *Złotna*, by the road from Jarkowice to Kowary. Former crystalline limestone quarries are connected with both.	Information boards with general sightseeing content, yellow and red hiking trails, educational trail, black bicycle trail	Knapik and Migoń 2011
Conglomerates in the Srebrnik valley	An outcrop on the left bank of the *Srebrnik*, with visible weakly encrusted pebbles. A geological border between the Intra-Sudeten Depression and the metamorphic rocks of the eastern shield of the Giant Mountain massif.	Blue hiking trail, educational trail	Knapik and Migoń 2011
Former agricultural terraces	At the foot of *Lasocki Grzbiet*, a testimony to former agricultural activity, currently afforested as a result of changes in farming and population after World War II.	Tourist trails in various locations	Knapik and Migoń 2011
Mass-wasting	Traces of landslides by the red tourist trail between *Okraj* Pass and *Rozdroże pod Łysocinq*.	Red hiking trail	Sikora and Wojciechowski 2019

Grzbiet is located outside the Giant Mountains National Park. This circumstance is usually considered as a weak point for tourist potential (the national park has a higher tourist rank, and thus attracts and concentrates tourism), but in this case it means the pleasures resulting from less tourism, away from the heavily exploited tourist trails of the western Giant Mountains. Protective regimes cover less land here, although this does not mean their absence: the black grouse (*Tetrao tetrix*) nests in some places on *Lasocki Grzbiet* (Klatka and Jarkowice forests, but in 2017 there were only five individuals, Sodolewski 2019) and this has resulted in the temporary closure of sections of selected tourist trails[2].

The scenic and geotourism value of *Lasocki Grzbiet* in relation to the road network has so far been noticed mainly along the so-called *Sudeten Geostrada* (Cwojdziński et al. 2011) and are described in the geotourism guide by Cwojdziński and Kozdrój (2007) as part of the Kamienna Góra – Marciszów – Wieściszowice – Rędziny – Czarnów – Pisarzowice – Leszczyniec – Ogorzelec – *Kowarska* Pass – *Okraj* Pass section. Alt hough its potential was appreciated and popularized by preparing professional geotourist guides, websites and information boards placed along the *Geostrada* at several important locations, no roadside leisure and viewing points were prepared (*Geostrada Sudecka* n.d.). At the same time, the potential of the existing tourism infrastructure in *Lasocki Grzbiet* has not been used for facilitating its educational and aesthetic landscape values, although they are significant for many reasons. *Lasocki Grzbiet*, together with *Brama Lubawska*, and the *Krucze* and *Zawory* Mountains accompanying it from the east, have become a space in which a cross-border (Czech-Polish) geological educational trail has been prepared, intended mainly for families with children (Vlček 2014). However, this path is only 'virtual' (cf. Kołodziejczyk 2014; Stasiak 2006), no boards or other educational facilities have been prepared along its route.

7.2 Results – scenic potential for geoheritage appreciation

The routes of hiking trails and unmarked tracks and paths within *Lasocki Grzbiet* naturally favor admiring the landscape. This is because they usually traverse slopes and at the same time large sections are devoid of tall vegetation, so numerous scenic 'openings' are found. Simultaneously, the dominant

[2] Unfortunately, this applies to the most scenically valuable: the red tourist trail from the *Okra*j Pass to *Rozdroże pod Łysocinq* and blue tourist trail from there towards the road connecting the *Okraj* and *Kowarska* Passes.

Table 2 Scenic routes analyzed in the paper

Region	Scenic route (distance)	Potential types of tourist activities	Types of geotourists according to Hose (2000)	Viewpoints with visibility analysis in Fig. 9	Most important geoheritage topics possible to discuss
Lasocki Grzbiet	*Okraj* Pass – *Rozdroże pod Łysocinq* (2.9 km)	Hiking, cycling, cross-country skying	predominantly casual, additionally dedicated	P5	geographical regions, geological units, local relief, geological evolution of the Sudeten Mountains, cuesta landscape, river gorges, volcanic activity, exploitation of mineral resources
Lasocki Grzbiet	*Rozdroże pod Średniakiem* – *Dzwonkówka* – *Rozdroże pod Łysocinq* – *Borowa Góra* (5.2 km)	Hiking, cycling, cross-country skying	predominantly casual, additionally dedicated	P6	geographical regions, geological units, local relief, geological evolution of the Sudeten Mountains, cuesta landscape, river gorges, volcanic activity, exploitation of mineral resources
Pasmo Lesistej	*Polanka* Pass – slopes of *Wysoka* – slopes of *Stachoń* – crossing below *Sucha Góra* (4.6 km)	Hiking, cycling, cross-country skying	predominantly casual, additionally dedicated	P3, P4	geographical regions, geological units, cuesta landscape, exploitation of mineral resources
Pasmo Lesistej	Unisław Dolny – *Lesista Mała* – *Ostrosz* (3.5 km)	Hiking, cycling, cross-country skying	predominantly casual, additionally dedicated	P1, P2	geographical regions, geological units, local relief, cuesta landscape, river gorges, volcanic activity, landslides, 'table'-type mountains

geomorphological type, where ridges with steep slopes and deep valleys in a dendritic arrangement occur (Kasprzak and Traczyk 2013), together with perpendicular side ridges, make the views here particularly 'deep'. It is obvious that the best viewing opportunities are provided by the highest tracks. On *Las ocki Grzbiet* these include two forest tracks leading from *Rozdroże pod Łysocinq* to the north (Fig. 8; Table 2): one rising up towards the *Okraj* Pass (a red hiking trail leads along it) and another maintaining a similar height and gently sloping down *Dzwonkówka* towards the crossroads beneath *Średniak* (this is located on the public road leading to the *Okraj* Pass, a blue hiking trail leads along the track described). Good scenic value is generally characteristic of the whole *Rozdroże pod Łysocinq* neighborhood, as well as forest roads in the higher parts of *Borowa*, *Bielec* and *Biała* (with *Białe Skały*, attractive from a geotourism point of view, see: Table 1). Due to the significant altitude (over 1000 m) and the lack of other mountain ranges of similar height in an easterly direction (the Polish side of *Lasocki Grzbiet* generally declines to the east), views covering a great distance can be observed (Fig. 9A, point P5 and most of the forest track leading to the south through *Rozdroże pod Łysocinq* to point P6 and *Biała* – see: Fig. 8; Table 2), covering the eastern parts of the Western Sudeten Mountains (including the *Kaczawskie* Mountains and *Rudawy Janowickie*), a significant part of the Central Sudeten Mountains (Figs. 1, 10 and 11) and even fragments of the Eastern Sudeten Mountains and the Sudeten Foreland (mainly *Ślęża*, 718 m, together with the surrounding hills, being a transformed – rotated – ophiolite sequence, see: Floyd et al. 2002; Majerowicz 2006). Closer to point P6, more parts of *Rudawy Janowickie* and the *Kaczawskie* Mountains are exposed to the north, and in addition the eastern part of the *Jeleniogórska* Basin with inselbergs (Migoń 1997a, 1997b), of which the highest are *Sokolik Wielki* (628 m) and *Krzyżna* (654 m). The attractiveness of the views is dete rmined by the coulisse arrangement of the Central Sudeten ranges (Fig. 10). They are mainly seen from the west, while these ranges usually have a Sudeten orientation (from northwest to southeast) so they overlap and obscure each other only partially. It is also possible to see into some of the more significant depressions separating them. Among the more important summits are *Chełmiec* (851 m) and *Borowa* (854 m) in the *Wałbrzyskie* Mountains; *Lesista Wielka* (851 m), *Włostowa* (903 m), *Bukowiec* (886 m) and *Waligóra* (936 m) in the *Kamienne* Mountains; *Wielka Sowa* (1015 m) in the *Sowie* Mountains, as well as the Śnieżnik Massif, classified as part of the Eastern Sudeten Mountains. Moreover, several towns (Lubawka, Kamienna Góra) and monuments (the

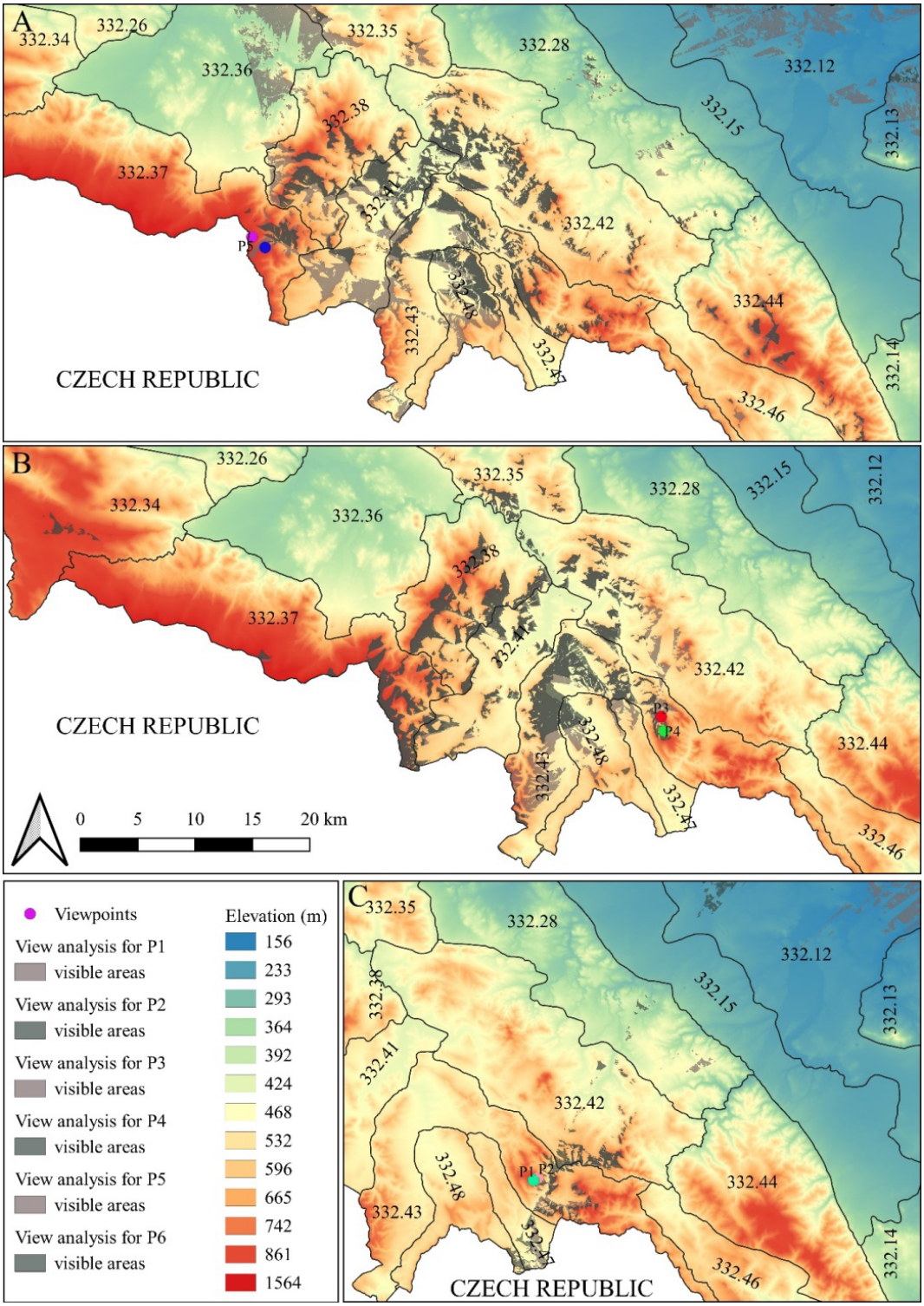

Fig. 9 Visibility from selected points within *Lasocki Grzbiet* (A) and the western (B) and eastern (C) parts of *Pasmo Lesistej*. Mesoregion numbers according to Kondracki (2000): 332.12 Świdnica Plain, 332.13 Ślęża Massif, 332.14 Niemcza-Strzelin Hills, 332.15 Sub-Sudeten Depression, 332.26 Izerskie Foothills, 332.28 Wałbrzych Foothills, 332.34 Izerskie Mountains, 332.35 Kaczawskie Mountains, 332.36 Jeleniogórska Basin, 332.37 Giant Mountains, 332.38 Rudawy Janowickie, 331.41 Lubawka Gate, 332.42 Wałbrzyskie Mountains, 332.43 Kamienne Mountains, 332.44 Sowie Mountains, 332.46 Nowa Ruda Depression, 332.47 Ścinawka Depression, 332.48 Stołowe (Table) Mountains.

religious complex in Krzeszów and the chapel on św. Anny Mountain) can be seen (Fig. 10).

However, more important for geoheritage education is the immediate view, because for the more visible landforms it is possible to interpret processesbased on the topography. The most important natural border visible from *Lasocki Grzbiet* (Fig. 9A – mainly point P5 and Figs. 10 and 11) to the east is the one between the Western and Central Sudeten Mountains, expressed in the form of *Brama Lubawska* (Kondracki 2000), a wide depression between the Giant Mountains in the west and the *Kamienne* Mountains and *Wałbrzyskie* Mountains to the east, which in the northern part transforms into *Kamienna Góra* Basin (Fig. 1; it is important that all these are visible from *Lasocki Grzbiet*). This border has a geological justification because here the metamorphic rocks of the eastern shield of the Giant Mountain batholith, found in *Lasocki Grzbiet*, have an unconformity with the sedimentary rocks of the Intra-Sudeten Depression, of which *Brama Lubawska* is the westernmost part within Poland (Fig. 2). The Intra-Sudeten Depression, or trough, is a vast geological unit (60 km long and 35 km wide) in the central part of the Sudeten Mountains, stretching from northwest to southeast, contained between the Giant Mountain batholith, the *Kaczawski* Metamorphic Zone, the Świebodzice Depression, the *Sowie* Mountain Block, the *Bardzka* Structure, the *Kłodzki* Metamorphic Zone, the Lądek and *Śnieżnik* Metamorphic Zone, and the *Bystrzyckie* and *Orlickie* Mountain Metamorphic Zone (Awdankiewicz 1999a; Kryza et al. 2004; Oberc 1972). From the southwest (in the Czech Republic) it is limited by the Hronov

Fig. 10 Panorama from *Dzwonkówka* (1004 m) to the east.

Fig. 11 View from the summit parts of *Borowa* (1056 m) to the southeast.

Fault (Fig. 2). The undoubted advantage of the views from *Lasocki Grzbiet* is that not only a significant part of the depression can be seen, but also most of the above-mentioned units as well (except for the Świebodzice Depression, although when visibility is good one can see several of its higher hills). Thus, *Lasocki Grzbiet*, and especially the route connecting *Rozdroże pod Łysocinq* with the *Okraj* Pass (including point P5) and the tracks on the eastern slopes of *Borowa* and *Bielec* (Fig. 8; Table 2), can be considered excellent observation points for the Intra-Sudeten Depression.

The Intra-Sudeten Depression is in the form of a basin – the rock strata dip concentrically inwards, with those on its outer ring generally older than in its central part. This relation and other geological processes mean that the geological structure and terrain are quite diverse within the trough. Looking from *Lasocki Grzbiet,* it is worth paying attention to two features of this area: its cuesta landscape and volcanic phenomena. In the first case, the existence of cuestas results from the gentle dip of the rock strata of the basin towards its central part (monocline) – the moderate slope of the ridge corresponds to the direction of the dip in the strata and their steeply angled slope intersect these strata. From *Lasocki Grzbiet*, the cuestas within *Brama Lubawska* are the most visible (Vítek 1999) created from conglomerates of the Lower Carboniferous (the so-called Błażkowa strata). From this perspective, one can see mainly the steeper slopes, cutting the conglomerate beds at an angle of even more than 45°, largely forested (view to the southeast towards *Szczepanowski Grzbiet* and *Zameczek*, 590 m; Fig. 11), although some of the cuestas in the east and northeast can be identified from their profiles (*Zadzierna*, 724 m; *Długa Góra*, 612 m; *Skowroniec*, 581 m; Fig. 10), hence it is possible to compare the gradients of both slopes. The *Bóbr* river flows alongside the southern sequence of cuestas, then enters a gorge cutting through the col between *Zadzierna* and *Zameczek* (Fig. 10). Unfortunately, its form is only partially visible due to the flooding of part of the valley by an artificial lake (*Bukówka*). The river then flows east approaching the axis of *Brama Lubawska*, where it turns north on a foreland of Permian vulcanites, returning to the area of the cuestas described and creating another gorge through the Carboniferous sedimentary rocks between *Długa Góra* and *Skowroniec*, south of Błażkowa village (Vítek 1999).

Behind *Brama Lubawska*, in turn, the *Krucze* Mountains can be seen, which are the westernmost microregion within the *Kamienne* Mountains mesoregion (Kondracki 2000; Potocki 2009). This N-S range separates *Brama Lubawska* from the *Krzeszowska* Basin. In terms of geological structure, it is located in the western part of the vast *Krzeszów* brachy-syncline, which creates the north western edge of the Intra-Sudeten Depression (Bartuś 2012b). The *Krucze* Mountains consist of sedimentary rocks, mainly sandstones and conglomerates, as well as volcanic rocks, above all Permian rhyolites and trachybasalts (traditionally referred to as porphyry and melaphyre). The latter form the highest hills, clearly visible from *Lasocki Grzbiet*. Three periods of volcanic activity can be distinguished in the development of the Intra-Sudeten Depression: from the early Carboniferous (at the turn of Turnaisian and Visean); from the late Carboniferous (at the turn of the Westphalian and Stefanian); and from the early Permian (Rotliegend). The manifestations of volcanic activity observed in the *Krucze* Mountains belong to the youngest eruptive period. The volcanic deposits of the *Krucze* Mountains form a large, asymmetrical structure, slanting in the main structural direction (Awdankiewicz 1999a; Bartuś 2012b). A characteristic feature of the areas formed of volcanic rocks are sharply-defined peaks and steep slopes (despite the relatively low altitudes and relative heights), which are the reminder of the period when many volcanoes were active here. They clearly stand out from the gentler parts consisting of sedimentary rocks. A good example of the steepness of the slopes is the geological and landscape reserve of *Kruczy Kamień* (Bartuś 2012b; Bartuś et al. 2009; Vlček 2014) located on the south eastern edge of Lubawka, visible from *Lasocki Grzbiet* (behind the southern part of *Bukówka* lake; Fig. 10). Cliffs within the reserve are as high as 100 m. This is the result of the activity of a volcano, whose diameter, measured at the cone base, could have been about 15 km, and the height in the central section of the cone could have measured several hundred meters. The eruption center was probably located west of Chełmsko Śląskie (Bartuś 2012b). *Lasocki Grzbiet* is the only place that allows observation of the entire area, thanks to which, through appropriate educational panels, it would be possible to visualize volcanic processes occurring not only in the vicinity of Lubawka and Chełmsko Śląskie, but more broadly in the north western part of the

Intra-Sudeten Depression.

Volcanic and sedimentary rocks occurring in the Intra-Sudeten Depression are exploited in many places. From *Lasocki Grzbiet* inactive quarries of melaphyre (basalts) in Kamienna Góra and Borówno near Czarny Bór (Awdankiewicz 1999a, 1999b, 2006; Cwojdziński and Kozdrój 2007) can be seen, as well as one still open on the Czech side of the *Krucze* Mountains (near Královec village; Fig. 11). Moreover, taking into account other geological units, within *Rudawy Janowickie* the dolomite quarry in Rędziny can be seen (Fig. 9) within the metamorphic rocks of the eastern Giant Mountain batholith shield, and in the *Kaczawskie* Hills the crystalline limestone quarries near Wojcieszów, a part of the *Kaczawski* Metamorphic Zone (Baranowski and Lorenc 1981; Białek et al. 2007; Stupnicka 2007; Fig. 2). Hence, a walk along the scenic routes of *Lasocki Grzbiet* can be an opportunity to discuss not only the history of the various Sudeten geological units, but also the economic significance of the rocks occurring within them.

8 Potential of Pasmo Lesistej

8.1 General characteristic and geosites

Pasmo Lesistej is a microregion within the *Kamienne* Mountains mesoregion (Central Sudeten Mountains, Figs. 1 and 2). More precisely, this is a part of its longer eastern arm, which is formed (from the west) by *Czarny Las*, *Pasmo Lesistej* and the *Suche* Mountains. *Pasmo Lesistej* (named following Kondracki 2000 and Pawlak 1997) is relatively poorly dissected and consists of two main parts (Fig. 12): *Lesista Wielka* Massif, located in the south, which extends quite evenly northwards into the *Dzikowiec* Massif. The whole resembles the outline of an isosceles triangle with a base between Mieroszów and the surroundings of Grzędy and Czarny Bór villages. Within this area, three main ridges are distinguished (Fig. 12) which follow the so-called Sudeten orientation, i.e. from northwest to southeast (Koszarski and Ranowicz 1982). They are as follows:

- the northern ridge, with the main part in the form of the distinct, narrow ridge of *Dzikowiec Mały* (695 m) and *Dzikowiec* (836 m); between this and the next ridge there is a transition zone with *Sokółka* (800 m) and *Brzozówka* (765 m);
- the highest, middle ridge with a length of about 6 km, including the highest point in the region, *Lesista Wielka* (851 m), as well as *Lesista Mała* (780 m) above the *Ścinawka* gorge;
- the shortest southern ridge culminates in *Sucha Góra* (776 m).

Deep valleys cut into the aligned ridges, divide them into smaller parts. *Pasmo Lesistej* is almost entirely (except for the western foothills) part of the Wałbrzych Sudeten Mountains Landscape Park, which was created on January 15, 1999 (Śnigucki 2005).

Geologically, *Pasmo Lesistej* is located in the north-central part of the Intra-Sudeten Depression (Fig. 2). It consists of Lower Permian trachyandesites (or trachybasalts) in the north eastern part, as well as rhyolites and rhyolite tuffs in the south and west, surrounded by coarse-grained conglomerates with pebbles, sandstones, mudstones, clays and clay schists (Awdankiewicz 1999; Koszarski and Ranowicz 1982; Migoń, Jancewicz and Kasprzak 2014; Żelaźniewicz 2005). Volcanic rocks are associated with the aforementioned volcanism occurring in the inner part of the Intra-Sudeten Depression, whose synclinal form caused the volcanic products to form an arc corresponding to most of today's *Kamienne* Mountains. Pahoe-hoe, aa and block lava covers were produced by Icelandic-type shield volcanoes. At the end of Permian volcanic activity, pyroclastic eruptions took place in this area, which are expressed in thick (100–400 m) rhyolite tuffs stretching along a 50 km strip from Czarny Bór to Suszyna, i.e. also through *Pasmo Lesistej* (Żelaźniewicz 2005). The resistance of the Permian volcanic rocks within *Pasmo Lesistej* (like the entire *Kamienne* Mountains) resulted in substantial relative heights (up to 300 m) and very steep slopes (up to 40°) (Migoń 2005b). Due to these morphological features the forest tracks traversing the slopes have considerable scenic value, which is also a result of changes in the species composition to a mixed forest and its economic use. At the same time, the dense network of forest roads (Fig. 12) supplemented by marked hiking trails, allows tourists to reach many places important from a geotourism point of view (Table 3). Landslides which have been identified in the area of *Dzikowiec*, *Wysoka* (808 m), *Lesista Wielka* and *Lesista Mała* (Migoń, Jancewicz and Kasprzak 2014; Migoń et al. 2016; Synowiec 2003), are, unfortunately, not clearly visible in the area, but important from a scientific perspective.

As noted by Kondracki (2000), the *Kamienne*

Mountain region, and within it *Pasmo Lesistej*, is attractive for tourists, but due to its location slightly away from the main transportation and tourist routes, it is relatively rarely visited. *Pasmo Lesistej* is not often discussed in tourist guides and the sightseeing literature. Information about this area, when it exists at all, is merely a reference, and this applies to both older publications from before 1990 (e.g. Chanas and Czerwiński 1979) and the guides published by the currently leading publishing houses (e.g. Czerwiński

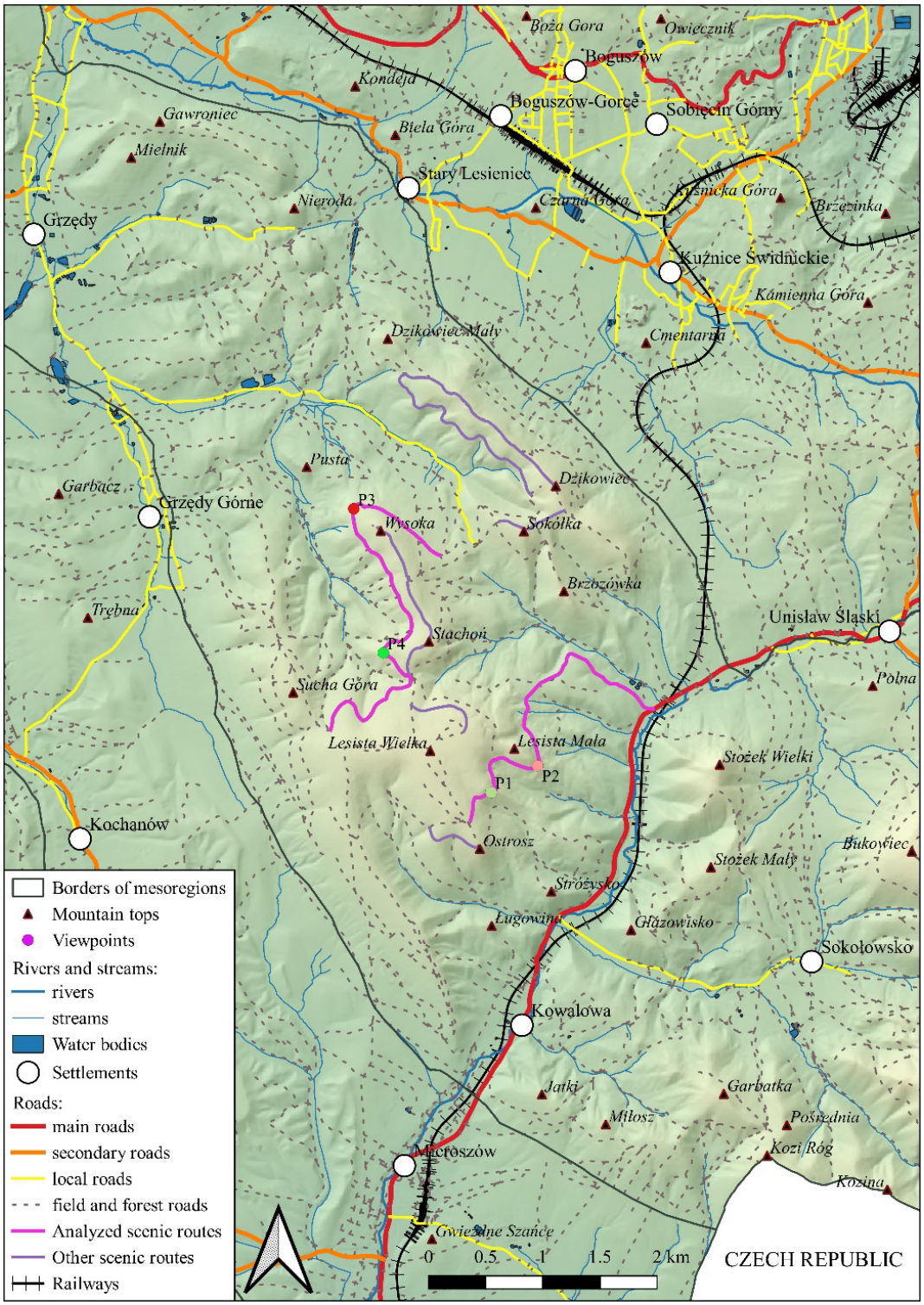

Fig. 12 *Pasmo Lesistej* with its current road network and scenic routes.

Table 3 Potential geoheritage sites on *Pasmo Lesistej*

Geo-attraction	Characteristic	Tourism and geotourism infrastructure	Literature
'Wind crevices' near the summits of *Lesista Wielka* and *Lesista Mała*	A system of cracks in the rock commonly known as 'wind crevices', through which air circulation takes place. Inside, the air has a temperature close to the annual average, thanks to which it is higher than the air temperature in winter and lower in summer. As a result, when the air escapes through the cracks to the surface, in winter there is a warm flow of air (the snow is melted around the cracks, making it easy to locate them), and in the summer – a cool one. These crevices were formed in rhyolite tuffs as a result of weathering and the sliding of soft clays underneath them. The system on *Lesista Wielka* consists of three perpendicular crevices about 4 m long, 1–3 m wide and about 5 m deep. The cracks on *Lesista Mała* are much smaller. In winter, warm air also escapes from the porous ground in several other places, which is evident in locally melted snow. Wind crevices are protected as a natural monument.	Blue and yellow hiking trails; information board and fence next to the crevices on *Lesista Wielka*; the rest of the crevices are unmarked and without infrastructure	Dudziak 1984; Koszarski and Ranowicz 1982; Migoń 2017; PIG n.d.; Rzeczycki 2008
Rocks and cliffs on *Dzikowiec*	Small rock formations (height about 1.5 m) on the northern slope and on the ridge of *Dzikowiec*.	Green hiking trail, local walking and mountain bike routes	Koszarski and Ranowicz 1982
Adits and mining excavations in the *Dzikowiec* Massif	The mountain was used for mining operations at the turn of the 20th century and in the 1940s. In addition, adits were created there to serve as water intakes. Those preserved include: *Rycerska* (Knight's) Adit, 'Adit with a Wagon' (*Sztolnia z Wagonikiem*), *Nad Stawami* Adit and *Barbara* Adit.	Blue hiking trail, local walking and mountain bike routes	Retecki 2015; Wójcik and Krzyżanowski 2005
Ścinawka gorge	Behind Unisław Śląski, the *Ścinawka* river changes its course to N-S and forms one of the best developed gorges in the Sudeten Mountains. It divides the *Kamienne* Mountains into *Pasmo Lesistej* to the west and *Suche* Mountains to the east. The slopes reach 300 m in height, and the length of the gorge is 4 km. It is the deepest valley in the *Kamienne* Mountains.	Blue and black bicycle trails, fragmentary red and yellow hiking trails	Migoń 2005a; Skała 2000
Former quarry in the northern part of Kowalowa	A rock wall at the end of the current car park, where trachyandesites are exposed, usually massive, in some cases breccia or vesicular trachyandesites. These are lava streams and domes, partly sub-volcanic, resulting from the eruption of a multiple crater volcano.	Blue and black bicycle trails, information board	Awdankiewicz 1999a; PIG n.d.
Former quarry in the southern part of Kowalowa	An old quarry with volcanic rocks – rhyolites.	None	Awdankiewicz 1999a; PIG n.d.
Quarry in Stary Lesieniec	The quarry walls are made of basalt aphanite trachyandesites, dark grey, 50–100 m thick, constituting several layered lava streams 5–25 m thick. Among them are mudstone and sandstone layers.	Yellow hiking trail	Awdankiewicz 1999a; PIG n.d.

2009; Motak 1998; Myszkowska 2007; Skała 2000). This area also does not appear in geotourism studies (e.g. Cwojdziński and Kozdrój 2007; Cwojdziński et al. 2011), but several geosites have been designated (Table 3; PIG n.d.). Rogowski (2016) excludes the area of *Pasmo Lesistej* from the proposed geotourism regions of the Sudeten Mountains which cannot be accepted due to its significant sites (Table 3), as well as scenic value (cf. Fig. 9).

Pasmo Lesistej was discovered by tourism relatively lately. *Dzikowiec* was mentioned in German guidebooks of the Wałbrzych region much later and described more modestly than even the *Chełmiec* Massif located further north. Among other areas, this resulted from the fact that at the beginning of the 20th century this area belonged to the estate in Stary Lesieniec and was inaccessible to outside visitors. However, as early as 1928 it was suggested as a destination for a short trip from Boguszów, with the permission of the owners of the local property needed.

The viewpoint on *Dzikowiec* summit was recommended, especially the panorama to the south. Probably at that time there were no hiking trails on the *Dzikowiec* Massif, although in the vicinity (*Chełmiec* Massif, *Mniszek*, 704 m and *Stożek Wielki*, 840 m) there was already a fairly dense network marked by active Wałbrzych tourist organizations, especially by *Waldenburger Gebirgsverband* (Wałbrzych Mountain Federation), established in 1922 as a continuation of the associations operating in the Wałbrzych region from the second half of the 19th century, including the *Verschönerungs-Verein* ('Improvement Society') from Boguszów (cf. Retecki 2012, 2013a, 2013b). The activities of these, however, covered areas mainly north and east o f *Pasmo Lesistej*, because access to it (or at least to its northern part – the *Dzikowiec* Massif) was somewhat limited until World War II. Despite this, accommodation and catering facilities developed in the villages at the foot of *Pasmo Lesistej*, however, with only a limited focus on serving tourists or vacationers (Retecki 2015). After World War II, *Pasmo Lesistej* was gradually made accessible to tourists and equipped with a tourist infrastructure. By the 1960s, three marked hiking trails already ran through this area (PPWK 1967).

8.2 Results – scenic potential for geoheritage appreciation

As written above, *Pasmo Lesistej* consists of several, fragmented ridges, so it allows views to be enjoyed from different perspectives. On the one hand, the viewing possibilities are slightly less good than in the case of *Lasocki Grzbiet*, because the elevation of this area is about 200 m lower, but on the other – views in different directions can be enjoyed from here while in *Lasocki Grzbiet* most of the panoramas are to the east (this is due to the fact that in this work only the Polish side was analyzed, but it should also be emphasized, however, that the Czech side is not so attractive because the upper parts of the Giant Mountains are very close, obscuring further views). The scenic value of *Pasmo Lesistej* is increased by the steep gradients, especially in its western, eastern and north eastern parts (the gradients are gentler to the northwest and south – to the *Lesk* valley and to the wide *Ścinawka* Depression in the Mieroszów area, respectively; see: Kasprzak and Traczyk 2012).

Considering the western aspect, the forest track traversing the north, west and south slopes of *Wysoka* (808 m) and the west and south slopes of *Stachoń* (808 m) is particularly scenic (Figs. 12 and 13; Table 2). From a number of places on this trail (e.g. points P3 and P4 – Fig. 9B), the views of the western part of the *Kamienne* Mountains are open, i.e. the E-W *Czarny Las* to the northwest and the N-S *Krucze* Mountains to the west. In front of them, in the foreground is the northern edge of the *Ścinawka* Depression with its Permian sedimentary geology, and in the middle distance, the northern part of the *Stołowe* Mountains (Table Mountains), formed from conglomerates and sandstones of the Lower Triassic and Upper Cretaceous (the state border divides the *Stołowe* Mountains into three parts: southern Polish with the Table Mountains National Park, central Czech, for which the name *Broumovská vrchovina* is

Fig. 13 View from the forest track traversing the slopes of *Wysoka* (808 m) to the northwest.

Fig. 14 Panorama from the forest track leading along the eastern slopes of *Lesista Mała* (780 m).

used, and northern Polish, know n as Zawory, which can be seen from the trail; Fig. 1). In the latter part, and especially in the surroundings of the *Krzeszowska* Basin microregion, the already mentioned cuesta relief can be seen (Migoń 2005c; Tułaczyk 1992), with the axis of the s edimentation basin running approximately along the visible part of *Zawory* Mountains and the aforementioned basin. As a consequence, east of the axis the steeper slopes corresponding to the front of the cuesta can be observed (a ridge with summits at *Ziuty*, 631 m, and *Czerep*, 582 m, between Grzedy Górne a nd Kochanow in the east, and Krzeszów, and Gorzeszów in the west), and further away (west of the axis) the gentler slopes, corresponding to the dip of the strata towards the basin center (e.g. a cuesta with *Głazy Krasnoludków* – Dwarf Boulders, between Gorzeszów and Jawiszów – see: Bartuś 2012a; Vlček 2014). Returning to the *Kamienne* Mountains, the track leading along the slopes of *Wysoka* and *Stachoń* allows the sequence of Permian volcanic rocks to be admired (Awdankiewicz 1999a, 1999b) forming the highest parts of the range, running in an arc from north and west and surrounding the sedimentary rocks described above. The area of volcanic rocks, apart from their greater elevation, is also marked by quarries which are visible within *Czarny Las* (Cwojdziński and Kozdrój 2007; Fig. 13). The location of volcanic rocks is a good illustration of the geological structure of the Intra-Sudeten Depression and the impact of geology on the relief.

From the western part of *Pasmo Lesistej*, the border between the Central Sudeten Mountains (where the observer is) and the Western Sudeten Mountains (Fig. 1) is only indirectly visible. *Rudawy Janowickie* (Fig. 13) and the eastern part of the Giant Mountains are clearly visible, and their central part with *Czarna Kopa* (1408 m), *Śnieżka* (1602 m) and *Smogornia* (1489 m) can also be seen, while from point P3 (Fig. 9B) even the highest parts of the *Izerskie* Mountains (*Wysoka Kopa*, 1126 m). Since only small parts of *Brama Lubawska* can be observed from *Pasmo Lesistej* (mainly its higher, western parts on the foreland of *Lasocki Grzbiet*), this border runs from the *Krucze* Mountains, part of the Intra-Sudeten Depression, to *Lasocki Grzbiet*, the rest of the Giant Mountains and *Rudawy Janowickie*. Due to this perspective, it is easy to notice the differences in relief resulting from different rock hardnesses: sedimentary and eruptive volcanic rocks in the immediate view, and metamorphic and deep-crustal volcanic ones in the back ground. The highest landscape element, *Śnieżka*, consists of the most weather-resistant hornfels, adjoining directly from the south to the granite batholith of the western part of the Giant Mountains (Knapik and Migoń 2011; Kryza et al. 2004; Migoń 2012a).

Contrary to the locations presented so far, the advantage of the scenic route in the eastern part of *Pasmo Lesistej* (Table 2) is not the particularly distant view (Fig. 9C), but the opportunity to see from above and from different perspectives a mountain river gorge and the dynamic landforms of the *Suche* Mountains, the microregion within the *Kamienne* Mountains located east of *Pasmo Lesistej* (Fig. 14). From the forest track leading along the northern, eastern and southern slopes of *Lesista Mała* and the eastern slopes of *Lesista Wielka* (Fig. 12), in the foreground we can see slopes steeply descending into the *Ścinawka* gorge. On its other side, the terrain rises equally (or even more) steeply in the form of the *Stożek Wielki* and *Stożek Mały* (745 m) massifs (Fig. 14). That we are dealing with a gorge, the observer will be convinced of by looking up (north) and down (south) the valley. Although the view is not very wide, it can be seen that in both directions it becomes wider with more gentle slopes. After its source on the slopes of *Borowa* in the *Wałbrzyskie* Mountains, the *Ścinawka* flows through a wide valley within the *Unisław Upland* (Wojewoda 2007). Then, on the border of Unisław Śląski and Kowalowa villages, the

valley becomes significantly narrower and a section begins breaking through the *Kamienne* Mountains, considered, as described above, one of the better shaped gorges in the Sudeten Mountains (Table 3). From the presented scenic route (Figs. 9C and 12) the steep slopes of the main river valley and its tributaries can be admired. The gorge ends at the border of Kowalowa and Mieroszów, where the river flows into the wide *Ścinawka* Depression, a mesoregion stretching between the *Stołowe* Mountains to the southwest and the *Kamienne* Mountains to the northeast (Fig. 1). On this section the river flows according to the so-called Sudeten orientation, crossing the northern part of the locally monoclinal Intra-Sudeten Depression throughout the majority of its course (Pawlik 2010).

To the east, the *Suche* Mountains rise in the background (Fig. 14). They are distinguished by a dynamic landforms related to Permian volcanic activity and numerous landslides which, however, are hardly visible from the track, or at least not at a scale that would allow a straightforward discussion of their origin (cf. Kacprzak et al. 2013; Kasprzak et al. 2016; Kasprzak and Traczyk 2012; Migoń et al. 2010, 2016; Migoń, Jancewicz and Kasprzak 2014; Migoń, Kacprzak et al. 2014; Synowiec 2003). One can only partially see the location of a landslide on the north western slope of *Stożek Wielki*, while the rest are located quite far away. However, the panorama creates very good conditions for presenting the genesis of other contemporary landforms of the *Suche* Mountains. The eruptive complex consists of various types of basalt and rhyolite lavas, as well as pyroclastic formations, mostly in the form of tuff, which occur among sedimentary rocks, mainly sandstones and mudstones of an age close to the volcanic activity or older. Volcanic rocks pierce sedimentary rocks (forming plugs) or lie directly on them in the form of lava cover. Rocks of the eruptive complex, more resistant to denudation, form isolated monadnocks, up to 936 m in the peak of *Waligóra* (Awdankiewicz 1999a; Mastej 2012; Synowiec 2003). The slopes are therefore very steep despite the relatively low altitudes. However, in the context of mass-wasting, it should be emphasized that the scenic route crosses the landslide complex on the north eastern slopes of *Lesista Wielka* and *Lesista Mała* with a total area of 17.5 ha, including the second largest mass movement on the *Kamienne* Mountains (14 ha) (Synowiec 2003; cf. Migoń et al. 2016). It is associated with wind crevices (Table 3) on the higher parts of the slopes. The track, apart from its value for views, may therefore have an educational value too, which even now is partially implemented (one information board).

The *Ścinawka* Depression, visible from the eastern part of *Pasmo Lesistej* (especially point P1 – Fig. 9C), gives another opportunity to discuss cuesta relief, and also 'table'-type mountains, unique to the Sudeten region. Above the gorge of the *Ścinawka* river, within the wide *Ścinawka* Depression, several cuestas can be seen, the highest being on the border between the *Ścinawka* Depression and the *Stołowe* Mountains (Fig. 1). This edge is known as the Mieroszów Wall (*Mieroszowskie Ściany*) on the Polish side, and the Broumov Wall (Czech *Broumovské stěny*) in the Czech Republic (Vítek 2016). In both cases the steep slope (front) of the cuesta can be seen. Farther on, the Broumov Wall passes into the southern Polish part of the *Stołowe* Mountains protected as a national park. At this point, the cuesta relief changes into a 'table'-type landform which corresponds to the central part of the Intra-Sudeten Depression where the strata are horizontal, unlike in the marginal sections (Bartuś et al. 2009; Cwojdziński and Kozdrój 2007; Migoń 2012b, 2012c; Wojewoda 2012). Among the major summits of the *Stołowe* Mountains, *Szczeliniec Wielki* (919 m), *Szczeliniec Mały* (895 m) and the *Skalniak* Massif (925 m) can be seen, above which fragments of the *Orlickie* Mountains stand out. In geological terms the *Bystrzyckie* and *Orlickie* Mountain Metamorphic Zone forms the southern border of the Intra-Sudeten Depression (Fig. 2). Within the latter, on the Czech side an observer can see an area of the extremely attractive Teplice 'Rocks' and another 'table'-type mountain, *Ostaš* (700 m). These observations confirm that *Pasmo Lesistej,* like *Lasocki Grzbiet*, is a perfect place from which to observe the morphology and explain the geological structure and development processes of the Intra-Sudeten Depression. At the same time, its eastern part provides very good views of the *Suche* Mountains, enabling an explanation of their origin.

9 Discussion

Although, as has been shown above, scenic routes in geotouristically attractive areas can potentially be

of great importance for improving the educational value of this form of tourism, this will only happen if they are properly equipped with infrastructure serving both admiration of the landscape beauty and interpreting its geological history, natural processes and anthropogenic transformation. In the case of Poland, what draws attention is the lack of development of its own or an adaptation of an existing tourism certification system for scenic routes (based on aesthetic, recreational and educational criteria). This should refer to both roads and routes designed for hiking, skiing, horse riding and cycling. These last types seem especially to be predisposed to combine leisurely recreation (in the case of hiking, cross-country skiing, horse riding) or recreational sport (cycling and cross-country skiing) with the experience of a changing landscape. In this context, it is regrettable that the idea behind the development of certified scenic routes in Polish tourism (not necessarily in a geotourism context) has not gone beyond academic consideration and that is, unfortunately, mostly quite old (the 11th volume of the academic journal 'Problems of Mountain Land Development', *Problemy Zagospodarowania Ziem Górskich*, published in 1973 by the Polish Academy of Sciences, was almost entirely devoted to the topic). The use of landscape for the explaining of geological/geomorphological processes is currently implemented only in some parts of the Sudeten Mountains, the most attractive geotouristically, but also the most frequented by tourists (Giant and *Stołowe* Mountains; Knapik and Migoń 2011; Knapik et al. 2011; Migoń 2016; Migoń and Knapik 2013; Pijet-Migoń and Migoń 2019; Wojewoda 2011) where there is not necessarily a need to create new tourist routes (see: Kołodziejczyk 2019, 2020b). On the other hand, the remaining parts of the Sudeten Mountains are almost undeveloped in this respect, including areas analyzed in this paper.

The growing network of view-towers in the Sudeten Mountains, although undoubtedly a tribute to the beauty of their panoramas, makes little use of the educational value of landscapes. Moreover, many of them are located in places relatively easily accessed by tourists, including those motorized (sometimes it is possible to reach the towers by such a vehicle using forest tracks, although under Polish law, it is illegal). Quite often only a relatively short distance on foot needs to be covered from parking lots located at mountain passes or at the foot of the hills. This is conducive to the development of mass tourism, often without reflection, instead of a broader tourist experience. A simple observation of tourism, especially around the newly built view-towers, creates numerous environmental problems (waste, noise, increased erosion on tracks used by cars, motorcycles or quadbikes) as well as problems of tourist numbers and the damage caused by them. Currently, investments that are quickly undertaken and implemented above all testify to fashion both among visitors and investors, and decision-makers. It is difficult to judge their duration and, at the same time, it is necessary to think about the cost of these towers (the investment itself and maintenance), which are usually high. It seems that mountain scenic routes, requiring more effort (distance, difficulty) from tourists, attract more mature tourists in many ways. Moreover, scenic routes are relatively cheaper, especially since they are also used in forest management. As a consequence we would like to promote scenic routes as a potential way to facilitate certain mountainous areas to tourists' needs. In our opinion in both the *Lasocki Grzbiet* and the *Pasmo Lesistej* there is no need to create view-towers as existing trails already provide very good conditions for admiring the landscape and appreciating geoheritage in a macroscale. This also applies to many other mountain ranges, not only in the Sudeten Mountains, where in recent years, in response to a specific fashion, numerous view-towers have been built, leading to transformation of the landscape, as well as to other negative changes (new roads for the purpose of towers' construction and the related relief transformations and erosion, changes in the summit areas, where towers are erected, the subsequent negative effects associated with intense tourist movement, as described above). In the same time natural viewpoints are not maintained and scenic routes are not promoted.

The scenic routes proposed by the authors in both analyzed areas (Table 2) do not require any special skills as they use wide forest paths, there are no significant height differences or sections leading over the rocks. Taking into account this feature and the content that can be communicated (geographical and geological districts, geological and geomorphological development of the Sudeten Mountains, selected forms of mass movements, the utilization of rock materials, selected aspects of contemporary relief transformations), it seems that

the offer should be addressed to a wide range of tourists. Hiking, cycling and (to a lesser extent) skying tourist appear in both analyzed areas. Geotourist scenic routes may contribute to their interest in geoheritage. Taking into account the classification according to Hose (2000), these will be casual (non-dedicated) geotourists, i.e. people acquiring knowledge in the field of geoheritage on the occasion of various journeys having predominantly recreational character. Of course, the routes can also be interesting for dedicated geotourists, but they will not be a dominant group. Their knowledge and experience make it possible to obtain information about geoheritage not necessarily on the basis of arranged educational paths.

The scenic routes analyzed in this study are not connected with the previously mentioned *Sudeten Geostrada*, the longest tourist route related to geoheritage in the region (Bartuś et al. 2009; Cwojdziński et al. 2011; *Geostrada Sudecka* n.d.). This is due to the peripheral location of the research areas in relation to its course. Nevertheless, the content presented in the paper may indicate the potential directions of development of this tourist offer, which has so far been rather poorly facilitated (educational panels in the field, paper and internet guides, but no regular marking leading the tourist, no souvenirs related to visited places or other components of a developed tourist product). The *Sudeten Geostrada* is intended for motorized tourists, who are to travel between geosites by car. What direction for future development can be indicated? The designation of hiking and cycling trails, branching off from the *Geostrada*, would increase the diversity of experiences. Such routes should be characterized by scenic values, which would allow tourists to get to know and understand geoheritage from a wider perspective. Scenic routes focused on active tourism (hiking, cycling, or even skying) should be complementary to *Sudeten Geostrada* in its present form.

Laying out and popularizing scenic routes, considered in general or in relation to those analyzed in this work, requires undertaking specific action, both legislative (as mentioned above) and practical. The latter is primarily associated with maintaining proper conditions for observation from the viewpoint and the quality of the view itself. Therefore, the first mentioned should focus on counteracting the mechanical impact of people on the surface from which the observation takes place (e.g. by building low viewing platforms or daises, limiting opportunities for tourists to disperse). Equally important is the proper care of vegetation, whose growth could effectively obscure the view (especially the immediate view, the most valuable interpretively). In this regard, cooperation with forest managers, in the case of Poland with the State Forests (as part of the so-called forest management plans), or the administrators of environmental protection, seems indispensable and should have a local dimension. It is also worth bearing in mind the possible conflicts that may occur here under the influence of various, sometimes contradictory tasks and functions implemented in a selected area (biotic environment protection versus geoheritage protection as well as making it accessible to tourists, the recreational and economic functions of the forest, etc.).

The view must not be anonymous. Each organized viewpoint (independent or one of a series located along a scenic route) should be equipped with a panel on which the view will be clearly explained. However, it is not only about giving the names of the visible forms of the relief or localities, but also explaining the genesis of the relief, what processes led the landscape to its present state. For this purpose, diagrams and other illustrations should be prepared, linking the observed landscape with the geological structure and geomorphological processes. Geologists have extensive experience in this (Badman 1994; Hose 2000, 2005b), but so far projects of this type most often refer to phenomena on a microscale, and not macroscale (such as processes shaping entire geological units, e.g. the Intra-Sudeten Depression, which can be explained on the example of views from the scenic routes of *Lasocki Grzbiet* and *Pasmo Lesistej*). An example of an educational path that very successfully explains the development of sculpture, although still on a microscale, is a set of panels called "Geoattractions of the *Stołowe* Mountains" (Polish *Geoatrakcje Gór Stołowych*, Wojewoda 2011). They include the discussion of accurate phenomena exactly in places where one can observe evidence of their existence (e.g., processes occurring at the bottom of the Cretaceous Sea are illustrated by sandstones with various lithology and structure; the process of disintegration of the sandstone cover is discussed at its relics). The Sudeten Mountains lack this type of infrastructure that would refer to large forms of relief (macroscale), for which the roads analyzed in this

article could be used. Besides classical interpretation panels, in this context the QR-codes giving links to more information or videos, including 3D animations, can be used (Rapprich et al. 2017). Even means of augmented reality can be applied.

According to Hose (2012) geo-interpretation together with geohistory and geoconservation are three interrelated key elements of modern geotourism development. These aspects are also very important regarding the theme of this paper. As presented above, the Sudeten Mountains, including both study areas, have a great potential for geotourism development. Various geosites and views can tell a story of geological and geomorphological development of the region. The notion of conservation is particularly important regarding viewpoints and scenic routes which are prone to being overgrown. As mentioned above, tourists need to have proper conditions to observe the landscape and understand its geoheritage significance. In terms of scenic routes particular emphasis needs to be placed on geo-interpretation, so – using Hose's (1995) words – selling the geological history and making scientific knowledge understandable to tourists. According to Hose (2012, p. 17) "geo-interpretation is not about 'dumbing down' the science but developing vehicles to carry the message to geotourists along a graded journey of knowledge and understanding to the destination of comprehension and empathy with the appropriate mix of text and graphics" (cf. Hose 2005b). Such initiatives appear in the Sudeten Mountains, but unfortunately so far not in the discussed research areas, where geoheritage stays rather anonymous, especially for casual (non-dedicated) geotourists. The landscape observed from the scenic routes should not be just a picture, but should be able to provide knowledge to tourists in an attractive way.

A well-designed scenic route should include not only educational facilities enabling appreciating geoheritage in various scales but also infrastructure connected with more basic human needs. Marking is advisable, although it is not necessary if the route's course is clear. At the beginning of a trail, especially if it is connected with a higher-rank motor tourist trail, at least a carpark should be provided. A complex program of facilities suggested at the entry points to tourist trails was proposed by Kołodziejczyk (2015a, 2015b). Furthermore, along the course of the trail more facilities should be provided, their range and frequency resulting from the length and difficulty of the trail and assumed predominant type of tourists using it ("car" tourists having a short walk as a break in a journey on one hand and more advanced active tourists covering longer distances on the other). Among the facilities rest zones with benches and tables, and weatherproof sheds can be mentioned (cf. Kołodziejczyk 2015b, 2019; Marion and Leung 2004). Usually such facilities might occur at viewpoints, as these are places where tourists will spend most of time, however such constructions should not adversely influence the landscape value of an area. There are various proposals how to develop tourist infrastructure along tourist trails (e.g. Colorado State Parks 2000; National Park Service 1990; Portland Parks & Recreation 2009; Tennessee Department of Environment and Conservation 2007) and most of them can be adapted to the needs of scenic routes. If a given trail is to take the form of a tourist product, it is necessary to standardize the style of the infrastructure being prepared and, if necessary, to develop a logo that will appear on devices arranged along the route (Kaczmarek et al. 2010; Stasiak 2006).

It can be stated that the significance of scenic routes in the development of tourism should depend on the protective regime (cf. Eagles 2008; Price 1992). This type of infrastructure attracts tourists, therefore it is not necessarily appropriate to develop it in national parks or nature reserves, where the protective function should be dominant and elements of tourism infrastructure should be kept to a minimum (Kołodziejczyk 2020c). It is also inadvisable to create new attractions here which would usually intensify the already substantial tourism. Scenic roads, however, fit perfectly into the objectives and operation principles of landscape parks, protected landscape areas or other areas with a lower protection regime (e.g. nature parks) or having recreational functions (e.g. forest parks). They can be an additional attraction, and if they are properly equipped with information (educational) infrastructure, they can contribute to increasing knowledge and the awareness of tourists of geoheritage. On the other hand, creating them in the vicinity of national parks or other particularly valuable areas may contribute to redirecting some of the tourists to the surroundings of these protected areas which have a higher tourist capacity.

The need to care for the quality of the view has a broader, supra-local dimension (due to the extent of a view) and is more difficult to obtain in the conditions of

a still insufficient protection system for natural (including geoheritage) as well as cultural landscapes in Poland. According to the authors, the solution could be to protect the most physiognomically legible natural landscapes in a form analogous to the so-called cultural park (Act of 23 July 2003 on the protection and care of cultural monuments, Journal of Laws 2017, item 2187; compare: Bogdanowski and Myczkowski 1996; Myczkowski 2018; Myczkowski and Siwek 2017), intended to protect and preserve the characteristics of the country's most valuable cultural landscapes.

10 Conclusions

From a single tourist's point of view, the basic aim of the development of tourism space is to prepare tourist attractions and their attributes for the most optimal, efficient and comprehensive usage. Thus, using a view as a pure canvas for interpretation of all cognitive layers of tourism space seems to meet this prime tourism goal. Scenic routes, described here on the basis of *Lasocki Grzbiet* and *Pasmo Lesistej*, gently winding in diversified mountainous landscape, let tourists combine different recreational activities (hiking, cycling, cross-country skiing, or even horse riding) with numerous forms of cognitive tourism, among them geotourism. According to Berlyne's aesthetics, the presence in a landscape of such attributes as complexity, novelty, incoherence, and those that cause amazement (see: Bell et al. 2001) results in its positive assessment. The views that are offered by scenic (geotouristic) routes fulfill at least two of mentioned categories: complexity is ensured by numerous plans building panoramas, whereas novelty is hidden behind the landscape components important from the geotouristic perspective. The role of aesthetic values of a landscape is indisputable in terms of geotourism promotion, aimed at, fore and foremost, non-dedicated, casual tourists. The beauty of nature equipped with substantive information lets tourists shape a special kind of sensitivity and focus their attention to geotouristic sites through the so-called '(geo)tourist gaze'.

Although the paper draws attention to geotourism potential of the scenic routes on a local scope, it might be useful for any comparative analyses in a local and global scales. To some extent, selected solutions proposed in the paper will work independently from an exact locality.

In our opinion, further studies in the Polish geotourism field should be focused on: 1) working on the inventory of Polish, top-class scenic routes (including scenic drives) with the biggest potential for both cognitive and active tourism as well as proposing a system of their tourist certification, 2) creating a sustainable model of protection of the views (and viewpoints) having great geotourism potential, 3) lobbying for the model's adoption by local governments, the State Forests and national parks' authorities.

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