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The English Peak District (as a potential geopark): mining geoheritage and historical geotourism

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ABSTRACT
The Peak District is an upland region in central Britain with a rich mining geoheritage. It was established as the UK's first National Park in 1951. It was the region, due to its widespread loss quarries and mines sites to inappropriate remedial measures, which led to the recognition and promotion of the modern geotourism paradigm. It is the birthplace of British geotourism with the earliest recorded instances of leisure travellers purposefully choosing to visit mines and caves. Metalliferous mining in the region can be traced back to the Bronze Age. Gangue minerals, especially fluorspar and barites, later became significant primary extraction activities and underpinned a small-scale semi-precious stone industry. It is home to the World Heritage inscribed site of the Derwent Mills, significant in the development of early Industrial Revolution textile technology and manufacturing practices. The almost equally significant mining geoheritage has yet to be similarly recognised and, indeed, its survival is still threatened because most tourism and many mining geoheritage stakeholders have a limited understanding of geo-history and the geo-interpretive significance of the individuals and geosites that shaped historical geotourism and geological exploration in the Peak District; their exploits and the legacy of their publications, alongside its superbly exposed and well researched geology and associated mining geoheritage, could underpin a bid for the region's recognition as a geopark. Hence, this introductory paper summarises the key aspects of the region's geology and major mining geoheritage sites, together with the major works and influence of some key individuals that should be included as a very minimum in such a bid.

Key words: geo-history, geo-interpretation, geopark, geotourism, Peak District.

THE PEAK DISTRICT

Introduction

It has been suggested since 2014 that the Peak District in central Britain could be a European Geopark Network member by 2017with a bid seemingly based upon traditional lines (Benghiat, 2015) – an emphasis on scientific geology, economic benefits and community engagement. This paper explores a possible alternative, geo-historical approach underpinned by mining geoheritage, that better resonates with currently employed industrial heritage management and promotion practices, too little explored in European geological and geopark circles. The Peak District is an upland area, generally above 300 metres, mainly in the English counties of Derbyshire and Staffordshire (but also parts of Cheshire, Greater Manchester and South Yorkshire), in central Britain. Not all of the area broadly recognised as the Peak District lies within the boundaries of the 1,437 km^2 of the Peak District National Park, established in 1951 as the UK's first such. It has some 40,000 permanent inhabitants and 16.1 million people live within an hour's drive (or 65 km), and 80% of the UK's population is within a four hour drive, of its boundaries. The Manchester and Stoke conurbations border its western margin and Sheffield abuts its eastern edge with the Derby and Nottingham conurbation to its south; they (with a combined population of some 3.7 million) contribute to the Peak's estimated 8.5 million annual visitors. To the north the Peak merges with the southern Pennines; to the south it gives way to the Midland Plain.

Despite its name it generally lacks sharp peaks and is characterised by rounded limestone hills and dales (river valleys with cliffs) and gritstone escarpments (the 'edges'); its highest point, at just 636 metres, is the Kinder Scout plateau. The region's depiction in topographic and geological maps has been summarised by Henry and Hose (2015). Metaliferous mining began in pre-Roman times (Barnatt, 1999). Its (geo) tourism began in the late seventeenth century (Hose, 2008). Its scientific geological exploration began in the late eighteenth century. These historical elements, explored within this paper, are underpinned by the region's geology and mineralogy and its exploitation (the mining geoheritage), the latter two are the recognised basis for its potential recognition as a European Geopark (Benghiat, 2015) with information centres, viewpoints, self-guided walks, cycle trails and a Peak District GeoPark Way as five of its 16 projected outcomes especially relevant to this paper.

Peak District Geology

The region's solid geology (see Fig. 1) is mostly of Carboniferous age rocks. A plateau of (Visean age) limestones, the White Peak, is surrounded by outcrops of successively newer strata. Firstly, mainly mudstones, and sandstones of the (Namurian age) Millstone Grit, of the Dark Peak uplands, and then, in more broken form, by the outcrop of the (Westphlalian) Coal Measures of the East Pennines, and the Lancashire and Staffordshire Coalfields. Usually on the west, the rocks dip steeply to the west or are highly folded. The dips to the east are gentler. The rocks to the north and south also usually dip away from the centre. The overall effect is that of a dome-shaped feature, the 'Derbyshire Dome'. The apparently simple structure encouraged early geologists to assume there was a central block of hard ancient rocks (Pre-Cambrian or granite) over which the Carboniferous limestones had been draped as relatively thin beds like on a large coral atoll, and that later rocks were laid down on top. However, deep boreholes and seismic surveys have revealed a complex system of almost east-west faults defining the edges of two or three south-westerly dipping tilted blocks of basement rocks (known as tilt blocks and half grabens).

Peak District Ore Fields

The region is underlain (see Fig. 2) by the southern part of the South Pennine Ore Field (SPOF) and, as at Ecton, the separate Derbyshire Ore Field (DOF). The SPOF's main lead deposits lie on the eastern side of the White Peak in a belt, a few kilometres wide and about 35 kilometres long, between Castleton and Wirksworth. The SPOF consists of hydrothermal vein and stratiform deposits, within the Upper Dinantian limestones, of galena and sphalerite together with barites, calcite and flourpsar. The veins occupy ENE-WSW, NW-SE and NE-SW vertical, fault controlled, fractures; mineralisation is due to wall rock and pore fluid interactions at a burial depth of some two kilometres. The SPOF is reckoned to have originally held some 4 million tonnes of galena, 1 million tonnes of sphalerite, 20 million tonnes of fluorspar and 20 million tonnes of barites.

Quirk (1993) has provided a summary of the origins of the SPOF; likewise Ford (2004) for the DOF. It is generally agreed that the ore bodies are pipe-like but Ford (2004) concluded that they are large masses of mineralized crush-breccia formed within tightly folded limestones and shales.

Peak District Mining Geoheritage

Metalliferous mining, for lead, zinc and silver ores, in the Peak District dates back to at least Roman times. Copper mining

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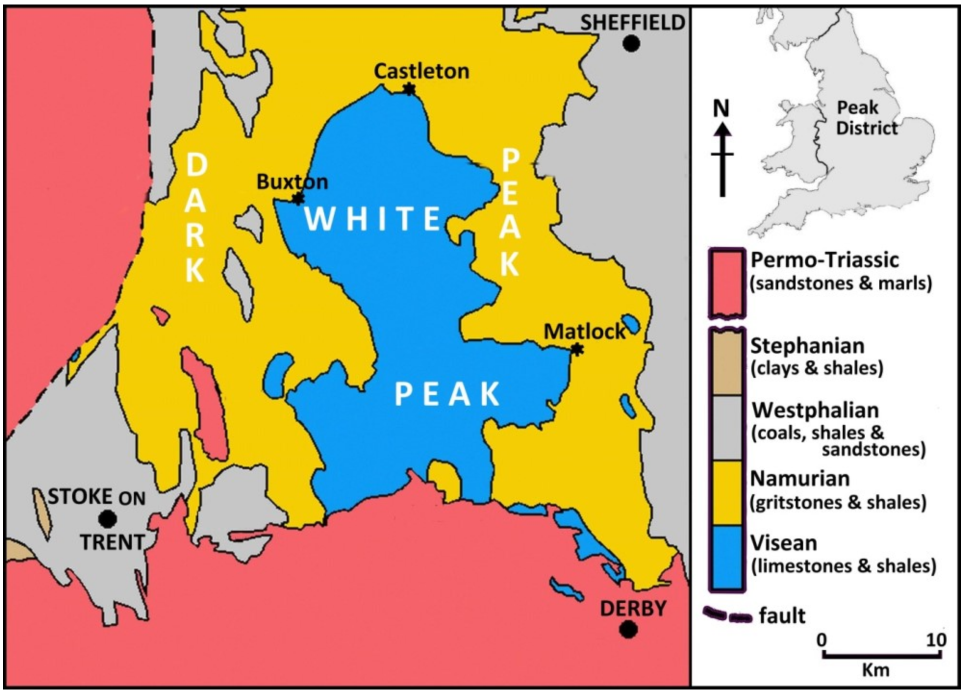

Fig. 1 Map of the Solid Geology of the Peak District

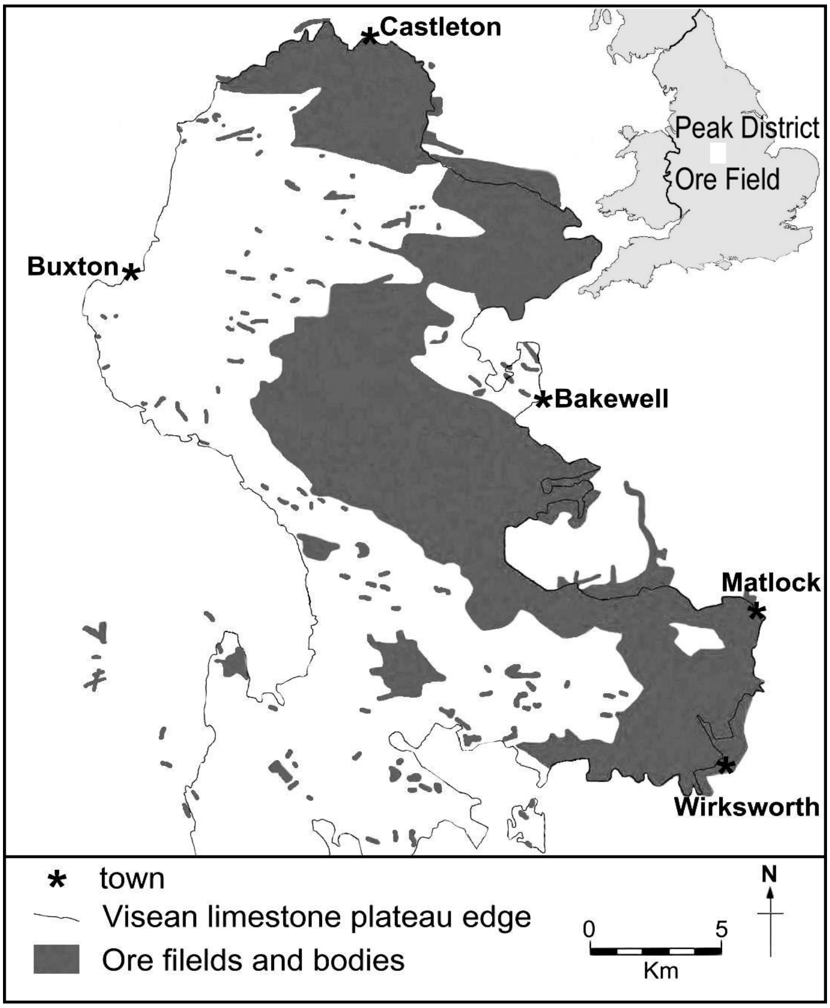

Fig. 2 Map of the Ore Fields of the Peak District

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began in the Bronze Age. Iron and manganese have also been extracted. The mines were of three types: shaft and gallery; bell pits; and rakes (open surface workings that followed mineral veins often along fault-lines). Lead mining reached its zenith in the seventeenth and eighteenth centuries, before declining from the mid-nineteenth century; the last major mine closed in 1939; Barnatt et al. (2013) provides an excellent inventory of the remaining major sites. Lead mining was particularly concentrated in the area around Winster and Wirksworth (especially Crich); the most notable surviving mine is the Magpie Mine, worked until 1960, which is one of the UK's finest examples of an eighteenth and nineteenth century lead mine. Now a scheduled Ancient Monument, it is preserved by the Peak District Mines Historical Society. Copper ores were the main focus on the western edge of the Peak where at Ecton and Clayton a major mining complex of mines and spoil heaps, first worked in the sixteenth century, was developed in the eighteenth and nineteenth centuries. Lead was also extracted because it lay above the copper deposit. Its 1 km^2 site is protected as a SSSI and an Ancient Monument. Its various sites, including a visitor centre, is owned and managed by the The Ecton Mine Educational Trust and the National Trust.

A major flourpsar mining centre was at Masson Hill above Matlock, now a derelict part-reclaimed site. Flourspar underpins a small-scale semi-precious stone industry based on the extraction of the world famous Blue John variety. The semi-precious mineral's name is supposedly derived from the French 'Bleu et Jaune' which aptly describes its banding. Today only a few hundred kilograms are mined annually for ornamental and lapidary use. The Blue John Cavern in Castleton is now just a show cave but mining still takes place in the nearby Treak Cliff Cavern.

Parts of the limestone plateau of the White Peak are dotted with numerous small mounds (see Fig. 3) and distinctive lines of hillocks; these follow the mineral veins (large veins are 'rakes', small veins are 'scrins') mainly worked for lead in the SPOF. The mounds are usually capped mine-shafts with the entire original mine structures above ground having been demolished. The hillocks are the spoil heaps from underground workings. They are significant because, after several re-working due to changes in smelting technology (enabling successively lower grades of ore to be worked) they contain evidence of significant changes in mining practice. They also often seal in evidence of earlier mining phases along mineral veins; open-cuts were worked first with later spoil from brought up from below burying the earlier workings. Although worked out for ore minerals they have abundant gangue minerals, especially barites and fluorspar, within the crushed and broken country rock fragments. The gangue minerals were the main reason for twentieth century mining. A mid-1990s survey of the hillocks, prior to the wholesale removal of many, showed that halve had already been lost and another quarter were in a poor state. Just under a quarter (23%) of the surviving hillocks have protected SSSI status, with around a tenth (11%) protected by temporary agri-environment scheme agreements. Despite their mining geoheritage significance they have little or no statutory protection and can be destroyed by landowners (Barnatt, 2000) without any prior notification. The hillocks are associated with features such as an estimated (Willies, 1993) 25,000 mine shafts, open-cuts, engine houses, gin

Fig. 3 Carsington Pastures Lead Mines, near Wirksworth
The obvious feature in the foreground is the mine-shaft capped with concrete railway sleepers; other capped shafts and an ore dressing area can also be seen in the middle distance.

circles, crushing circles and ore washing 'buddles' (Ford & Rieuwerts 2000).

PEAK DISTRICT GEOTOURISM AND THE GEOPARK

The history and development of the geotourism paradigm has been explored by Hose (2015) and need not be covered herein. However, it is worth noting that it arose from the late-1980s recognition of the accelerating loss of the UK's, especially in the Peak District (Hose, 2011), mines and quarries. Its newest definition (Hose, 2012) as 'The promotion to visitors of interpreted geosites and their associated artefacts whether *in-situ* or *ex-situ*, to ensure their protection and conservation through sustainable management that promotes their appreciation, enjoyment, education and research by current and future generations' (Hose, 2012, p. 11) reinforces its original geoconservation rationale. Its initial definition (Hose, 1995) and underpinning rationale were incorporated within the *UNESCO Geoparks Programme Feasibility Study* (Patzak, 2000). Thus, at the outset

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geotourism and geoparks were linked approaches to geoconservation involving geo-interpretation. The development and rationale of Europe's geoparks has been documented by Zouros (2013) and need not be elaborated further herein.

The Peak District is a major geotourism area because it has: varied and well exposed (economically important) geology with associated aesthetic and mining geoheritage landscapes; adjacent major urban centres (such as Derby, Manchester and Sheffield) have long resulted in good transport infrastructure providing ready access for local and visiting tourists; and historical geo-literature, maps and sections. It was the UK's first wild upland region explored, from the late-seventeenth century, by leisure travellers. By the seventeenth century's end the Peak District's major attractions were organized and promoted by the 'guidebooks' of Thomas Hobbes (in 1678) and Charles Cotton (in 1681) as seven 'wonders': *'two fonts'* - wells of Tideswell and St Ann; *'two caves'* - Poole's Hole and Peak Cavern; *'one palace'* - Chatsworth House; *'one mount'* - Mam Tor; and *'a pit'* - Eldon Hole pothole. The original 'wonders' are all well described by Ward (1827); that volume also contains much interesting geological information and would have been useful to nineteenth century geotourists visiting the region; for example, on the Cumberland Cavern near Matlock Bath noted '…several parts of this cavern also have a very brilliant appearance; and exhibit different substances that will be inspected by the curious mineralogist with great interest and satisfaction.' (Ward, 1827, p. 59-60). One of the first documented leisure visitors to the wonders was Celia Fiennes, probably England's first geotourist (Hose, 2008). She observed that around Buxton its '…Bowells are full of mines of all kinds off Black and white veined Marbles, and some have mines of Copper, others tinn and Leaden mines, in which is a great deal of silver.' (Fiennes, 1888, p. 82). In so observing she shows how the 'wonders' attracted travellers to look at other underground sites such as mines.

A century after Fiennes, John Byng (1743-1813) journeyed, during the summers of 1781 to 1794, on horseback throughout England and Wales. His recorded travels, unpublished in his lifetime and only re-discovered in the twentieth century have been in print ever since, display his training as a retired Army officer and his antiquarian interests; whilst mainly about domestic and social matters they include descriptions of the countryside, including geological observations, through which he journeyed, such as 'All the country is scooped by lead mines and their levels; betwixt Winster and Elton are the great lead mines of Portway.' (Byng, 1966, p. 186). And 'Macclesfield looks well in approach: and one knows a place to be enriching and increasing when it is surrounded by brick-kilns: the copper works have done this and disseminate their coin far and wide.' (Byng, 1996, p. 174). Like Fiennes he believed that there was just as much of interest in Britain as in France and Italy, particularly because England and Wales contained so much that was picturesque. He equally admired contemporary industrial technology, including Richard Arkwright's (1732-1792) Cromford Mill and Josiah Wedgwood's (1730-1795) Etruria potteries. On the Derbyshire mills he wrote 'These cotton mills, seven storeys high and fill'd with inhabitants, remind me of a first-rate man of war and, when they are lighted up on a dark night, look most luminously beautiful.' (Byng, 1966, p. 188) making him an ideal links person between the potential geopark and the Derwent Valley Mills World Heritage Site

In the 1720s Daniel Defoe (1660-1731) typically characterized the moorland around Chatsworth as a 'houling wilderness' and that Peak Cavern, near Castleton, was disappointing for tourists '…with a just curiosity...when they go to see it, they generally go away, acknowledging that they have seen nothing suitable to their great expectation, or to the fame of the place.'

(Defoe nd, vol.1, 168). Half a century later, in 1771, Arthur Young (1741-1820), a writer on agricultural improvement, travelled through Dove Dale and recorded (in *The Farmer's Tour through the East of England…*) in complete contrast that it was '...bounded in a very romantic manner by hills, rocks and hanging woods; which are extremely various; and the hills in particular of a very bold and striking character. They are spread on all sides in vast sweeps, inexpressably magnificent...' (in Trench, 1990, p. 158). It was also noted in the early nineteenth century that 'The caverns of the Peak and the lead mines, afford something strange and new. Altogether we can warmly commend a trip through Derbyshire, as one affording great variety of hill and dale, wood and stream, barren moors, and rich cultivation, fine parks and mansions, and beautiful hamlets, cottages, and roadside gardens…' (Sydney, 1851, p. 221) and 'The environs of Buxton afford ample room for rides, drives, picnics, and geological and botanical explorations.' (Sydney, 1851, p. 224).

The first formal account of the region's geology appeared towards the end of the eighteenth century, John Walcott's (?-1813) *An inquiry into the original state and formation of the Earth* of 1778 which went into two further (1786 and 1792) editions. Its fossils were described in William Martin's (1767-1810) *Petrificata Derbiensia; or figures and descriptions of petrifactions collected in Derbyshire* (1809). John Farey's (1728-1798) *General View of the agriculture and minerals of Derbyshire* (1811) and White Watson's (1760-1835) *A delineation of the Strata of Derbyshire...* (1811) (which are cross sections) and *A section of the strata in the vicinity of Matlock Bath...* (1813) were major descriptive works of the regions geology; the latter was a groundbreaking approach (see Fig.4) to representing subterranean geology. However, there is no evidence that the works of Farey and Martin had a wide readership amongst the early travellers to the region; likewise for Watson's works although travellers visited his Bakewell museum-shop in some numbers. Walford's *The Scientific Tourist* of 1818 included both an account of the counties of the Peak District and general geological information, including advice on how to describe geological features.

Today, the original 'wonders' are still major geotourism attractions along with mines and industrial history sites (Harris 1971), together with geosites (see Horton & Gutteridge, 2003; Rodgers, 1977; Wolverton Cope; 1999) in and around Bakewell, Buxton, Castleton (see Ford, 1996) and Matlock; these are mainly old mine sites of which a mere handful have any remaining structures above ground. The region has been acknowledged (Hose, 2008) as the birthplace of geotourism, particularly because of the visits of Celia Fiennes to some of its geosites. Indeed, from the late-seventeenth century, travellers to the region visited them because they were comparatively readily accessible from its adjacent and then industrialising towns; they would often break their leisure journeys to visit its textile mills (the world's first such buildings), potteries smelting works and other manufacturing attractions - much as today's tourists visit its industrial history sites chief of which is The Derwent Valley Mills World Heritage Site.

The Derwent Valley Mills World Heritage Site (Derbyshire County Council, 2014) which lies south of, and abuts, the Park received its inscription in 2001. It delineates and promotes a cultural landscape where the factory system was born in the eighteenth century. It has historic mill complexes and the watercourses that powered them, together with the settlements developed for the mill workers, the canals, railways and other structures; these are grouped within a distinctive landscape setting which has changed little over two centuries. The Derwent Valley also houses at Matlock Bath the Peak District Lead Mining

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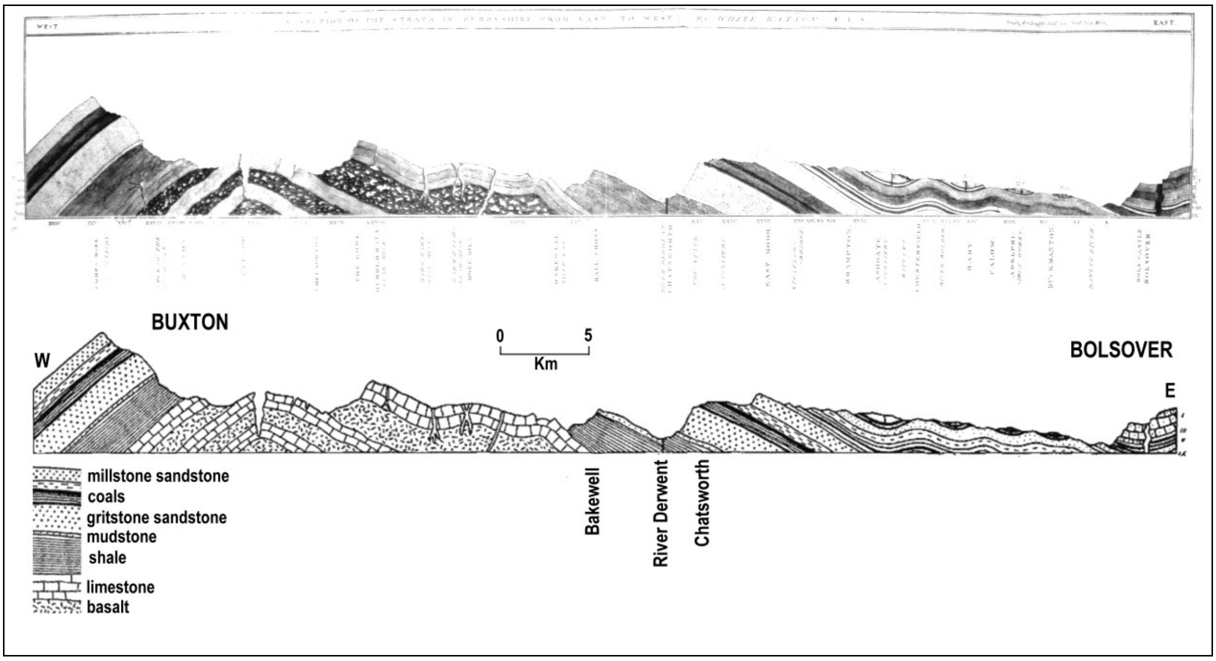

Fig. 4 White Watson's (1813) Cross Section of the Derbyshire Dome
The top section is as it appears in Watson, W. the 1813 volume "A Delineation of the Strata of Derbyshire forming the surface from Bolsover in the East to Buxton in the West designed from a Tablet, Composed of the Specimens of Each Stratum above the Line, With an Explanatory Account of the same, together with A Description of the Fossils found in these Strata; and also Of the Natureand Quality of the respective soils". The bottom section is a modern version employing conventional litho-stratigrahic symbols.

Museum opened in 1976, where visitors can access the fluorspar Temple Mine on a guided tour. The Derwent Valley is also home to the National Stone Centre (Thomas & Prentice, 1994) established in 1990 within six limestone quarries; it has a geotrail and a visitor centre concerned with the extraction and uses of stone. The World Heritage Site provides a model for how parts of a Peak District Geopark might be managed (see Derbyshire County Council, 2014), especially for sustainable (geo) tourism.

SUPPORTING THE GEO-HISTORICAL APPROACH: SOME KEY PERSONS

Geo-history and its materials

The writings and researches of seventeenth to nineteenth century individuals recorded their observations and the reading of which encouraged others in the past to visit the Peak District.

This geo-historical material is an ideal basis for geo-interpretive materials; geohistory, 'The study, evaluation and application of a systematic narrative of geological discoveries, events, personages and institutions' (Hose, 2012), has a published model (Hose, 2010; 2015) indicating its practical outcomes and contextualising geotourism research.

Almost a century ago it was noted that 'The curiosity shown by the tourists in the agricultural and industrial development of those parts of the country they visited seems to have been in a degree general. The number of books which may be described as topography, although their compilers often call them geography, or a tour, is fairly large, and they were reprinted in a more or less amended, expanded, and up-to-date form at frequent intervals.' (Fussell & Goodman, 1929, p. 86). Such works, as shown herein, can still and should be consulted today when developing mining geoheritage geotourism because they provide useful background information, often on sites with little or no present-day surface expression; they can also provide information on the social conditions of the miners. Examining a few selected individuals, some of whose words have already been quoted herein, is sufficient to indicate the nature of the contributions and the potential of their and writings for Peak mining geoheritage geo-interpretation. Indeed, 'The object of the, so to say, lay tourist was to see the country: he wanted views and what he was pleased to call ' the picturesque '. Consequently we find that many of these diarists and letter-writers visited the same parts of the country, while other parts, not less interesting to us, were comparatively neglected. The favourite places were almost the same then as they are to-day with the more ubiquitous motorist.' (Fussell & Goodman, 1929, p. 85). The lives and works of a few individuals – such as those reported herein – with Peak District connections are worth noting, even in summary, because these, together with their recorded observations, have much to offer the mining geoheritage geo-interpretation copy writer. These individuals include poets (Cotton and Hobbes), travellers (Fiennes) and geologists (Farey, Mawe, Watson, and Whitehurst) of whom the following vignettes illustrate their geo-interpretive potential for the proposed geopark.

Thomas Hobbes (1588-1769)

Thomas Hobbes was a graduate of Oxford University. In 1610 he travelled to France and Italy on a Grand Tour. In 1613 he was employed as tutor, at Chatsworth House, to William Cavendish. His pupil became the 2nd Earl in 1626. For the next two decades, with Hobbes as the official travelling companion and Secretary, they travelled together. When the 2nd Earl died Hobbes then escorted a Nottinghamshire landowner's son on a 1629-1630 Grand Tour. On his return to England he was employed, as a tutor to the young 3rd Earl. From October 1634 to October 1636 he toured Europe, with the 3rd Earl, and met the leading continental mathematicians. In Paris, he exchanged natural science views with Descartes, via his secretary Marin. He met Galileo and was inspired by the idea that motion was the underlying universal force. He subsequently planned and part published an ambitious three-part project explaining Nature, Man, and citizenship based around this idea of motion. Significantly for geotourism, sometime around 1627 he presented a Latin poem, *De mirabilibus Pecci. Carmen*, of some 500 verses to William Cavendish, 2nd Earl of Devonshire, describing a trip through the Peak; it praises (in verse 79) its 'Seven Wonders'. The poem was printed around 1636, reprinted in 1666, 1675 and – with an English translation – in 1678. It inspired Charles Cotton's *The Wonders of the Peake* of 1681. However, because there is no published modern edition or translation, few people today has read Hobb's volume, although it is the first attempt to produce a travel guidebook in England.

Charles Cotton (1630-1687)

Charle's Cotton's father was friends with many contemporary writers of his day including Ben Jonson, John Donne, John Selden, Sir Henry Wotton, and Izaak Walton. As a young man he travelled in France and a probably also in Italy on the Grand Tour. He had no paid profession and seemingly spent his entire life on various inadequately funded literary pursuits. About 1670 he composed the semi-autobiographical poem *A Voyage to Ireland in Burlesque* about his captain's commission forcing him, with a near shipwreck, to Ireland and regrettably having to relinquish his passion for angling – he contributed an account on fly-fishing to the 5th edition of the world's most famous angling book, Izaak Walton's *The Complete Angler*. He was a skilled horticulturalist and published in 1675 *The Planter's Manual, being instructions for the raising, planting, and cultivating all sorts of Fruit-Trees, whether stone-fruits or pepin-fruits, with their natures and seasons*. He published in 1681 the descriptive poem, *The Wonders of the Peak*. An unauthorised collection of his poems was posthumously published in 1689. *The Genuine Works of Charles*

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Cotton (which included *Scarronides*, *Lucian Burlesqued*, *The Wonders of the Peak*, and *The Planter's Manual*) was published in 1715 and by 1771 had gone to a further five editions. During his life and right up to the Romantic poets of the nineteenth century his poems were highly regarded; *Ode to Winter* was a favourite poem of William Wordsworth who did much to popularise Romantic travel.

Celia Fiennes (1662-1741)

Celia Fiennes was an elite traveller in the last two decades of the seventeenth century who undertook and kept a journal of her several long distance horseback journeys in England, between 1684 and about 1703, partly to regain and improve her health. At that time the idea of travel for its own sake, except perhaps for spiritual and physical health reasons, was still somewhat novel. She was keen on domestic tourism and her interest in the products and manufactures of the places she visited anticipated the later genre of 'economic tourism' that became formalised with Daniel Defoe's professional and survey-like *A Tour through the Whole Island of Great Britain* (1724–26). Fiennes recorded that at Chesterfield she '…Came by ye Coale mines where they were digging. They make their mines at ye Entrance Lie a Well and so till they Come to ye Coale then they dig all the Gorund about where there is Coale and set pillars to support it, and so bring it to ye well where by a basket Like a hand barrow by Cords they pull it up – so they Let down and up the miners with a chord.' (Fiennes, 1888, p. 77). On Ashbourne's copper she noted that 'They digg down their mines like a well for one man to be let down wth a rope and pulley, and so when they find oar they keep digging under ground to follow the oar wch lies amongst the stone yt lookes like our fine stones. In yt mine I saw there was 3 or 4 at work and all let down thro' ye well; they digg sometymes a great way before they come to oar. There is also a sort of stuff they dig out mixt wth ye oar and all about the hills they call sparr, it looks like crystal or white sugar candy, its pretty hard; ye doctors use it in medicine for the collick...' (Fiennes, 1888, p. 82-83). She also recorded aspects of mine construction and the health of its miners who'...wall round the wells to ye mines to secure their mold'ring in upon them, they generally look very pale and yellow that work underground, they are fforc'd to keep lights wth them and sometymes are forced to use gunpowder to break ye stones, and yt is sometymes hazardous to the people and destroys them at ye work.' (Fiennes, 1888, p. 83). She worked up the notes scribbled on her various journeys into a travel memoir in 1702 but this was never intended for publication, only family reading. It was passed down through the family before being fully transcribed for publication by a descendant, The Honourable Mrs Emily Griffiths, and Robert Southey published unacknowledged extracts of it in 1812. The first complete edition, *Through England on a Side Saddle in the Time of William and Mary*, only appeared in 1888. A scholarly edition, *The Journeys of Celia Fiennes*, was produced by Christopher Morris in 1947 and has since been constantly in print.

John Whitehurst (1713-1788)

John Whitehurst served an apprenticeship as a clockmaker with his father. He was fascinated by the Peak's natural wonders. He explored, sometimes accompanied by the likes of Josiah Wedgewood and Erasmus Darwin, the northern part with its caverns and mines and gradually developed a keen interest in geology. He began to formulate theories on the origin and structure of the Earth. He met with Benjamin Franklin in 1758 and 1759 with whom he discussed his theories, finally crystallised in An Inquiry into the Original State and Formation of the Earth of 1778; it has a considerable section on Derbyshire's strata and is one of the earliest such accounts. Although his theories on the Earth were flawed, his accounts of Derbyshire's structure and geology are remarkably accurate. He was the first to recognise that the 'toadstone' of the lead miners was of volcanic origin. His remarks and observations were the basis for further work by later geologists such as John Farey and White Watson.

John Farey (1728-1798)

John Farey was a pupil at Robert Pulman's Academy in Halifax where he received special instruction in mathematics and philosophy (including natural science), drawing and surveying. In 1792 he was appointed Land Steward to the 5th Duke of Bedford's Woburn Estates. For ten years he pursued his duties, especially overseeing land and agricultural improvements. He honed his skills in land surveying, the evaluation of soils and underlying rocks, and land drainage. He heard of William Smith (1769–1839) and his skills in land surveying and especially drainage in 1800. During Smith's visits to drain parts of the Woburn Estate they met and Smith outlined his principles of stratigraphy to him in 1801. Through his Estate work Farey knew Sir Joseph Banks, President of the Royal Society, and he reported enthusiastically to him in early 1802 of Smith's geological insights. Farey was unjustly blamed for the Estate's mismanagement and dismissed whereupon, after failing as a farmer, he moved to London establishing himself as land surveyor, graduating to mineral surveyor (a term he coined) in 1808. Like Smith he hired out his services to landowners who required appraisals of their estates and assessments of any possible minerals worth the cost of extraction. He travelled extensively throughout Britain but the number and location of the estates he surveyed are unknown.

White Watson (1760-1835)

White Watson was a Bakewell man, spending most of his life there, and seldom travelled more than 40 kilometres away. He was a sculptor, marble-worker and mineral dealer. A pioneer of Derbyshire and Peak District stratigraphy, he published sections (1788 and 1811) with some assistance from John Farey and inlaid marble tablet 'sections of strata' (inlaid into slabs of Ashford Black Marble) with samples of the actual rock types so that they were decorative as well as informative; amongst, but not, the first reasonably accurate geological sections as recognised today to appear in England. He had a combined shop and 'museum' in Bakewell from which he sold minerals to wealthy travellers, such as Josiah Wedgewood and Sir Joseph Banks, on Peak tours. He assembled cabinets of minerals for collectors and was patronised by Georgiana (1757-1806), Duchess of Devonshire; a regular visitor to Chatsworth, he arranged and catalogued her collections and gave geology lessons to her son (later

John Mawe (1766-1829)

John Mawe (see Torrens, 1992) was born and schooled in Derby. He worked as merchant seaman until he married, in 1794, the daughter of Richard Brown (1736-1813), a mineral dealer and marble worker. Mawe then worked for his father-in-law. By late 1794 he was managing the London shop near Covent Garden. A year later the business was trading as 'Brown, Son and Mawe, Petrifaction Warehouse'. His interest in mineralogy seemingly stemmed from his seafaring days, his travels provided ample opportunity to collect minerals and seashells. He travelled extensively in Britain collecting minerals to sell in the shop and making geological observations. For some years he lived in Castleton, where there is a memorial to him in the parish church. In 1802, he published The Mineralogy of Derbyshire. During 1804 he set off on a long voyage to South America, and between 1807 and 1810 extensively travelled in the interior of Brazil. On his return the mineral business flourished so well that he opened 'Royal' museums in London, Cheltenham, Castleton and Matlock Bath; the 'Royal' epithet related to patronage by the Spanish, not the British, royal family which had commissioned him furnish them with Derbyshire minerals and fossils for their collections.

the 6th Duke). He learned about subterranean geology by talking to miners and observed in the field, becoming an expert geologist and botanist, supported by a fine library – the latter suggesting he was making a good living despite common assertions that he had precarious finances.

GEO-INTERPRETATION AND THE GEOPARK

Geo-interpretation, 'The art or science of determining and then communicating the meaning or significance of a geological phenomenon, event, or location.' (Hose, 2012), is founded upon environmental education approaches from the USA's National Parks adopted in the UK from the 1960s; Aldridge (1975) provides a summary of such UK countryside interpretative practice. Comprehensive guides to USA practice, such as by Ham (1992) and Knudson et al. (1999), and numerous on-site geo-interpretation schemes, whether acknowledged or not, incorporate Freeman Tilden's (1883-1980) mid-1950s suggestions. He defined interpretation, with regards to the USA's National Parks Service, as 'An educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information.' (Tilden, 1977, p. 8); he argued that interpretation must be underpinned by research about the locations on which it is focussed (Tilden, 1977, p. 5) and should evoke an emotive response rather than merely imparting information. It has been suggested within the European Geopark Network, at the 2013 Arouca meeting, that Tilden's principles need to be reasserted (Brilha, 2011); further, 'Any presentation of geological heritage that does not somehow relate to something in the personal experience of the visitor will be sterile.' (Brilha, 2011, p. 10). A key interpretation element from USA interpretive practice seemingly lacking from many geoparks is 'The human element [which] should always be part of your topic… Natural history topics may be fascinating in themselves but people relate best with other people... You can incorporate people into your writing by talking about historical figures associated with your subject.' (Heintzman, 1988, p. 2). The Peak District's association with some early geotourism and scientific geology individuals lends itself to this geohistorical approach in developing a geopark proposal.

Some existing Peak District Geo-Interpretation

Several Peak District geosites have been interpreted over the past 20 or so years with each reflecting the prevalent interpretive style and practice of their time. One of these, Brown End (limestone) Quarry, has had two distinct phases of interpretation. Both the original (Cossey et al., 1994) and new interpretive (Staffordshire Wildlife Trust, 2004) panels tell a geological story with no human interest whatsoever (Hose, 1997, p. 2958); likewise, the panels at the Ecton Copper Mine (see Fig.5). Although innovative in its consideration of stone usage, the National Stone Centre's (Thomas & Prentice, 1994) interpretive provision generally lacks human focus; it has been critiqued by Hose (1994, 1999). The Buxton Museum and Art Gallery, housed since 1928 in part of the former Peak Hydropathic Hotel built in 1880, has the permanent exhibition 'Wonders of the Peak' which explores the region's history from 'Big Bang' times to the present-day; it also has the Prof. William Boyd Dawkins (1837-1929) recreated Victorian study and displays on him and John Wilfred Jackson (1880-1978) – both local geologists. Overall, there is very little on-site geo-interpretive, whilst there is comparatively much general countryside and wildlife interpretive, provision in the Peak District; consequently most visitors are unaware of the nature, longevity and significance of the mining geoheritage literally beneath their feet and just occasionally in front of them.

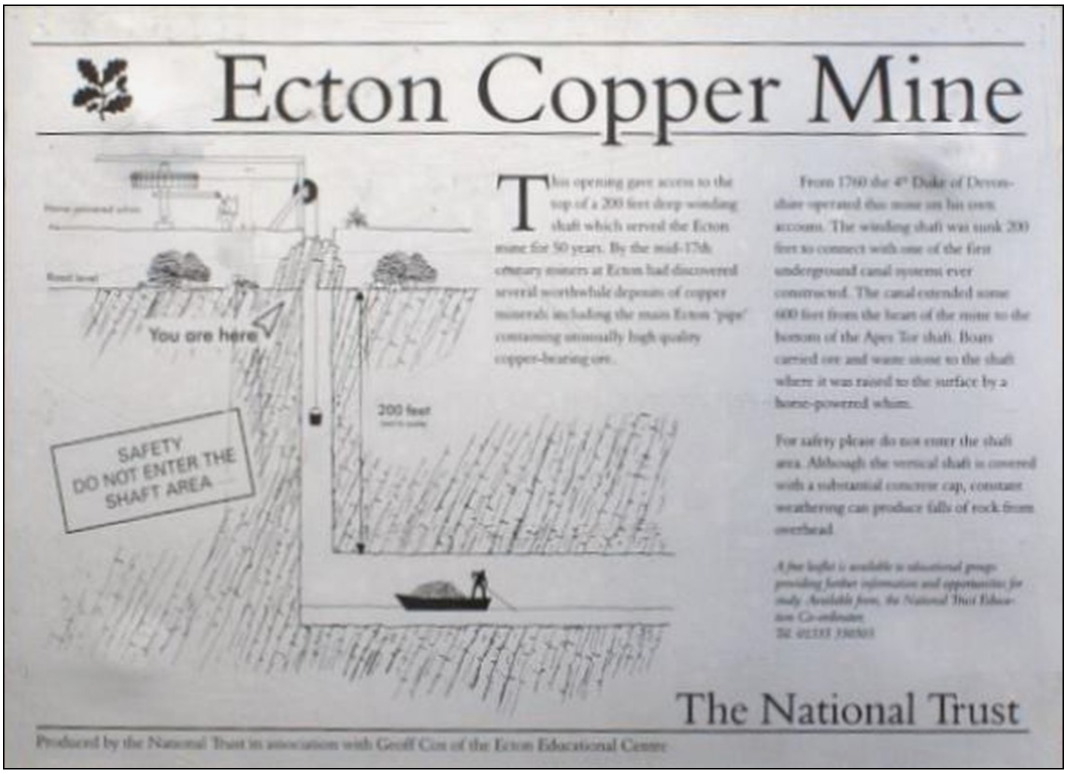

Fig. 5 Ecton Copper Mine Information Panel
Information panel providing an explanation of how the mine-shaft was used.

Hence, there is an urgent need to develop communicatively competent geo-interpretation for the Peak District, almost as a pre-cursor to the geopark, in order to generate public support for such a venture.

Suggested Geopark Interpretive Provision

In supporting and promoting a European Geopark Network candidacy for the Peak District employing a geo-historical approach the suggestion is that geo-interpretive materials should be developed for deployment along the major existing (Derwent Valley, High Peak, Monsal, Tissington) Trails, the Manifold Track and the South Pennine Bridleway with linking routes where needed; geo-historical information and signage materials should be made available to their managing organizations. Arguably the High Peak and Tissington Trails (see Fig. 6) are the most accessible, popular and fairly well routed in the White Peak to show good aspects of its mining geoheritage; the mines near Ashbourne early attracted the attention of Celia Fiennes amongst the early geotourists. For outdoor on-site usage it is suggested that small (but measuring at least 15x15 cm) colour-printed ceramic tiles, such as those employed in Spain's Aliaga Geopark, either singly or in combination to create small plaques be employed. This is because of their ability to reproduce photo-images, durability, relatively low cost, graffiti resistance and limited maintenance apart from cleaning; unlike metal panels they are unlikely to be stolen and unlike fibreglass panels will not be damaged by portable barbeques! The small ceramic tiles are also considerably less visually intrusive than the usual A0 and larger panels generally employed for outdoor on-site interpretive provision, further they lend themselves to unobtrusive affixing to walls and historic buildings. The tiles could, for example, be affixed to either the actual buildings or those occupying the site (of say the Mawe Royal Museum at Matlock Bank - see Fig.7), or at a viewpoint where the work of someone such as White Watson (see Fig.8) can be appreciated. Further, there should be made available print-on-demand pdf versions of the tiles, together

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with leaflets and information sheets, placed on-line for off-site access; the designs on the individual tiles could also be printed on drinks mats. These essentially printed media could later be used as a basis for developing smart-phone on-site usage applications. All the geo-interpretive media must have a common 'brand identity', such as the PEAK District GEOPARK, which has some resonance with the current National Park branding but is sufficiently distinct so as to avoid confusion and to promote the geopark's recognition.

CONCLUSIONS

Generally geopark candidacy and later management and promotional approaches are founded on practitioner and economic led (supply-side) approaches, rather than addressing the actual needs and, especially human, interests of geotourists (consumer-side led), with a limited understanding of the relevance of the history, development and philosophy of landscape tourism. The individuals and their works noted in this paper could provide the basis for a number

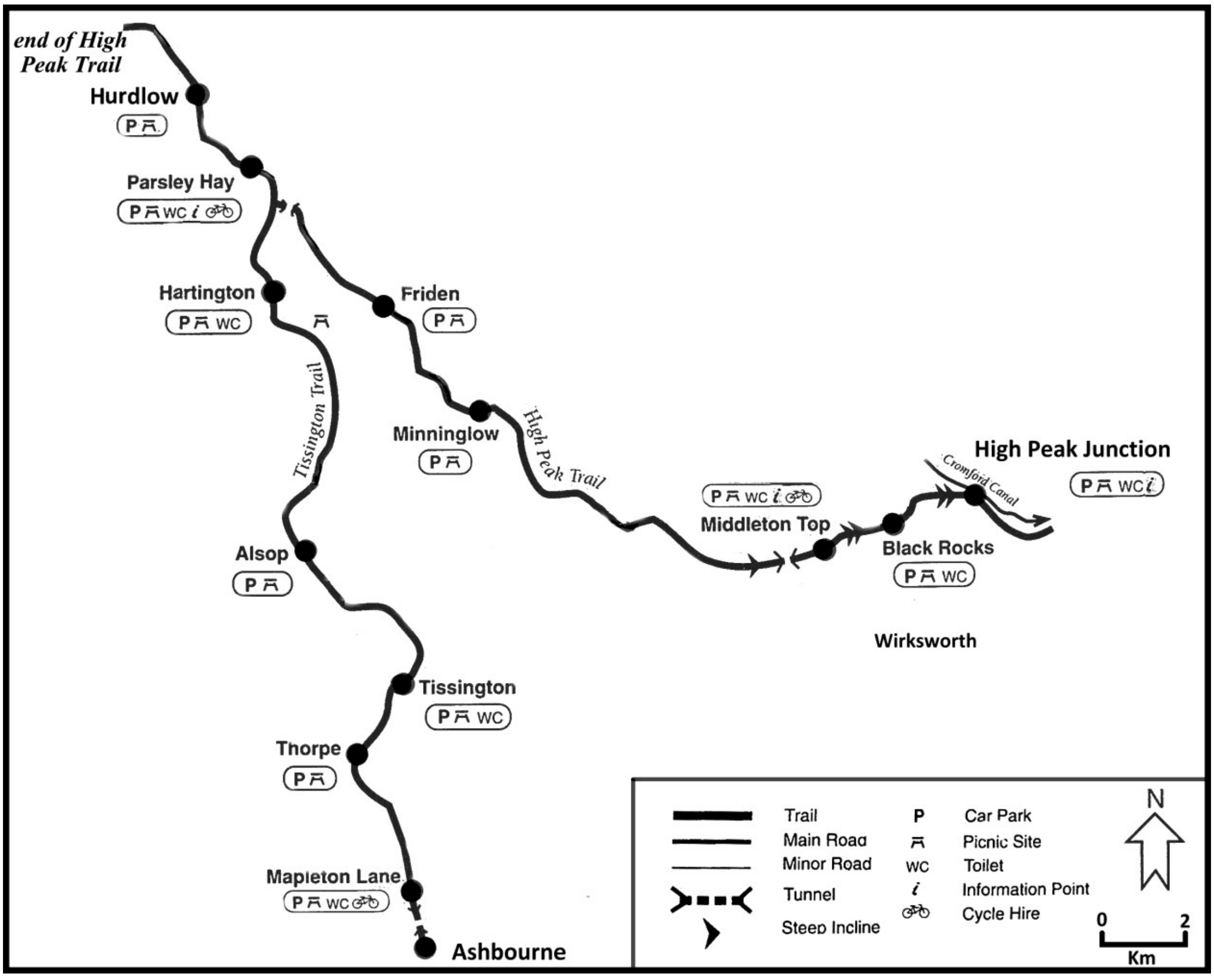

Fig. 6 Map of the Part of the High Peak and Tissington Trails
The Tissington Trail runs for 21 km, along the route of the 1899 Buxton to Ashbourne railway that was closed in the 1960s, from Ashbourne to Parsley Hay where it joins up with the High Peak Trail; this runs for 28 km from High Peak Junction near Wirksworth to Dowlow near Buxton. The High Peak Trail follows the route of the Cromford and High Peak Railway constructed in 1825-1830 which also finally closed in the 1960s. The local rocks are well displayed in the various cuttings and tunnels along the two Trails from which various mining geoheritage sites can be seen. Both Trails are open to pedestrians, cyclists and horseback riders.

of themed geotrails, the details of their lives and their writings providing the essential human interest element in the associated geo-interpretive media; the latter should be more than the usual leaflets and panels commonly associated with geo-interpretation (Hose, 2000), which quite frankly too often fails to inspire any interest by visitors, but should embrace the possibilities to reach wider and younger audiences by exploiting the opportunities provided by the UK's widespread smart-phone and tablet personal computer ownership. The region has a long tourism, and even longer mining history, whose literary record and *in-situ* remains offer much potential to support the legitimacy of a bid for the Peak District to become a European Geopark.

Fig. 7 Possible John Mawe (1764-1829) Interpretive Plaque
The images show Mawe's Royal Museums, opened in 1800 and a rock specimen, encrusted with native gold and diamonds, he brought from Brazil. The simple bullet point text draws attention to some keys aspects of his personal and professional life. Note that this plaque is composed of our abutted tiles.

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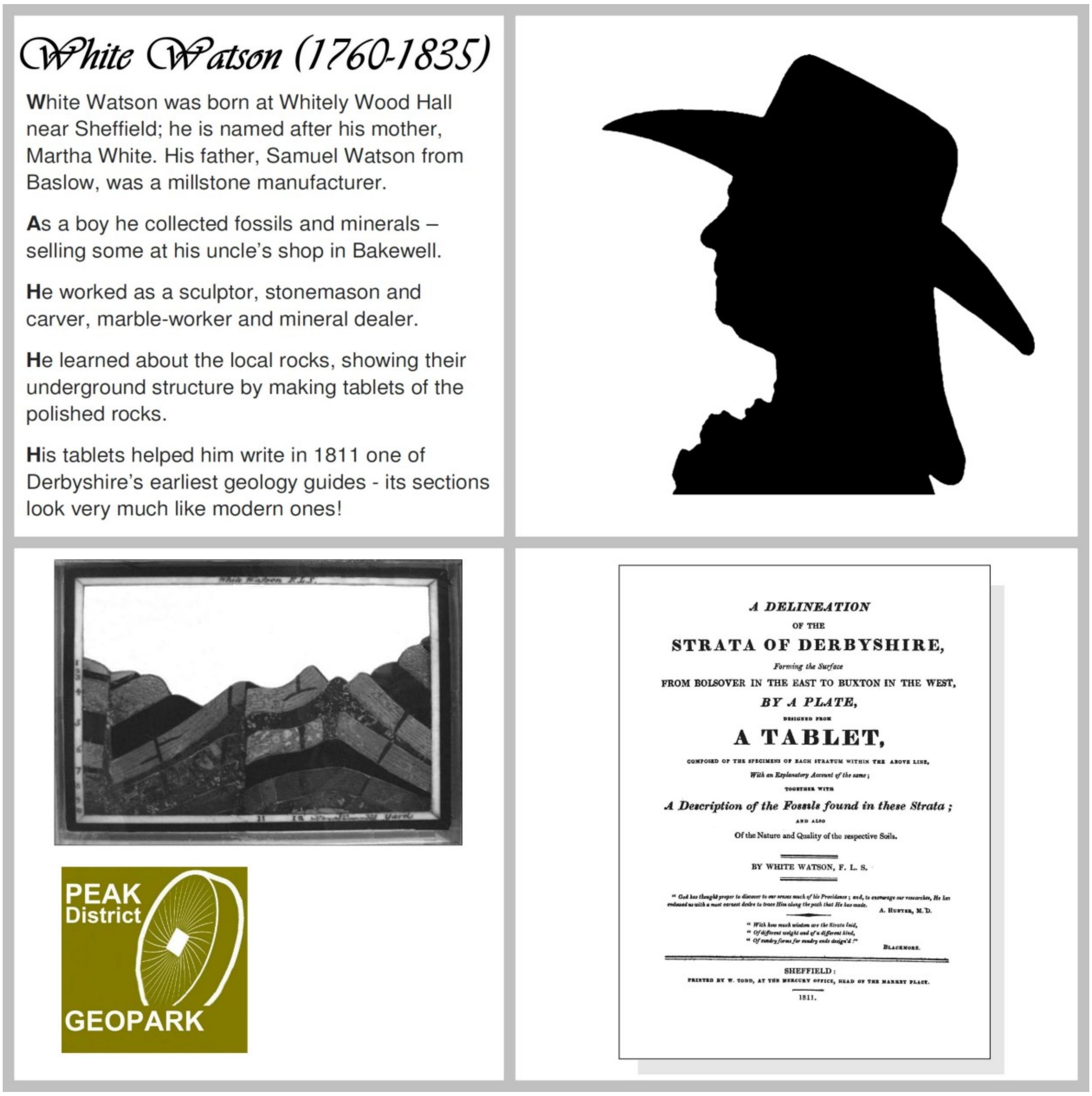

Fig. 8 Possible White Watson Interpretive Plaque

The images show one of Watson's tablets made from real polished stones, the title page of his major book on Derbyshire geology, and silhouette of him in later life. Note that this plaque is composed of our abutted tiles.

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Geotouristic attractions of the Ostrava part of the Upper Silesian Basin: geological and environmental sites

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ABSTRACT
In the Ostrava part of the Upper Silesian Basin there are many geotouristic sites connected with the underground mining of Carboniferous bituminous coal. Text is focused on those related to the geology of the Basin and environmental issues connected to coal mining. Of great intrest are outcrops of Mississippian sediments of the paralic Ostrava Formation, as well as two most important museums with permanent geological exhibitions. Some interesting geological features conncted to younger periods of Quarternary glaciation are also mentioned. Two types of publicly accessible sites related to the environmental burdens (burning coal heaps, saline mine water drainage system) are also described.

Key words: geotourism, Ostrava, Upper Silesian Basin, Czech Republic

INTRODUCTION

In the Czech Republic, the Czech part of the Upper Silesian Basin has always been the most important bituminous coal basin and at present it is a last bituminous coal basin in which mining operations are carried out. The extractive industry in the Ostrava conurbation is closely interconnected with the town, which makes it possible to study sites related to geology, coal mining and processing together with residential buildings and buildings designed for the management of mining industry. In this article we draw attention to the most interesting of these sites occurring in the area of present-day Ostrava, including the most important museums, in which the visitor can find information necessary for understanding the broader context of development of the Ostrava industrial conurbation.

STUDY AREA - GEOLOGICAL SETTING

The Upper Silesian Basin, which is situated in the area of Poland and the Czech Republic, is at present the most economically important European bituminous coal basin. Approximately four fifths of the area of the basin are there in Poland, the remaining part of the basin lies in the Czech Republic. The present-day extent of occurrence of sediments of the Upper Silesian Basin is affected by post-sedimentary erosion processes so that the original extent of the basin must have been undoubtedly greater (Dopita, 1997).

Carboniferous sediments of the Upper Silesian Basin (Late Mississippian to Pennsylvanian age), renowned for their deposits of bituminous coal, have been gradually developed from the underlying marine sediments of the Moravian-Silesian Palaeozoic Basin. After shallowing and ending the sedimentation of siliciclastic flysch (so-called Culm Basin), a transition to the sedimentation of paralic type took place (Kumpera, 1990). This is characterised by the prevalence of river and lake sedimentation, which is usually interrupted only by seldom, time-limited shallow-marine sedimentation. Under such conditions, environments suitable for the

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origin of coal seams began to be created. The complex of sediments originating in these environments is called the Ostrava Formation (designated as the Paralic Series in the Polish part of the basin). In the area of its Ostrava sub-basin, the Ostrava Formation is divided (from the oldest to the youngest) into the Petřkovice, Hrušov, Jaklovec, and Poruba members (Dopita, 1997).

At the end of the Early Carboniferous (Mississippian), definitive withdrawal of the sea from the area of the Upper Silesian Basin occurred. After temporary interruption of sedimentation in the basin, the sedimentation was resumed with deposition of the Karviná Formation, to which the Upper Silesian Sandstone Series and the lower part of the Claystone Series corresponded in the Polish part of the basin. The youngest lithostratigraphical units, Cracow Sandstone Series and Kwaczala Arkose, are developed only in the Polish part of the basin (Dembowski, 1972; Kotas et al., 1988). The Karviná Formation was formed exclusively in continental conditions as combination of river and lake sedimentation. In the basin were also formed environments suitable for the development of coal swamps giving rise to coal seams. In the Czech part of the basin, the Karviná Formation is divided (from the oldest to the youngest) into the Saddle, Suchá, and Doubrava members (Dopita, 1997).

The exact spatial extent of sedimentation of the Upper Silesian Basin is not known because its upper boundary in the basin is erosional. In the Ostrava part of the Upper Silesian Basin, Neogene sediments of the Carpathian Foredeep are forming oiverburden to the Carboniferous sediments. That is why natural outcrops of Carboniferous sediments are scarce and small in surface area. Moreover, a number of outcrops have ceased due to anthropogenic activities. In the surroundings of the outcrops, sediments of the Upper Silesian Basin with coal seams occur at minimum depths below ground surface. For this reason, these places were also the places in which mining activities in the Upper Silesian Basin started. These places stood at the cradle of present-day vast industrial conurbations, namely Ostrava conurbation in the Czech Republic and Katowice conurbation in Poland.

METHODOLOGY

Choice of geological and environmental attractions of the Ostrava part of the Upper Silesian Basin was made using the data owned by the Faculty of Mining and Geology of the VŠB-Technical University of Ostrava. Major limit was an open access to described localities. There is a large number of interesting places such as burning coal dumps, mine water drainage systems or land reclamation areas, which have large scientific value and could be of interest for education and specific industrial/environmental tourism, but are not accessible freely.

All selected objects are described with the same structure – name, brief description, location with position on the map (Fig. 1) and GPS coordinates, recommended access, description with references to other information sources and picture. Such structure allows an easy orientation and might be in the future used for web presentations of local tourism as well.

SITES OF GEOLOGICAL INTEREST

Outcrops on Landek Hill

content: the best outcrops of Mississippian sediments in the Czech part of the Upper Silesian Basin

location: Ostrava-Petřkovice (Fig. 1), between N 49° 51.964 E 018° 15.420 and N 49° 52.285 E 018° 17.000

access: from Petřkovice along the red-marked tourist trail through the premises of former Anselm Mine (at present Landek Park) in the direction of Koblov. Sandstone outcrops appear at the westernmost point of

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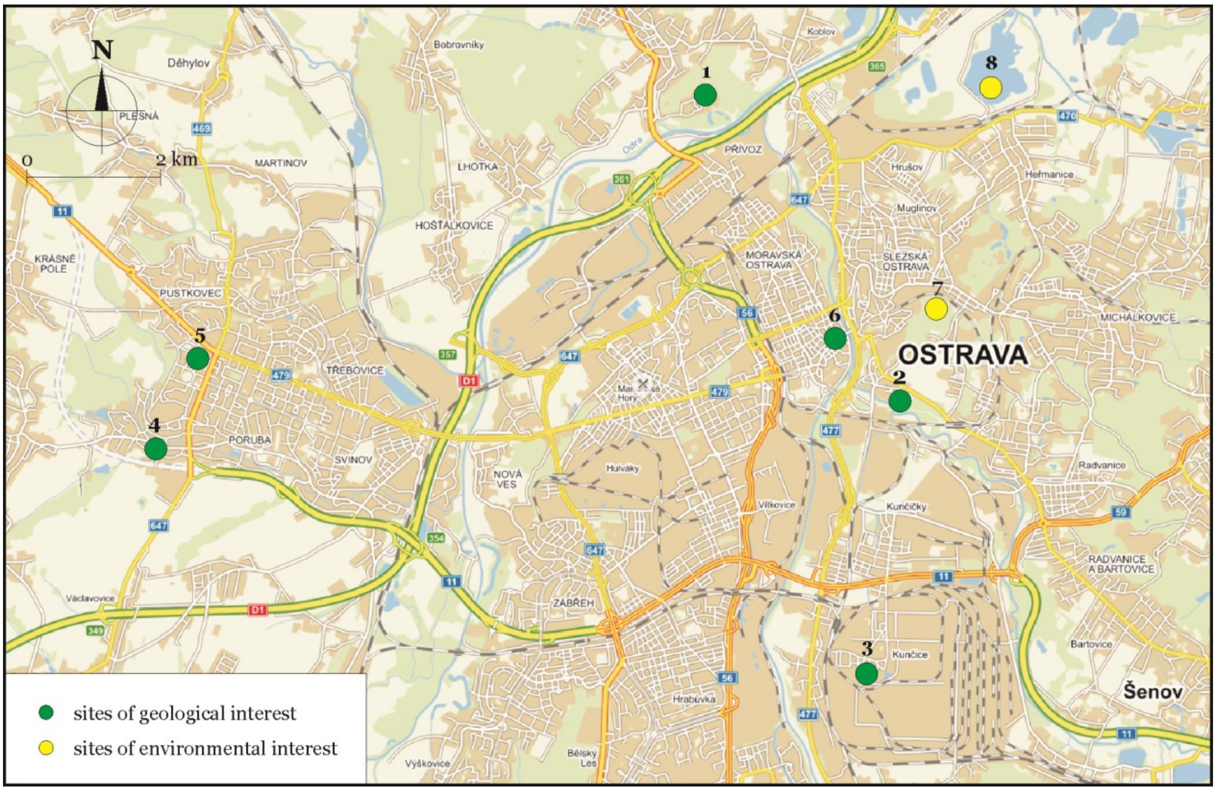

Fig. 1 Location of described sites. 1 – outcrop on Landek Hill, 2 – outcrops of the Castle Conglomerate, 3 – glacial erratic in Kunčice, 4 – glacial erratic in Poruba, 5 – František Pošepný Geological Museum, 6 – Museum of Ostrava, 7 – Ema heap, 8 – Heřmanice pond.

Landek Hill; a classical field trip locality begins at the back (east) portal of the Mine. The disconnected outcrops end closely before the bridge over the Oder River in Ostrava-Koblov. One can get to the locality also from this side (from the east); the recommended direction is however opposite in order to make it possible to proceed from older to younger sediments.

description: An almost continuous steep rock wall above the Oder River about 1,200 m long and 10-20 m high. The locality is easy to access, especially during the vegetative rest of plants. In the middle of the rock wall, layers are moderately inclined; on the other hand, in the west and in places in the middle part, the dip of the layers is considerable. The steep outcrop is formed by sandstones, siltstones, claystones (in places with marine fauna and fossilized parts of plants) and coal seams (Fig. 2A). In the lower part of the wall, several seams from the surroundings of the seam Neočekávaný from the upper part of Petřkovice Member are there. In the direct base of this coal seams, seatearth with fossilized plant roots occur. The middle part of the steep rock wall (about 470 to 800 m from the beginning of the outcrop) with subhorizontal layers of claystones to siltstones represents the sediments of the Naneta Group of Faunistic Horizons with marine fauna (Dopita & Kumpera, 1996). They are followed by an about 50 cm thick layer of the light grey clayey rock that is a product of resedimenmtation the volcanic material – so-called Main Ostrava Whetstone. This layer lies in the uppermost part of the Petřkovice Member and its upper surface forms the boundary between the Petřkovice and the Hrušov members. The dating of zircons from this horizon provided a value of 327.35 ± 0.15 Ma, so it belongs to the Serpuhkovian Stage of Mississipian (Jirásek et al., 2013a). Further towards the bridge at Koblov, sediments of the Lower Hrušov Member outcrop.

Outcrops of the Castle Conglomerate Unit

content: outcrops of Mississippian fluvial sediments in the Czech part of the Upper

Silesian Basin

location: Ostrava-Silesian Ostrava (Fig. 1), between N 49° 49.761 E 018° 18.094 and N 49° 49.631 E 018° 18.693

access: The locality can be accessed from the Silesia-Ostrava Castle. It is necessary to go along Podzámčí Street to the bridge over the Lučina River and at its north end to go down to the valley to a footpath running along the right bank of the River and continue going up the stream. Non-continuous outcrops occur in the steep slope on the left side.

description: The locality consists of a system of outcrops in former building stone quarries (Fig. 2B). The steep rock wall is mainly comprised of coarse-grained sandstones with sporadic cobbles, in which quartz prevails. In the lower part of the outcrops, a thin coal layer accompanied with grey coal siltstones is exposed in places. The sandstones are only moderately inclined and form clearly distinguishable bodies – river channels and sandbars. Visible is only the upper part of this unit, named the Castle Conglomerate Unit. It is a unique, up to 115 m thick complex of mostly coarse-grained to medium-grained sandstones with conglomerate intercalations in the lower part of Poruba Member of the Ostrava Formation. It can be observed along the whole axis of the basin from Frenštát pod Radhoštěm in the south to beyond the town of Rybnik in the north and forms a filling of a wide palaeovalley. The exceptional coarse granularity of the rocks is either a reflection of tectonic activity or a the onset of one of Middle Carboniferous glacial periods (Jirásek et al., 2013b). In spite of not being a high-quality building material (see original stones in walls of Silesia-Ostrava Castle), it was more suitable for construction purposes than the other sediments of the Ostrava Formation.

Glacial erratic in Kunčice

content: largest gracial erratic in the Czech Republic

location: Ostrava-Kunčice (Fig. 1), N 49° 47.540 E 018° 17.939

access: freely accessible from the Vratimovská Street

description: During Pleistocene period, the continental glacier for two times reached the area of present-time Ostrava (Tyráček, 2011; Nývlt et al., 2011). Some of the youngest sediments in the area therefore originate in glacier malting and connected presence of glacial rivers and lakes. In such situation were also deposited glacial erratics – rocks brought by the moving glacier from the north to the south. Such rocks differ from native rocks of the region. Largest one was found in 1954 during the construction of metallurgical plant (Vodička, 1954). Its size is ca 3,2×2,5×1,5 m (Fig. 2C) and weight ca 20 t. Such unusual boulder of porphyric biotite granite probably originate in Sweden of southern Finland. It was moved to the publicly accessible place and later elevated on the concrete easel. It was recognized as a Natural Monument in the year 1989.

Glacial erratic in Poruba

content: second largest gracial erratic in the Czech Republic

location: Ostrava-Poruba (Fig. 1), N 49° 49.357 E 018° 09.181

access: freely accessible from the Vřesinská Street

description: Second largest glacial erratic and the one with greatest length was found in the Porubka Stream in Svinov. In 1928 it was moved to the centre of Poruba to form monument commemorating 10th anniversary of Czechoslovakia establishment. To its present place was moved in 1968 (Fig. 2D). Its size is ca 3,7×1,7×1,2 m and weight ca 13 t. Such unusual boulder of porphyric granite/granodiorite probably originate in Sweden of southern Finland (Lexa, 2007). It was recognized as a Natural Monument in the year 1990.

František Pošepný Geological Museum

content: geological museum with a collection devoted to the Upper Silesian Basin

location: Ostrava-Poruba (Fig. 1), N 49° 49.910 E 018° 09.815, for entrance fee and opening hours see http://geologie.vsb.cz/gp
access: The Geological Museum is part of the campus of VŠB–Technical University of Ostrava (Fig. 3A).
description: At the establishment of Mining School at Příbram (from the year 1865 Mining Academy, since the year 1918 VŠB), a mineralogical collection was bought in the year 1849; it has grown over years. In the year 1945, collections together with the University were moved to Ostrava, where they were finally deposited in a new building of Geological Museum, named after professor František Pošepný, a prominent 19th century economic geologist (Adamus et al., 1997). At present, 12 displays (mineralogy, petrography, paleontology, economic geology, and others), including the collection devoted to the Upper Silesian Basin are open to both the students and the public. Open-air exhibition of rocks from the Bohemian Massif and Carpathians was opened in 2016 right at the front of the museum.

Museum of Ostrava
content: museum with a collection devoted to the Upper Silesian Basin
location: Ostrava-Moravian Ostrava (Fig. 1), N 49° 50.110 E 018° 17.580, for entrance fee and opening hours see http://www.ostrmuz.cz
access: the building of the Old Town Hall in Masaryk Square in the centre of Ostrava (Fig. 3B).
description: The Museum of Ostrava was created by merging already existing two institutes in the year 1924. It is housed in the building of the Old Town Hall. One of the most important parts of geological collections is a rich collection from the mines of the Ostrava-Karviná Coalfield; the collection contains more than 22,000 items (Kroutilík, 1968). The basic parts of the collection are specimens of fossil fauna and flora collected by important paleontologists: Václav Šusta (1892-1953), František Řehoř (1933-2001), Milada Řehořová (*1935), and Eva Purkyňová (*1933).

SITES OF ENVIRONMENTAL INTEREST

Ema Heap
content: a cone-shaped burning heap, the highest point of the centre of Ostrava
location: Ostrava-Silesian Ostrava (Fig. 1), N 49° 50.390 E 018° 18.885
access: freely accessible along the yellow-marked tourist trail from Silesia-Ostrava Castle, Sýkora Bridge or Ostrava Zoo
description: Tailing heaps represent a significant environmental burden from the underground coal mining. In the Ostrava part of the coalfield, more than 100 heaps with an approximate volume of 65,000,000 m^3 were formed in the past (Havrlant & Martinec, 2003). The most distinctive and best known of them is the cone-shaped heap of the Trojice Mine, incorrectly called Ema Heap. Although in the sixties of the 20th century deposition on cone-shaped heaps was forbidden, the material was deposited in the same way till the cessation of mining activities in the Trojice Mine in the year 1967. The volume of the heap is about 28,000,000 m^3 and a height above the original Burňa Valley is about 80 m (Klát & Slíva, 2011). In the year 1952, spontaneous ignition appeared in the heap and, in spite of restoration (sealing with fly ash and burnt tailings) and forest rehabilitation, the core of the heap is still thermally active ((Fig. 3C, Kroutilík, 1954; Havrlant & Martinec, 2003). In the year 2012, the owner of the land forbade access to the heap to avoid potential danger; a year later, the ban was removed.

Heřmanice Pond
content: pond used as retention reservoir for mineralized mine water
location: Ostrava-Heřmanice (Fig. 1), N 49° 52.300 E 018° 19.500

Fig. 2 A – outcrop on Landek Hill with Coal No. 074, B – outcrops of the Castle Conglomerate Unit in the Lučina Valley, C – glacial erratic block in Kunčice, D – glacial erratic block in Poruba.

access: a nature trail leading around the pond begins near the crossroads of Orlovská and Vrbická streets

description: It was mine drainage that became a big problem of coal mines in the Ostrava-Karviná Coalfield in the second half of the 20th century. What is problematical is especially high salinity chloride water with total mineralization of up to 300 g/l (Matýsek et al., 2014), which occurs in Carboniferous rocks and overburden. The amount of pumped water is up to 20,000,000 m^3 per year and thus the desalination of this water would be economically unfeasible. That is why the water is drained from the mines and discharged under control. The amount of salts in the Oder River at the Czech-Polish border is determined in intergovernmental agreements, so that at low flow rates, part of water was accumulated in Heřmanice Pond and from it the water was discharged when water level in the river was rather high. Since the cessation of mining activities, a fixed water level has been maintained in interconnected mine workings and the water has been continuously pumped in the Generál Jeremenko Mine and Žofie Mine. It is expected that water salinity will be decreasing with time (Brosch, 2005). The locality is, as wintering grounds (thanks to the salinity, the pond does not freeze easily) and assembly point of at least 250 bird species, a part of Natura 2000 European network (Fig. 3D). For the reason of occurrence of many rare amphibians and birds, it was designated a Natural Monument in the year 2013.

DISCUSSION

The amount of geological points of interest of the Ostrava region is limited by the geological structure of the area, where the interesting coal-bearing Late Caboniferous strata, with only minor exceptions, are covered by the younger sediments of Tertiary and Quaternary. This is the reason why the most economically significant bituminous-coal basin

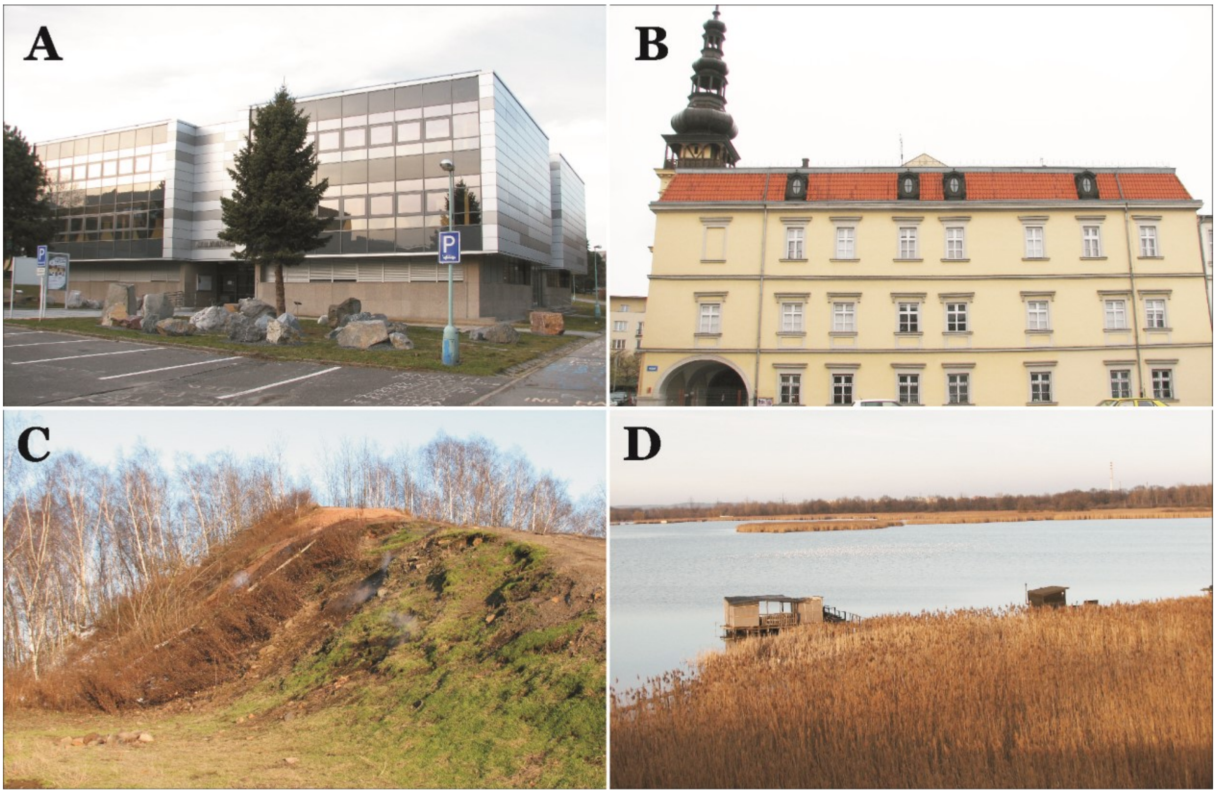

Fig. 3 A – František Pošepný Geological Museum after reconstruction in 2015 , B – Museum of Ostrava in the Old town hall, C – apical part of the Ema heap with signs of thermal acticvity, D – Heřmanice pond during the winter.

practically lacks places useful for teaching geology. A similar situation exists also in the neighboring Polish part of the Upper Silesian Basin. On the contrary, natural attractions related to Quaternary glaciation, such as glacial erratic boulders, are quite common.

In the case of environmentally interesting sites, the selection was not limited by the lack of sites, but by the possibility of their visits without significant restrictions. There are many remarkable localities in the Ostrava region not mentioned in the text, which are mostly related to the industrial history of the town (heaps, mud settling ponds, reclaimed areas of industrial sites, etc.). These are subject to the scientific interest of environmental specialists, but from the point of view of the wider public they are often limited by the need to obtain entry permits. Also their attractiveness without a dedicated guide is relatively small.

Out of reach of this article were industrial and architectural monuments of Ostrava region, whose meaning is still not fully appreciated. However, due to their extent, we have decided to focus a separate article on them.

CONCLUSIONS

The submitted article draws attention to yet unappreciated possibilities provided in the Ostrava part of the Upper Silesian Basin. In a relatively small area, many sites not mentioned in common travel guides can be found. They can be well-used in geological and environmental education.

Since the beginning of the 20^{th} century, Ostrava is renowned centre of the bituminous coal mining and connected metallurgical and chemical industry. Mining activities already ceased during 1994 in the town itself by closure of the Odra Mine. From that point later on, Ostrava conurbation is seeking for opportunities to introduce tourist attractions connected to its mining history. Unlike in other European mining towns, the choice of education guides, trails dealing with both geological and environmental features is very limited or almost missing. From the sites described above, only the František Pošepný Geological Museum is mentioned at official web presentation of local tourist attractions (Turistické atraktivity Ostravy, 2016). Enlargement of such choice by new localities would allow establishing new offer focused on education and industrial heritage.

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DE GRUYTER OPEN

Creating demand for the tourist product during the implementation of geotourist project for post-mining objects

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ABSTRACT
The experience of recent years shows that geotourism in post-mining objects has got a large development potential due to, among others, moving away from the typical museums to modern tourism products much more engaging visitors and the transition from the idea of 3S (sun, sand, sea) for 3E (experiment, excitement, education) and 4H (heritage, handicraft, habitat, history). In the article the specifics of the tourism product in projects related to the adaptation and using of post-mining objects and sites were presented. The article presents an assessment of the possibility of building a branded tourist product based on the relics of the mining industry in the context of the development and implementation of subsequent phases of the project consisting in making these relics available to tourists. The examples of completed projects, among others, in Poland and Germany were used. The division of the primary and secondary value of the geotourist project and the activities affecting the increase of these values were proposed. The article also raises issues of variation in demand for mining heritage products and the economic viability of such projects, as well as the recommendations for future investor in the post-mining tourism' venture were specified.

Keywords: tourist product, geotourist project, geotourism, post-mining objects, destination management.

INTRODUCTION

Mining heritage objects around the world raise a range of emotions of a different nature – from the aversion and source of variety problems for the environment and local communities in the case of unprotected objects and degraded areas to the rapture and the name of branded tourist products in the case of objects skillfully developed for the purpose, among others, geotourism and post-tourism. Indeed, as the experience of the Polish and foreign show, in particular, in recent years, a lot of projects related to the transformation of post-industrial areas in tourism products turns out to be accurate, attracting crowds of visitors.

The areas and objects left over from open pit and underground exploitation of mineral resources are in various states of preservation, but all of them carry value in historical and cultural dimension. Seeing that they sometimes are the testimony of the industrial era, mining crafts and often have a natural, architectural and cognitive values, in any case constitute a cultural landscape with unique features and arguably have the potential for development. This potential can and should translate into an increase in the value of such facility or land in the intangible and tangible dimension - in the form of economic recovery of the region and the financial return for the investor or the beneficiary in the long term.

However, some projects connected with the management of mining objects despite investing large expenditures and potential tourist advantages do not bring the expected economic effects. Some of them, despite the fact that in a short time they generate significant revenue through e.g. excessive focus on recreational values, degrade the historical and education value of these, often unique, cultural landscapes and testimonies of mining history. In addition, according to the Butler' model, in the cycle of life (evolution) tourist area (Tourism Area Life Cycle) inevitably occurs the stagnation phase, after which the absence of the thought-out strategic actions results the inhibition of growth of the number of tourists (Butler 2006). It should also be noted the alteration of paradigm of tourism, where tourism policy becomes one of the key tools of regional development, the scope of tourism is becoming wider, cultural factors - the dominant, and the main subject of tourism is not the state but business (Kozak, 2010).

Therefore, the questions are: how to increase the probability of success of the project associated with the transformation of post-mining relics into tourist product? How to evaluate the level of competitiveness of such projects and how to measure it? How to maximize the market value of this type of tourist product and how to build its brand without losing the cultural value of landscapes in the mining region? An attempt to answer these questions is the content of this article.

DEMAND FOR THE PRODUCTS OF MINING HERITAGE

The potential of getourism in post-mining objects

Among the reasons that geotourism in post-mining objects has a large potential for development, you can include the following trends and phenomena:

(1) departure from the usual museums and open air museums (often with outdated organization of work) to the modern tourist products, much more involving visitors and with higher quality services, departure from the traditional division into regions predestined to tourism development and others and the growing emphasis on cognitive and educational functions of tourism (Migoń, 2012),

(2) the alteration of paradigm of tourism, expressing through, among others, the increasing importance of cultural factors in the development of the tourist, the opening of the visitor to the community reception area, moving the center of gravity of promotion from resources (assets) to the products and taking over the role of the main body of the tourist market from the state to the business (Kozak, 2010),

(3) moving away from the idea of 3S (sun, sand, sea), so the tourist' rest preferences for 3E (experiment, excitement, education), associated with active relaxation and cognitive aspect of sightseeing and 4H (heritage, handicraft, habitat, history), which focuses on the interest in the history and cultural goods.

In post-mining tourism the geotourist interests are post-mining objects and sites, and these values should be dominant in the process of making them available for tourist traffic. This points to the appropriateness of creating "living mining museums" and creating geotourist attractions in places originally utilized used as mining facilities. It also follows a series of recommendations for the future investor and the main of them are as follows:

(1) care of highlighting the mining heritage of a particular place through preserving, protecting and exhibiting its elements,

(2) the least interference with the state of existing objects (e.g. excavations), which enables one to preserve the historic value of the relics of mining activity and may be used in promoting a tourist attraction (maintaining safety of the visitors),

(3) avoiding the degradation of historic cultural landscapes through disturbing the scenery with random architectural objects and elements of tourism-related infrastructure,

(4) care of increasing the social

awareness of the visitors concerning legacy and craft of mining, as well as its significance for the civilization development, e.g. through interesting and properly conveyed information (among others, information provided by the guide, website, educational materials).

Products of mining heritage

From the perspective of direct and indirect consumers of heritage (industrial heritage, mining heritage etc.) Towse distinguished two basic types of demand for the products of the heritage (Towse, 2002): demand for direct consumers of the heritage, possible to express in monetary form:

- demand for access to heritage (e.g. access to underground excavations),
- demand for services directly related to heritage (e.g. the guide),
- demand for additional services referring to heritage (e.g. catering services in the former mine),
- demand associated with inutility values of heritage, difficult to express in monetary form:
- demand for keeping the possibility of using heritage in the future,
- demand from people that don't utilize directly heritage for its existence,
- anticipated demand for future generations.

Thanks to the mechanisms of supply and demand the mining heritage can be converted into tourist products. What in general is the tourist product? There are many definitions of this term. The tourist product includes all tourist attractions, benefits and services used during the stay in a given place, as well as everything that visitor experiences (Panasiuk, 2005). This product are the natural and man-made tourist facilities, goods and services that enable the arrival, stay and use of tourist assets and spend time attractively. According Oleksiuk the tourist product is a whole set of material goods and services enabling tourist to come to the location of tourist attractions, stay and their use (Oleksiuk, 2009). The common feature of all definitions is the complexity of the tourist product and the co-existence of its tangible and intangible components.

In the case of the project associated with the tourist development of the post-mining object or site the tourist product may be (Kaczmarek et al. 2005):

- thing e.g. replica coin,
- service e.g. gold panning,
- object e.g. Historic Silver Mine in Tarnowskie Góry, Poland,
- show e.g. ScopriMiniera Programme "Discover the Mine" in Regional Eco-museum of Mining of Germanasca Valley, Italy,
- path e.g. Industrial Monuments Route of the Silesian Province, Poland,
- event e.g. "Million of steps" ("Un millón de pasos") in Linares-La Carolina mining region, Spain,
- area e.g. Archeological Museum and Reserve "Krzemionki", Poland (Fig. 1).

Tourist products may stand alone or be linked, e.g. the event can be part of the product-event or the product-place. Because they may occur separately (item, service) or create collections (trail, event), they can be divided into simple (one-piece) and complex (multipart) (Oleksiuk, 2009).

It should be mentioned that the tourist product from the point of view of its creator (investor, contractor) often differs from the product seen by the tourist, so its perception by the customer. From the point of view of the creator the tourist product consists of objects and tourist attractions, services provided (e.g. guide), souvenirs, advertising brochures etc.

In contrast, the tourist product from the point of view of statistical tourist is the totality of lived experience since his departure from the house to the return, they are also all possibilities and experiences associated with spending time at the destination. Therefore from the perspective of building the branded tourist product based on mining heritage there is important to recognize the needs of the customer (visitor) and the development of the tourist

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Fig. 1 Reconstruction of exploitation in former flint mine in Archeological Museum “Krzemionki”, Poland (photo by: M. Kobylańska)

offer tailored to these needs (Kobylańska, 2013). This adaptation may relate to the age, the possibility of concentration and interest of the various groups of visitors, e.g. for school groups works best the combination of education with fun (edutainment).

THE CONSTRUCTION OF PRIMARY AND SECONDARY VALUE OF GEOTOURIST PRODUCT

In the case of geotourist projects based on post-mining objects it is necessary the conscious construction of the total value of tourist product based on the market value of the object (existing, primary value) and on the market value of the adaptation and services related to tourism (secondary value). For the primary value should be considered the market value of the object or the post-mining landscape resulting from the valorization of its tourist potential. In turn, the secondary value is the market value of the method of adaptation (reclamation and development) of the object or the post-mining landscape and services related to tourism. The combination of these two values leads to the creation of the tourist product, the value of which is greater than separately the primary and secondary value (synergy effect). This allows the operation of the post-mining object in a new scene and its development in the future (Fig. 2). In creating the tourist product based on the post-mining object / site very important are the activities and actions taken in order to maximize both of these values.

Primary value of the object

Influencing on the original value of the mining heritage resource exists:

- before operation – the valorization of the mining area due to the tourism potential and value of the landscape,
- during the operation – e.g. mining entrepreneur can shape the slopes of open-pit excavation for plans for later use or not demolished e.g. former shaft tower,
- after operation – there is need to update the development concept, depending on current conditions e.g. spatial policy, local authorities can also after reclamation lead temporary measures protecting the most precious objects.

At this stage, the key is to determine the components of the resource, taking into

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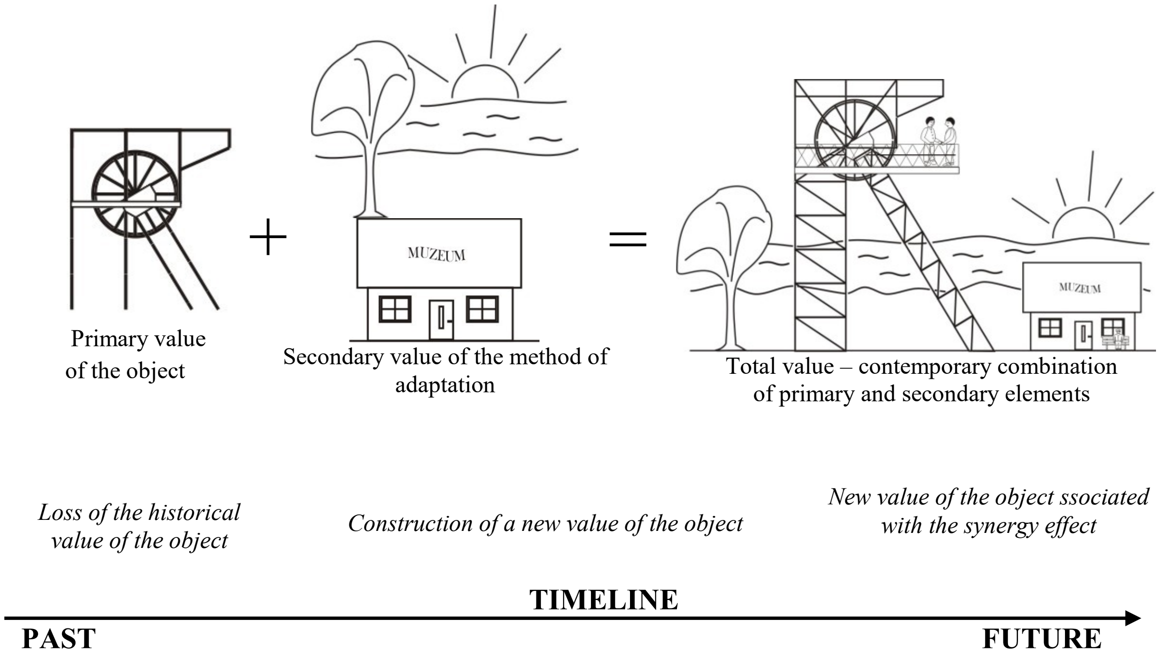

Fig. 2 Diagram showing the construction of the tourist product based on the object of mining heritage.

account the context of environmental, social and economic development and interpretation of the original value of each of these components. The important role in this process can play the public debate and the inclusion of the stakeholders for the valorization. The stakeholders in the geotourist project based on mining heritage are all individuals and organizations involved in the project implementation: the contractors, suppliers of capital and services, beneficiaries, local government organizations, but also interest groups, the media and so on.

Secondary value of the project

The secondary value of the object affects all activities related to the processes of revitalization and adaptation, and all the results of these processes. The elements associated with the creation of a secondary value of geotourist project (added value) include (Kobylańska 2014):

- construction and taking care of tourism infrastructure at the appropriate quality, because without it even objects and places with very high tourist values will not generate tourist traffic at a level enabling the maintenance and development,
- continuous and reliable informing the tourist about the object and its values: historical geological, cultural, etc.,
- moving away from the image of the tourist who arrives just visit the attraction, you should attempt to create an object as a place where he will want to stay longer – so the important thing is the complexity of tourism services (basic and accompanying), implying active and passive recreation, sightseeing and associated services (Fig. 3),
- in the case of underground facilities using modern lighting systems and sound effects (the sounds of the working miners, the rock mass, etc.),
- application of new systems and technologies, e.g. mobile applications on the phones, among others, to help tourists navigate the terrain and obtain direct information about the visited object and a virtual tour available from the website of the object.

CREATING THE BRANDED TOURIST PRODUCT WITHIN THE GEO-TOURIST PROJECT

To create a branded tourist product one should take into account the expectations of its future customers, their ideas about the

Fig. 3 One of the many climbing routes on the site of the former metallurgical Thyssen complex in the Landscape Park „Duisburg Nord”, Germany (source: http://en.landschaftspark.de).

product and its component elements. Knowing at least some of those expectations, you can adjust to them the tourist offer and accordingly shape the message, among others, advertising message. The form and the content of the argumentation offering travel services affect the decisions of the visitor, because they largely shape his ideas. The message referring to the tourist imagination also acts on all actors on the mining heritage market, including public opinion. The success of the tourist product may also motivate others to create new products (services) or complementary to the existing offer. Thanks to these the same relics of mining activities serve to create a variety of goods and services for different consumer groups and market segments.

Post-mining objects can be the background for the different type of events: cultural, sporty or artistic, among others conferences, exhibitions, concerts, lectures, film screenings, theater performances, dance shows and competitions in many sports (Fig. 4).

The experience of objects and areas of high tourism rank show that the best are mixed solutions, and therefore investment in the development of the tourist product should bear in mind the diversity of consumers’ expectations. It is clear that offer formulated by the investor must reach the potential buyer of the tourist product through using selected media and public relations activities, depending on the target group of this offer (age, status, interests, place of residence etc.). Marketing activities in the tourism sector should focus on understanding consumer behavior, which is a prerequisite for the effectiveness of three processes: the development of the tourist product, sales of tourist products and their promotion (Choibamroong, 2005).

Economic viability of geotourist projects

The problem, which is dominated by the issues related to the revitalization processes and geotourist projects is their economic viability. These projects are for standard

Fig. 4 The concert in the Dalhalla amphitheater in the excavation of the limestone exploitation in Rättvik, Sweden (photo by: C. Eklund).

investment projects, subordinate to the laws of the free market economy, even though the processes related to the protection of tangible and intangible cultural heritage and revitalization projects are not fully commercial. For this reason, due to demand parent - participation of the state in subsidizing the revitalization projects and projects related to the protection and promotion of geo-diversity.

Practice shows that the highest profits, though difficult to measure in a currency, resulting from the such project, outside the investor, gain local residents, followed by the contractors of the project and then the local authorities in accordance with the territorial division of the country.

In some cases, the income from new use of the post-mining object may be higher than for the same parcels of land during the period before the exploitation (Paulo, 2008). It is also possible for the development of mining facilities for tourism (Fig. 5).

The costs associated with the adaptation of the post-mining object / site can be divided into investment costs and costs related operational phase of the project (operations, management). Typically, raising funds for these purposes is done separately and therefore it happens that the investor implements the project thanks to the acquired funds, but has a problem with its subsequent maintenance. Even more important are the funds for the development so needed in the process of building a branded tourist product. Then he does not realize reconstruction investments and development activities, by which the interest of the object gradually decreases, resulting in the loss of the entire region in terms of tourist attractiveness, and hence - its economic situation. Therefore it should be remembered that the operational phase of the project, beginning in practice after the completion of the investment of a tourist destination, often affects the whole outcome of the project, and the lack of additional investment in increasing the tourist attractiveness of the adapted or the newly created object can result in strikethrough its results.

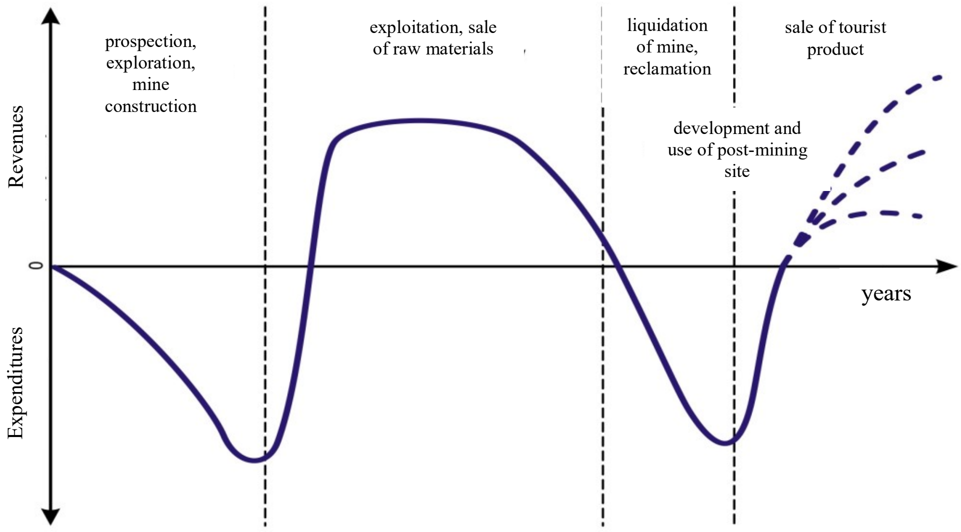

Fig. 5 Schematic flow of funds for the mining and post-mining area (Kobylańska, 2014).

CONCLUSION

Please note that in order to encourage people to come to the place are not enough the tourist attractions. What is needed is the infrastructure that provides the values that are objects of interest to tourists. The attractiveness of the object as a whole can also result from the attractiveness of the infrastructure, and so everything that allows visitors to get to know the attractions and spend time at the target destination. All these additional elements are the tourist management and build a "secondary value" of geotourist object.

Getting the competitive advantage by geotourist projects related to former mining in the contemporary model of development based on the ability to innovations, and so on building the total value of a new tourist product, having the hallmarks of product innovation. Promotional activities and associated with the creation of demand for mining heritage products should strive to shape a broad and diverse tourist offer in the area of cultural heritage tourism.

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Geoheritage and geotourism potential of the Homolje area (eastern Serbia)

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ABSTRACT
The region of Homolje in Eastern Serbia represents an area rich with numerous geological and geomorphological features, especially karst formations which are excellent representatives of this area's geodiversity. However, the geotourism potential of these geosites still remains fully unrevealed. In this paper we analyzed the most representative ones based mainly on their aesthetic value as well as their geotourism potential. The aim of this paper is to emphasize the geotourism potential of Homolje and to determine its strengths, weaknesses, opportunities and threats as well as interactions between them when it comes to tourism development. The results of the SWOT and TOWS analysis indicate that Homolje as a tourist destination possesses immense geotourism potential but is still in the exploration phase according to the Butler tourist cycle of destination evolution. Research results also identify four different strategies which can be applied as solutions for current problems and for further tourism development.

Key words: geoheritage, geotourism, SWOT analysis, TOWS analysis, Homolje, Eastern Serbia.

INTRODUCTION

As a small geographical area in eastern Serbia, Homolje is an excellent representative of rich natural heritage. Within this region there are numerous geosites with unique diversity, which can provide authentic and unforgettable experience to tourists. Such an environment possesses an outstanding opportunity regarding geotourism development.

This paper will provide an analysis of geoheritage in the Homolje region and it will determine which aspects of geoheritage can be implemented for geotourism development. The Homolje area has an irregular shape of a rectangle that is 35 km long with its widest point of 26 km. It is surrounded by mountain ranges on all sides. Zvižd area is located in the north, Beljanica mountain (1336m) is positioned to the south, mountain top Crni vrh (1027m) in the east, while the mountain Gornjak (825m) extends from the lower plains of the Mlava River to the west. The geomorphological unit of Homolje consists of two parts: Žagubica Valley to the east and Krupaj-Krepoljin Valley to the west (Prentović et al., 2016).

Research was mainly focused on the natural values of Homolje, but there is also a great need to point out significant cultural uniqueness. Ethnographic elements certainly have their impact on the tourist offer of Homolje. It is this impact that links the cultural identity of the region with other tourist attractions and potentials that it holds, such as natural, scientific, educational etc. The geoheritage of this area mainly consists of a large number of unexplored geosites which is one of the key issues in this paper related to geotourism potential and development. Information about these unexplored areas can be mostly obtained from local residents or through participation in mountain hikes with several mountaineering associations. Current infrastructure development is at a very low, basic level, which significantly complicates road access to certain sites. This must be improved in the near future, so that any kind of development would be possible. It should also be noted that these natural resources are often not recognized by local and regional tourism organizations. As institutional holders of tourism promotion, these organizations are obliged to present all tourist attractions and potentials in the best way possible.

Geotourism is a relatively new phenomenon based on an old idea and falls within the category of special interest tourism. In simple words, geotourism represents the promotion and protection of geological heritage through tourism with the help of education and interpretation (Tomić, 2016). At the end of the twentieth century the concept of promotion and interpretation of geological diversity and geological heritage has been presented to a much wider audience. In essence, geotourism represents a recognition process and giving a broader meaning to geosites which should further lead to better and more efficient conservation of geoheritage and geosites (Hose, 1997; Hose, 2005). Taking into consideration the original approach by Thomas Hose from the mid 1990's and by accepting the best aspects of modern approaches and literature, Hose and Vasiljević (2012) presented this latest definition of modern geotourism: “The provision of interpretative and service facilities for geosites and geomorphosites and their encompassing topography, together with their associated in situ and ex situ artefacts, to constituency-build for their conservation by generating appreciation, learning and research by and for current and future generations.”

This main focus of our research is the geoheritage of Homolje and how the features of some geosites can be used as a tool for intensive development and growth of geotourism. The aim is to present the potentials of specific geological heritage resources, as well as to perform a detailed analysis of their quality. The observed sites have exceptional aesthetic value. Landscape and nature in the region have a strong power of attraction for all nature lovers. It is this high aesthetic value that makes Homolje a unique destination suitable for geotourism development. The existence of good management and sustainable development in the future should create conditions for growth and development of all types of sustainable tourism, including geotourism, as well as favorable conditions for the application of geoconservation measures.

STUDY AREA

The Homolje area is located in the karst region of Eastern Serbia which is very rich with numerous gorges, canyons, waterfalls, springs, caves, pits and other karst formations. These geosites are excellent representatives of this area’s geodiversity. Among plenty of geosites, we analyzed the most representative ones based mainly on their aesthetic value as well as their geotourism potential. The analyzed geosites (Figure 1) are described in the following text.

Gornjak gorge is a landmark that indicates the entrance to Homolje and it is located between the peaks Mali Vukan (752 m) and Veliki Vukan (825 m) on the right side, and the peak Ježevac (675 m) on the left side of the Mlava River which flows through the gorge. The terrain in this area is made out of red sandstone, cretaceous flysch and andesite of the Krepoljin zone. In the basin of the Krupaj river, apart from limestones, red sandstones are most dominant. Further downstream, the basin is made out of Neogene sediments, represented by sandstones, clays and clay marl (Manojlović et al., 2012). The road to the peaks Mali Vukan, Veliki Vukan and Ježevac includes areas rich in forests, wildlife and diverse flora. At the gorge entrance, from the lower Mlava River, there are remains of the medieval metropolitanate, where 400 monks resided and wrote and copied scriptures. They belonged to the Manasija monastery and the famous Resavska school.

Osanica gorge - The Osanica River which passes through the settlement of Osanica is the right tributary of the Mlava river. It originates from several smaller streams which arise below the Homolje mountains. The Osanica Gorge is located about 500 m upstream from the settlement and it is protected as a natural monument by the Institute for Nature Conservation of Serbia. The gorge covers the left and right bank of the Osanica river in an area of 30 hectares, starting from the artificial dam built on the river. A rich variety of geomorphological formations, mainly karst and hydrology features from Palaeozoic, Mesozoic and Cainozoic can be found throughout the area. The gorge itself is unique in this region as it contains 166 plant communities including relict dominant species, 22 bird species and 15 mammal species (Mirković, 2003).

Mlava spring, or Žagubica spring is located in northern Beljanica, on the top of Homolje valley, where Velika Tisnica river flows out of the meander canyon and arises into the valley. The system of Mlava spring includes the basin of Žagubica lake and a submerged cave system. The Žagubica lake is 40 meters long and 35 meters wide. It has a surface of 655 m^2 and is located at a height of 325 meters (Petrović, 2002.).

Krupaj spring is a typical karst spring that flows from a cave. It surfaces in the western side of Beljanica, at a height of 225 meters. The cave from which an underground river rises is located on the top of the short valley. The length of the valley is 30 meters, while the width is 12-15 meters. At the exit of the valley local residents built a stone dam (3 meters high) which flooded the valley and the cave entrance (Petrović, 2002).

Waterfall Siga is located 4 kilometers from the Ceremošnja cave. It is located right beneath the spring of the Siga stream which originates under a high karst section and then quickly descends, creating a 15 meter high cascading waterfall. In the last few years the waterfall dries up in early summer. Downstream from the waterfall, 1.5 km away, on the hill above the right bank of the Siga river stands Golubinje cave, a small cave but with an interesting speleotourism potential. The cave is in walkable distance of about 80 meters.

Felješana forest has the status of a strict nature reserve, and it is only 11 kilometers away from Majdanpek. The area of the reserve is full of mountain beech, in which some of the trees are 300 years old and over 40 meters high. The reserve was first protected in 1950. and since then it is state-owned under the jurisdiction of the Faculty of Forestry, University of Belgrade which often organizes research expeditions in this area (www.zzps.rs). Impressive tourist attractions in the Felješana forest are Gaura Ursuli karst, Danilo spring, Breza ridge and canyon of the Crna river.

Picnic park Rajkovo and Lake Veliki Zaton- The main attraction in this picnic park is Rajkova cave. Rajkova cave can be reached by asphalt road, off the coast of Mali Pek river and the artificial lake Veliki Zaton. From what is known so far, Rajko's cave corridors are over 2 kilometers long and divided into a river and a dry horizon. A concrete path leads through a large concert hall and hedgehogs hall. Then there are the altar, arena waterfalls, winter's tale and the crystal hall. New reconstructions of Rajkova cave connected the two horizons so that visitors could have a circular tour. The present popularity of the cave opens up a lot of opportunities for geotourism developement, given the significant natural potential in its immediate vicinity (Mirković, 2003).

Feasibility study of tourism development in the area Rajkovo in Majdanpek, which was implemented by the company ’’Amber Consulting’’, states that there are four areas that need to be adequatly valorized for tourism purposes. This potential tourist complex could be the main initiator for the development of tourism in Majdanpek, as well as an indicator of regional development and growth of tourism in Eastern Serbia.

METHODOLOGY

Our research was based on the bibliographical-speculative method in the phase of defining the theoretical framework and the descriptive method during processing and interpretation. The analysis of strengths and weaknesses, opportunities and threats (SWOT analysis) was also used in order to obtain more reliable results of the study. The results of the SWOT analysis were implemented in strategic and analytical analysis (TOWS analysis) that helped in the process of identifying the relationship between the strengths, weaknesses, opportunities and threats. The matrix also provided the basis for formulating strategies on these relationships.

TOWS analysis represents a variation of the SWOT analysis that identifies various factors and then binds them together (Božac, 2008). This analysis helped to determine the level of quality of these geosites, as well as possibilities for their implementation in the geotourist offer of Homolje.

SWOT analysis enables the development of strategies within the TOWS analysis. Strategies inside the TOWS analysis are based on a suitable combination of factors that represent strengths, weaknesses, opportunities and threats. TOWS analysis contains four strategies:

1. **Maxi - maxi (SO)**. This strategy is focused on strengths and opportunities. It explains how strengths can be used for the realization of certain opportunities.
2. **Maxi - mini (ST)**. This strategy shows strengths in relation to threats (eg. fromcompetitors). Basically the management should strive to use all resources in order to minimize threats or completely remove them.
3. **Mini - maxi (WO)**. This strategy demonstrates weaknesses in relation to opportunities. It is necessary to overcome weaknesses to be able to take advantage of some opportunities.
4. **Mini - mini (WT)**. This strategy shows weaknesses in comparison to threats. It is extremely defensive strategy. The goal is to minimize weaknesses and avoid threats.

For TOWS analysis to perform successfully it is necessary to systematically explore the internal and external condition of the environment, define the information used in the analysis, as well as information used in the process of identifying the key relationship between the environment variables. Only then competitive strategies could be carried out (Božac, 2008).

Successful application of this methodology was also presented in the paper by Višnić and Began (2015) which dealt with the issues of geotourism in Serbia. Although the study had some limitations, it revealed that the two most frequently visited geosites in Serbia are Devil's Town and Resava Cave, the latter being located in eastern Serbia. The same methodology was also applied by several Iranian researchers (Farsani et al, 2012; Tavallaei et al., 2012; Entezari & Aghaeipour, 2014) for determining the geotourism potential as well as the data analysis and presentation of geotourism development strategies in several regions.

RESULTS AND DISCUSSION

Today the concept of landscape is related to the various fields and aspects of cultural assets. It is, in fact, a sort of fundamental notion, which confers new value and character on the relationships between nature and history, man and territory. In these terms a landscape can be considered as the most complex and morphologically most extended and continuous cultural asset, since it contains and communicates messages and values with which everybody can identify. The observation phase is the first step in understanding a landscape.Therefore, the concept of landscape takes on a social dimension and can be proposed as an object of study with strong educational implications, especially for constructing a new relationship between man and nature. Geomorphological features are among the most widespread and spectacular physical aspects of a landscape: a gorge, a mountain peak, a sea cliff and many more have always exerted high interest and appeal on account of their scenic component. Nevertheless, these are not the only attributes, which should confer value on landscape elements, but also other less subjective and more lasting merits linked to the more general meaning of cultural heritage (Panizza and Piacente, 2008).

The analyzed natural resources are located in eastern Serbia, in the Homolje region. They include seven geosites (Fig. 1) which are of great importance for tourism in this area. as they are the best for the development and promotion of geotourism in this region and are among the most visited tourist sites in Homolje. From Table 1., it can be concluded that Homolje offers authentic natural values, which are generally protected by the state or some kind of local protection. The preservation of natural resources, high level of landscape and aesthetic value, popularity of Rajkova cave and unique hydrological properties of Krupaj and Mlava springs represent the most important aspects when it comes to the strengths of this destination. On the other hand, lack of promotion, poor development of alternative forms of tourism, minimum investment in infrastructure and the nonexistence of a complete geotourist offer are the main weaknesses of Homolje as a tourist destination.

The best opportunities for tourism

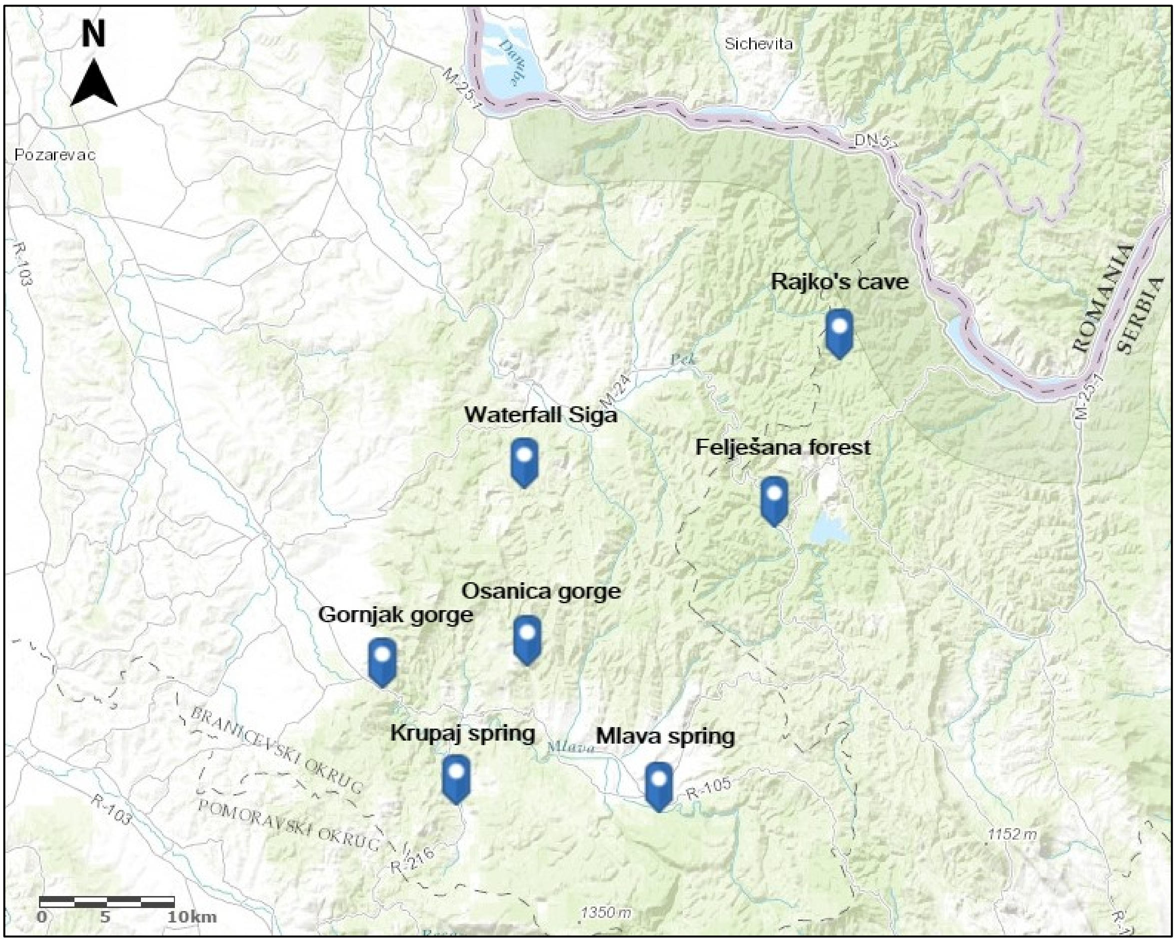

Fig. 1 Geosites in the Homolje region

Tab. 1 SWOT analysis

		Description
Internal condition	**Strengths**	1. Unique natural potentials (hydrological characteristics of Mlava spring and Krupaj spring, extraordinary representativeness of the Siga waterfall, flora and fauna inside of the Felješana forest and geomorhological characteristics of Rajko's cave); 2. Attractive landscapes of Gornjak gorge and Osanica gorge; 3. High level of aesthetic values of all geosites; 4. Preserved environment; 5. All geosites are relatively close; 6. Popularity of Rajko's cave; 7. National protection within most of the geosites; 8. The existence of interpretive panels and road signs; 9. The existence of the local support in terms of rural hospitality and traditional cuisine.
	Weaknesses	1. Insufficient and poor quality promotion of the local tourism organizations; 2. Insufficient implementation of the basic principles of sustainability and environmental protection; 3. Lack of investments in tourism and infrastructure of the receptive centers; 4. Lack of investments in traffic infrastructure; 5. Not developing environmental awareness; 6. Homolje is not well recognized in the tourism market; 7. Alternative forms of tourism are not developing in this area; 8. Lack of geotourist offers for active holiday.
External condition	**Opportunities**	1. Exploiting the popularity of Rajko's cave for the sake of increasing the tourist traffic; 2. Mlava spring and Krupaj spring as one consolidated tourist offer; 3. Organizing tours to Ceremošnja and Ravništarka (explore the two caves and waterfall Siga); 4. Organizing tours to Osanica (explore the Osanica gorge and waterfall of the Osanica river); 5. Business networking of local tourist individual organizations and active mountaineering associations, due to increase tourism traffic and tourism revenue of Homolje; 6. More professional and responsible management for the sake of preservation and quality control;
	Threats	1. Unfavorable economic and political situation in the country and the world; 2. Lack of interest of the local authorities; 3. Tourism competition is currently strong for Homolje; 4. Not developing ecological awareness; 5. Non-existence of local action plan for sustainable development; 6. Non-existence of national awareness about the natural potentials and opportunities for development in this area.

development in Homolje are the aforementioned geosites. However, firstly it is necessary for tourist organizations to cooperate with travel agencies and active hiking and mountaineering associations in order to increase the number of tourists. Combining certain geosites into one unique offer is also quite significant as one of the first steps towards geotourism development. For example, Ceremošnja cave and Ravništarka cave are located in the immediate vicinity of the Siga waterfall. These sites hold a crucial potential for geotourism development in the municipality of Kučevo and would certainly assist in the development of tourism in the whole area and it is best to offer them as a combined and unique product on the tourism market. Moreover, the popularity of Rajkova cave can be used for the sake of strengthening the excursion tourism at Rajko picnic park, which has significant natural and anthropogenic potentials (lake Veliki Zaton, ski center and Rajko meadows). In terms of threats, Homolje has a very strong competition. Current development of Zlatibor, Kopaonik, Tara and other mountainous regions negatively affects the tourist numbers in Homolje. On the other hand, Homolje possesses a large number of natural sites with great tourism potential, however they still remain unexplored and mostly unknown to a wider audience. Unfavorable economic and political situation in the country and the region also has its impact on tourism in this part of Serbia. The nonexistence of a management plan for the sustainable development of Homolje also presents a major problem and falls within the category of threats in the analysis.

Although Homolje does not have geopark status, it represents an area where there is potential for this in the future. A Geopark represents a territory where protection and promotion of geological heritage is combined with sustainable local development (Farsani et al., 2011). For the sake of sustainability, tourism management of Homolje and local authorities should put into effect an action plan with strategic effects. This way it is possible for a destination to have continuous growth and development of tourism with the minimal use of resources.

By applying the TOWS analysis, four strategies (Tab. 2) for the improvement of the Homolje tourist offer were developed. The proposed strategic guidelines represent the first step towards successful and profitable management of Homolje as a tourist destination.

The first strategy, which links strengths and opportunities, indicates the necessary integration of geosites into one geotourist offer. Specific hydrological features are also mentioned in this strategy as a potential focus of some geotours. Modernization of roads, road signs and interpretive panels is also included in the strategy. A very important aspect of this strategy is the process of identifying Homolje as a potential candidate for obtaining the status of a geopark. Geopark advantages are numerous and very important. The process is very complex and demanding, but in the case of Homolje quite realistic. According to Dowling and Newsome (2006) geoparks are a fairly recent development that are particularly focusing on geotopes of regional and national geoscientific importance. They can be seen as instruments to coordinate the many stakeholders towards the common purpose of regional sustainable development. In this way Homolje would become an attractive and unique destination with a variety of geotourist attractions.

The second strategy indicates the correlation between strengths and threats. One of the main threats is related to the human factor. This strategy emphasizes the need for high-quality, educated and professional staff that will work on improvement of tourism in the given circumstances. It also includes building several tourist information centers and the foundation of the Tourist Organization of Eastern Serbia which would be in charge of tourist promotion of Homolje and entire eastern Serbia.

The third strategy is focused on the connection between weaknesses and opportunities of this destination. Weaknesses must be eliminated in order to take advantage of some opportunities. The strategy draws attention to the unstable cooperation among certain tourism organizations and hospitality companies. Successful internal collaboration is needed in order to enable a quality stay for tourists at Homolje. In addition to improving internal cooperation it is also necessary to adopt tourism projects, implement basic principles of sustainability and manage the development of environmental awareness.

Tab. 2 TOWS analysis

		Internal condition	
		Strengths	**Weaknesses**
External condition	**Opportunities**	**SO strategy: maxi- maxi** • Establishing geotourism (integration of all geosites); • Creating geotours featuring hydrology (Mlava spring, Krupaj spring, waterfall Siga and waterfall of the Osanica river); • Modernization of road signs and interpretative panels; • Promoting local hospitality and traditional cuisine; • Identification of Homolje as a potential candidate for receiving the status of geopark;	**WO strategy: mini- maxi** • Improving internal cooperation between tourism institutions and hospitality companies; • More active promotion of geosites and geotourism; • Applying the basic principles of sustainability; • Developing ecological awareness.
	Threats	**ST strategy: maxi- mini** • The introduction of professional and appropriate educational personnel to the tourism industry of Homolje; • Infrastructure investments for the sake of road improvement, construction of new units, construction of bicycle and pedestrian paths; • Setting several tourist information centers within Homolje; • Foundation of the Tourist Organization of Eastern Serbia that would incorporate all the attractiveness and potentials of the area and promote Homolje as an important destination.	**WT strategy: mini- mini** • Maximum use of existing natural resources and with minimal harm to the most efficient manner; • Developing alternative forms of tourism, such as sustainable tourism, geotourism, ecotourism, mountain tourism, camping tourism and others; • Modernization of roads and other infrastructural units; • More professional and active connection between the tourist organizations through the integration of tourist activities featuring nature and culture.

The fourth strategy is related to weaknesses and threats. This is a defensive strategy that involves eliminating weaknesses and avoiding threats as much as possible. The strategy includes the maximum use of natural resources for the purpose of tourism, with minimal harm. It includes the development of geotourism as an alternative form of growth and development of tourism. Furthermore, the strategy is focused on modernization of infrastructure and linking local tourism organizations for the sake of integrating tourist activities that feature nature and culture.

The economic importance of geotourism for local communities is adequately presented in the study of Farsani, Coelho and Costa (2011). The authors state that geotourism is an emerging vision that involves the creation of new tourism products, new jobs and new recreational activities. These recreational activities are often related to the topography and geology of the scientific and educational nature, which enables the connection of this type of tourism with school field trips, science camps and the like. Within the Homolje region there are many rural areas, which hold a large number of natural and anthropogenic tourist potentials. Geosites presented in this paper are a valid representatives of these values. Research has shown that the geoheritage of Homolje has great potential, which is unused and under-researched. Quality tourist valorization of these geosites could enable economic development of local communities, while geoconservation could lead to continuous preservation and improvement of the existing tourist sites.

Geoconservation refers to active

management. The main role of geoconservation is to maintain quality and ensure that certain natural phenomena and processes occur at "normal" speed and by the laws of nature, without being slowed down or sped up by human activities (Burek & Prosser, 2008). The geoconservation concept also includes the development of mechanisms and measures that will enable the preservation of geodiversity for future generations. This primarily includes the inventory and interpretation of geological diversity, creating tourist trails and pathways, publishing various publications, both scientific and those intended for the general audience, maintaining geosites in good condition and of course adequate presentation at visitor centers or museums (Boškov et al., 2015; Tomić, 2016).

The geoconservation and geotourism aims need the support of several types of initiatives and products in order to achieve different target groups. The deliverables for management should be technical, though of easy to understand and use by the natural parks staff. The products for the public should be designed according to the target public, although simplified, attractive and well-structured products can be understood by different types of public even without awareness of geomorphological heritage and geoconservation (Pereira et al., 2009).

Given the fact that Homolje is a mountainous region and that all geosites are located near Homolje mountains, it holds potential for community-based mountain tourism. This form of tourism represents only a small fraction of the overall tourism activity in mountain areas. In its ideal form, it is initiated and operated by local mountain communities in harmony with their traditional culture and responsible stewardship of the land. It also works toward balancing power within communities so that conservation and communal well-being, not individual profit, are emphasized.

Communities may be empowered through supportive, arbitrating regional and national policies, partnerships with NGOs, training and education, and equitable distribution of tourism opportunities and revenues.As a tool that brings empowerment to a community and sets a basis for sustainable development, community-based mountain tourism, then, suggests a highly responsible form of tourism through which the tourist experience, environment and community are all mutually benefited. Local communities thus take a leadership role in the planning, decision making, management and ownership of these mountain tourism projects. Policy makers have effectively assisted mountain communities by supporting local ownership and strengthening traditional stewardship roles toward mountain resources (Godde, 1999).

To catch the attention of potential geotourists, outcrops with spectacular patterns should be promoted properly by guides, brochures, special signs, on-line resources, etc. Such a classification will facilitate the choice of objects suitable for such a promotion, and it will also indicate on features that should be promoted. In this way, the approach “aesthetics first, geology second” may work well in support of the necessary tourist flows to geosites and geoparks (Mikhailenko et al., 2017).

According to Popesku (2011) one of the most widely accepted approach to the model of life cycle or the evolution of tourist destinations is by R.W. Butler (1980). According to this model, a tourist destination is passing through a cycle that consists of six basic phases: exploration, involvement, development, consolidation, stagnation and decline, rejuvenation or conversion. Based on the results of descriptive analysis, Homolje is positioned in the initial phase, or research phase in the Butler model (Fig. 2). This circumstance is a result of the apparent lack of interest of local authorities for the development of tourism in Eastern Serbia, which certainly requires a much larger and more important dedication. One of the main reasons for this is political. People that are leading local tourist organizations are quite often people

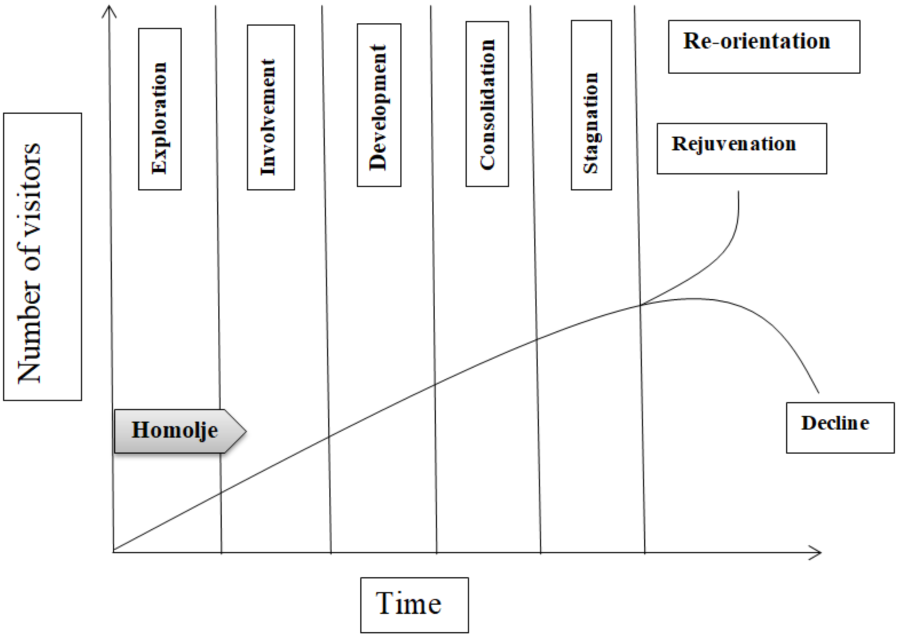

Fig. 2 Modification of the Butler Tourist Cycle of Evolution Model

that have no or very little knowledge about the tourism industry. They are appointed as heads of tourism organizations simply based on their political merit and not on their expertise. They are usually not interested in making an effort and contributing to further tourism development. This is one of the main obstacles for further tourism development not only in eastern Serbia, but throughout the country as well. The first step towards better tourism development would be to employ people who actually have knowledge and experience in the tourism industry, regardless of their political views. Better yet, local people who possess the knowledge and actually wish to do something for their local communities, but do not have the opportunity due to their political beliefs. This has proven to be the best solution and there are some municipalities in Serbia (for example, Sombor and Zrenjanin) where this solution has given good results.

CONCLUSION

The purpose of this study is to show the geoheritage potential of the Homolje region, as well as prerequisites for the development of geotourism in this area. Our SWOT analysis presents the strengths, weaknesses, opportunities and threats of this tourist destination. The TOWS analysis included all measures, which are necessary for research, identification and eventual involvement of Homolje in the tourist market. Displayed strategies are adequate solutions to the current condition and problems of the area. The study presented a high level of tourism potential, both in terms of natural resources, and in terms of anthropogenic values. By using the strategies presented by the TOWS analysis, the natural and anthropogenic values are highlighted, tourist potentials which can create economic benefits are identified and an ambiences which emphasizes geological, geomorphological and archaeological values is created. The main reason why Homolje is a suitable territory for the development of geotourism is the fact that there is a prominent diversity of geomorphological and hydrological phenomena. However, according to our study analysis it can be concluded that this destination is in the exploration phase. It is necessary to modernize road signs and interpretive panels, develop and promote geoturs in the Homolje area, significantly invest in infrastructure and hire skilled and professional personnel with extensive knowledge of geology, which will take into account the preservation and promotion of geological heritage of Homolje. When it comes to geotourism development in other parts of Eastern Serbia similar problems also occur. Extensive research of geotourism potential in other areas of Eastern Serbia has been done by several other researchers (Tomić, 2011; Tomić & Božić, 2014; Marković et al., 2014; Božić et al., 2014; Božić & Tomić, 2015; Tomić et al., 2015) and the existing problems are almost always pretty much the same in every case.

According to the strategy for tourism development of the republic of Serbia, our country's priority are tourism destinations which do not require large investments. Since geotourism is a type of tourism which does not require big investments it is ideal and completely in accordance with the tourism strategy of the Republic of Serbia. It is not a type of mass tourism and it can generate larger income with smaller investments. The inclusion of the local community is also a integral part of the geotourism concept and thus the development of this type of tourism can be an important factor in the economic development of rural areas in Serbia where most of the geosites are located.

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"LANDSCApp": a friendly way to share the Italian geo-heritage

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ABSTRACT
The geological landscape is an excellent topic for a better enhancement of the sustainable tourism. Considering Landscape as the result of the endogenous and exogenous activities that form the Earth's surface, and/or as the result of the interaction of many natural and cultural components, it is almost mandatory the use of such a theme as an informative vector in Environment Sciences popularization. Modern technology offers new powerful tools to reach and share a complete knowledge on the territory (intended as the integration between natural and cultural components). The overlay of thematic maps (geological, geomorphological, physiographic maps) as well as the integration of collected data allows us to identify the areas of greater natural and cultural value. The outdoor sports, expecially cycling and ski, give us an opportunity to talk about the territory, referring to its natural and cultural history; GIS and 3D modelling, are flexible and friendly tools in educational plans as well as in territorial promotion, fitting for the purpose of a twinning with TV sport transmission, as confirmed by the GeoloGiro experience (Geology at the Giro d'Italia 2013/14/15/16). The prototypical App here proposed, will show the landscape where the sports are played, through the visualisation of thematic maps and correlated images (3D modelling, animation, cartoons) integrating information on local environment and culture: the "LandscApp". We argue that special attention should be devoted to the link between landscapes, wine tourism and sports, and that this new field would spur new actions to promote sustainable development in Italy, as well as a more sensible culture of responsible wine consumption.

Keywords: Landscape, Heritage, Divulgation, Italy, Sport, SmartApp

INTRODUCTION

The variety of cartographic products made by the National Geological Survey and other Departments in ISPRA (the Italian National Institute for Environmental Protection and Research), allows a complete analysis of the landscapes that deeply characterize our country, identified through a dynamic pattern of the characterizing components. Starting from the existing data base and cartographic documents (Geological and Geomorphological Maps; Physiographic and environmental maps), the project aims to create a cartography of Italian landscapes, in correlation with those cultural issues significantly related to the territory, in comparison and integration with social-economic data.

The cognitive tools currently available, following the important trial during the International Year of Planet Earth, now enjoy a wide use and offer us a means of immediate communicative diffusion of scientific knowledge relative to an area and an environment. The advent of GIS marked a real media revolution as it has provided us with an integrated management environment and an agile sharing of data, an interactive use of tools and contents, according to different levels of complexity and needs, presenting the various users/operators with new flexible means to arrive at new potential understandings.

METHODOLOGICAL APPROACH IN ANALYSING LANDSCAPE

The Landscape Ecology approach allows us to recognise the main land settings, and evaluate the state of the environmental systems characterising our country.

Ecological – naturalistic value and territorial fragility of the studied areas, are investigated in a spatial-temporal scale, following a holistic approach that consider all the components of an area, in reciprocal interaction (Naveh & Lieberman, 1994), (Turner et al., 2001) (Amadio et al., 2002).

One of the projects based on this approach in Italy, is the Carta della Natura project (APAT, 2003), which describes the Italian territory according to a multiscale and holistic approach.

The study, performed at two principal scale of analysis (1:250.000 and 1:50.000), produced two different map outputs: the Landscape Physiographic Units (Fig. 1) and the Italian Habitats (Fig.2).

New ways in reaching a complete and effective understanding of territory, are a great resource, even at the level of tourism, which is a primary resource in the postmodern age. Studying "Landscape Units" and "Habitats" provides a guide for land management, sustainable development and risk assessment, in order to safeguard the landscape and promote and manage resources.

Nature and culture, incorporated in an index of environmental quality, despite their complexity, are easily understandable thanks to maps realised by GIS. The final indexes used to represent the state of the habitat are: Ecological value, Ecological Sensitivity, Anthropogenic Pressure and Environmental Fragility. The Ecological-Environmental Value of a habitat is expressed by its characteristics that determine conservation priority. A bio-centric approach supported by a traditional anthropocentric one provides an integrated interpretation of ecological and economic components.

The sum of ecological value, socio-cultural value, and economic value determine the total value of the ecosystem to be used for land management and conservation.

The total value of the habitat is the result of the superimposition of environmental, economic, social and cultural values. The ecological value of an ecosystem in a bio-centric perspective is determined by structures and processes and is calculated by indicators which take into account structural aspects, institutional aspects, biodiversity and rarity. The Anthropic Pressure is intended as the disturbance that may concern both structural and functional characteristics of a habitat, including any process altering the birth/death rates of the individuals present in a patch (Petraitis, 1989). Anthropic Pressure is calculated by indicators like Fragmentation of the habitat, Constriction of the habitat, Demographic pressure (present/potential).

Environmental Sensitivity is intended as the potential hazard of a habitat to be degraded or lose its own identity from external pressures. (Ratcliffe, 1976). In calculating Environmental Sensitivity, indicators of the following are considered: compositional aspects (endangered species), structural aspects, institutional aspects, and isolation. The selected indicators are related to the hazard from CEE Directive (priority), from the presence of endangered vertebrates, from endangered flora, from rarity, from isolation, from ratio habitat area/total area of that type.

By combining a multi-criteria analysis of ecological sensitivity and anthropic pressure, it is possible to produce a map of

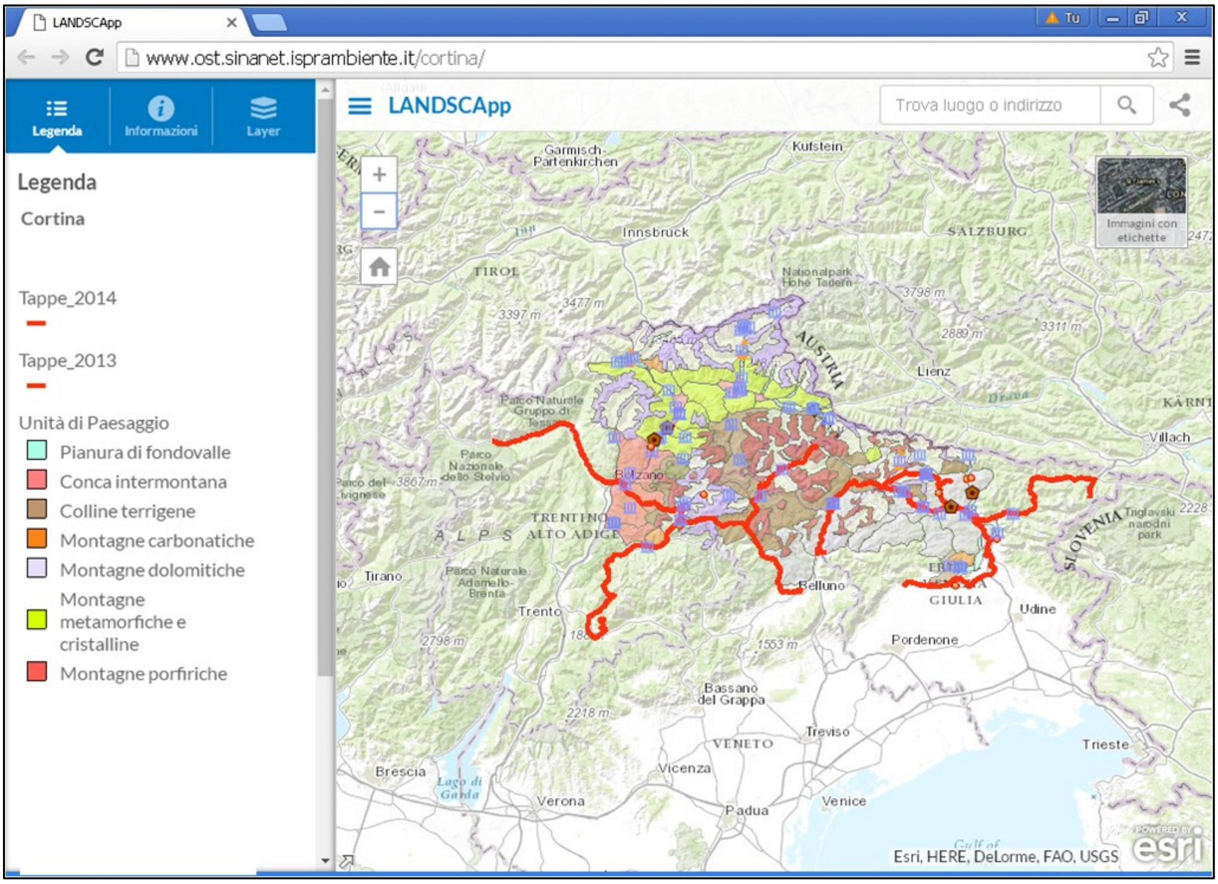

Fig.1 LandscApp: Dolomites

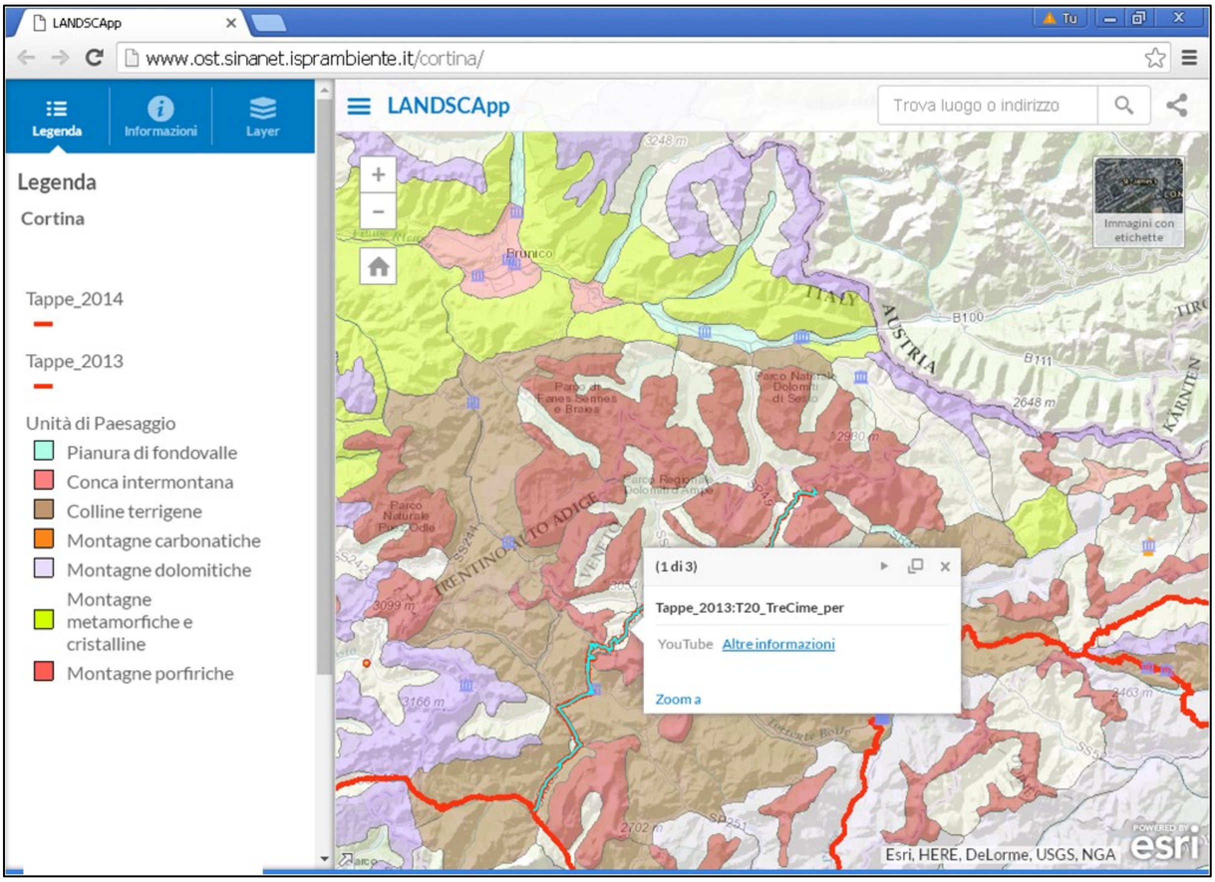

Fig. 2 LandscApp: Dolomites; 3 Cime di Lavaredo and related information

the fragility of habitats (Nilsson, 1995).

NEW TOOLS FOR AN INTEGRATED VISION OF THE TERRITORY: "LANDSCAPP"

LANDSCApp gives the public a chance to try an alternative approach to the knowledge of the natural and cultural territorial heritage, thanks to a set of information related to the geological, morphological, environmental settings of the Italian Landscapes, integrated with other information on the traditional wine and food production.

Moreover, considering the vocation of some natural areas, for some outdoor sports, this App will include information on the most important sport challenges, performed by champions into the magnificent natural sceneries in our country.

LandscApp is an App for smartphone and tablets, now realized in an experimental version as a web App, available at the following link:
www.ost.sinanet.isprambiente.it/cortina

The App has been presented in Cortina d'Ampezzo, on July. This tool aims to offer an unconventional approach to some scientific concepts, developed through images, maps, synthetic information, easily understandable, appealing to the public as well.

The Dolomites area, UNESCO World Heritage Site, represents an ideal location for developing and testing an appropriate methodology in the realization phase of the project, both for the natural beauty of the Landscapes and the available scientific information.

Sharing the project with the local society, during the project realization, is an essential part of the project itself.

The project starts from the collection of images, as a basis for an integration with the thematic Maps, reaching a Landscape analysis understandable and full of significance.

The Geological and Landscape Physiografic Unit Maps provide a different and wider point of view on many themes and it frames the studied areas into a Territorial/Environmental System.

Recent experiences (such as the "GeoloGiro: Geology at the Giro d'Italia") confirm the increasing interest of the public in the geologic arrangement of the Italian peninsula. (Fig. 1, 2)

The project was welcomed by the organisers of the, Giro RCS Eds., the Italian Cycling Federation and Rai Sport (the Italian state TV company), which has included in the live programming of each stage -"Anteprima Giro"- a short insert dedicated to offering the public a new and interesting point of view of the landscapes and the sites, linking scientific information to the competitive value of the stage. The morphology of the territory becomes a key component in the context of the race; scientific information about the geo-morphologic settings of an area is related to cultural news and to the local arts and tradition (always deeply linked to environmental conditions).

A SPECIAL THEME: LANDCAPES AND WINES

By using advanced technological solutions, an appropriate use of GIS and the numerous correlated databases provide us with scientific tools that can depict the complex and rich reality of the areas of production that is typical of Italian wines. This informed position constitutes a starting point for modern planning policies for wine-producing areas and leads to a greater understanding of the culture of Italian wines, which can then in turn lead to the promotion and improvement of this "fruit of our land". (Angelini et al., 2009), (Gregori, 2009), (Lugeri et al., 2009; 2011).

As told before, modern mapping has a great potential for presenting comparisons and syntheses that are useful instruments in many situations: technical, scientific, educational. Special attention is devoted to tourism since it represents both an opportunity for local development and a creative approach to educational programs. It also offers new opportunities to highlight the link between the Earth and its products (Montanari et al. 2008). In recent years, there has been growing attention in Italy towards wine production and promotion of this most important product on the national and global market and which has become a symbol of Italian culture throughout the world.

A further link, interesting for our project, is represented by the Giro d'Italia Wines' stage (Fig. 3).

Economic and social efforts to bring about marketing of the wine and food industry are on the rise and they use the media to give wine a new image, underlining its refined and exclusive nature. In this context, the wine's provenance on the geographical level and the reference to correlated disciplines are underlined, but the profound tie between wine and its "terra madre" has still not acquired a significant role on the stage of wine culture

Direct public participation results in a greater awareness of interaction with the environment and, as a consequence, induces an informed consumption. Modern media and technological means used for geo-territorial study provide further and powerful instruments to spread and share knowledge

Wine, in particular, a protagonist in Italy's culture (as in others' too) given its constant presence in history and due to its very nature, has a tie to the land and therefore represents a path of geo-ecological-environmental knowledge. (Gregori, 2009).

Establishing an interest for wine by a process of recognition of territory through its manifestation in landscape can lead to the realisation of effective strategies for territory management (Brilha 2002), improvement aimed at reaching a consensus and participation of the local population, and strategies aimed at the attainment of goals based on a more stable and shared well-being.

The link between the environment in the areas of production and the characteristics of each wine are provided by some designations; for example the DOC areas ("Denominazione Origine Controllata": mark guaranteeing the provenance and quality of a wine) are a significant mark of a territory. (Fig. 4)

Fig. 3 cycling trough the vineyards landscape from Treviso to Valdobbiadene - Giro d'Italia 2015

Particular attention to viticulture and to the integration of this agricultural practice in the landscape is needed. Another fundamental element is the study of the substratum and the analysis of the soil.
The soil cover is an element that characterises landscape and deserves a separate discussion. We observed that, apart from the territories greatly altered by humans such as the metropolitan areas, there is a clear correspondence on the regional scale between the soil cover pattern and the typology identified by the physiographic criteria. Another important aspect is the climate, which helps determine the configuration of the landscape influencing the soil cover and the forms in relief due to the action of external processes. To this end we observed that types that are analogous yet located in different climatic contexts display different landscape structures. The climatic influence, in the context of landscape variability on the regional level, is explicated on a general hierarchical level.

CONCLUSIONS

The presence of scientific information in the Italian media offer is still limited, mainly confined to an area that does not

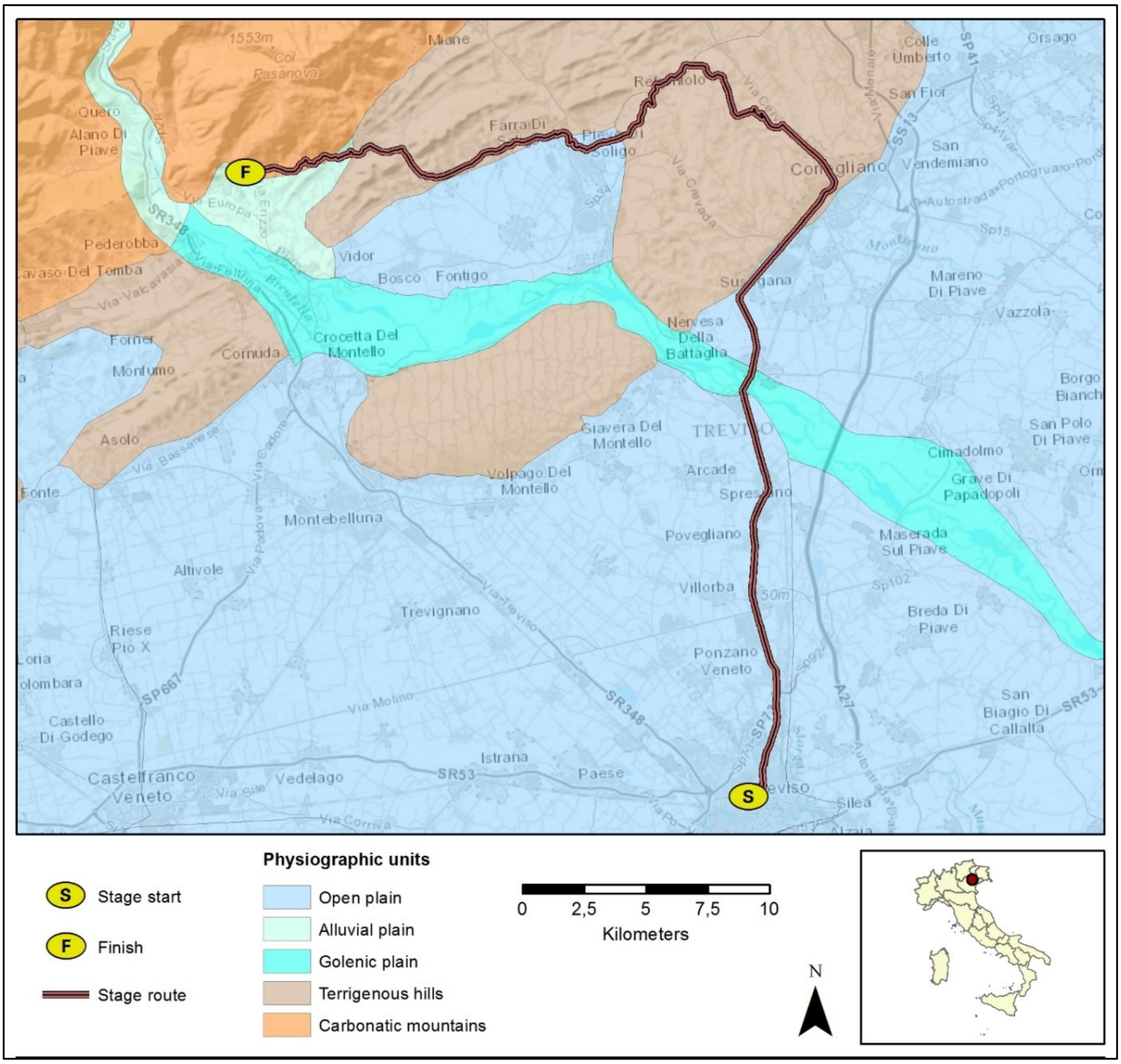

Fig. 4 Physiographic Units of the landscapes crossed by the wines' stage Treviso Valdobbiadene Giro d'Italia 2015

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have sufficient exchange with the multiple communication channels. Even codes and styles of the proposals remain static in a format that often fades to spectacularization or myth, subtracting reliability to the scientific truth.

Modern media and technological tools used for geo-territorial studies (GIS) provide powerful instruments for spreading and sharing knowledge.

Referring to the important role of the Landscape in the Italian culture and economy, it is easy to understand the potential of a complete and synthetic tool, usable at different levels of needs, such as LandscApp can be.

A deeper reflection is devoted to Wine: it is a product deeply linked to its territory, and territory is nothing else than the result of the interaction between society and the natural environment. The extraordinary profusion of studies, and the continuous attention of the winemakers over many centuries, recently shared with the scientific community, point to the need for guidelines in order to reach more balanced land use policies and practices.

The sharing of scientific knowledge related to wine can be reached through an integrated study with the components of the various social structures and levels (schools, alpine communities, parks, protected areas) using experimental cultivation that, for example, would reintroduce in defined areas native grape varieties no longer used.

This approach to the use of natural resources and traditional cultures could help promote local development favourable for production and employment.

It is therefore finally possible without further hesitation, to put into effect and share with the general public a balanced land management and enhancement of places, also by way of an area's typical products that are so deeply rooted the land.

The knowledge of one's own territory, is the first step towards a conscious knowledge, aimed to sustainable development and the prevention as well.

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Underground quarries their possible use for mining tourism purposes – Slovak perspectives on the example of the underground stone quarry of Veľká Stráň

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ABSTRACT
In the first part of the study, we have pointed out that mining tourism is a new, undervalued and less used a form of tourism, geotourism. We present its definition and present its specifics that make it unique on such a scale – by which it can be defined as a separate form of tourism. Mining tourism can be thought to contain virtually all objects, phenomena and processes, which, from prehistory till today, were related to one of the oldest human activities - mining and their subsequent access to and inclusion in tourism. In the world, underground quarries are currently used for various purposes, such as environmental, cultural centers, concert halls, wineries, churches, warehouses, and tourist destinations.In the second part of the study, we deal with mining tourism on the example of the most extensive underground stone quarry in Slovakia. Quarry, Veľká Stráň currently serves as the goal of unorganized 'mining' natural tourism as part of a geological site protected as a nature reserve. However, underground stone has the potential to become the destination of organized mining tourism not only for school educational excursions but also for the general public.

Keywords: mining tourism, underground quarries, tourism localities, Slovakia

INTRODUCTION

There is no generally accepted definition of mining tourism yet. Perhaps this is one of the reasons why mining tourism has not yet been qualified as an individual form of tourism.

The Slovak school of geotourism, forming at the Technical University of Košice was farm by Professor Rybár (Faculty of Mining, Ecology, Process Control and Geotechnologies - F BERG). Rybár understands mining tourism as discovering technical monuments connected with the historic mining and related activities (metallurgy, coal trade, transport, building industry,etc.). The tangible or intangible monuments and mining relics, such as buildings, museums, technical facilities, mining and trade routes, mining culture, mining uniforms and clothing, mining tools, traditions, customs, also create part of mining tourism. (Rybár, 2016; Rybár et al., 2010; Rybár et al., 2012).

Today, we can find a mining tourism as a part of geotourism and industrial tourism, respectively. Schejbal defines montanistic tourism as a kind of industrial tourism, which is focused on exploring montanistic disciplines and their developments in the history of human society (Schejbal, 2016). Examples of linking both historical and contemporary mining to tourism are known from many countries (Edwards & Coit, 1996; Cole, 2004; From, 2012; Conlin & Jolliffe, 2011; Vargas et al., 2009).

Geotourism is a form of sightseeing tourism, although, in some cases, it may also have some features in common with tourism specialist. So the phenomenon of having relationships with other types of tourism can be separated as an independent form. It involves getting to know the geological attractions and active participation in the "discovery" of interesting forms, rocks, minerals, terrain, and landscape (Rozycki & Dryglas, 2016). His findings have been made in line with other authors (Farsani et al., 2011; Hose, 2012; Garofano & Govoni, 2012; Dowling & Newsome, 2006; Dowling, 2011; Huang et al., 2011; Wu & Tsai, 2015).

Based on our research, we can add that the preserved and also interesting tangible and intangible cultural component of the mining landscape is essential for the development of mining tourism. The cultural component of the mining landscape is an integral part of the human mining heritage.

The first definition of mining tourism as individual tourism form was presented by Rybár and Štrba (2016) at the international conference Geotour 2016 in Florence. Its content is that mining tourism is a form of adventure tourism when just the presence of a tourist in underground mining areas is providing to him new feelings. Mining tourism is defined as a phenomenon describing unique mining machinery and facilities, enabling to get acquainted with the underground spaces with the specific abiotic and biotic component of nature present there, allows for admiring the cultural heritage linked to historical mining and is open to the general, professional and lay public.

Mining tourism is devoted both -to individual mining sites, and the entire mining regions and their development over time. Also, the architecture of historic mining towns and financial resources arising out of mining activities, form part of the mining tourism. Last but not least, the influence of mixed communities as mining was a freelancing occupation of free people who have moved across Europe (in recent times throughout the world as well) in various historical periods for work in new mining centers (Rybár, 2016).

According to our findings the term 'mining tourism' includes objects and activities associated with naming this relatively new form of tourism. The term 'mining' can be imagined to contain virtually everything that is related to one of the oldest human activities – mining, from the pre-history until today from its oldest and the simplest forms to unique modern technologies. From its in-situ presentation, in the form of old mining relics and following the footprints of applied technologies to preserved or restored parts of mines, from architectural sacral and secular treasures to mining colonies built for miners, from money acquired by mining, to presentations of featuring mining activities with modern multimedia techniques.

As for quarries utilized in the mining tourism, they must be thoroughly reviewed. Historically, geologically and geomorphologically significant quarries should become objects of mining tourism. The use of quarries in mining tourism is marginally dealt in works of, e.g., Baláček (2007), Weis (2009) and Hronček (2009; 2012).

In the research, the processing of individual quarry analyzes and the subsequent use of quarries in geotourism and mining tourism we have to proceed with the valid laws of the Slovak Republic (Regulations of Act No. 44/1988 Coll. on the Protection and Utilisation of Mineral Resources (the Mining Act) (Anonymus, 1988), Act No. 543/2002 Coll. on Nature and Landscape Protection (Anonymus, 2002), and Act No. 49/2002 Coll. on the

Protection of Monuments and Historical Sites, as amended (Anonymus, 2002a).

In the present article we are introducing the possibility of using quarries in mining tourism in Slovakia. The potential of quarries as targets of tourism in Slovakia has been underrated and underused so far. We must not forget about the fact, that the quarry immediately after opening of mineral resources extraction becomes more or less an interesting geological, morphological and landscape object, without any further research, promotion or anthropogenic modifications, conservation, reclamation, revitalization or construction.

UNDERGROUND QUARRIES IN THE WORLD AND THEIR USE IN MINING TOURISM

The use of the quarries for other purposes than mineral extraction was already known in the past.The underground quarries have been largely used, for example during the Cold War or the World War II. Especially in the territory of the German Empire, but also in England, Bohemia, Austria or Poland, factories, warehouses or shelters, built to protect people from Nazi, were placed in the quarries. During this period was enlarged the underground space of the limestone quarry at Litoměřice which became the largest underground factory in the Czech Republic (Hronček, 2015). Description on world known underground quarries are available on http://213.0.14.154/wordpress/wp-content/uploads/2014/07/Quarrylandscapes database.pdf

At the present, the former limestone quarry Val d'Enfer (Valley of Hell) in France is one of the most attractive tourist quarries, where cultural events, light and shadow projections, massive light installations and presentations of paintings from world artists (Gauguin, Van Gogh, Monet) are holding place (Clébert, 1972). 15 km from the Chisinau (Moldova) is built a wine cellar called Cricova Winery in the space of the former limestone quarry, where up to a million bottles of wine can be stored thanks to the large chambers. The limestone was extracted here from the 15th century. In the past, in Moldova, even the Orthodox churches were placed in the underground quarries. In the Lengefeld (Germany), wherein the past was extracted building material (Steche, 1885), is currently The Museum of lime and cement. The old china clay quarry in Great Britain, currently well-known as Eden Project, serves as a center for environmental education, Adnet quarry in Salzburg is used as a recreational area for locals, and in the limestone quarry in Rüdersdorf (Germany) the museum park is created. Fertőrákos Kőfejtő is a name for limestone quarry in Hungary, which is also called „the cave theater“ and thanks to the excellent acoustics it serves as a concert hall. The underground quarry in Utsunomiya (Japan), is a historical museum that allows to visitors to sail by a boat in the flooded parts of the quarry.In the other underground spaces, there are installed trampolines and slides.Unique is also the biggest European underground lake Seegrotte in town Hinterbrühl (Austria), which is former gypsum quarry and visitors can get to know these mining spaces and their history by a romantic cruise. It is open to the public from 1930, and since that time more than 10 million tourists have visited this quarry. The sandstone quarry of Carrière souterraine du Petit Banc in Belgium today serves as a museum of geological and archeological heritage.

The excursions to the underground chambers with guides and expert interpretations are organized in the dolomite quarry in Donosa (Spain), but also in the underground quarries in Solvajove doly in the district of Beroun (Czech Republic).

Another limestone quarry in Burgos (Spain) is partly active but it is not a tourist point yet. The same situation is with the underground slate quarry in Anjou (France). However, these underground spaces also provide many opportunities for the future development of mining tourism and geotourism.

Quarries in other countries serve as target objects of mining tourism not only after the end of their operation and recultivation of their space to the state of “comfortable” environment for tourists but also during normal operation of the quarry, even during working hours. Common is the group tours of visitors transported directly into the center of the quarry by special services, regardless of comfort - noise, dust, often a health risk (Rybár, 2012).

UNDERGROUND STONE QUARRIES IN SLOVAKIA

Quarries were being opened in Slovakia only exceptionally in the period of modern history. We have managed to locate several underground quarries. Probably the most famous and oldest is an andesite quarry in Kysihýbel near Banská Štiavnica (Herčko, 1975). Others were opened, e.g., in Marianka near Bratislava for the slate mining (Kráľ, 2009), the Körmendy´s cave near Kremnica, where the pyroxenic-amphibolic andesite blocks were mined, and the tufa sandstone quarry in Vyšná Pokoradz. Interesting underground stone quarries were also found on medieval castles Devín and Lednica. We identified smaller underground chambers by the field research in the stone quarry of Devín, Vlachov and probably also in Hliník nad Hronom, where they are cluttered up.

The underground stone quarries that are found in Slovakia do not have excavated underground spaces to that extent that would correspond to a mine regarding an anthropogenic mining geomorphology. They are just simple incomplete underground spaces - galleries or mining chambers. Tunnels or mining corridors were excavated, e.g., during the slate mining in Marianka. The museum demonstration of the excavated tunnel of the chamber blasting in the quarry is located in the stone quarry at Ondrej's shaft in the Mining natural museum in Banská Štiavnica. Underground quarries in Kysihýbel, where a short tunnel with a chamber is formed and the stone quarry of Körmendy cave in Kremnica, which is formed by a chamber, are most shape-like to the underground stones quarries (mines). Both underground stone quarries have only

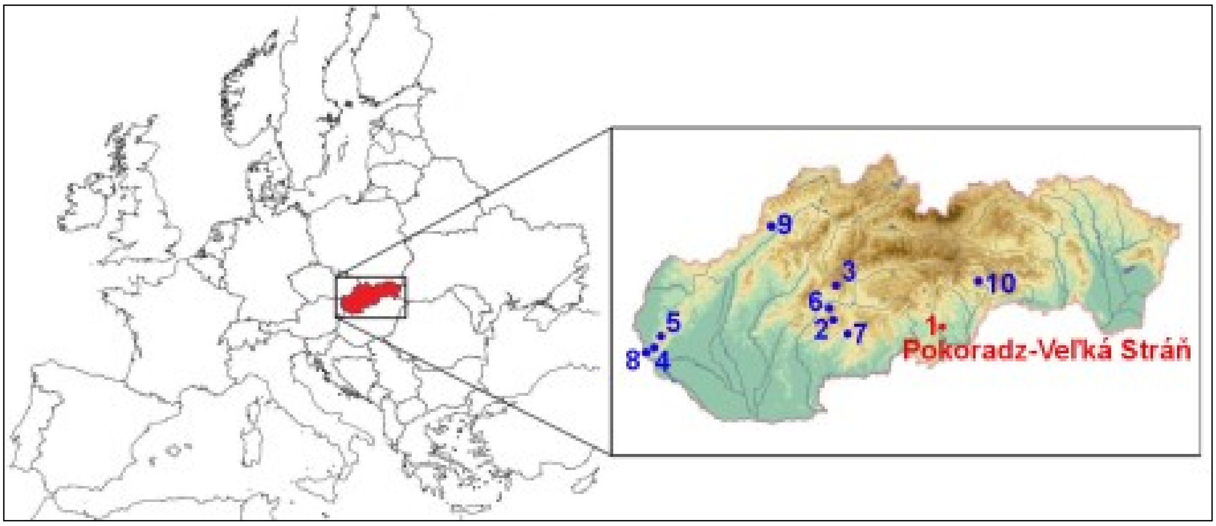

Fig. 1 The location of underground stone quarries in the area of Slovak Republic (quarrying until the end of the 19th century). 1. Pokoradz – Veľká Stráň, 2. Banská Štiavnica – Kysihýbel, 3. Kremnica – Körmendy´s cave, 4. Devín – Devínska Kobyla, 5. Marianka – slate quarry, 6. Hliník nad Hronom – Kečka, 7. Krupina – Turecké studne (Turkish wells), 8. castel Devín, 9. castel Lednica, 10. Vlachovo (ice-cellar) (compiled by authors)

Fig. 2 Underground stone quarry Kysihýbel near mining town Banská Štiavnica (photo by K. Weis)

Fig. 3 Underground slate quarry in Marianka near Bratislava (photo by P. Ondrus)

Fig. 4 Körmendy´s cave near Kremnica – underground stone quarry for the production of pyroxenic-amphibolic andesite (photo by P. Hronček)

Fig. 5 Extracted underground (cellars – formerly a Romanesque palace) at Devín Castle (photo by P. Hronček)

Fig. 6 Extracted underground (access tunnel) on Lednice Castle. This medieval tunnel is the oldest on the territory of Slovakia (photo by P. Hronček)

Fig. 7 Chamber in the medieval stone quarry in Devin (photo by P. Hronček)

small mining chambers, so we cannot talk about caverns. As the stone quarries are mined in the rock massifs, the entrance portals are formed by the surrounding rock cliff without any alteration (Hronček et al., 2011; Hronček, 2015).

The existence of **underground stone quarries or underground mining chambers** was confirmed in numerous quarries by field research. A few of them have preserved to the present, e.g., Kysihýbel, Štampľoch, Kermödy´s cave, Devín or Pokoradza. There are more relicts that point to their widespread occurrence, e.g., Devín, Chtelnica, and Hliník nad Hronom.

The essential feature of these shapes is that they originated in the rock walls of the surface stone quarries after the quarriers (breakers) were able to assess the quality of the extracted rock (stone) based on empirical experience. The highest quality material was usually found inside the massif, deeper below the earth's surface. This stone, suitable for disintegrating the building blocks of stone, was then followed by mining until they gradually reached the underground. The first step was the creation of a "cell" - a rectangular micro quarry, in which the underground chamber began to be gradually mined at the foot-wall. Such cells are well visible, for example in Chtelnica, Dechtice, Hliník nad Hronom or Kermöndy's cave. The width of the chamber depended on the assumed stability of the overlay, but it was usually about 5 - 10 m (Devín, Chtelnica). Only after the stability check, it could have expanded inwards (Kysihýbel, Kermödy's cave, Pokoradza). Stabilising pillars were left in more extensive chambers, e.g., in the underground of the upper Devín castle or the back of the chamber in Kysihýbel.

Overhangs have also been preserved as a transitional from in the stone quarries. In these cases, the lower part of the wall, where the better stone is located, is mined. Three overhangs are found, e.g., in Devín and one extensive in Pokoradza.

As mentioned above, chambers have been preserved only in four stone quarries, with up to six chambers in Pokoradza. Collapsing processes that created specific shapes on the walls of these historic stone quarries point to their higher occurrence. It is easy to identify the chamber if the entrance portal or its rectangular upper part, which has not fully collapsed. Two such relics have been preserved in Devín stone quarry.

Rock overhangs are a more familiar shape after ceilings of chambers collapse and become filled with talus. A new space, a rock overhang, opened at the top of the former wall of the stone quarry after the collapse of the overlay in the chamber. Three such overhangs can be identified, e.g., in Hliník nad Hronom and two in Chtelnica.

A particular type of relic after the collapse

Fig. 8 The first step of the excavation of the underground chamber - the wall is modified into a "cell" in which the underground chamber began to be gradually mined at the foot-wall. The stone quarry of Chtelnica (on the left) and the stone quarry Krupina (on the right) (photo by P. Hronček)

Fig. 9 Stabilising pillar in the chamber of the stone quarry in Kysihýbel (photo by Ľ. Lužina)

Fig. 10 Overhang, as the transition form of the mining chamber in the stone quarry Devín (photo by P. Hronček)

Fig. 11 Overhangs in stone quarry in Pokoradz (photo by P. Hrončǒek)

Fig. 12 Defunct chamber in the stone quarry Devín (photo by P. Hrončǒek)

Fig. 13 Cluttered up the chamber in a stone quarry in Hliník nad Hronom. Contemporary anthropogenic collapsing caveTmavá jaskyňa cave (photo by P. Hronček)

of the mining chamber is collapsing or crevice-like anthropogenic caves, which have been created by collapsing the overlay to the area of the former mining chamber. Three of them were created at the stone quarry in Hliník nad Hronom and one small in Chtelnica.

CASE STUDY: THE UNDERGROUND STONE QUARRY OF VEĽKÁ STRÁŇ

The most extensive underground quarry area in Slovakia is the Veľká Stráň stone quarry, located 1.3 km northeast of Vyšná Pokoradza (currently the local part of Rimavská Sobota) on the southwest slope of Veľká stráň (526 m above the sea level) at an altitude of 460 meters above the sea level.

The whole slope of Veľká stráň is built by the Pokoradza complex folding Miocene vulcanite with a significant layering. The highest part is formed by the breccia, which after the preparation of less resistant parts have created exciting rock formations (towers). The largest one of them is called Kamenný Janko. A thick set of diverse volcanic sedimentary material is found beneath the breccias. They are mostly pudding stones with rounded andesite oblongs with sandstone locations, which are cross-layered. This set is stored on a lahara layer, which is composed of chaotically arranged tiny breccias. They are agglutinated with tuff sands. The stream of lahara flowing southward absorbed all the vegetation that stood in the way. Therefore, we can now observe the prints of the leaves or the cavities of trunks, branches, and roots in its lower part, which is visible on the ceilings of the mining chambers. The bottommost part of the complex folding profile consists of well-sorted and layered tufa sandstones that settled in the freshwater lakes of the vast lowlands in the middle Miocene 15 million years ago. Tufa sandstones in some places also include discontinuous locations of gravel, dust, clay and volcanic tuffs (Elečko,1985; Vass & Elečko, 1986; Vass & Elečko, 1989; Gaál, 1990).

The stone quarry Veľká Stráň was opened right on the base of the bottommost layer of grey, dark grey and in some places the brown-colored, mostly fine-grained tuff sandstones. We cannot accept the previously published stone quarry opening period in the second half of the 19th century (Jeleň& Galvánek,2009). Apparently, this is a much older stone quarry. We can say this not only because of the scale and shape of his relics but primarily by preserved relevant historical documents and stone artifacts in historic buildings in situ. Its importance and extensiveness are evidenced by the map of the second military mapping from 1839. The quarry is represented by an area symbol, which is why we assume that it had a length of at least about 250 or 300 m during this period. In addition to the area symbol, a point symbol is used as well. The maintained forest path led to the excavation shaft from the south, the relict of which exists even today. The German nomenclature also points to the importance of the stone quarry by naming it in the form of *Steinbruch*. Due to the extent of the stone quarry, it can be said that the surface mining was being performed there definitely at least in the 18th century. The existence of underground chambers cannot be documented but due to their current extent and excellent quality of the rock inside the massif, their existence in this period is possible. We do not know when the mining at the Veľká Stráň locality started by the current historical-mining knowledge. A specific indication is the occurrence of the same stone in medieval buildings in the surroundings of Rimavská Sobota. Tufa sandstones were already used for the construction of the Romanesque single-nave Church of St. John the Baptist, and probably also to the buildings of a preserved monastery in Rimavské Jánovce, built at the end of the 12th century and in the 1st quarter of the 13th century. However, the use of this material in the Middle Ages does not directly prove the existence of a stone quarry as the tufa sandstones north-east of the Rimavská Sobota emerge on the surface on several places (Elečko, 1985).

Until now, the vast relic of the stone quarry, which is overgrown by adult forests and has been extensively naturalized by geomorphologic processes, has been preserved. The length of the southern, more significant part of the stone quarry wall is 500 m, its height is about 8 m, it reaches a maximum of 13 m, but in several places, it has already been filled up with the

Fig. 14 Romanesque church in Rimavské Jánovce(photo by P. Hronček)

overlay. The vertical depth of the stone quarry reaches an average of 20 m but maximum up to 30 m. The relic of the access road leads along the entire wall. As mentioned above, a rocky overhang is placed above the mined stone, which was deposited on a great sloping heap behind the access path along the entire stone quarry. The former working courtyard is currently covered by some slopes of overlay slides, stones, and boulders. Most of the rock overhangs, formerly along the entire length of the wall of the stone quarry, have already fallen into the former working courtyard where there are some stone blocks up to 8 or 10 m in size. There are several large underground chambers in the stone quarry. The second, smaller stone quarry is located about 250 m north. It is about 160 m long, the wall height is about 12 m, and the vertical depth is up to 20 m. The stone quarries were not interconnected, and a separate road led to the northern stone quarry. As the mining in this stone quarry was less intense, there are no overhangs, nor underground chambers.

In the southern quarry wall, there is a set of the most extensive underground stone quarry in Slovakia, even individual chambers, depending on several parameters, are among the most extensive. Overall, 6 chambers were preserved at different stages of naturalization and an extensive overhang at the larger length of the former mining wall. We did not identify relics after the manual disconnection in the surface areas or stone quarries chambers. Scratches after chopping by the pick axe have already disappeared as a result of weathering. The overhang was on average buried up to 5 m; its height was about 4 m, which is approximately the thickness of a quality stone layer of the tufa sandstones. At present, most of these overhangs have already been destroyed by the collapse of entire large blocks of overlay layers to the former work courtyard of the quarry. The most massive overhang has been

Fig. 15 The wall of the northern quarry (photo by P. Hronček)

Fig. 16 Part of the wall of the southern quarry (photo by P. Hronček)

preserved in the northern part of the wall. It begins 446 meters from the southern edge of the stone quarry and is a demonstration of the transition between the surface and subsurface mining in the stone quarry. The length of the overhang that is the beginning of the next underground chamber is 27 m, the maximum depth is 6, and the maximum height is 3 m. It is considerably reduced by weathering and sliding of overlay layers.

Approximately 160 m from the southern edge of the wall of the stone quarry is the portal of the first underground chamber. The largest chamber has a rectangular ground plan; the entrance is 19 m wide and 4.6 m high. The height of the wall above the entrance portal is about 8.5 m. The chamber has a maximum width of 24.5 m and a maximum depth of up to 28 m. The rear wall height is 5.4 m. As a single chamber, it has almost no foot-wall without boulders fallen from the ceiling. With a volume of 3220 m^3, Kysihýbel is the second largest underground chamber in Slovakia. In the back of the chamber, there is a rock step about 50 cm high and about 4 meters long beneath the wall, which is a relic after the manual disintegration of stone blocks.

The second chamber with a rectangular ground plan and a volume of 1368 m 3 lies 329 m from the southern edge of the wall of a stone quarry. The entrance portal is 19 meters wide, and the chamber does not extend inwards. The height of the entrance, greatly reduced by the overhangs, is 3 m, the wall height increases to 4 m at the rear wall. The maximum depth of the chamber is currently 13.5 m. It was originally a depth of about 20 m because before its entrance there is a whole block of overlays, which broke into four smaller blocks in the fall. This chamber is immediately followed by the third in the order, the smallest

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chamber in volume (184 m^3). It is separated by only a 5 m wide pillar from the second.

Fig. 18 The entrance portal of the biggest (the first) chamber of the stone quarry wall of Veľká stráň (photo by P. Hronček)

Fig. 19 The first (the biggest) chamber in the stone quarry of Veľká stráň (photo by P. Hronček)

Fig. 20 The entrance portal to the second chamber of the stone quarry wall of Veľká stráň (photo by P. Hronček)

Fig. 21 The second chamber in the stone quarry of Veľká stráň (photo by P. Hronček)

This chamber of the elliptical ground plan is largely covered by a slide overlay, so the input is high 1.5 m at maximum with a rear height of 3.2 m. The entrance to the chamber has a width of 10.5 m, and its maximum depth is 7 m. Another large chamber is an underground space with an elliptical ground plan. Its maximum depth is 19.2 m in width at the entrance is a maximum of 30 m. The height of the chamber at the rear wall is 4.2 m. The height of the entrance portal ranges from 4.5 m to 7 m, at the point where the overlay layers were removed. The entrance portal of the third most abundant chamber in Slovakia (2295 m^3) is located 396 meters from the southern edge of the stone quarry wall. The last but one, the fifth chamber in the order (1282 m^3) is the underground space following the above-described overhang, from which it separated by only a 3 m thick pillar. The portal to the elliptical ground floor is 476 m from the southern edge of the stone quarry wall. It is 3.2 m high and 28.5 m wide. The maximum height of 5.5 m has a chamber at the rear wall. The maximum depth of the chamber is 12 m. The last sixth chamber is located on the northern edge of the wall of the stone quarry. Its current depth is only 5.5 m, but the original was about 10 m. The width is 15 m, the maximum height is 4 m, and the volume is 600 m^3.

Thanks to the total volume of all six chambers it is the largest historical underground quarry (excavated until the middle of the 20th century) in the territory of Slovakia. The total volume of underground spaces is approximately 8900 m^3.

For the comparison, the total volume of underground spaces of the quarry in Kysihýbel is about 6100 m^3 and the total volume of the extracted chamber in underground stone quarry Körmedyho cave is about 2250 m^3.

Fig. 22 The interior of the fourth chamber in stone quarry Veľká stráň (photo by P. Hronček)

Fig. 23 The fifth chamber in stone quarry of Veľká stráň (photo by P. Hronček)

Fig. 24 The sixth chamber in stone quarry of Veľká stráň (photo by P. Hronček)

CONCLUSION

The issue of underground quarries and their possible use for mining tourism purposes is a fascinating area that can support the development of mining tourism in practice. At the same time, it provides theoreticians the opportunity to analyze the problem from all geotourism, mining tourism, and mining heritage. Introduced Slovak locations enrich the offer of destination management as well as globalizing regional offers.

In the following, we present a simple model of mining tourism in the Veľká Stráň area. The largest Slovak stone quarry Veľká Stráň has situated in Nature Reserve Pokoradzské Jazierkaand it is part of the state administration for nature protection of Cerova vrchovina Mts.The nature reserve is an unusual area with sloping lakes, an open-air slope with the rock formation called Kamenný Janko, and the mining chambers analyzed above. Since it is a protected area under the fourth and fifth degree of protection, it is necessary to provide regulated mining tourism (or geotourism) activities in this area. Tourists can reach the stone quarry and mining chambers without any problems following the red tourist sign from the Vyšná Pokoradze to Maginhrad and by the short unmarked turn-off to the old access road. The trail is easy, with an elevation of 155 m and a distance of 5.3 km.The easy trail, the good system of trail signing and free access for tourists are the reasons why in some parts of the underground stone quarry of Veľká Stráň unorganized mining tourism is taking place.Speaking about the safety of the tourists, but also to preserve the best condition of the underground spaces, it is necessary that the individual municipalities in the district of Rimavská Sobota would deal with the problem.

Mining tourism and geotourism situated

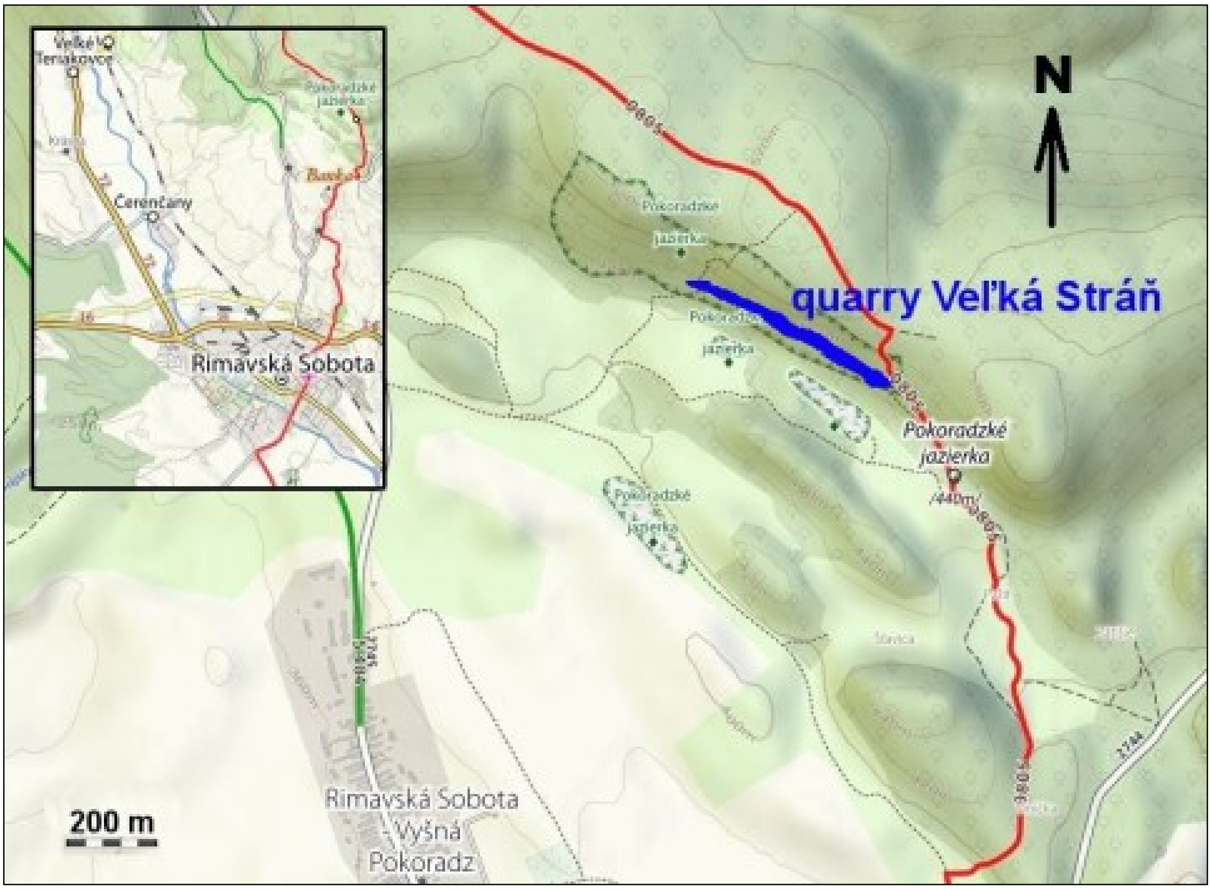

Fig. 25 The hiking trails and the accessibility of the underground stone quarry located in the Nature Reserve of Pokoradzké Jazierka (compiled by authors)

to localities with the presence of underground quarries have not to be dedicated just to researchers and scientists.The re-use of underground spaces is also a major asset for sustainable tourism. In locations where mining is completed or significantly lower than in the past, it can bring new job opportunities and financial resources.The possibilities of using such underground spaces are very variable (creating museums, educational, environmental centers, concert halls, massive projections, etc.). Thanks to the wide-spectrum use of the quarries, mining tourism could be interesting for various target groups of tourists.

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