Natural Oil Seep in Korňa – Significant Locality for Geotourism

Marian Marschalko 1, Miloš Duraj 1, Dominik Niemiec 1, Işık Yılmaz 2

1 VŠB-Technical University of Ostrava, Faculty of Mining and Geology, Institute of Geological Engineering, 17 listopadu 15, 708 33, Ostrava, Czech Republic
2 Cumhuriyet University - Faculty of Engineering - Department of Geological Engineering - 58140 Sivas, Turkey

E-mail address: marian.marschalko@vsb.cz

Abstract. From the geological point of view, Kysuce does not have such a varied structure as other parts of Slovakia as flysch dominates in the region. Still, there are a number of geological formations, and were included among protected natural monuments in the past. Very frequent are the manifestations of landslides, typical for this type of geological structure, and their impact on the landscape. There are also specimens of large sandstone concretions in several localities, the occurrences of which are unique world-wide. Next, there are several mineralised springs that contain various concentrations of hydrogen sulphide or methane. Such springs demonstrate the abundance of caustobioliths in the deep bedrock. A possibility of natural oil is confirmed by a protected natural monument of a natural oil seepage in Korňa. This world unique seepage of slightly paraffinic oil has been protected since 1984.

1. Introduction

Tourism is currently experiencing significant changes as for destinations as well as its forms. Among the new forms of tourism there is also geotourism, which is documented in many scientific works worldwide [1, 2, 4, 7, 8, 12, 16, 17]. This form of tourism concentrates on areas that may offer active tourists interesting sites in relevant respect. The above mentioned publications also inform on the fact that a wide attention is paid to the topic. The growing number of reported destinations world-wide shows the direction which this new form of tourism should head towards. Kysuce have belonged to popular destinations thanks to its well-preserved rural and folk architecture and extensive forests. Another attraction are the good conditions for winter sports. Lately, Kysuce has experienced significant changes as urban planning, changes in the land-use plans and climatic changes have affected the local colour of the landscape. Therefore, new attractions must be offered to tourists. However, the geotourist phenomena in Kysuce caught local tourists’ attention a long time ago and they were declared protected natural monuments. Among the most important phenomena for tourism there is, apart others, the natural oil seep in Korňa.

2. Geological-geomorphological structure of Kysuce

The geological structure of Kysuce is not as varied as other regions in Slovakia. The region belongs to the Outer Western Carpathians that make part of the Carpathians [5, 13, 14]. The Carpathians are then a small part of a long and extensive European Alpine Orogen. A klippen zone, i.e. a narrow belt of
Jurassic to Lower Cretaceous sediments, occurs in the south-eastern part of Kysuce. This belt contains a varied range of limestone with different pelitic admixtures with chert layers (cherts and radiolarites). Siltstone settled next in the Medium to Upper Cretaceous. A substantial part of Kysuce is built by a flysch belt, which significantly manifests on the landscape geomorphology. The flysch belt is represented by claystone and sandstone. This Tertiary formation begins in South Moravia and as an arch continues via the north-west of Slovakia, to Poland and to eastern Slovakia. The nappe structure is typical for this belt and they were overthrusts from south-east. Several units may be classified there. The Bystrica Unit and Rača Unit belong to the inner (Magura) zone. The Magura Zone concerns a substantial part of Kysuce. Contrary to the Rača Unit, the Bystrica Unit contains irregular, crumbly, lacustrine claystone and glassy sandstone. In the Rača Unit non-industrial seeps of oil and gas occur. The Silesian Unit belongs to the outer (Silesian-Krosno) Zone. In the layers of this unit, there are sandstone-aggregate concretions of huge dimensions. This unit forms a narrow band on the north-west of Kysuce and continues behind the borders of the Slovak Republic. The different mechanical rock properties as well as other factors cause landslides in Kysuce, which is a characteristic feature of the flysch belt. More extensive weathering occurs with dominant low-resistance, soft claystone and lowlands form. On the other hand, there are hilly terrains with predominant sandstone. Overall, the terrain has been modelled mainly by fluidal action resulting in river valleys. Glaciation also affected the area in the earlier Quaternary. Erosional and depositional activities manifested in the glacial period succeeded by the interglacial period. When the area was poor in vegetation cover, rock breaking by freezing occurred. The weathered material was carried by water into the valley, where alluvial cones formed. Subsequently, river terraces formed via further erosion (the terraces of rivers Kysuce and Čierňanka, and Milošová stream).

3. Hydrogeology and hydrology of the studied area

3.1 Brief hydrogeology of Kysuce

From the hydrogeological point of view, Kysuce may be classified into the flysch belt and stream-laid sediments. The petrographic composition of the flysch formation creates such conditions that larger quantities of water cannot accumulate in the layers. The most suitable layers are those with the dominant psammitic-rudaceous rocks. Interesting mineralised springs with increased hydrogen sulphide and methane occur in such areas. Pelitic sediments make a barrier for ground water. The so-called stratal springs occur in such layers. Frequent landslides have been reported in the areas with such layers. The areas with predominant pelites, spring yields are low (0.05 – 0.2 l/s). The yields may reach 0.5 l/s in exceptional cases. Even if there are many springs of that type in Kysuce, the majority of them dry out in summer. The second type are stream-laid sediments along the rivers forming in the Quaternary. Such occurrences are abundant mainly along the rivers Kysuca and Bystrica [5, 13, 14].

3.2 Brief hydrology of Kysuce

The major water course in Kysuce is the Kysuca River that springs in Makove. This river is streamed with by other significant courses, e.g. Čierňanka and Bystrica, and many other smaller water courses. The overall area of Kysuce belongs to the Váh River catchment area as for hydrology. The Kysuca discharges into the Váh River near Žilina. The Kysuca River also drains the neighbouring localities in the Czech Republic and Poland, i.e. an area of around 1 000 km². The average water temperature is mere 9 ℃. The ground geomorphology of Kysuce and other factors result in increased water course levels during high precipitation, followed by rather fast decreases. An important water management works in Kysuce is a reservoir Nová Bystrica. It is a drinking water reservoir for the citizens of Kysuce and Žilina, and it was built between 1983 and 1989. On its bottom, at the depth of 50 m, there had been the villages of Harvelka and Riečnica with adjoining settlements and a road connecting Kysuce and Orava Region before the reservoir was constructed. The surface area of the reservoir is 180 ha.

4. Occurrences of oil and gas on the contact of the bohemian massif and outer western carpathians
The complicated geological structure of the contact of the Outer Western Carpathians and the south-eastern slopes of the Bohemian Massif resulted in suitable conditions for the formation of bituminous caustoboliths. Their major deposits in the Czech Republic are in South Moravia, while less important occurrences are in eastern and south-eastern part of North Moravia. The first two exploration wells in South Moravia were opened in 1900. There are deposits of both natural oil and natural gas that often makes part of such deposits. Several tens of deposits were discovered there, but not all have been exploited. Currently, the extracted oil and gas cover only a negligible percentage of oil and gas consumption in the Czech Republic. The oil extraction has a falling trend at present. The Slovak Republic is also influenced by the offsets of Vienna Basin, the sediments of which also contain oil and gas deposits. The first discovered deposit was Gbely, where natural gas and oil are bound onto the formations of sand to slightly consolidated sandstone to agglomerates formed in the Badenian and Sarmatian. Further occurrences in east Slovakia are in the Pannonian Basin (Senné, Stretava, and Ptruš) as well as in several deposits in the flysch belt (e.g. Miková). Well-known are also occurrences from the areas between the klippen zone and the Central-Carpathian Paleogene Basin (Lipany Deposit). The processing of imported natural oil from abroad began to develop in Slovakia back in the 19th century, i.e. before own extraction in Slovakia started.

5. Natural oil seep in Korňa
From the geological point of view, the spring belongs among unique phenomena in Slovakia, and is a rare phenomenon in the European scale too. The spring is located in the Turzovka Highlands, at the edge of an extensive village Korňa, in the vicinity of a settlement called U Muchov [13, 14]. In the past similar natural oil seeps were reported in Papradno, Turzovka and Olešná, and it appears that this occurrence is one of the last ones. As it is unique, this seep was mentioned in many old records and legends. One legend attributes the discovery to a poacher Žúbor, who fell into the seep when hunting. Another legend dates back to the 17th century and says that devils from the surrounding forests used to come to drink this ‘black water’ springing in the Turzovka forests. The locals used the oil for lighting and heating mainly in the difficult times of the Second World War. It was also used for polishing shoes, lubricating wheels or to cure skin diseases in animals. In the past, there were efforts aiming at industrial use of the deposit. Back in 1898 – 1902 a company of L. Holzmann and M. Bonda drilled the first wells. The first well T I reached as deep as 703 m, while the second well T II did not reach even a half of the earlier well. The first well encountered the layers of the Zlín Formation, Beloveža Formation and Soláň Formation. Due to the tectonics, the layers repeated in the well. The signs of oil and gas were recorded in the Zlín Formation and Beloveža Formation. The second well reached the Zlín Formation and Beloveža Formation only. After the geological investigation, extraction followed but was not profitable. In total, around 15-16 wagons of oil were extracted. Later, the company came back to implement a third well in 1920. This drilling was complicated by a drilling rig fire. Two more wells were drilled in the late 1920s. The last well was driven for several years and was the deepest, almost 1 km. At that time the extraction work was intense but the extracted volumes were not high. A German company DEA became interested in the deposit during the Second World War. The most recent investigations on the turn of the millennium showed that the oil and gas deposit is not economically viable. The past analyses of the oil show that it is the case of a light paraffinic oil of a light-brown to brown colour, with a low sulphur content. It has a high content of oils, but low amounts of aromatic hydrocarbons and asphaltic-resin substances. Along with the oil, methane liberates and forms bubbles on the seepage level. Water also springs there. The surroundings of the seep are characteristic of an oil odour. All the information may be found on an information board in the locality. Even if the seep has recently been rather active, it does not significantly pollute the environment. It was declared a natural phenomenon in 1973, later reclassified as a natural monument in 1984 and 1995 with its 0.171 ha.

6. Conclusions
The natural oil seep in Korňa is one of the last remnants of natural oil seeps in Kysuce and it is still active. Such seeps are not very common world-wide and thus they become sought-after destinations for
geotourists. For decades, the information on the unique phenomenon has appeared in the local and national press and other media, which certainly supports its popularity. The overall reserves of this oil-gas deposit appeared as low productive from the start, which was confirmed by the last investigations. The cold mineralised water that also springs there is interesting from the balneology point of view. Despite some plans, no business plan was implemented. This seep is currently a protected natural monument and is a popular destination for many tourist events in Korňa and the Kysuce Region. Lately, as in the Czech Republic and other countries [3, 11, 18], also Slovakia begins to pay a wider attention to the questions of geotourism [6, 9, 10, 15]. In future, Kysuce may significantly contribute its unique phenomena to the offer of geotourist sights in Slovakia and complement the development of non-traditional forms of tourism in the region.

References
[1] Amrikazemi, A., Mehrpooya, A. (2006). Geotourism resources of Iran. Geotourism, 78-92.
[2] Dowling, R. K., Newsome, D. (2006). Geotourism. Routledge.
[3] Duraj, M., Marschalko, M., Duda, R., Sitániová, D., Masarovičová, S. (2015). The History of Pyrope Extraction and Processing in the Czech Republic and its Significance for Geotourism. Procedia Earth and Planetary Science, 15, 663-668.
[4] Farsani, N. T., Coelho, C., Costa, C. (2011). Geotourism and geoparks as novel strategies for socio-economic development in rural areas. International Journal of Tourism Research, 13(1), 68-81.
[5] Gerát, R. (1988). Príroda Kysúc a jej ochrana. SZ OP.
[6] Hlavňová, B., Pavolová, H. (2013). Evaluation of the geotourism development potential in Malá Fatra mountain range. Acta Geoturistica volume, 4(2), 21-30.
[7] Hose, T. A. (2000). European geotourism—geological interpretation and geoconservation promotion for tourists. Geological Heritage: its conservation and management, 127-146.
[8] Hose, T. A. (2007). Geotourism in Almeria province, southeast Spain. Turizam: znanstveno-stručni časopis, 55(3), 259-276.
[9] Chrobáková, A. (2015). Geotourism potential in the Podhale, Orava, Liptov and Spiš regions (Southern Poland/Northern Slovakia). Acta Geoturistica, 6(2), 1-10.
[10] Jablonská, J., Timčák, G., Pixová, L. (2009). Geotourism and water quality of river Hornád (E. Slovakia). Acta Montanistica Slovaca, 14(3), 213.
[11] Lamich, D., Marschalko, M., Yilmaz, I., Bednářová, P., Niemiec, D., Duraďák, J., Kuběčka, K., Duda, R. (2016). Utilization of engineering geology in geo-tourism: few case studies of subsidence influence on historical churches in Ostrava-Karvina District (Czech Republic). Environmental Earth Sciences, 75(2), 1-12.
[12] Pför, C., Megerle, A. (2006). Geotourism: a perspective from southwest Germany. Geotourism, 118-139.
[13] Ponczová, N. (2014). Pozoruhodné minerální prameny a geologické zajímavosti na území Kysuc. Notable mineral springs and geological conditions on the territory of Kysuce, Final Thesis, 77 pp.
[14] Svojbodová, I. (2012). Zajímavosti severní části Kysuc a blizkého okolí. Bakalářská práce, 42pp.
[15] Timčak, G. M., Rybár, P., Jablonská, J. (2010). 13 Geotourism site development in Slovakia. Mining Heritage and Tourism: A Global Synthesis, 158.
[16] Tipton, E. (2015). Assessing the Character of Place to Guide Geotourism in Montana: A Case Study of Whitefish and White Sulphur Springs, Montana.
[17] Tongkul, F. (2006). Geotourism in Malaysian Borneo. Geotourism, 26-41.
[18] Yilmaz, I., Marschalko, M. (2012). A leaning historical monument formed by underground mining effect: An example from Czech Republic. Engineering geology, 133, 43-48.