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A GEOLOGICAL EDUCATION ROUTE ACROSS POST-MINING AREAS OF THE TRZEBINIA COMMUNE

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Abstract. The communes in which mining ceases to exist may use the post-mining areas for scientific and teaching purposes, particularly in protection of geological heritage and in environmental education. A geological education route proposed in the Trzebinia commune confines two natural outcrops of interesting rock formations (Permian Myślachowice conglomerate and Triassic dolomites) and three sites associated with former mining activities. The latter include: an abandoned quarry in Trzebinia (currently the Balaton pond), an area of mining subsidence over the former "Siersza" coal mine, and a reclaimed pit after sand exploitation. The route is thought to serve the secondary schools pupils, natural sciences students, teachers of environment-related subjects, and persons interested in geology. Each stop-point of the route has been explained in a leaflet and provided with an information board. They are supplemented by a booklet "A guide to the geological education route" (Paulo, Głogowska, 2003), containing questions and tasks for pupils for each stop-point of the route, together with extensive answers for teachers. The geological education route has been laid out in the manner securing easy accessibility to all stop-points, which, at the same time, reveal geological variability of the area.

Key words: education route, geological heritage, former mining activities.

Abstrakt. Zanik górnictwa stwarza nowe wyzwania dla gmin, w których żywe są tradycje górnicze, a jednocześnie ujawniają się skutki eksploatacji oraz potrzeba nowego zagospodarowania terenu i ochrony formacji geologicznych, jako stanowisk dokumentacyjnych lub przyrodniczo-krajobrazowych. Można z nich uczynić atrakcję turystyczną i przedmiot edukacji. Geologiczna ścieżka dydaktyczna, zaprojektowana w gminie Trzebinia, obejmuje dwa naturalne odsłonięcia interesujących formacji skalnych (zlepieńce myślachowickie i dolomity triasu) oraz trzy miejsca związane z eksploatacją górniczą. Są to: dawny kamieniołom miejski w Trzebini (dzisiaj zalew Balaton), obszar zapadlisk nad byłą kopalnią węgla kamiennego (KWK) „Siersza" oraz zrekultywowany teren po eksploatacji piasku. Ścieżka jest przeznaczona dla uczniów gimnazjów i liceów, studentów kierunków przyrodniczych, nauczycieli przedmiotów związanych ze środowiskiem oraz osób interesujących się geologią. Do każdego punktu ścieżki został przygotowany folder i tablice objaśniające. Uzupełnieniem tych materiałów jest „Przewodnik po geologicznej ścieżce dydaktycznej" (Paulo, Głogowska, 2003). Przewodnik ten zawiera pytania i zadania dla uczniów, opracowane dla każdego punktu ścieżki, wraz z szeroko uzasadnionymi odpowiedziami dla nauczycieli. Trasa geologicznej ścieżki dydaktycznej jest wytyczona w ten sposób, aby poszczególne punkty były łatwo dostępne, a zarazem ukazywały georóżnorodność gminy.

Słowa kluczowe: ścieżka edukacyjna, dziedzictwo geologiczne, dawna działalność górnicza.

INTRODUCTION

Trzebinia commune has long lasting mining traditions. Unfortunately, a majority of the mines was closed and ex-mining terrains need new development and protection against the degradation. At the same time, these terrains have great didactic potential because they have distinguished geodiversity, favourable exposure of some rock formations in the abandoned quar-

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ries, and numerous remnants of former exploitation which could easily be bound to the history of the land.

Apart of deciphering of the natural processes written in the rocks, the ex-mining terrains offer excellent opportunity both for study of environmental transformations caused by exploitation and processing of minerals, and for presentations of the reclamation issues. Society and local government attention paid to the popularisation of their small native land values forms a favourable factor for implementing the environment protection and conservation of the geological and mining heritage.

A BRIEF IN-SIGHT INTO THE OLD MINING AREAS PROBLEMS

Trzebinia is one of the Silesian communes in which mining traditions are several centuries old, and its geological environment and living nature have became significantly transformed by exploitation of mineral resources. Closure of the mines did not stop negative mining effects on the environment, but sometimes even intensified the problems. Mining-degraded areas are not only abandoned, but new environmental hazards have appeared which must be dealt with. To those problems belong, for instance: ground subsidence over the mined-out workings, inundation of the subsiding depressions, as well as shortage of specialised institutions and/or companies repairing environmental damages. The problems are further aggravated by such social problems like pauperisation of local community due to the structural unemployment. Perspectives for the commune development are seen in the new type of the post-mining areas land-use for which the relevant authorities can prepare, for instance, geotourist offers.

A GEO-TOURIST OFFER FOR THE TRZEBINIA OLD MINING SITES

In abandoned quarries various geological formations crop out that should be protected for educational and scientific reasons. A project of an education route has been undertaken to make such places more popular and better protected from devastation, while the areas where degraded environment is subject to rehabilitation can also be used as educational examples of land reclamation.

The route confines five stop-points (Fig. 1): natural outcrops of Triassic dolomites, a foundation trench exposure in which the Permian conglomerate crops out, and three mining-related sites. The latter are: the so-called Balaton pond in an old quarry, subsiding areas over the underground excavations of the old "Siersza" coal mine, and a pit left after sand exploitation, currently being recultivated.

Two days give an ample time for a thorough visit to the whole route. During the first day, two sites localised within the Trzebinia town can be inspected: the Balaton pond and Permian conglomerates. The remaining three sites, i.e. the subsiding areas over the mining area of the "Siersza" mine, the Triassic dolomites in Czyżówka, and the recultivated sand pit can be visited on the next day, but every person is free to plan the visit according to one's own interests.

The Balaton pond is an artificial lake formed in a quarry that till 1974 exploited carbonate rocks for cement manufacturing (Fig. 2). The remnants of the quarry are geologically attractive. On its walls, one can observe limestones and marls formed in the Jurassic sea. The limestones are developed in two varieties: bedded and massive, the latter formed of sponge-microbial bioherms (Fig. 3). Sinkholes in the limestones are filled with fine, banded, Tertiary sands, and in one of them a huge quartzite concretion was formed, of which, unfortunately, only fragments

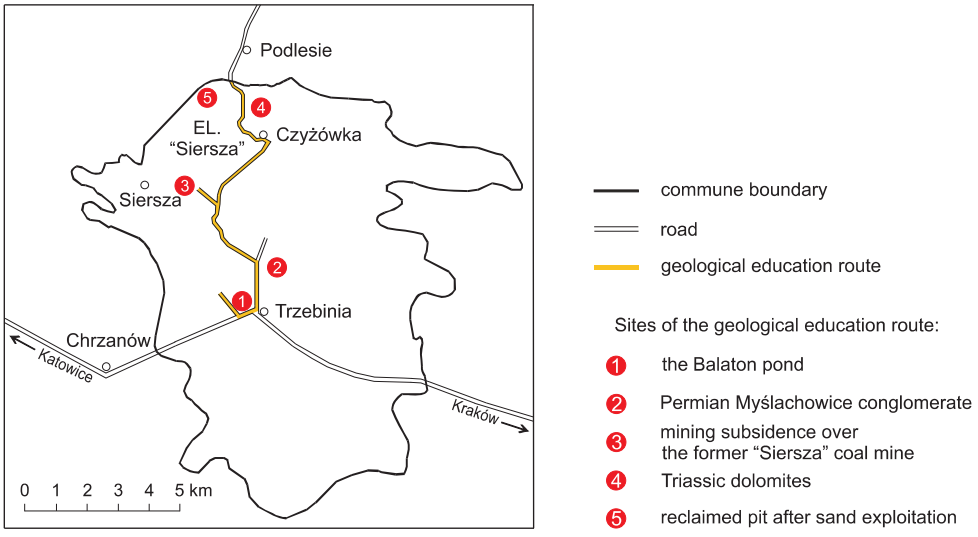

Fig. 1. Localization of the geological education route

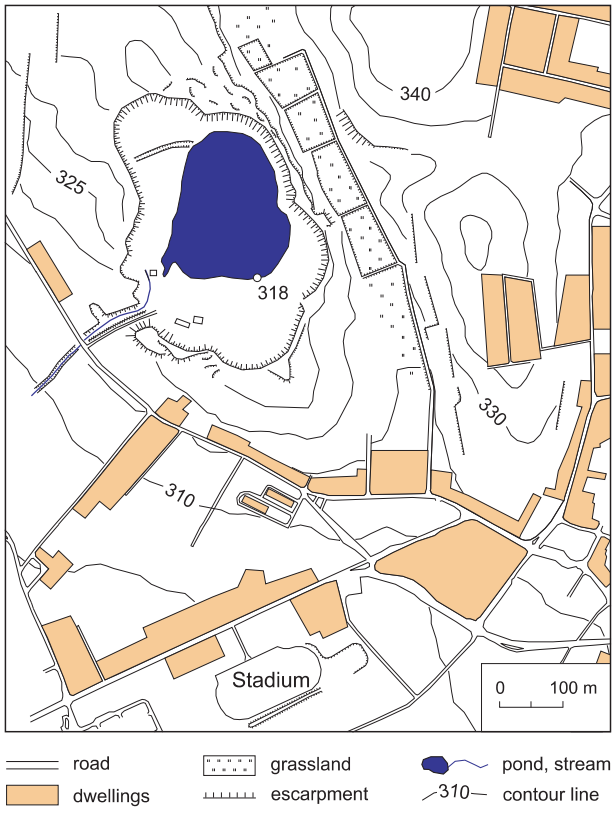

Fig. 2. Location of the Balaton pond

have remained. There are also many faults to be observed, and in scree deposits Jurassic fossils abound: sponges, brachiopods of a Terebratula genus, and ammonites of a Perisphinctes genus. The lowermost bench of the quarry was flooded when dewatering of the quarry had been stopped, and the site has been converted into the town swimming pond with a very clean water.

The areas of mining subsidence over the "Siersza" coal mine excavations visualise effects on the land surface of the underground exploitation, particularly damage caused by the liquidation of underground workings. Although the observation sites are partly masked by forest, they remind an over 200-year history of coal mining in the vicinity of Trzebinia. They are practical demonstration to a fundamental lecture in rock mechanics, showing the way in which mining damage develops. As a result of closing of the "Siersza" colliery, which mining area covered about 40 km^2 (Fig. 4), and in which the exploitation reached more than 400 m depth below the ground surface, dewatering stopped in 1999 and the underground water started to fill the depression cone and to change the composition, flowing back to the aeration zone where decays pyrite (Fig. 5).

Formation of numerous, small subsidence sites is limited to the areas of exploitation of shallow but thick coal seams. In turn, suffosion holes were formed in places where the roof caving reached the layer of loose sand, which was washed down into the collapsed workings (Figs. 6, 7). The roof caving over the deep-seated seams does not reach the surface directly, but results in deflection of the overburden strata. The greatest stress is observed along the edges of subsidence troughs, where tension results even in breaking the continuity of rock layers, and where the mining-related damage is most pronounced (Fig. 8). Such areas cannot be used for construction purposes but should be afforested.

The abandoned sand open pit being currently under recultivation is situated next to the waste tailings pond of the "Siersza" power plant (Fig. 9). Exploitation of the backfill sand for the colliery resulted in forest cutting and in transformation of a hillock into a deep pit. Then, the pit was used for disposing of coal mining waste, i.e. sandstones and mudstones containing pyrite. Mainly due to the presence of iron sulphides, such waste rocks are toxic to the environment (acid effluents), and the overlaying soil should be properly recultivated, minimising penetration of rainwater into the waste. The method of reculti-

Fig. 3. Sponge-microbial bioherm

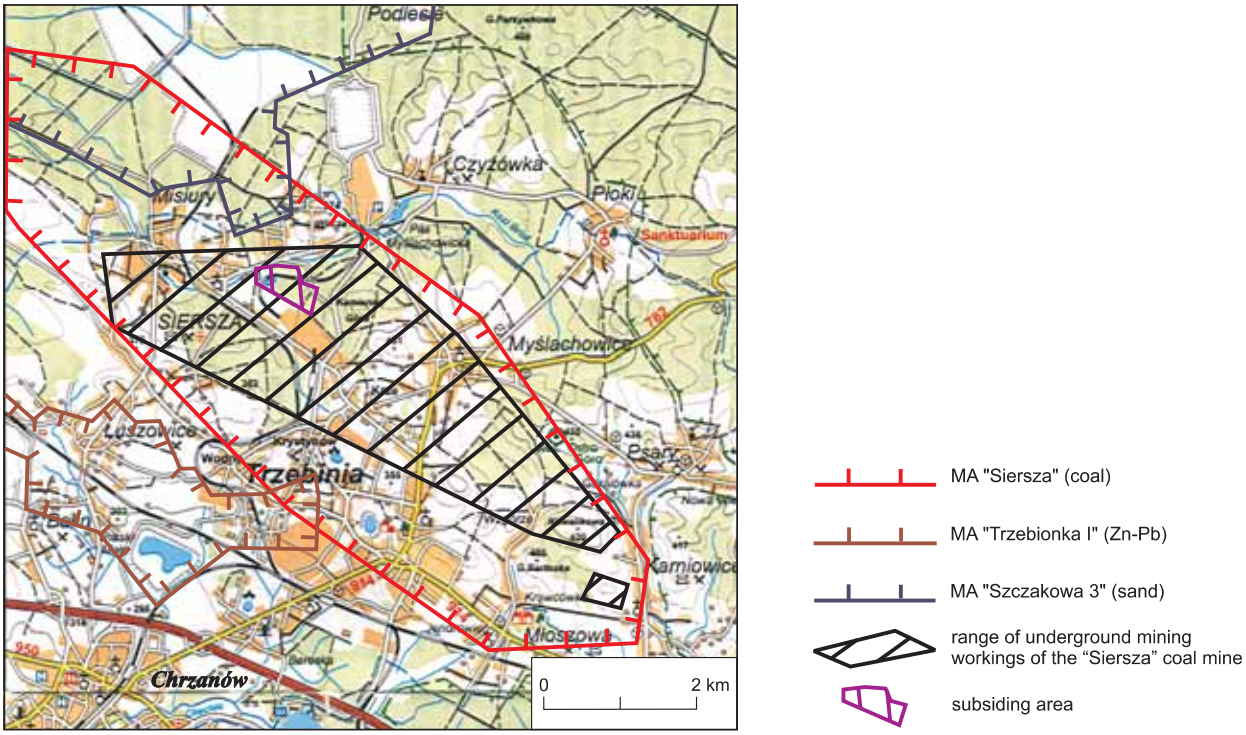

Fig. 4. Mining areas

Fig. 5. Suffosion holes over "Siersza" colliery

vation, its stages, the extent of necessary works, utilisation of the neutralising and, at the same time, insulating power plant fly ash, as well as the applied agrotechnical measures, are demonstrated at this stop-point of the route. Recultivation was split into three stages, and the first, preparatory one, included surveying (field situation and elevation measurements), soil investigations and habitat studies, resulting in preparation of a report. Next contained technical recultivation in which a proper shape of the landfill was prepared (Fig. 10). The third stage has been focused on biological recultivation, based on mineral fertilisation (providing of N, P, K, Ca) and followed by cultivation of leguminous plants, followed by shrubs and trees. At first, a low-demanding, pioneering vegetation was introduced, and only sometime later, the plant species desirable in forest husbandry were planted.

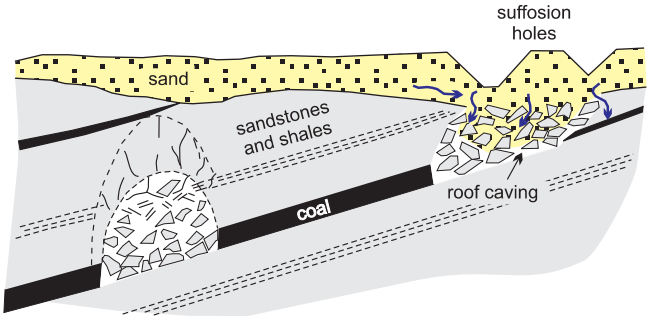

Fig. 6. Mining-degraded area

Several leaflets have been prepared containing the essential information, illustrating by photographs the important stages of the route, supplemented by a generalised cross-section and a map. In the guide, the relevant information is much extended, applying the method of questions and answers. A teacher overseeing the field classes can ask questions adequate to the education level and interest of the participants, selecting some from sets of 10–15 questions prepared for the each route point. The answers contained in the guide are to help teachers in understanding problems presented and directing proper reasoning of the pupils. For instance, in case of the former pit site, the understanding of hydrogeological issues as well as of the ecosystem functioning when it is brought back to the norm, are the main problems.

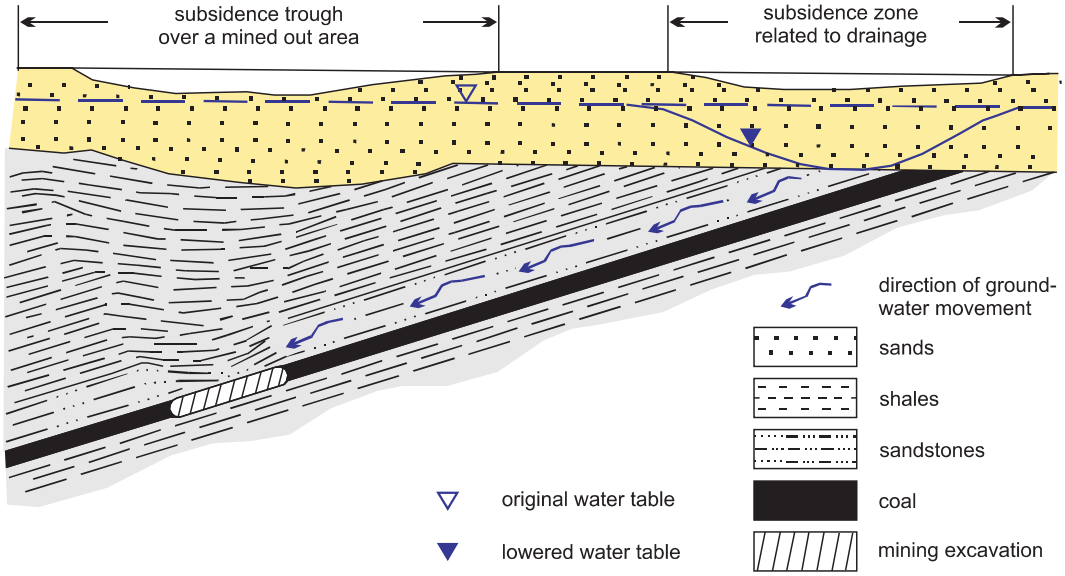

Fig. 7. Surface lowering related to a drainage of the rock-mass in the area distant from the exploitation site (Borecki, 1980)

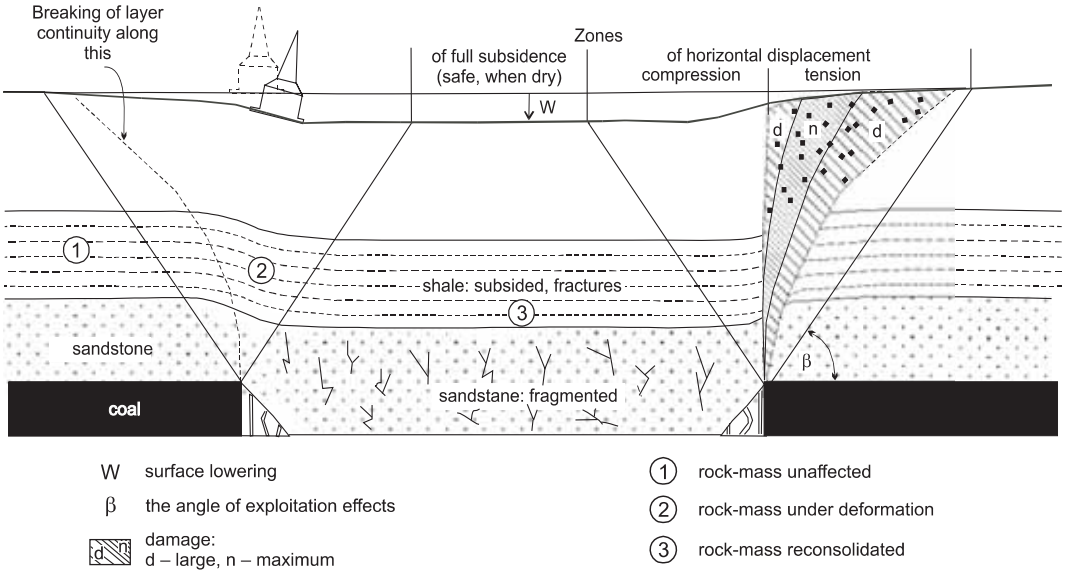

Fig. 8. Schematic cross-section of a subsidence trough over a mined out coal seam (roof caving exploitation)

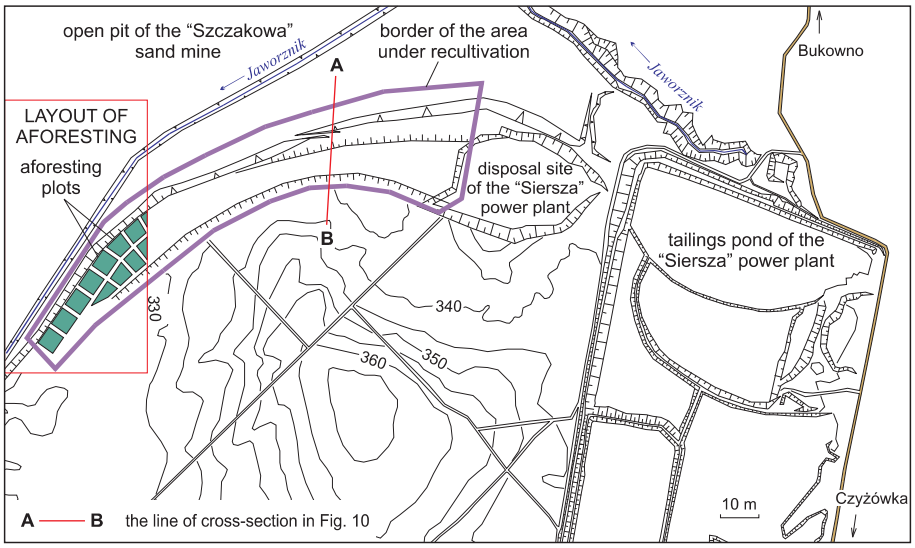

Fig. 9. Map of the area under recultivation

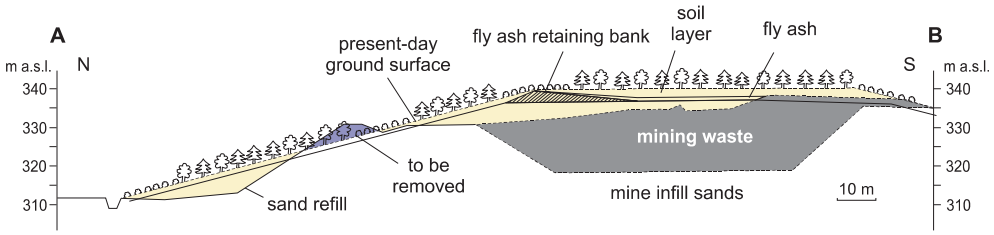

Fig. 10. Cross-section of the area under recultivation

FINAL REMARKS

The proposed education route and the respective materials are to help schools to organise field classes, for instance, those included into the activities of the so-called "green schools" or of the Day of the Earth, while for the devoted tourists they open a new insight into the problems created by the post-mining areas. They have also turned out to be useful in teaching students of the Faculty of Geology, Geophysics and Environment Protection at the University of Mining and Metallurgy (AGH). Inclusion of the new sites and problems, not limited to the area of the Trzebinia commune only, can extend the proposed education route in the future.

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