No detailed investigations on the origin of pyrite and associated mineralization in the western part of the Main Range (Holy Cross Mountains) have so far been conducted. The obtained results will be of cognitive character and will enable a better understanding of geologic setting of the Łysogóry region (northern part of the Holy Cross Mountains). In addition, based on the results derived from geochemical, mineralogical, petrological and isotopic studies, it will be possible to determine an extent of pyrite mineralization and its role in different geologic processes.

Another significant issue related to the occurrence of pyrite (iron sulfide – FeS_2) is acid mine drainage (AMD) water generation, which is one of the greatest hazards to the environment. This phenomenon is described in the American geologic literature by the term acid-mine drainage if induced by man and acid-rock drainage when only natural processes are involved. The release of hydrogen ions and heavy metals accelerates as a result of human activity. The geologic literature has described many examples of ecologic hazards linked to accidental heavy metal loaded AMD water discharges into rivers and seas, or disruptions of mineral pond dams that jeopardized various environmental compartments. One of these examples is southwestern Spain where ecologic disaster took place in April of 1998. About 4 million m^3 of AMD waters and 2 million m^3 of ore pulp disrupted a dam of the Aznalcóllar mineral pond, flooding 6 500 acres of arable fields and a 70-km long zone of the Guadiamar River and its Agrio tributary. The water with a pH of about 3 and high concentrations of Ag, As, Bi, Cd, Co, Cu, Hg, Pb, Sb, Se, Tl, Zn, posed a threat to the ecosystems of Doñana National Park.

As a result of bacterially-induced pyrite oxidation, sulfuric acid and other intermediate sulfur species lead to a pH decrease (pH 2–4) of waters and soils and remobilization of heavy metals. These processes are particularly intensive in the areas of occurrence of metal sulfide ore or coal deposits or non-buffering mineralized rock formations. In spite of complex studies conducted at many AMD sites throughout the world, generation of AMD waters and their interactions with rocks have not fully been identified. This is the reason why these processes should be further studied in relations to different geochemical environments induced by different geologic setting – especially by mineralogy of rock formations.

One of the most unique sites of pyrite mineralization in Poland is located in the Wiśniówka massif about 5 km north of Kielce. There are two quartzite quarries there, i.e. ”Wiśniówka Mała” and ”Podwiśniówka”, containing AMD water bodies showing a pH in the range of 2.2 to 3.0. The most interesting is the ”Podwiśniówka” pit pond and an acid pond situated outside of the mining area at Marczakowe Doły (Fig. 1, 2A-D), which are highlighted by high levels of arsenic and some heavy metals. These three reservoirs display diverse chemistry and therefore may be sort of field laboratories not only for detailed studying various aspects of pyrite oxidation, spatial and temporal distribution of trace elements in waters and colloids/ochrous precipitates, but also geochemical interactions between these abiotic media.

The following objectives can be attained from these studies:

1. Detailed characterization of mineralogy and geochemistry of exposed pyrite mineralization zones in the ”Podwiśniówka” and ”Wiśniówka Duża” quarries, which will be a basis for determining the origin of pyrite and associated minerals.
2. Pinpointing of factors that influence seasonal variability of basic physicochemical and chemical parameters of AMD waters in the ”Podwiśniówka” pit pond, Marczakowe Doły pond and ”Wiśniówka Duża” pit sump on the basis of combined geochemical and isotopic analyses.
3. Assessing geochemical interactions of lanthanides and selected trace elements between acid waters and colloids in the Marczakowe Doły acid pond and between acid waters and plant species that occur around the acid water ponds and pools.
4. Evaluation of the extent of potential hazards to the environment from AMD water bodies and tailings piles derived from characteristic elemental (primarily lanthanide) and isotopic (S, O and H) signatures.

Because many research teams all over the word have been working on AMD waters, therefore different theoretical and practical aspects of the Wiśniówka project may arouse an interest among Earth and environmental scientists. The results derived from this study will be published in national and international journals and presented at scientific conferences. Moreover, the essential environmental problems linked to AMD waters in the Wiśniówka area will be discussed during meetings with the local community.

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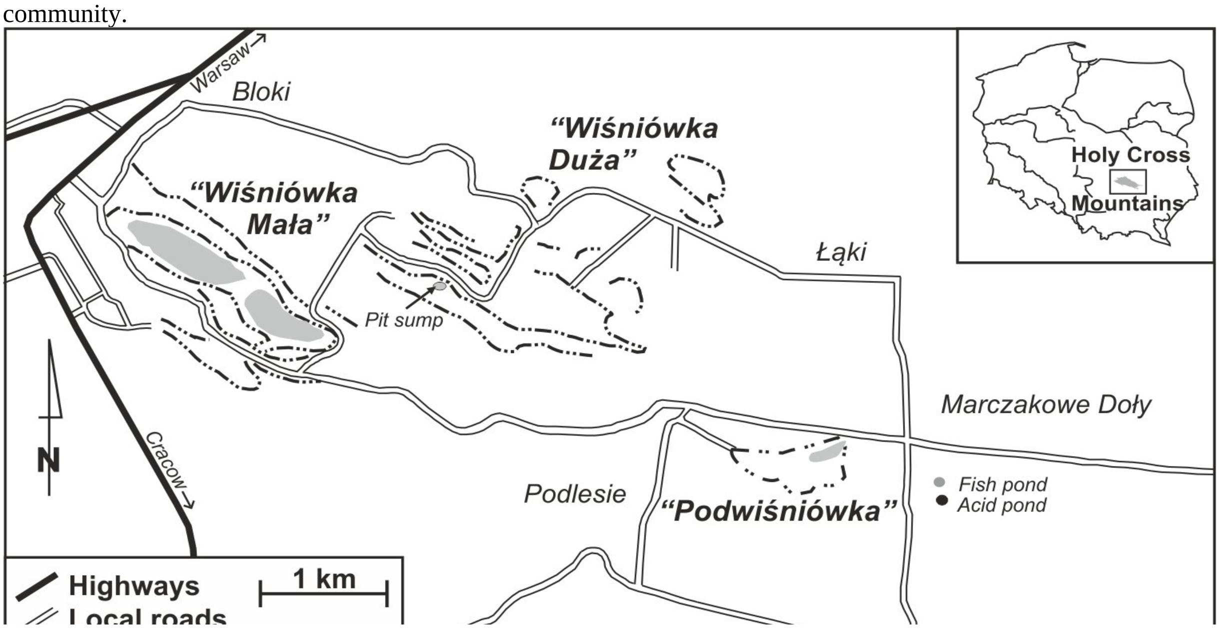

Fig. 1. Localization of three acid mine drainage ponds in the Wiśniówka massif: ”Wiśniówka Mała”, ”Podwiśniówka” and ”Marczakowe Doły”; pit sump is located in the western part of the ”Wiśniówka Duża” quarry (for photos see Fig. 2)

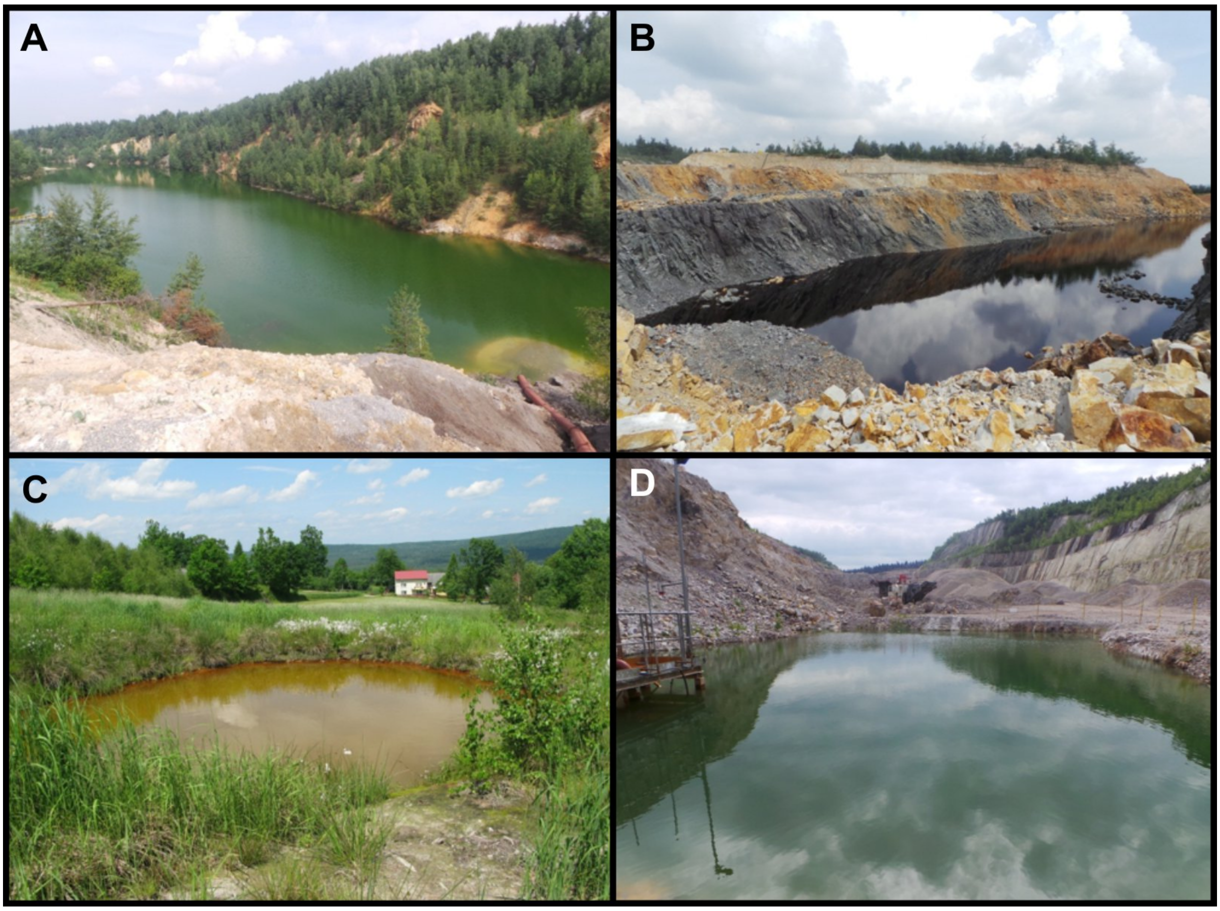

Fig. 2. Acid water bodies (pH varies from 2.2 to 3.3) in the Wiśniówka massif: (A) western part of the lake in the abandoned ”Wiśniówka Mała” quarry; (B) “Podwiśniówka” pit pond (quartzite extraction was ceased at the end of 2014); (C) acid pond in the village of Marczakowe Doły outside of the mining area; (D) pit sump in the ”Wiśniówka Duża” quarry (quartzite extraction was resumed in 2015)