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Arsenic in the wiśniówka acid mine drainage area (Poland): Combining hydro geochemistry with mineral microanalysis

Due to potential toxicity to organisms, arsenic (As) has been of great concern in many countries especially in south-eastern and eastern Asia. The most significant source of this metalloid is some rock formations that undergo weathering releasing As to different environmental compartments. However, this process is distinctly expedited in acid mine drainage areas, where the highest concentrations of As are noted. The principal objective of the Wiśniówka case study (south-central Poland) was to compare concentrations of As in three acid pit lakes and strongly acidic seeps and pools with host rock series using the ICP-QMS and mineralogical methods. The last mentioned encompassed optical microscopy, scanning electron microscopy coupled with energy dispersive spectroscopy (SEM/EDS) and electron microprobe (EMP). Of the three acid pit lakes, the Podwiśniówka located in the eastern part of the mining area, revealed the highest contents of As in the broad range (7.02 to 22.2 mg/L) induced by evaporation or influxes of rainwater/meltwater. The main source of this metalloid is Upper Cambrian As-rich pyritiferous sandstone-shale series that crops out particularly at the Podwiśniówka quarry. However, the highest levels of As (370 mg/L) were found in strongly acid pools and seeps occurring at the foot of tailings piles composed of Podwiśniówka waste material. The mineralogical examinations indicate that pyrite (FeS^2) is the only As-rich sulfide mineral in this area whereas the other sulfide minerals, for example: galena (PbS), sphalerite (ZnS), chalcopyrite ($CuFeS^2$), covellite (CuS), occur only in trace amounts in the form of tiny inclusions of 0.001–0.015 mm in diameter. Arsenic is not uniformly distributed within a pyrite matrix, but forms alternating As-rich and As-depleted bands. Another specific feature of this pyrite is also its size. This predominantly forms tiny grains and framboids 0.0X–0.00X mm across, thus additionally favoring rapid oxidation of this mineral.

Biography

Zdzisław M Migaszewski is a Full Professor at the Institute of Chemistry, Jan Kochanowski University in Kielce, Poland and a Chairman of the Scientific Board of the Polish Geological Institute in Warsaw. He has graduated from the Faculty of Geology, University of Warsaw. He received his PhD and DSc degrees from the AGH University of Technology in Cracow, and in 2009 he was awarded a Professorship of Geology. His key interests are Trace Element and Stable Isotope Geochemistry, Mineralogy, Sedimentary Petrology and Environmental Analytical Chemistry. He has conducted some projects in close collaboration with the US Geological Survey in Denver and State University of New Mexico in Albuquerque.

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