Research problem: The Olkusz mining district is a part of the Silesia-Cracow zinc and lead ore deposits. This area is characterized by the presence of historical mining remnants as well as resides generated at present. Mining remnants are mainly industrial wastes disposed on heaps. The wastes are enriched in potentially toxic elements (Zn, Pb, Cd, As, Tl) and often these constitute a parental material for soils being developed at this area. Mining sludges accumulated within recent post-flotation impoundment are also enriched in such elements and may therefore serve as source of metallic pollution for surrounding soils. Toxic elements are bound in sulfides and sulfosalts, which are relatively unstable minerals on the Earth surface; as the result these elements may be released into environment during chemical weathering. The weathering factors that determine the rates and intensity of the process include changes in pH conditions, presence of inorganic and organic compounds and many others which when act together accelerate release of metallic contaminants. Furthermore, mobilization of trace elements to a great extent may be affected by microorganisms whose activity may be enhanced in top-soil dominated by plant roots (called rhizosphere). In this part of soil, organic acids being the plant exudates cause pH depletion that may accelerate the release and mobility of toxic elements from mineral soil particles and wastes. Microorganisms within soils obtain nutrients and energy from minerals therefore interactions between microorganisms and studied soils and wastes are particularly interesting.

The main goal of planned project is to assess the impact of microbial activity and root exudates on mobilization of toxic elements (Zn, Pb, Cd, Cu, As, Tl, Ga, Ge) from mineral particles of soils and post-flotation wastes. Investigations will be carried out under laboratory conditions, where soils gained from top-soil (0-0.2 m) and tailings collected from post-flotation impoundment will be put into solution stimulating grow of soil bacteria. These studies will allow to compare the impact of microorganisms on leaching of trace elements from parental material and wastes (both characterized by different properties and composition). In order to determine the impact of root exudates on metals mobilization, soil and tailing samples will be put into solution composed of mixture of organic compounds (including sugars and acids) reflecting conditions encountered in the rhizosphere. Before and after biogeochemical experiments, sequential extraction studies will be carried out in order to assess impact of biological activity on bioavailability of trace elements. Any changes of physicochemical conditions of soils (e.g. pH, Eh) may cause alterations/weathering of primary minerals. However, changes affected by microorganisms activity are of particular concern. Therefore, biogeochemical studies will be complemented by mineralogical analysis. Based on mineralogical results, geochemical processes taking place during bioweathering will be proposed.

The Olkusz mining district is the last one within the Silesia-Cracow zinc and lead area, where ore was excavated until 2020. In order to avoid negative results (i.e. contamination of the environment) inherent to historical and recent mining activity, effective remediation is necessary. Among different remediation methods of mining areas, biologically assisted methods are recently of main interest because these are considered to be the most environmentally friendly. Bioleaching investigations using the chemoautotrophic bacteria (*A. thiooxidans, A. ferrooxidans*), indigenous soil microorganisms and root exudates have been not conducted yet within the Silesia-Cracow zinc and lead mining area. Results of planned biogeochemical investigations could significantly expand the knowledge of scientific community on the geochemical behavior of toxic elements (especially of Zn, Pb and Cd). In addition, gathered data and observations can be of significant use for development of microbially assisted remediation strategies at the study area.