Arsenic is an omnipresent metalloid found in the environment. That element is extremely toxic and considered to be a global health risk factor. Serious effects on human health are caused due to the exposure to arsenic. Drinking water probably is the greatest risk to human health. As drinking water is predominantly sourced from surface water, groundwater, or rainwater, all of which are susceptible to contamination by arsenic depending on environmental conditions and treatment methods, thus its quality may be highly variable. Arsenic drinking water standards throughout the world range from 0.01 to 0.05 mg/L, however large aquifers in many parts of the world are identified with problems from As occurring at concentrations above these values. Researchers indicate that 226 million people are exposed to arsenic contamination. The identification of As toxicity and its impact on human health, fundamentally increased the intensity of As research over last years, focusing on large problem areas, particularly in Southeast Asia, where the situation is the most serious in terms of the population that is exposed. Due to these problems reassessment of the factors controlling the distribution of As in the natural environment, the ways of its mobilization and waters remediation technologies have become an object of researchers' interest.

Release of arsenic may occur under natural conditions, e.g. during weathering of rocks, biological activity or volcanic emissions. However, anthropogenic actions have also a significant impact on arsenic release into the environment. Mining activities, combustion of fossil fuels or the use of arsenical wood preservatives and agricultural chemicals contribute to arsenic discharges. Although, the use of arsenical products has been reduced in the last few decades, their impact on the environment will remain for many years. Furthermore, mining industry still generate enormous amounts of mine waste around the world, which can potentially pollute the environment through the oxidation of sulphide minerals, generating acid mine drainage (AMD). These effluents often contain high concentrations of toxic elements, including arsenic, lead, cadmium, copper, iron and zinc. Their release may be transported to the nearby environment resulting in contamination of soils, sediments, ground and surface waters. A similar effects are observed during excavation and crushing of rocks during the underground space development for urban and industrial construction projects.

Methods for As-contaminated waters, including rock leachate and mine drainage, have been investigated for decades. The most common method applied for removal of As in waters is precipitation of calcium arsenates or ferric arsenates. Unfortunately, in the presence of water and CO_2, these products are unstable. Calcium arsenate may be transformed into $CaCO_3$ and arsenic acid, while ferric arsenate have variable stability depending on conditions.

In this project we would like to test a new method for removal of As from contaminated waters that is associated with an innovative water processing route which allows for implementation of small and mobile treatment facilities. That new approach has the potential to become a cost-effective technology, resulting in uptake of As from waters to concentrations that do not pose a threat to aquatic ecosystems. We propose to explore an alternative pathway that has been poorly researched before, and which is quite simple and promising: induced precipitation of As - bearing, insoluble crystalline phase - lead chloride arsenate $Pb_5(AsO_4)_3Cl$ (mimetite). Mimetite, belonging to the unique supergroup of minerals, apatites, is the most stable crystalline form of As(V) in the environment and it will precipitate spontaneously and significantly reduce the contaminant concentration. Its low solubility and relatively high stability ensure very low final concentrations of As in the solution. A process of desorption from Pb-zeolite will be used to obtain lead source needed for mimetite formation. Through desorption, conditions encouraging the release of trapped lead ions will be introduced, making them available for the experiments. This method allows to efficiently harness lead from a pre-existing material, minimizing waste and cost while ensuring a sustainable approach to our research.

The basic study on the reactions and processes associated with this approach will be performed to determine the feasibility of future development of a mobile set of reactors to remove arsenic from water, e.g. waste rock leachate or mine drainage. The proposed research brings with it a large load of innovation in both, basic research and (in the future) in applied sciences. The growing problem of contamination of post-industrial waters with arsenic justifies the need for a research on new, economical and efficient methods for purification of wastewaters.