

Ultramafic rocks (UMR) are susceptible to natural carbonation - the chemical reaction that is responsible for the alteration of Mg-rich silicates into carbonates (mainly magnesite – MgCO_3). The main minerals of UMR are olivines, pyroxenes, and serpentinites, which can react with carbon dioxide in the various geological setting. UMR- CO_2 reactions result in the formation of magnesite mineralization which may form economically viable deposits. Therefore, UMRs are considered promising lithology for anthropogenic CO_2 storage. The most common natural source of Mg^{2+} ions is UMRs, however, the source of CO_2 is still debated. Currently, it is known that magnesites hosted by UMR can be formed due to many processes under a range of conditions. The occurrence of magnesite veins has been proved in the modern ocean floor, as a result of ocean-floor metamorphism (serpentinization). Also, UMR that represents the mantle wedge can be carbonated due to CO_2 liberation during the marine sediments subduction in subduction zones. On the other hand, tectonically exposed ultramafic rocks are capable to directly interacting with atmospheric CO_2 . Tropical weathering (lateritization) and near-surface reaction between UMR and atmospheric CO_2 form Mg^{2+} and HCO_3^- - rich waters, which results in the formation of abundant magnesite mineralization. Therefore, magnesite can be formed and evolve through an extended period of time essentially recording certain geological processes from the past to the present.

The main goal of the project is to demonstrate how magnesite and coexisting carbonates could reflect the long-term evolution of ultramafic massifs. The field studies will be conducted in the Central Sudetic Ophiolite (CSO) which represents a fragment of the Early Devonian oceanic lithosphere. The ultramafic rocks of CSO have been already well recognized, however, the comprehensive petrographic characteristics of magnesites and coexisting carbonates have not been investigated yet. Studying petrogenesis and the properties of carbonates associated with UMR provide important insight into the deep carbon cycle. Also, this project will provide new information about the source of CO_2 and the age of natural carbonation of CSO. The project aims to demonstrate how magnesite and coexisting carbonates could reflect the long-term evolution of ultramafic massifs. The implementation of the project will allow answering several research questions about naturally induced carbonation of ultramafic massifs, magnesite mineralization, paleoclimate reconstruction, and CO_2 sequestration. These questions will be answered by interpreting the results of petrological, geochronological, and geochemical (including trace elements, light, and heavy isotopes) analysis. The project will be implemented in several stages. First, the exact mineralogical and chemical characteristics of the studied magnesites and associated carbonates will be determined. Fluid inclusions will be analyzed using the thermal microscope stage. After selecting representative samples of carbonates and associated minerals occurring in well-identified paragenesis, strontium isotopic composition will be determined. Next, we plan to construct Rb-Sr isochrones for well-defined mineral associations. The final stage of the research involves in situ trace elements analysis in carbonates (LA-ICPMS).

We infer that a combination of selected methods will be a useful tool for the reconstruction of the long-term evolution of ultramafic massifs. It is also expected that comprehensive studies of magnesites and associated carbonates from Central Sudetic Ophiolite (CSO) will allow for the specification of knowledge about the natural carbonation of the Devonian oceanic lithosphere. Finally, the results will be interpreted in terms of anthropogenic carbonation of UMR and may yield important information on possible conditions that should be used during carbonation to reach the most efficient and stable CO_2 sequestration.