# Metal migration and ore formation in the slow-spreading oceanic lithosphere: an insight from the Central Sudetic Ophiolite, Poland

## Abstract for the general public

Precious metals on land are intensively exploited and plummet quickly. Therefore, increasing attention is being paid to the submarine deposits of polymetallic sulfides, which are a source of gold, silver, zinc, lead, and copper. Developing technology gradually enables machines to work under high water pressure on the ocean floor. There are now several private companies aiming at underwater resource exploitation. Major countries compete to buy exploration licenses in various parts of all three oceans. In 2018, Poland became the seventh country with the International Seabed Authority's license to search for polymetallic sulfides on the ocean floor. For over a dozen years, starting from 2022, Polish scientific expeditions will study the geologically and naturally spectacular section of the Mid-Atlantic Ridge (26–33°N).

To minimize the economic and environmental costs of future exploitation, we need to understand the processes involved in the formation of marine metal deposits. Although these deposits are located at the bottom of the ocean, they form due to the migration of hot fluids transporting metals from the Earth's mantle. During the partial melting of the mantle, these metals pass into magma and then into hot hydrothermal fluids that carry them to the ocean floor. The sulfide deposits appear to be the largest, where their source is related to plutonic rocks of the lower crust and upper mantle. Therefore, large deposits of massive sulfides are formed within the Atlantic and Indian Oceans, which are characterized by slow spreading, where plutonic rocks are most often exposed on the ocean floor. Oceanic drilling in such zones would thus be the best way to understand the relationship between the ocean floor metal deposits and their main source in the oceanic lithosphere. However, due to the high cost, such drilling is so far rarely performed and it is therefore difficult to fully understand the geometrical relationships between the various rock layers.

Alternatively, these can be accessed on land via so-called ophiolites. Ophiolites are remnants of the ancient oceanic lithosphere tectonically emplaced onto continental margins. In another National Science Centre (NCN) project (OPUS-17), we are already studying the ophiolite sequence of the world's largest ophiolite in Oman. However, this ophiolite represents the lithosphere representing a fast-spreading ridge. Ophiolites related to slow spreading have not yet been investigated in terms of metal migration but luckily there is such a well-preserved ophiolite in Poland. It is the Central Sudetic Ophiolite (CSO), which is exposed around the Ślęza Massif near Wrocław.

In the project, we will focus on the migration of metals between the mantle and ocean floor and its role in the subsequent ore-forming processes by investigating 235 representative rock samples from the CSO. We will combine traditional (optical microscopy) and the most modern techniques, such as Sensitive High-Resolution Ion MicroProbe (SHRIMP) and femtosecond laser ablation – inductively coupled plasma mass spectrometry (fs-LA-ICPMS). Fs-LA-ICPMS can determine the isotopic composition of important metals such as copper, nickel, or iron, and measure the concentrations of even very rare metals such as gold or palladium with a resolution down to a dozen of microns. The fruition of this project will allow us to identify key processes causing rock enrichment in ore minerals, and determine their role in shaping the global distribution of seafloor massive sulfides. This is particularly important in the context of the upcoming Polish research expeditions to search for seafloor massive sulfides in the North Atlantic.