Upper mantle / lower crust metasomatism as a source of unique Cr-Sc-Ree-Be-Nb mineralization at the contacts between felsites and ultramafic-rodingite rock association at Jordanów Śląski

In a quarry near Jordanów Śląski, on the edge of the Gogołów-Jordanów serpentinite massif, which is a part of the Ślęża Ophiolite, a serpentinite composed mainly of actinolite is exposed. Within this rock there are relatively narrow bodies of uncertain origin, composed of leucocratic granitoids and highly texturally and mineralogically diverse calc-silicate rocks. Traditionally, these bodies are called *leukocratic zones* in the scientific literature. Locally, jade appears at the contacts of these zones with the surrounding serpentinite, and therefore in older literature the quarry was also called a jade quarry. The extraction of serpentinite, and also jade, lasted until the end of the 1970s, after which the quarry remained practically inactive.

In 2015, as a result of routine mineralogical examination of a pegmatite sample with tourmaline collected in this quarry by the project manager in the 1990s, it turned out that scandium mineralization occurred in the contact zone of this pegmatite with chlorite schist. This was even more surprising because scandium forms its own minerals very rarely, usually occurring as a trace substituent replacing Mg, Fe or Al in common rock-forming minerals, mainly pyroxenes and amphiboles. As a result of this discovery, in the following years the presence of four new Sc minerals was documented in the locality: scandio-winchite, heflikite, dubinskiite, and the Sc-bearing augite, as well as several others known from other occurrences, such as cascandite, kristiansenite, jervisite, kolbeckite, and three chemical varieties of bazzite.

In the spring of 2022, exploitation in the quarry resumed, revealing numerous, small aplite-pegmatite bodies and associated calcium-silicate rocks. A review of the newly obtained rock material allowed, in addition to scandium mineralization, to identify unique Be-REE-Nb mineralization. In addition to the common Be minerals, such as beryl, phenakite, bertrandite, bavenite, bohseite, milarite, there are also beryllium phases, probably unknown to science so far. In turn, REE minerals include xenotime-(Y), monazite-(Ce), various types of rhabdophanes, clinozoisite–allanite-(Ce)–heflikite solid-solutions members, dissakisite-(Ce), allanite-(Y), allanite-(Nd) and allanite-(Sm), described for the first time from this location, which is the third documented Sm mineral. The Nb-Ta-Ti mineralization is represented by minerals of the samarskite-, columbite- and ixiolite-groups (including varieties enriched in Sc), minerals of the pyrochlore supergroup, and titanite, also locally enriched in Sc. In 2024, the presence of hydrothermal Cr-bearing mineralization (Cr-bearing grossular, Al-bearing uvarovite, Cr-bearing allanites and pumpellyites) was identified in the tectonic pegmatite breccias, and relics of chromite in calck-silicate rocks with the characteristics of chromite formed at the boundary of the upper mantle and the lower Earth's crust, which evolved into chromite strongly altered by the interaction of metasomatizing fluids. They all were accompanied by the already mentioned hydrothermal Cr-bearing garnets.

The Cr-Sc-Ree-Be-Nb mineralization occurs within narrow leukocratic zones at the junction of felsites and the ultramafic rodingite rock complex. There are several reasons why this mineralization should be thoroughly characterized, including its genesis. They result primarily from the broad interest of the scientific community in new data on Cr, Sc, REE, Be and Nb over the last dozen or so years and the unique opportunities created in this respect by the reactivation of mining in the quarry at Jordanów Śląski. It should also be emphasized that all the elements mentioned are recognized by the European Commission and the US Department of Commerce as critical raw materials or critical metals. Therefore, research that will allow us to better understand the processes and factors controlling the mobility, concentration and deposition of these elements in the lithosphere is extremely important. To assess the genesis of this unique mineralization, an important issue is the way in which Cr and Sc, two elements unusual for granite pegmatite, were transported and accumulated in rocks of the Earth's crust by metasomatizing fluids. Although the behavior of Sc in fluids is still poorly understood, the presence of hydrothermal Cr-bearing mineralization in the Jordanów Śląski lekkocratic zone may significantly help in resolving the origin of the entire mineral assemblage of interest.

Metasomatic mineral assemblages rich in Cr are found both in the subduction zone and in deeper parts of the Earth's mantle, where alkali-rich hydrothermal fluids containing HCO_3^- and CO_3^{2-} are considered the main metasomatizing factors. Such a case is most likely encountered in the leukocratic zone of Jordanów Śląski, where Sc and Cr must have been supplied by fluids of the upper mantle/lower crust. To confirm the above scientific hypothesis, we plan to perform comprehensive mineralogical, geochemical and geochronological research on the material we already have, as well as on the material that will be collected in the newly exposed parts of the leukocratic zone during the implementation of the research project, and to publish the results of our research in renowned foreign journals.