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Summary of the Ph.D. thesis

Evolution and genesis of tourmaline group members from the eastern metamorphic cover of the Karkonosze granite in the Kowary-Czarnów unit.

Tourmaline-supergroup minerals is a large group of complex borosilicate phases. A wide range of P-T conditions in which tourmaline is stable as well as their chemical diversity allow to use these minerals as valuable indicators of metamorphic processes and activities of ions in the crystallization environment. The dissemination of modern analytical methods and classification changes in the tourmaline-supergroup made it necessary to reinterpret the previously published chemical and petrogenetic data.

The Kowary-Czarnów unit is a part of the Karkonosze-Izera Massif, built of a rock complex composed of a metapelite series, Lower Paleozoic granitoids, and the Variscan intrusion of the Karkonosze granite. The area of the Kowary-Czarnów unit consists of a metapelitic series and ortogneisses metamorphosed during the Variscian regional metamorphism (MP-MT) overprinted by contact metamorphism involved by the intrusion. Metamorphic rocks of the Kowary-Czarnów series besides typical dravitic to schorlitic tourmaline species contain also much rarer species like oxy-dravite, magnesio-lucchesiite, and a magnesium analogue of dutrowite (magnetio-dutrowite). Specimen of the magnesio-dutrowite from the Rędziny dolostone quarry was approved by the Committee on Mineral Names, Nomenclature and Classification of the International Mineralogical Society (IMA-CNMNC) as a new mineral in 2023.

The collected samples contained zoned tourmaline crystals from the vicinity of Wołowa Góra, Budniki and the Rędziny quarry. These tourmaline crystals occur as accessory minerals in host metamorphic rocks and may also be accessory phases of the epigenetic quartz veins. Individual tourmaline samples were characterized in terms of the chemical variability (major and trace elements), and the isotopic composition of boron, using an electron-probe microanalyzer (EPMA), laser ablation inductively coupled plasma mass spectrometry LA-ICP-MS, and secondary ion mass spectrometry (SIMS). Based on crystallochemical differences in tourmaline crystals of individual generations, the origin of the tourmaline was attributed to (1) pre-metamorphic stage of growth, (2) crystallization at the stage of progressive metamorphism, or (3) crystallization during retrogression overlapped by contact metamorphism related to the Karkonosze granite intrusion. The behavior of such elements like Ca, Ti, Sr, F, and Sc in the tourmaline was determined on the basis of the evolution of the Karkonosze granite metamorphic cover. Elements incorporated into the crystal structure of the tourmaline are related to protoliths of the host metamorphic rocks and processes during regional and contact metamorphism stages. During the research, the world's highest contents of scandium have been documented, which indicate that Sc can plays a significant role in the structure of tourmaline of metamorphic origin.

Studies of crystallization conditions of rare tourmaline species during metamorphic events presented in the Ph.D. thesis, significantly contribute to broaden our knowledge about the tourmaline-supergroup minerals forming under metamorphic conditions.