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Chromium clinozoisite and allanite-(Ce) from the leucocratic zone within serpentinite at Jordanów Śląski in Lower Silesia, Poland

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The leucocratic zone exposed in the serpentinite quarry at Jordanów Śląski comprises tectonically assembled serpentinite, calc-silicate, and leucogranite rocks, along with pegmatite and aplite. Mining activity has cut through this zone, which is at least 20-25 m wide and approximately 100 m long, to a depth of ~20-30 m.

Relics of primary Cr-bearing, Fe^{3+}-poor chromite-I in actinolite–diopside rock and in altered metasomatic clinozoisite–quartz–albite rock indicate a mantle origin. They are overgrown by euhedral Fe^{3+}-bearing chromite-II, which is altered by fluids to Cr-bearing clinozoisite (up to 0.40 Cr apfu), grossular, and rare clinochlore. The compositions of both chromite types indicate retrograde crystallization from the low-amphibolite (~600°C) to greenschist facies, with Cr-grossular forming at <400°C.

Similar Cr-bearing mineralization (grossular-uvarovite, rare allanite-(Ce), Cr-bearing diopside) occurs in tectonic breccias of leucocratic rocks and in adjacent pegmatite fissures. Chromium-enriched pegmatite zones contain grossular-uvarovite, allanite-(Ce) with Cr_2O_3 content exceeding >21 wt%, and other phases. Chromium allanite-(Ce) forms small grains (<100 μm). In contrast, Cr-bearing clinozoisite associated with zoisite-bearing calc-silicate rocks and altered actinolite–diopside metasomatites occurs as large crystals (up to 2-3 cm) and contains no detectable lanthanides by EPMA.

Chromium is mobile in ultramafic and mafic magmas, but its behavior in magmatic and metamorphic fluids remains unclear. Hydrothermal dissolution of chromite in the Oman ophiolite by fluids containing CO_2^{2-}, SO_4^{2-}, and Cl^-, followed by the incorporation of Cr into silicates and the precipitation of new chromite and uvarovite, has been proposed [1]. Chromium mobility has been demonstrated across a wide pH range and at varying CO^2 partial pressures [2]. The uncommon occurrence of Cr-bearing mineralization in pegmatite suggests that the chromium in the studied mineralization originated at deeper levels of the Ślęża ophiolite and was mobilized during subduction.

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References:

[1] Arai and Akizawa, 2014, American Mineralogist. 99(1), p. 28-34;

[2] Rai et al., 2007, Journal of Solution Chemistry. 36, p. 1261-1285.