Metamorphic vanadian-chromian silicate mineralization in carbon-rich amphibole schists
from the Malé Karpathy Mountains, Western Carpathians, Slovakia

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ABSTRACT

Mineralization, involving vanadian-chromian silicates, has been studied in Lower Paleozoic, carbon-rich amphibole schists with pyrite and pyrrhotite near Pezinok, southwest Slovakia. A detailed electron-microprobe study has revealed the presence of V,Cr-rich garnet, clinozoisite, and muscovite, associated with amphiboles (magnesiohornblende, tremolite, actinolite, and edenite), diopsidite, and albite. The garnet contains 5–19 wt% V2O5, 5–11 wt% Cr2O3, and 2–13 wt% Al2O3 (16–64 mol% goldmanite, 19–36 mol% uvarovite, and 9–59 mol% grossular end-members). The garnet is unzoned or shows V-rich cores and Al-rich rims, or irregular coarse oscillatory zoning with V, Cr, and Al, locally involving Ca and Mn as well. The V,Cr-rich clinozoisite to mukhinite and “chromian clinozoisite” contains 2–9.5 wt% V2O5 and 1.5–11 wt% Cr2O3; the muscovite contains 2.5–8 wt% V2O5 and 0–7 wt% Cr2O3. The mineralization originated from primarily V-, Cr-, and C-rich mafic pyroclastic rocks, affected by volcano-exhalative processes. These rocks were weakly metamorphosed during early Hercynian regional metamorphism (M1), followed by late-Hercynian contact metamorphism (M2) with crystallization of V,Cr-rich silicates, diopsidite, amphiboles, phlogopite, titanite, albite, quartz, carbonate, pyrite, and pyrrhotite. The youngest Alpine (?) retrograde metamorphic event (M3) is connected with production of V,Cr-poor muscovite, clinohloire, clinozoisite, pumpellyite-(Mg), prehnite, quartz, and carbonates, under prehnite-pumpellyite facies conditions.

Keywords: V and Cr mineralization, amphibole schists, contact metamorphism, goldmanite, uvarovite, mukhinite, Western Carpathians, Slovakia

INTRODUCTION

Vanadium-rich silicate phases are found in mineral associations from metamorphosed fine-grained pyroclastic and clastic sediments rich in organic carbonaceous matter or from skarns, calcareous metapelites and marbles, associated with mafic rocks. Vanadian grossular to goldmanite [Ca3V3(SiO4)2], a V-dominant member of the ugrandite garnet subgroup, is the most conspicuous mineral in such associations, together with other V-rich phases including micas, diopsidite, amphiboles, titanite, biotite, oxide minerals, and even sillimanite (e.g., Moench and Meyrowitz 1964; Karev 1974; Suwa et al. 1979; Benkerrou and Fonteilles 1989; Canet et al. 2003; Donohue and Essene 2005). Moreover, goldmanite has been described in refractory inclusions from the Leoville carbonaceous chondrite (Simon and Grossman 1992). Vanadian clinozoisite to mukhinite [Ca2Al3V3+3(Si2O7)(SiO4)O(OH)], in association with goldmanite, has been described in marbles from the Tashegilskoye deposit, Siberia, Russia (Shepel and Karpenko 1969). Vanadian epidote to allantite occurs in association with goldmanite, vanadoan muscovite, vanadoan titanite, and tommieite in the main ore zone of the Hemlo gold deposit, Ontario, Canada (Pan and Fleet 1991, 1992).

The above-mentioned minerals are V-rich but relatively Cr-poor in most localities. However, in the Poblet area, Spain, V- and Cr-rich goldmanite and other minerals have been described (Canet et al. 2003). Donohue and Essene (2005) have also described chromian hercynite with vanadoan sillimanite. Our investigated occurrences in the Pezinok-Penke crystalline complex, Malé Karpathy Mountains, Slovakia, represent another example of a rare V- and Cr-rich metamorphic association containing garnet (goldmanite-uvarovite-grossular s.s.) with other V- and Cr-rich silicate minerals. Preliminary results were reported by Uher et al. (1994). New mineralogical and petrogenetic results, based on detailed electron-microprobe analysis (EMPA) and X-ray diffraction (XRD) data, are the subject of this contribution.

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