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A Sb-As-W-Te-rich manganese-quartzite from the UHP-metamorphic Kimi Complex, Rhodope Massif, Greece

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A Mn-quartzite was found as a layer of ∼0.5 m in diameter within a sequence of garnet-kyanite metapelites intercalated with amphibolites and marbles in the UHP-metamorphic Kimi Complex, Rhodope Massif, Northern Greece. This rock shows an oxidized assemblage quartz + piemontite + garnet + phengite + biotite + K-feldspar + clinopyroxene + calcic amphibole + tourmaline + hematite + titanite + rutile + calcite + apatite + zircon. Zr-in-rutile thermometry yields 690-730˚C for cores and ∼600˚C for discontinuous Zr-poor rims of rutiles. Phengite barometry in the limiting assemblage with K-feldspar + phlogopite + quartz yields ∼9-10 kbar for phengite cores (Si = 2.25-3.32 apfu) and ∼6 kbar for rims (Si = 3.15 apfu). These low pressures are consistent with the diopside-rich (90-95 mol%) composition of clinopyroxene in spite of bulk Na-contents of 1.1-1.7 wt% Na_2O. The Mn-quartzite is rich in Sb, As, W, Te and Ba. This results in the local formation of Sb-Nb-Fe^{3+}-W-rich rutile with up to 13.2 wt% Sb_2O_5, 1.8 wt% Nb_2O_5, 7.6 wt% Fe_2O_3 and 1.1 wt% WO_3 which is equivalent to ∼14 mol% squawcreekite [$Fe^{3+}Sb^{5+}O_4$]-component. Textures indicate a late and locally confined Sb-W-Nb-Fe^{3+}-enrichment along narrow and irregular veins. Rutiles may contain numerous tiny (≥1-2 μm) inclusions of a Cu-Te phase which is most likely weissite [Cu_5Te_3]. Secondary titanite replacing rutile shows up to 4.5 wt% As_2O_5 and 2.0 wt% Sb_2O_5, respectively. Element correlations are consistent with an exchange Si^{4+} + Ti^{4+} = As^{5+} + M^{3+}. Both phengite and K-feldspar contain significant Ba with up to 0.4 and 5.4 wt% BaO, respectively. Garnets are mostly spessartite-rich solid solutions with up to 10 mol% calderite-[$Mn_3Fe_2^{3+}Si_3O_{12}$] component. The mineralogy and geochemistry of the Mn-quartzite is consistent with an origin as a siliceous deep-sea sediment mixed with polymetallic/ferromanganese crusts. Metamorphosed Fe-Mn rich metasediments with very similar geochemistry have been described from the Penninic Units of the Western Alps [1-3]. No evidence for UHP-conditions is present in the Mn-quartzite. A micro-Raman study of solid inclusions in zircon revealed abundant quartz and minor dolomite but no coesite. This suggests that the Mn-quartzite did not leave the quartz-stability field during subduction and exhumation. Instead, clinopyroxene and phengite compositions indicate an equilibration under upper amphibolite-facies PT-conditions. This is consistent with the new tectonometamorphic model of the Rhodope Massif devised by Krenn et al. [4].

[1] Schweiz. Mineral. Petrogr. Mitt. 67: 339-360 (1987)

[2] Can. Min. 37: 37-52 (1999)

[3] Lithos 42: 147-189 (1998)

[4] Tectonics, in press