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First occurrence of tainiolite in the Namalulu tsavorite deposit (Tanzania): evidence of evaporite-bearing sediments from continental platform in the Neoproterozoic Metamorphic Mozambique Belt

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In Namalulu, the lithostratigraphic column is similar to the Lemshuku one (Feneyrol et al., 2010) with a series composed from bottom to top of quartzite, different facies of graphitic gneiss, and dolomitic marble. The marble presents different facies: F-bearing tremolite marble, baryte-bearing marble, yellowish marble, orange marble, white-grey marble, pinkish marble hosting gypsum-anhydrite lens (type lens I), and white-grey marble hosting calcite-scapolite-diopside-graphite-sulphides lens (type lens II). The most common mineral phases within marbles are F-bearing tremolite (1.23-3.77 wt% F), fluoro-phlogopite (2.06-8.41 wt% F) and quartz. The pinkish marble and the lens type I contain a (Li-, B-)-bearing mica (2.01-2.05 wt% LiO2; 53-110 ppm B) with high fluorine content (9.00-9.28 wt% F), associated with calcite and dolomite. The chemical composition corresponds to the tetrasilicic mica tainiolite. It is the first time that tainiolite is observed in such a metamorphic formation. In the lens type II, scapolite (36-44 % Me) appears as greyish to black pluricentimetric euhedral crystals. Diopside is green, gemmy, and vanadiferous (up to 0.74 wt% V2O3). Sulphides are mainly pyrite, pyrrhotite and chalcopyrite. Karelianite (62-75 % Kar) is associated with the sulphides.
Graphitic gneisses of the Namalulu area are very weathered and only the mineralized ones were enough preserved for studies. They are composed of quartz, kyanite, green vanadiferous muscovite Ms1 (0.73-0.97 wt% V2O3), colourless muscovite Ms2 vanadium-free, vanadiferous rutile (1.53-1.93 wt% V2O3) and graphite. The temperature of metamorphism is estimated around 600-620°C and pressures between 6 and 8 kbars. The assemblage is crosscut by calcite-quartz veins. Few aluminium phosphate-sulfate (APS) minerals belonging to the woodhouseite-svanbergite series are found within the veins. Two kinds of graphite are distinguished: (i) Gr1 disseminated and elongated according to the foliation; (ii) Gr2, folded, located in the veins. Ms1 is also disseminated and elongated according to the foliation whereas Ms2 is located within the veins. Tsavorite (0.49-0.80 wt% V2O3) is found in quartz-calcite veins crosccutting the graphitic gneiss according to the foliation. Isotopic analyses give δ13C values of 19.9‰ (versus PDB; n=2) for graphite from the gneiss, and indicate an organic matter origin for carbon, and that V-minerals-bearing graphitic gneiss formed by the metamorphism of black shales. δ13C values for calcite and dolomite from marbles are comprised between 2.0 and 3.2‰ (with a mean of 2.6 $\pm$ 0.4‰ versus PDB; n=8), and equal -2.6‰ and -2.5‰ respectively for calcite and dolomite of the lens type II. δ18O of calcite and dolomite (n=9) are comprised between 22.1 and 27.6‰ (mean of 24.8 $\pm$ 1.4‰ versus SMOW). The C and O carbonates isotopic compositions show that the protolith of the marbles corresponds to marine carbonates. Presence of gypsum, anhydrite, scapolite and APS minerals indicate an evaporitic origin for the lenses. Records of evaporite in tsavorite deposits are also discribed in Merelani (Malisa, 1987), Lemshuku (Feneyrol et al., 2010), as well as in southeastern Kenya (Suwa et al., 1996). The paleoenvironment of the tsavorite host-rock belongs to platformal evaporite-bearing sediments basin in the Neoproterozoic Mozambique Ocean.

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