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The Mg-analogue of Ferro-Papikeite from UHT granulites at Ærøya (Bamble Sector), Norway: Description and crystal structure

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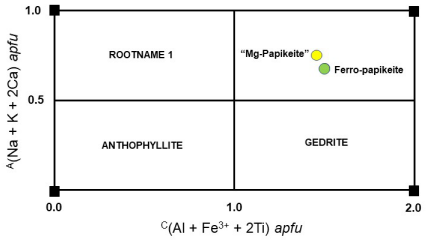

Figure 1. Compositional boundaries for the orthorhombic magnesium-iron-manganese amphiboles showing ferro-papikeite and its new Mg-analogue.

A new as-yet un-named mineral of the amphibole supergroup, the Mg analogue of ferro-papikeite (Fig. 1), ideally $NaMg_2(Mg_3Al_2)(Si_5Al_3)O_{22}(OH)_2$, has been discovered on the island of Ærøya, 5 km south of Arendal township, Agder, Norway. Here it occurs in a khondalite, a high-grade granulite rich in garnet, orthopyroxene, sillimanite, quartz, and cordierite (Fig. 2). It occurs as lobate to subhedral grains, 50 – 800 µm in size, as inclusions within Al-enriched orthopyroxene ($En_{66}Fs_{28}Ts_6$). It has a Mohs' hardness of ~6 and is brittle with a splintery fracture, has the characteristic perfect {210} cleavage of orthorhombic amphiboles which intersects at ~56°. In transmitted plane-polarized light, the amphibole is moderately pleochroic X = beige, Y = Z = pale brown; X < Y = Z. It is biaxial (+), dispersion is r < v, weak. The orientation is X Ç a, Y Ç b, Z Ç c.

The mineral is orthorhombic, space group *Pnma*. Chemical analysis by electron microprobe (n = 5) gave SiO_2 41.36, Al_2O_3 18.80, TiO_2 1.02, FeO 17.19, MnO 0.14, MgO 16.97, CaO 0.16, Na_2O 2.68 K_2O 0.01, Cl 0.00, H_2O_{calc} 2.09, sum 100.48 wt%. The formula unit, calculated on the basis of 24 (O + OH + Cl) with (OH) = 2 apfu is $^{A}(Na_{0.75}K_{0.00}Ca_{0.03})^{B+C}(Mg_{3.63}Fe^{2+}_{2.07}Mn^{2+}_{0.02}Al_{1.13}Fe^{3+}_{0.00}Ti^{4+}_{0.11})_{\sigma 8}O_{22}(OH_{2.00})_2$, resulting in the ideal formula $NaMg_2(Mg_3Al_2)(Si_5Al_3)O_{22}(OH)_2$.

The outcrop in which the amphibole was found occurs along the southeastern shore of the small island of Ærøya, within typical granulitic rocks of the southern part of the Proterozoic Bamble-sector, South Norway. The outcrop is some 600 m southwest of the UHT sapphirine-quartz-corundum-garnet paragenesis discovered at Hisøya in 2010 (Kihle et al., 2010) and the bedding of both outcrops is concordant. Cordierite in the more magnesian layers of the amphibole outcrop have very high optic-axial angles $2V_x$ of 99-104° indicative of high CO_2 contents during formation. The neighboring granulite-facies rocks became famous for their *CO_2*-dominated fluid inclusions, as first discovered by Jacques *Touret* in the 1960s.

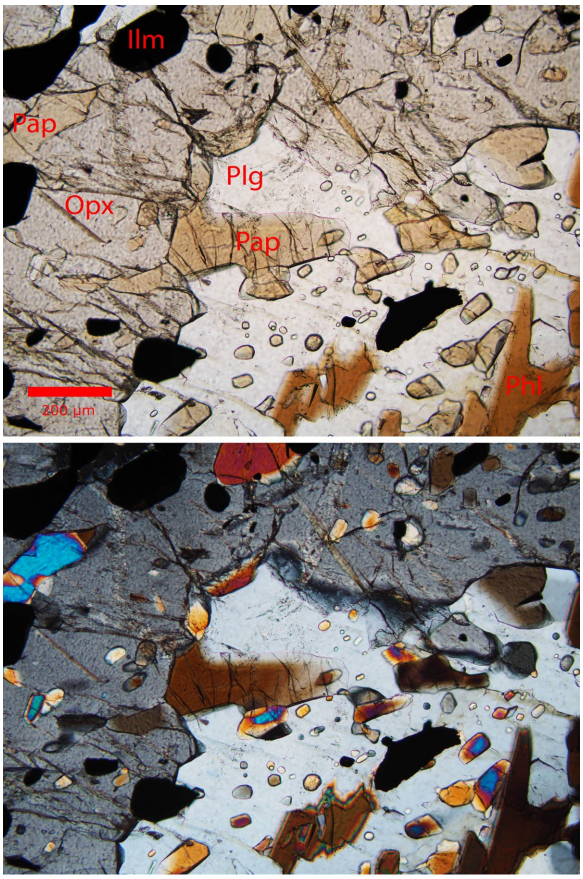

Figure 2. “Mg-Papikeite” (Pap) occurring as inclusions in orthopyroxene and neighboring plagioclase (Plg)