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Stornesite-(Y), (Y, Ca)$\square_2$Na$_6$(Ca,Na)$_8$(Mg,Fe)$_{43}$(PO$_4$)$_{36}$, the first terrestrial Mg-dominant member of the fillowite group, from granulite-facies paragneiss in the Larsemann Hills, Prydz Bay, East Antarctica

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ABSTRACT

Stornesite-(Y), end-member formula Y$\square_2$Na$_6$(Ca$_5$Na$_3$)Mg$_{43}$(PO$_4$)$_{36}$, is a new Y-dominant analog of the meteoritic mineral chladniite. A representative electron microprobe analysis is SiO_2 = 0.02, P_2O_5 = 48.11, SO_3 = 0.05, MgO = 23.16, MnO = 0.24, FeO = 15.55, Na_2O = 5.04, CaO = 5.66, SrO = 0.02, Y_2O_3 = 1.43, Yb_2O_3 = 0.24, UO_2 = 0.01, Sum = 99.53 wt%, which gives $Y_{0.68}Yb_{0.06}Na_{8.69}Ca_{5.40}Sr_{0.01}Mg_{30.71}Fe_{11.56}Mn_{0.18}Si_{0.02}S_{0.04}P_{36.22}O_{144}$. Overall, Y + REE range from 0.542 to 0.985 atoms per formula, and atomic Mg/(Mg + Fe) ratio from 0.684 to 0.749. Single-crystal X-ray diffraction gives trigonal symmetry, $R\overline{3}$, a = 14.9628(27) Å, c = 42.756(11) Å, V = 8290(4) Å^3, calculated density = 3.196 g/cm^3, Z = 3. The mineral is isostructural with synthetic chladniite, but the (0, 0, 0) site is dominantly occupied by Y instead of Ca. Bond lengths are considerably shorter than for Ca sites; Y and Yb are fully ordered at this site, which is our rationale for recognizing stornesite-(Y) as a distinct species. The strongest lines in the powder pattern [d in Å, (I), (hkl)] are 3.67 (40) (0 3 6, 3 0 6), 3.52 (40) (0 0 12, 3 1 2, 1 3 $\overline{2}$), 2.94 (60) (0 1 14, 3 2 $\overline{2}$, 2 3 2), 2.73 (100) (2 0 14, 0 3 12, 3 0 12), 1.84 (40) (1 5 14, 5 1 $\overline{14}$, 0 6 12, 6 0 12). The mineral is optically uniaxial +, n_ω = 1.6215(10) and n_ε = 1.6250(10) at 589 nm. Its color is pale yellow in standard thin sections. Stornesite-(Y) is found as inclusions in fluorapatite nodules in two paragneiss specimens from Johnston Fjord, Stornes Peninsula (whence the name) and in a third from Brattnevet, Larsemann Hills. Associated minerals are wagnerite, xenotime-(Y), monazite-(Ce), P-bearing K-feldspar, biotite, sillimanite, quartz, and pyrite; it is commonly altered to rusty material and secondary phosphates. Grains are anhedral, subhedral, or locally euhedral with hexagonal or rhombic outlines; maximum dimensions are 1 × 0.25 mm. It is inferred to have formed at 800–860 °C, 6–7 kbar by reaction of biotite with an anatectic melt locally enriched in P by interaction with fluorapatite.

Keywords: Phosphate, new mineral, Antarctica, Larsemann Hills, electron microprobe, crystal structure, granulite facies, anatexis