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Nixonite, $Na_2Ti_6O_{13}$, a new mineral from a metasomatized mantle garnet pyroxenite from the western Rae Craton, Darby kimberlite field, Canada

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Abstract

Nixonite (IMA 2018-133), ideally $Na_2Ti_6O_{13}$, is a new mineral found within a heavily metasomatized pyroxenite xenolith from the Darby kimberlite field, beneath the west-central Rae Craton, Canada. It occurs as microcrystalline aggregates, 15 to 40 μm in length. Nixonite is isostructural with jeppeite, $K_2Ti_6O_{13}$, with a structure consisting of edge- and corner-shared titanium-centered octahedra that enclose alkali-metal ions. The Mohs hardness is estimated to be between 5 and 6 by comparison to jeppeite, and the calculated density is 3.51(1) g/cm^3. Electron microprobe wavelength-dispersive spectroscopic analysis (average of 6 points) yielded: Na_2O 6.87, K_2O 5.67, CaO 0.57, TiO_2 84.99, V_2O_3 0.31, Cr_2O_3 0.04, MnO 0.01, Fe_2O_3 0.26, SrO 0.07, total 98.79 wt%. The empirical formula, based on 13 O atoms, is: $(Na_{1.24}K_{0.67}Ca_{0.06})_{\Sigma 1.97}(Ti_{5.96}V_{0.023}Fe_{0.018})_{\Sigma 6.00}O_{13}$ with minor amounts of Cr and Mn. Nixonite is monoclinic, space group *C*2/*m*, with unit-cell parameters a = 15.3632(26) Å, b = 3.7782(7) Å, c = 9.1266(15) Å, β = 99.35(15)°, and V = 522.72(1) Å^3, Z = 2. Based on the average of seven integrated multi-grain diffraction images, the strongest diffraction lines are [d_{obs} in Å (I in %) (hkl)]: 3.02 (100) (310), 3.66 (75) (110), 7.57 (73) (200), 6.31 (68) (20$\bar{1}$), 2.96 (63) (31$\bar{1}$), 2.96 (63) (20$\bar{3}$), and 2.71 (62) (402). The five main Raman peaks of nixonite, in order of decreasing intensity, are at 863, 280, 664, 135, and 113 cm^{-1}. Nixonite is named after Peter H. Nixon, a renowned scientist in the field of kimberlites and mantle xenoliths. Nixonite occurs within a pyroxenite xenolith in a kimberlite, in association with rutile, priderite, perovskite, freudenbergite, and ilmenite. This complex Na-K-Ti-rich metasomatic mineral assemblage may have been produced by a fractionated Na-rich kimberlitic melt that infiltrated a mantle-derived garnet pyroxenite and reacted with rutile during kimberlite crystallization.

Keywords: Nixonite, new mineral, crystal structure, jeppeite, mantle xenolith, kimberlite, Rae Craton