DISCOVERY OF COLOMERAITE, $NaTi^{3+}Si_2O_6$, A NEW JADEITE-GROUP MINERAL IN THE COLOMERA IRON METEORITE

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Introduction: During a nanomineralogy investigation of the historic Colomera iron meteorite, a new clinopyroxene mineral, $NaTi^{3+}Si_2O_6$ with the monoclinic *C*2/*c* jadeite-type structure, named "colomeraite", was identified in one silicate nodule in section USNM 7928. The Colomera meteorite, found at Colomera, Granada, Spain in 1912, is a silicate-bearing IIE iron. Field-emission scanning electron microscope (SEM), energy-dispersive X-ray spectroscopy (EDS), electron back-scatter diffraction (EBSD) and electron probe microanalyzer (EPMA) were used to characterize colomeraite and associated phases. The new mineral has been approved by the IMA-CNMNC (IMA 2021-061) [1]. The name is after the host meteorite "Colomera". Synthetic $NaTi^{3+}Si_2O_6$ is well known [2,3]. Presented here is the first natural occurrence of this phase as a new mineral in a meteorite.

Occurrence, Chemistry, and Crystallography: Colomeraite occurs as subhedral crystals, ~2–6 μm in size, with albite and K-feldspar in one silicate nodule (Fig. 1). The meteorite consists of mainly low-Ni iron, taenite, nickel-phosphide, troilite, and silicate inclusions containing albite, K-feldspar, pyroxene, kosmochlor, apatite, merrillite, rutile, loveringite.

The chemical composition of colomeraite by EPMA (WDS) is (wt%) SiO_2 54.82, Ti_2O_3 17.15, TiO_2 5.58, Na_2O 12.33, MgO 3.95, FeO 3.58, CaO 1.98, MnO 0.28, Al_2O_3 0.24, Cr_2O_3 0.13, K_2O 0.02, sum 100.05, showing an empirical formula (based on 6 O *pfu*) of $(Na_{0.88}Ca_{0.08}Mg_{0.04})(Ti^{3+}_{0.53}Ti^{4+}_{0.15}Mg_{0.17}Fe_{0.11}Mn_{0.01}Al_{0.01})Si_{2.01}O_6$, with Ti^{3+} and Ti^{4+} partitioned, based on stoichiometry. The simplified formula is $(Na,Ca)(Ti^{3+},Ti^{4+},Mg,Fe)Si_2O_6$. The ideal formula is $NaTi^{3+}Si_2O_6$, which requires Na_2O 13.89, Ti_2O_3 32.23, SiO_2 53.87, total 100 wt%. The EBSD patterns of colomeraite can be indexed only by the *C*2/*c* jadeite-type structure and give a perfect fit to the synthetic $NaTi^{3+}Si_2O_6$ cell [2,3], with a mean angular deviation of 0.35º-0.38º, revealing a = 9.70(1) Å, b = 8.88(1) Å, c = 5.30(1) Å, V = 316(1) Å^3, β = 106.8(1)º, V = 437(2) Å^3, and Z = 4.

Origin and Significance: Colomeraite ($NaTi^{3+}Si_2O_6$) is a new member of the jadeite group (Na pyroxenes). It is the Ti-analog of jadeite ($NaAlSi_2O_6$), aegirine ($NaFe^{3+}Si_2O_6$), jervisite ($NaSc^{3+}Si_2O_6$), kosmochlor ($NaCr^{3+}Si_2O_6$), namansilite ($NaMn^{3+}Si_2O_6$), or natalyite ($NaV^{3+}Si_2O_6$).

Colomeraite is rare in Colomera, only observed in one globular silicate inclusion, probably formed from plagioclase-Ca pyroxene melts via impact mixing of metal and silicates under reduced conditions.

Colomeraite is one of the newly-approved minerals from iron meteorites. Other recently-found new minerals in iron meteorites include joegoldsteinite ($MnCr_2S_4$) in Social Circle [4], edscottite (Fe_5C_2) in Wedderburn [5], and elaliite ($Fe^{2+}{}_8Fe^{3+}(PO_4)O_8$), elkinstantonite ($Fe_4(PO_4)_2O$) and olsenite ($KFe_4(PO_4)_3$) in El Ali [6,7].

References: [1] Ma C. (2021) *Mineralogical Magazine* 85:914, CNMNC Newsletter 63. [2] Ohashi H. et al. (1982) *Ganseki Kobutsu Kosho Gakkaishi* 77:305–309. [3] Redhammer G.J. et al. (2003) *Acta Crystallographica, Section B: Structural Science* 59:730–746. [4] Isa J. et al. (2016) *American Mineralogist* 101:1217–1221. [5] Ma C. and Rubin A. E. (2019) *American Mineralogist* 104:1351–1355. [6] Herd C. D. K. et al. (2023) *LPSC*, 54, Abs 2220. [7] Ma C. et al. (2023) *LPSC*, 54, Abs 1883.

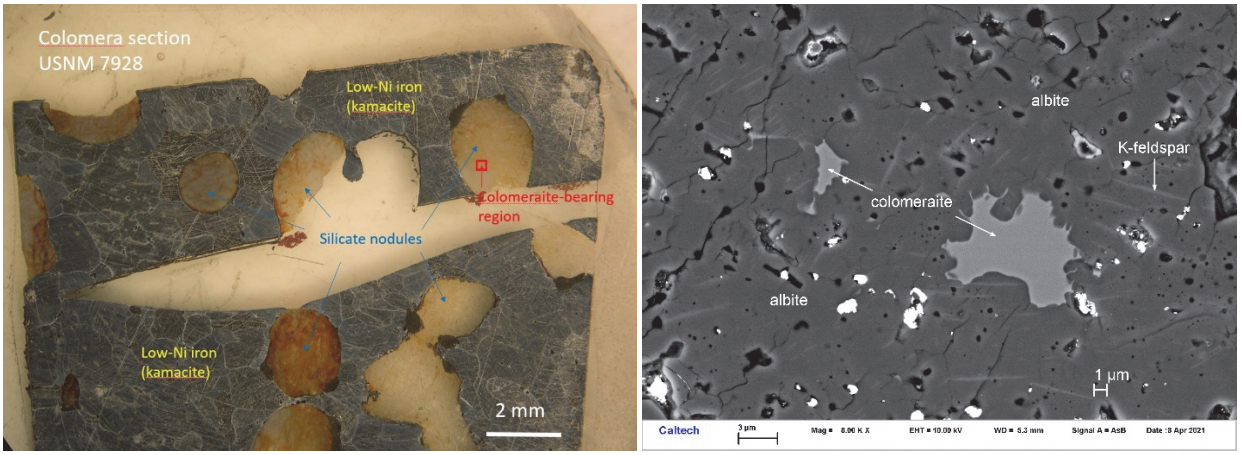

Figure 1. (left) Optical image and (right) SEM back-scatter electron image showing colomeraite in one silicate nodule with albite and K-feldspar in Colomera section USNM 7928.