DISCOVERY OF A NEW GARNET MINERAL, $Ca_3Ti_2(SiAl_2)O_{12}$: AN ALTERATION PHASE IN ALLENDE.

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Introduction: During a nanomineralogy investigation of the Allende CV3 carbonaceous chondrite, a new Ti-rich silicate, $Ca_3Ti_2(SiAl_2)O_{12}$ with the *Ia-3d* garnet structure, was identified in the Type B1 Ca,Al-rich inclusion (CAI) *Egg-3*. Field-emission SEM with EDS and electron back-scatter diffraction and electron microprobe were used to characterize the composition and structure. Synthetic $Ca_3Ti_2(SiAl_2)O_{12}$ is not reported. We present here the natural occurrence of $Ca_3Ti_2(SiAl_2)O_{12}$, as a new alteration silicate in a CAI, and discuss its origin and significance for secondary processes. The mineral is currently under review by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (IMA 2013-029). It is a new member of the schorlomite group in the garnet supergroup [1].

Occurrence, Chemistry, and Crystallography: This garnet mineral occurs as small grains, 500 nm – 4 μm in size, alone or in contact with monticellite, grossular and wadalite in alteration areas along some cracks between melilite, spinel and Al,Ti-diopside in the core area of the CAI. *Egg-3* is a Type B1 FUN (Fractionation and Unidentified Nuclear effects) CAI from Allende [2]. Melilite with spinel, Al,Ti-diopside and anorthite occupies the mantle-core area with a Wark-Lovering rim consisting of Al,Ti-diopside and forsterite. Trace of Ni-Fe rich metal is present in *Egg-3*. The matrix around the CAI consists of ferroan olivine, nepheline, salite-hedenbergite pyroxenes, and minor troilite and pentlandite.

The mean chemical composition of this new garnet is (wt%) CaO 34.58, TiO_2 25.35, SiO2 20.87, Al_2O_3 15.65, MgO 2.11, FeO 0.71, V_2O_3 0.45, total 99.72, giving rise to an empirical formula of $Ca_{2.99}(Ti^{4+}_{1.54}Mg_{0.25}Al_{0.17}Fe^{2+}_{0.05}V^{3+}_{0.03})(Si_{1.68}Al_{1.32})O_{12}$. The end-member formula is $Ca_3Ti_2(SiAl_2)O_{12}$. Electron back-scatter diffraction patterns of this phase can be indexed nicely by the *Ia-3d* garnet structure and give a best fit using the grossular structure from [3] with unit cell dimensions: a = 11.843 Å, V = 1661.06 Å^3, and Z = 8.

Origin and Significance: This Ti-rich garnet is a new secondary alteration phase, apparently formed by iron-alkali-halogen metasomatic alteration of the primary phases like melilite, perovskite, and Al,Ti-diopside in the CAI. Formation of the secondary Ti-rich minerals (Ti-rich garnet and Al,Ti-diopside) during the metasomatic alteration of the Allende CAIs suggests some mobility of Ti during the alteration.

References: [1] Grew E.S. et al. 2013. *Am. Miner.* 98, 785–811. [2] Wasserburg G.J. et al. 2012. *Meteor. Planet. Sci.* 47, 1980–1997. [3] Lager G.A. et al. 1987. *Am. Miner.* 72, 766–768.