DISCOVERY OF CI-BEARING MAYENITE, Ca_{12}Al_{14} O_{32}Cl_{2}, A NEW MINERAL IN A CV3 METEORITE
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Introduction: A unique dmitryivanovite (CaAl_{2}O_{4}) - dominant Ca-, Al-rich refractory inclusion (CAI), named “Cracked Egg” by [1], was observed in the NWA 1934 CV3 carbonaceous chondrite. During our nano-mineralogy investigation of this CAI, Cl-bearing mayenite, Ca_{12}Al_{14}O_{32}Cl_{2}, was identified. Electron-microprobe, SEM, electron back-scatter diffraction (EBSD), and micro-Raman analyses have been used to characterize its composition and structure. Pyrometamorphic and natural Cl-bearing mayenites have been reported [²,³] and synthetic Ca_{12}Al_{14}O_{32}Cl_{2} is well known [⁴]. Here, we report the first occurrence of Ca_{12}Al_{14}O_{32}Cl_{2} in a meteorite as a new alteration mineral in a CAI.

Occurrence, Chemistry, and Crystallography: Cl-bearing mayenite occurs as small (80 - 300 nm) crystals forming fine-grained aggregates (1 - 20 μm in size) along with Zn-bearing hercynite, gehlenite and perovskite in veins and inclusions within the dmitryivanovite-dominant CAI. The mean chemical composition is (wt%) Al_{2}O_{3} 48.48, CaO 45.73, Cl 5.12, FeO 0.80, Na_{2}O 0.12, TiO_{2} 0.03, O -1.16, sum 99.12. An empirical formula calculated on the basis of 34 O+Cl atoms is (Ca_{11.93}Na_{0.06})\sum_{11.99}(Al_{13.91}Fe_{0.16}Ti_{0.01})\sum_{14.08}O\sum_{31.94}Cl\sum_{2.11}.

Synthetic Ca_{12}Al_{14}O_{32}Cl_{2} has a cubic structure with a Ca-Al-O framework forming “cages” in which the Cl is located [⁴]. The meteoritic Cl-bearing mayenite showed no electron back-scatter diffraction pattern, due to small crystal sizes and, probably, poorly ordered structures but Raman microanalysis revealed a spectrum very close to that of synthetic Ca_{12}Al_{14}O_{32}Cl_{2}, confirming that the meteoritic phase has a similar structure.

Origin and Significance: Cl-bearing mayenite is not only a new meteoritic Ca-, Al-phase, but also a new Cl-rich phase, joining the Cl-rich meteoritic minerals sodalite (Na_{6}Al_{6}Si_{6}O_{24}Cl) and wadalite (Ca_{6}Al_{6}Si_{6}O_{24}Cl). Cl-bearing mayenite is a secondary alteration phase in “Cracked Egg”. A simple scenario for its formation would be the parent body breakdown of dmitryivanovite in a Cl-, Fe-rich vapor or fluid to produce Cl-bearing mayenite and hercynite, although we have not yet ruled out the possibility that Cl-bearing mayenite formed during terrestrial alteration or that preterrestrial Cl-free mayenite was later chlorinated. Multiple-alteration events seem to have occurred in this CAI.