Inclusion AF in Allende revisited - relationship to dark inclusions?

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Introduction: Inclusion AF was found in Allende CV3 meteorite and firstly described as "unusual xenolith" in 1989 [1, 2]. It is a cm-sized inclusion that appears dark in transmitted light. It consists predominately of platy olivine, fayalitic in composition (Fa 25 to 50, [1]) that vary in size from 5 to 30 μm and are larger than typical Allende matrix. The olivine plates are loosely packed wit abundant pore space in between. Common objects are silicate-rich, mainly olivine, suggested to have formed by aggregation and simultaneous condensation. Rare inclusions are olivine-sulfide-metal bearing and sulfide-andradite bearing objects associated with these are exotic accessory phases such as, e.g., PGE nuggets, HgS, native Cu, Ti-magnetite, ilmenite, perovskite. Based on petrologic and mineralogical arguments it was postulated that inclusion AF differs substantially from dark inclusions (DI) in Allende. In addition, AF has a bulk chemical composition of major and minor elements that is almost identical with bulk Allende composition which is also distinct from that of dark inclusions [2]. Oxygen isotope data reported by [2] show that compositionally it falls at most ^{16}O poor end of the range in Allende dark inclusions [3]. Condensation of olivine and gas solid reaction in a nebular environment under physico-chemcial conditions distinct from typical Allende components was invoked to explain its origin [1,2].

Oxygen isotope composition: We have analyzed two new samples from the AF inclusions. The samples were separated from two areas that are optically distinct. One samples (AFb) is texturally similar to that shown in Figs 1 and 2 from [1] containing many aggregates. The other sample (AFa) has been taken from an area that is devoid of obvious aggregates. Four replicates of each sample have been analyzed. Independent from the distinct textural appearance oxygen isotopes in both fractions are almost identical in composition; fraction AFa is $\delta^{17}O = 1.75$ and $\delta^{18}O = 7.11$ and AFb is $\delta^{17}O = 1.71$ and $\delta^{18}O = 6.93$. Both samples are even more depleted in ^{16}O than the compositions reported previously [2] and extend the range of bulk DI composition. Marginally they overlap with the oxygen compositional array of DIs reported from Vigarano and Leoville [4]. How this extremely 16-poor composition does relate to the alteration origin of Allende inclusion AF needs further study. At this point is rather unlikely that alteration on the asteroidal body could explain such a composition.

References:

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