GROWTH OF FERROUS OLIVINE IN THE OXIDIZED CV CHONDRITES DURING FLUID-ASSISTED THERMAL METAMORPHISM. A. N. Krot[1], M. I. Petaev[2], and P. A. Bland[3] [1]HIGP, U. Hawai'i at Manoa, USA (sasha@higp.hawaii.edu); [2]CfA & DEPS, Harvard U., USA; [3]Imperial College, DESE, UK.

The CV carbonaceous chondrites are subdivided into the oxidized [Allende-like (CV_{oxA}) and Bali-like (CV_{oxB})] and reduced subgroups [1], which reflect complex alteration histories experienced by CVs [2]. Although recent mineralogical [3-5] and isotopic [6-8] studies show that CV alteration occurred in the presence of aqueous solutions and lasted for at least several Ma, the origin of secondary ferrous olivine (Fa_{40-60}) remains controversial. Two types of models have previously been proposed: (*i*) gas-solid condensation from an oxidized nebular gas [9] and (*ii*) dehydration of phyllosilicates during thermal metamorphism [10, 11]. Here we argue that ferrous olivine in the oxidized CVs formed during fluid-assisted metamorphism by several mechanisms (1-4) described below:

(1) Replacement of opaque nodules in CV_{oxB} chondrules by fayalite ($Fa_{>90}$) [2, 12] is a two-stage process involving oxidation of metal to magnetite: $3Fe_{(s)} + 4H_2O_{(l,g)} = Fe_3O_{4(s)} + 4H_{2(g)}$, and replacement of magnetite by fayalite: $2Fe_3O_{4(s)} + 3SiO_{2(aq)} + 2H_{2(g)} = 3Fe_2SiO_{4(s)} + 2H_2O_{(l,g)}$. In MET00430, which is intermediate between CV_{oxA} and CV_{oxB}, the opaque nodules are replaced by ferrous olivine (Fa_{60-80}), whereas those in Allende are replaced by less Fe-rich olivine (Fa_{40-50}). This probably reflects higher alteration temperatures experienced by the CV_{oxA} compared to the CV_{oxB} [3].

(2) Direct precipitation of ferrous olivine from a supersaturated fluid in pore space: $Fe^{2+}{}_{(aq)} + Mg^{2+}{}_{(aq)} + SiO_{2(aq)} = (Fe,Mg)_2SiO_{4(s)}$, is indicated by the presence of euhedral ferrous olivines overgrowing Mg-rich olivines and pyroxenes in chondrules and AOAs in oxidized CVs, and by the ^{16}O-poor compositions of the ferrous olivines in Allende AOA [13]. Large compositional variations of the ferrous olivines (Fa_{50-80}) within individual AOAs in Kaba and complex Fe-Mg zoning (Fa_{50-80}) of individual ferrous olivines in MET00430 probably reflect fluctuations of fluid compositions on a local scale.

(3) Replacement of low-Ca pyroxene by ferrous olivine is commonly observed in the CV_{oxA} and CV dark inclusions (DIs) [11, 14]. The presence of phyllosilicates coexisting with these olivines [14, 15] suggests that this process occurred in the presence of aqueous solutions: $Fe^{2+}{}_{(aq)} + MgSiO_{3(s)} + H_2O_{(l,g)} = (Fe,Mg)_2SiO_{4(s)} + H_{2(g)}$.

(4) Formation of ferrous olivine by dehydration of phyllosilicates is inferred from fibrous textures of some of the ferrous olivines in the Allende DIs [10], and from the presence of inclusions of pentlandite and poorly-graphitized carbon in the CV_{oxA} matrix olivines [16]. However, the Mg-rich compositions of phyllosilicates in CVs, the rarity of fibrous olivines, and the lack of O-isotopic evidence for extensive hydration-dehydration of CVs [17] suggest that a direct substitution of olivine for phyllosilicates has played a minor role in the origin of ferrous olivine. Growth of ferrous olivine in the presence of fluid released during dehydration of CVs seems more likely.

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