MORE EVIDENCE OF THE IMPORTANCE OF AMORPHOUS SILICATES IN CM CARBONACEOUS CHONDRITES: NEW OBSERVATIONS FROM A FINE-GRAINED RIM IN THE CM2 CHONDRITE, TIL91722

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Introduction: A major component of the fine-grained matrices of CM, CR, CO and UOC chondrites consists of an amorphous silicate material [1-5]. Understanding the primary characteristics and response of this material to aqueous alteration are essential to unraveling the history of the fine-grained components of chondritic meteorites. Here we report new observations from the TIL 91722 CM2 chondrites, that based on its modal abundance of Fe, Ni metal, has an alteration grade of ~2.7 [6] and hence has experienced relatively limited aqueous alteration. Two focused ion beam (FIB) sections were extracted from a fine-grained rim surrounding a type IA chondrule in TIL 91722 and studied using TEM and Fe-edge Scanning Transmission X-ray Microscopy (STXM)-based XANES.

Results Both FIB sections are dominated by distinct, irregular-shaped regions of amorphous silicate that range in size from <0.2 µm to ~3 µm. Embedded within the amorphous silicate are Fe and Fe,Ni sulfide grains that range from <50 nm to ~ 1.5 µm. There is little or no evidence of development of fine-grained phyllosilicates within the amorphous silicate regions; however, pockets of coarser-grained phyllosilicates do occur locally. The boundaries between the regions of amorphous silicates are defined by a continuous network of nanophase Fe-oxyhydroxide. Several unaltered grains of crystalline silicate grains, including grains of forsterite, LIME olivines and twinned clinoenstatite, also occur within the FIB sections. Fe-XANES data show that the amorphous silicate and surrounding Fe-oxyhydroxide both have very high $Fe^{3+}/\sum Fe$ ratios, between 0.7 and 0.8.

Discussion: Although CM chondrites are commonly considered to have a matrix that consists of fine-grained phyllosilicates, this is the third CM chondrite [2,5] which, based on TEM studies has a matrix dominated by amorphous silicate, providing further support for recent XRD results [7]. Based on its high $Fe^{3+}/\sum Fe$ ratio, we infer that the amorphous material has undergone oxidation coupled with hydration (serpentinization) which was coupled to rapid outgassing of H_2 [8]. The presence Fe-oxyhydroxides indicates that oxidation of TIL 97122 matrix was more extensive than in the CR chondrites, perhaps as result of higher temperatures or longer duration alteration. However, temperatures were clearly not high enough to drive recrystallization of the hydrated amorphous material to form phyllosilicates.

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