NORTHWEST AFRICA (NWA) 8785, AN EL3 CHONDRITE WITH FEO-RICH MATRIX.

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Introduction: The enstatite (E) chondrites are enigmatic but important for understanding the evolution of the terrestrial planets. They have highly reduced mineral assemblages in which enstatite (near pure in composition) is the dominant silicate, metal is abundant and has >2.5 wt. % Si in some EH3s, elements that are generally lithophile in most chondrites occur as sulfide and some E3s contain nitrides and carbides [1,2,3]. Notably, stable isotope compositions are similar to the Earth-Moon [4,5,6]. Aside from E chondrite clasts in the Kaidun breccia [7,8], the enstatite chondrites are dry, lacking evidence of hydrous minerals, distinguishing them from most other chondrite groups and suggesting they formed relatively close to the sun, inside of the snow line. Compared to other chondrite groups, the E3s are also matrix-poor, with EH3s having ~4-12 vol. % and EL3s ≤5 vol % matrix [9,10]. Here we present a study of NWA 8785, a remarkable new EL3 chondrite with abundant, potentially altered FeO-rich, fine-grained matrix. Our goals are to understand E chondrite matrix and the evolution and alteration history of the EL3 parent body.

Results: NWA 8785 was studied in polished sections. It contains (in vol. %) sharply bound chondrules (45.9%), metal/sulfide-rich nodules (9.8%), mineral and lithic fragments (10.6%) and rare refractory inclusions all surrounded by a fine-grained FeO-rich matrix (33.7%) (Fig. 1a); the highest matrix abundance known among EL3 chondrites. Chondrules range in size up to 2mm with most 500-700µm, close to the mean EL3 chondrule size of 520µm [11]. All chondrule textures are present but are dominantly pyroxene-rich (PP and RP) varieties. The metal-rich nodules in NWA 8785, common in all EL3s [12, 13], are unlike those in other EL3 chondrites. They contain enstatite, silica, graphite and sulfides as in other EL3s but are texturally, and in some cases mineralogically, different; intergrowths of enstatite laths characteristic of nodules in other EL3s are less common, suggesting a different origin for the NWA 8785 nodules. Matrix, much more abundant than in other EL3s, is littered with mineral (enstatite, Na-rich plagioclase, FeS and FeNi) and lithic (chondrule) fragments up to 50µm in size surrounded by a fine grained (submicrometer) FeO-rich mixture (Fig. 1b, c) showing variable amounts of SiO_2, MgO and FeO, likely a product of alteration. This contrasts sharply with matrix in other E3s which is composed of silica and enstatite as major components, with metal and sulfides. (TEM and XRD are underway to decipher the mineralogy of the fine-grained matrix component in NWA 8785.) Additionally, in one matrix area, a 30µm spinel-rich inclusion was found, consisting of $MgAl_2O_4$ spinel surrounded by sodalite, a common alteration product in refractory inclusions in CV chondrites.

Discussion: NWA 8785 is an unusual EL3 chondrite with an FeO-rich, fine-grained matrix unlike matrix found in other E3 chondrite, except for the E3 clasts in the Kaidun breccia which show various degrees of aqueous alteration [8]. The NWA 8785 matrix, more abundant than in other EL3s, may have been the carrier of ices that accreted to the parent body, resulting in alteration. Further study of this altered material and alteration fluids may advance our understanding of the proposed E chondrite - Earth-Moon relationship.

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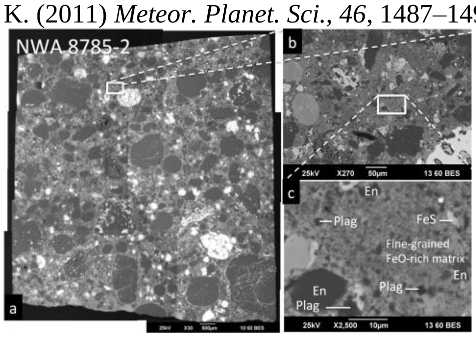

Fig. 1. Backscattered electron images of section NWA 8785-2 (a) whole PTS showing chondrules dominated by enstatite (dark grey), metal-rich nodules (white) and the fine-grained FeO-rich matrix (medium grey). (b) Enlargement of the area outlined in (a) showing the matrix which is littered with mineral and lithic fragments up to 50 µm in size. (c) Enlargement of the area outlined in (b) showing the FeO-rich fine-grained matrix with enstatite (En), Na-rich plagioclase (plag), FeS grains ranging from about 1-10 µm in the size. The fine-grained areas shows variable amounts of FeO, SiO_2, MgO.