A petrologic study of metal-rich nodules in anomalous EL3 meteorite Northwest Africa (NWA) 8785


1Dept. Geology, Mount Holyoke College, South Hadley, MA 01075 (rindl22m@mtholyoke.edu).
2Dept. Physical Sci., Kingsborough College CUNY, Brooklyn, NY 11235.
3Dept. Earth and Environmental Sci., CUNY Graduate Center, New York, NY 10016.

INTRODUCTION: NWA 8785 is a remarkable, recently identified unequilibrated enstatite chondrite. It was classified as an EL3 based on the Si content in the metal and the presence of ferroan alabandite [1], but contains unusual characteristics unobserved in other EL3s. For example, it has high abundance of FeO-rich (magnentite-bearing) matrix (34% by area) [2]. Our aim is to study the mineral assemblages and compositions in metal-rich nodules in this anomalous EL3 chondrite and to compare them to nodules in other EL3s. The goals are to evaluate formation of metal-rich nodules in EL3 chondrites, identity primary phases and any evidence of secondary alteration to gain insight into secondary processes on the EL3 parent body asteroid. Most notable in NWA 8785 is the abundance of the rare mineral roedderite (NaK(Mg,Fe)SiO3), an alkali-rich silicate that may reveal more about the meteorite’s origin and evolution.

METHODS: Polished thin section NWA 8785-2 was studied using:
- Petrographic Microscope
- Hitachi S4700 FE-SEM equipped with Bruker Energy Dispersive Spectrometer (EDS) and BackScattered Electron (BSE) imaging.
- Element maps and mineral compositions were obtained using the Cameca SX100 electron probe.

RESULTS: 10 out of 40 identified metal-rich nodules in blue were studied.

TEXTURAL AND COMPOSITIONAL VARIATION OF NODES: Roedderite-Bearing Nodules: The presence of roedderite and djerfisherite in M1, M2 and M7 is significant because these minerals have been previously reported in EH chondrites [3], but not in an EL3. Additionally, the association of roedderite with djerfisherite may indicate a relationship between the two minerals.

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CONCLUSIONS: (1) NWA 8785 is an EL3 chondrite based on mineral compositions, but the abundance of matrix and presence of roedderite, djerfisherite, and a magnetite-rich matrix make it anomalous. (2) The diversity of metal-rich nodules in NWA 8785 suggests that each nodule formed independently and supports an origin by primary processes prior to accretion. Presence of roedderite, a first in EL3 meteorites, as well as the magnetite-bearing matrix, suggests the possibility of hydrothermal alteration occurring on the EL3 chondrite parent body.

Table 1: Average compositions (wt%) of metal and sulfides in NWA 8785. * indicates below detection. Values generally match the values reported by the Meteoritical Bulletin Database (2017) for NWA 8785.

Table 2: Average composition (wt%) of roedderite (NaK(Mg,Fe)SiO3) in NWA 8785 compared to that of various meteorites and terrestrial examples. (*Rambaldi et al. (1986), **Fuchs et al. (1986), ***Olsen (1967), ****Hentschel et al. (1980))