THE HEDJAZ METEORITE: REE ABUNDANCES IN CHONDRULES AND LITHIC FRAGMENTS, Keiji Misawa and Noboru Nakamura★, Department of Science of Material Differentiation, Graduate School of Science and Technology, ★also at Department of Earth Sciences, Kobe University, Nada, Kobe 657, JAPAN

During the course of the detailed and systematic investigations on REE abundances of ordinary chondrites(1), one of the authors observed a stepwisely-fractionated REE pattern with high LREE and low HREE abundances in the Hedjaz(L3-6) chondrite(2)(Fig.1, upper right). This REE pattern is rather similar to that of the Allende carbonaceous chondrite(3). We therefore considered that the LREE excess is due to the addition of highly fractionated REE objects such as CAIs commonly observed in carbonaceous chondrites. In order to identify such objects, constituent components (chondrules and lithic fragments) separated from the Hedjaz were precisely analyzed for REE, Ba, Sr, Rb, K, Ca and Mg by mass spectrometric isotope dilution technique(4). Textures of chondrules and fragments were examined optically in thin sections and the constituent minerals were analyzed by EPMA.

CHONDRULES Three chondrules were studied. One has the radiating texture with low-Ca pyroxene(Px) + olivine(Ol)(Fa23) + glass(Gl). Another has the porphyritic texture with low-Ca Px + Ol(Fa23) + Gl. The third was too small to prepare a thin section and thus petrographic information about this chondrule is not available. REE abundance patterns of chondrules are generally flat. But in detail, minor Eu, Ce and Yb irregularities and LREE/HREE fractionation are observed (Fig.2). The Hedjaz chondrules are about two-fold enriched in K, Rb and Ca relative to CI, differing from the Tieschitz chondrules which are enriched in Sr and depleted in K and Rb relative to CI(5). These chemical characteristics in Hedjaz chondrules rather resemble to that of Allende chondrules(4).

LITHIC FRAGMENTS Light-colored fragment I has a igneous texture consisting of euhedral Ol(Fa23) and subhedral Ca-rich Px (Wo14En70Fs16) and interstitial plagioclase(Pl)(An83). Ol crystals are fractured and exhibit undulant extinction. These features indicate that the fragment has suffered a strong shock. Adjacent to this portion with euhedral Ol, there is an area containing elongated (~1mm in length) skeletal Ol and more abundant Ca-rich Px and Pl. Accessory whitlockite associated with interstitial Pl was found in this area. Light-colored fragment II consists of anhedral low-Ca Px(Fs16) and contains branching shock veins and numerous submicron-sized glass inclusions. In Fig.3, REE patterns of small splits (~100μg) of fragment I and bulk sample of fragment II (~1mg) are shown. Although the magnitude of positive Eu anomaly and degree of REE fractionation are different among the sampling portions, the REE patterns of fragment I are consistent with the textural features suggesting that this fragment represent a cumulate rock and solid/liquid fractionation took place during the crystallization. In spite of low refractory lithophile element abundance, enrichment of relatively volatile REE (Ce, Eu and Yb) and LREE compared to HREE in fragment II suggests that REE carriers of this fragment are condensates from the volatilized gas.

INCLUSION During analyses of fragment I, we found an unusual REE component which shows highly fractionated Group II REE pattern (Fig.1). This is the first occurrence of Group II object in L-group chondrites, and substantiate previous analyses for the bulk meteorite(2). Additional analyses of the trace elements and examinations for the thin section fail to confirm such a highly fractionated REE carrier. Thus, it is suggested that the refractory component(s) enriched in highly fractionated REE exists

Misawa, K and Nakamura, N

heterogeneously within the Hedjaz meteorite.

Acknowledgement: We are grateful to Dr. P.Pellas, Paris, for the Hedjaz samples.

References: (1)N. Nakamura (1975) PhD Thesis. Univ. of Tokyo (2)F. Kraut & K. Fredriksson (1971) Meteoritics 6, 284., K. Fredriksson et al.(1986) Meteoritics 21, 159.(3)A. Masuda et al.(1973) Geochim. Cosmochim. Acta 37, 239. (4)K. Misawa & N. Nakamura (1986) LPS XVII, 551. (5)H. Nagamoto et al.(1987) in this volume.

Fig.1 Chondrite normalized REE abundance patterns for bulk Hedjaz and Hedjaz inclusion. The inclusion contains 263ppm of K, 1.31ppm of Rb, 22.1ppm of Sr, 1.36% of Ca and 18.6% of Mg.

Fig.2 Chondrite normalized REE abundance patterns for Hedjaz lithic fragments, I and II.

Fig.3 Chondrite normalized REE abundance patterns for Hedjaz chondrules.

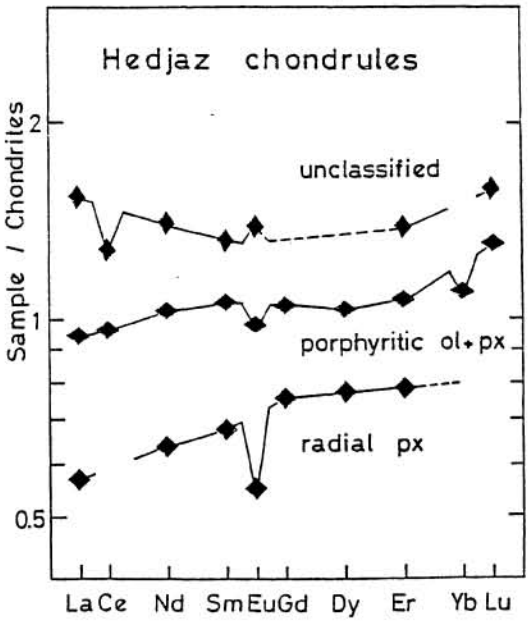

Fig. 2