NWA 7188 EUCRITE: PETROLOGY, CHEMICAL COMPOSITIONS AND EVOLUTION HISTORY.

Shaofan Che[1], Qi He[1] and Long Xiao[1] [1]Planetary Science Institute, Department of Earth Sciences, China University of Geosciences, Wuhan.

Introduction: Eucrites are differentiated achondrites and share a common provenance with howardites and diogenites. Homogenous oxygen isotopic compositions of "HED" group (Δ17O= -0.25 ± 0.05‰) [1,2,3] suggest an origin from a same parent body, and this homogenization of oxygen isotopes was a consequence of high degrees of partial melting. Researches into this unique asteroid will provide a profound insight into the formation and evolution of terrestrial planets, especially Earth. This work focuses on the petrographic description and geochemical analysis of an eucrite from Northwest Africa, NWA 7188. Also provided is an outline of the geological settings involved in its formation.

Results: Two texturally differnent parts are recognized: the main part with gabbro texture and the clasts with ophitic to sub-ophitic texture. Exsolved lamellae exist in both parts, yet with different width and density. Tiny pieces of metallic minerals exsolve in some of pyroxene grains forming the clouding texture. Rims of some pyroxenes suffered recrystallization due to post-metamorphism resulting in 120 ° junction between grain boundaries. Melt inclusions composed of pyroxene, chromite and SiO2 have been recognized within pyroxene grains. Such a composition demonstrate that these melt inclusions previously were residual melt enclosed by pyroxenes. Similar melt inclusions enclosed in pyroxenes seen in the main part were also found in calsts, through the metal compound in the melt inclusions is troilite not chromite. Rims of clasts are obscure or even transitional between clasts and the main part due to thermometamorphism. A clast with a complex poikilitic texture caught our attention (**Fig. 1**). Assembalges of pyroxenes, oriented plagioclases, ilmenites and silica are enclosed in a large pyroxene grain. Such a mineral assemblage present a sharp and straight boundary with the host pyroxene. Major-element compositions of minerals were determined using the electron microprobe. Compositions of pyroxenes and plagioclases are consistent between the main part and clasts (**Fig. 2**).

Classification: Textures and chemical compositions, especially pyroxene Fe-Mn co-variations confirm its classification as an ordinary eucrite. The application of widely used pyroxene Mn/Fe ratio plot [4] was revised in this work. The Mn/Fe ratio plot yeilds large uncertainties when applied to equilibried achondrites. That is, we would probably obtain a compositional region, not a single line. Overlapping between adjacent regions, especially those with approximate ratios, will ineluctably casuses confusions. The Mn/Fe ratio, therefore, need to be combined with other classification factors in order to acquire tenable results.

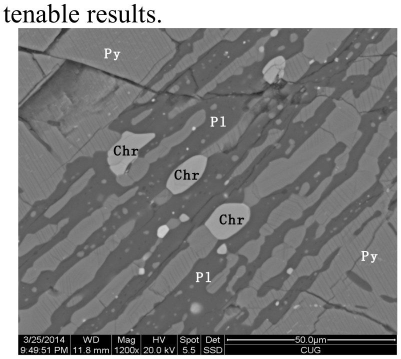

Fig 1: A special clasr with bar-shape texture, the mineral assemblage is composed of pyroxene (Py), plagioclase (Pl) and chromite (Chr).

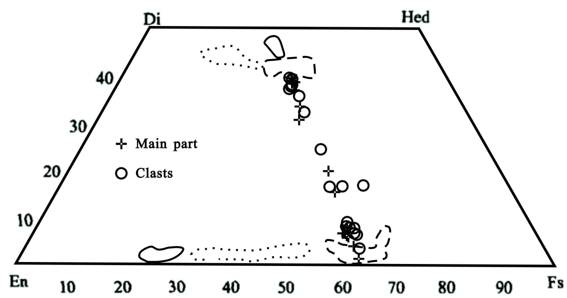

Fig 2: Pyroxene quadrilateral for NWA 7188.Ranges of diogenites (line), cumulate eucrites (dotted line) and ordinary eucrites (dashed line) after [7]. Plots outside the restricted areas are due to the relatively larger laser beam than the width of lamellae.

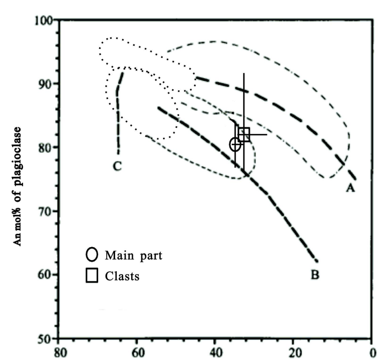

Fig 3: Hypothetical crystallization trends of HED meteorites plotted in an An vs. En diagram (Takeda, 1997).

Discussion: Two-pyroxene geothermometry [5] yields a small difference between crystallization and equilibration temperatures, (i.e. crystallized at about 1050℃ and reached equilibrium at about 900℃) indicating a rather short metamorphic period. Based on petrological and geochemical analyses, separate evolution processes for the two different parts were concluded. The clasts formed ahead of the main part, and were subjected to short metamorphism caused by overlying magma lavas [6]. Afterwords, clasts were enclosed by ascending magma , then took position with the main part and suffered another metamorphic event which generated exsolution lamellae in the main part. The latter metamorphic event was not supposed to be very severe, because the primary exsolution textures and the width of lamellae in the clasts were preserved to some extent. Possible reasons for the compositional homogeneity between the main part and clasts are: (1) magmas from which the two parts crystallized were products of different evolution stages of the same primary magma; (2) they belonged to two separate primary magmas, but became homogeneous as a result of assimilation. However, further analysis on precise trace element compositions is needed in order to distinguish between the assumptions above. On the basis of hypothetic crystallization trends proposed by [7], both the main part and clasts approcah the Na-rich trend (Trend B). Therefore, the primitive magma of NWA 7188 was located at rather deep level of the magma ocean, which was the cause for the richness of volatile sodium in plagioclase. The minute difference of Na contents between the two parts can also be explained that the earlier emplacement of the primitive magma of clasts brought about longer vaporization, thus lower Na content.

References:

[1] Clayton, R. N., Onuma, N., & Mayeda, T. K. (1976) *EPSL, 30(1),* 10-18.

[2] Clayton, R. N., & Mayeda, T. K. (1996) *GCA, 60(11),* 1999-2017.

[3] Wiechert, U. H., Halliday, A. N., Palme, H., & Rumble, D. (2004) *EPSL, 221(1),* 373-382.

[4] Papike, J. J., Karner, J. M., & Shearer, C. K. (2003) *American Mineralogist, 88(2-3),* 469-472.

[5] Lindsley, D. H., & Andersen, D. J. (1983) *JGR: Solid Earth (1978 –2012), 88(S02),* A887-A906.

[6] Yamaguchi, A., Taylor, G. J., & Keil, K. (1996) *Icarus, 124(1),* 97-112.

[7] Takeda, H. (1997) *Meteoritics & Planet. Sci*, *32(6),* 841-853.