

CLAST SELECTION AND METALLOGRAPHIC COOLING RATES: INITIAL RESULTS ON TYPE 1A AND 2A MESOSIDERITES. ¹B. Baecker, ¹B. A. Cohen, ²A. E. Rubin, ^{1,3}B. Frasl and ⁴C. M. Corrigan. ¹NASA MSFC, Huntsville, AL 35812. (bastian.baecker@nasa.gov). ²UAH, Huntsville, AL 35805 ; ³EPSS Department, UCLA, Los Angeles, CA 90095, USA; ⁴Smithsonian Institution, NMNH, Washington DC, 20560, USA.

Introduction: We initiated a comprehensive study [1] on selected clasts and metal of mesosiderites using SEM, electron microprobe and the complete suite of noble gases. Here we report initial results on the petrography of selected clasts and metallographic cooling rates using the central Ni method used in several publications (e.g. [2]). We focus on the approach of selecting grains in least recrystallized mesosiderites. Hence, especially (lithic) clasts in type 1A, 1B, 2A and 2B are the first choice. They provide highest primitive-ness and least annealing/metamorphism. All grains selected should be in close proximity to each other. Lithic clasts in mesosiderites are of high interest because of their igneous texture and similarity to eucrites and howardite petrography (e.g. [3]). We find pyroxenes (px) and plagioclase (plag) attached to each other which implies a common formation history. It will be interesting to see differences and similarities in their noble gas inventory (CRE ages, trapped components and closure temperature). In addition, we will investigate variations of the lithic clasts toward similar grains in the thick sections which are not igneous. Plag grains are the best bases for noble gas measurements concerning He to Ar and Ar-Ar dating since it delivers important target elements. We focus on plag grains in close contact to olivine (olv) / px grains to assess whether both grains show noble gas patterns being similar or different. Phosphate grains are suitable for Kr and Xe measurements since they yield REE abundances (target-elements).

Results: *Clover Springs* (2A) (ASU 646.1). Melt-clasts: L5d is a large low Ca-px grain (1.7x1.5 mm) and is closely surrounded by Fe-Ni metal, merrillite (M5c) and plag (L5w). All grains show multiple fractures and speckles, many filled with Fe-Ni metal, sulfides and oxides. A reaction rim around L5d is observable. Average px and plag compositions are; Fs = 28.6±3.5, Wo2-3, An93. Lithic-clasts: E18m is a plag grain located in a large lithic clast of ~6 x 3 mm. The borders between patches in this clast are irregular and intergrown. Adjacent to E18m is E18r, a low Ca-px to Ca-px grain. Average px and plag compositions are; Fs = 20.4-34.1, Wo3-28, An95.

Mount Padbury (2A) (ASU 927). Melt-Clas: E8m is a very large low Ca-px grain (4200 x 2100 μm) and is closely surrounded by Fe-Ni metal and adjacent to a plag-grain (G9m). All grains show multiple cracks and speckles, many filled with Fe-Ni metal and oxides. As observed for clover springs, the px grain exhibits a

reaction rim. Average px and plag compositions are; Fs = 22.7±0.3, Wo2-3, An90. Lithic-clast: Observable in Q17 are plag, silica, and low Ca-px grains located within a large lithic clast of ~7 x 6 mm (Fig. 1A). Average px and plag compositions are; Fs = 35.4-39.7, Wo4-40, An91.

Patwar (1A) (ASU 634-1-4). Melt-Clas: K2b is a low Ca-px grain rimmed by Fe-Ni metal. The size is ~2.5x1.5 mm. The grain exhibits multiple cracks and is appreciably porous. M4g is an euhedral to subhedral olv grain with a px-chromite corona/reaction rim. The corona seems to consist out of multiple mineral aggregates. Part of the grain seems to be resorbed at the top. Multiple small μm sized inclusions visible all over the grain. It exhibits multiple cracks. The grain is not in close contact to Fe-Ni metal. Size is ~1.8x1.4 mm. Average px, olv and plag compositions are; Fa = 32.0-36.6, Fs = 28.4±0.2, Wo3, An90. Lithic clasts: A large clast with a size of ~3.2x2.5 mm seems to be igneous and lithic (Fig. 1B). It is composed out of 2 anhedral grains which are in close contact and rimmed by Fe-Ni metal. B4m is a large plag grain; whereas D4a is a low Ca-px grain with elevated Mg content. D4a shows abundant lamellae which are probably due to exsolution and therefore characteristic for px. Both grains show multiple cracks and speckles, many filled with Fe-Ni metal and oxides. Average px and plag compositions are; Fs = 26.8-36.3, Wo5-21, An95.

Northwest Africa 1242 (1A). Melt-Clas: P14r is a large low Ca-px grain (1.2x1.0 mm) and is closely surrounded by Fe-Ni metal, merrillite (P14g) and plag - An90Ab10 (Q15g). The subangular px grain is characterized by multiple cracks, speckles, many filled with Fe-Ni metal and oxides and a reaction rim. Average px and plag compositions are; Fs = 26.5±2.5, Wo2, An91. Lithic clasts: J5h is a plag grain (550x350 μm) - An90. J5l is a silica grain (400x150 μm).

Toufassour. Melt-Clas: Toufassour overall shows a high weathering grade. Many limonite veins are observable. However, two grains (merrillite-C3h and low Ca-px-C3v) with sizes of 220x200 μm and 500x350 μm, survived. Both grains are in proximity to the for Toufassour typical large Fe-Ni grains. C3h is Ca-rich, P-rich and supposedly contains larger abundances of REE. This single grain is in close contact to the metal and not in an assemblage with other grains; i.e. px, olv or plag. [3] and references therein state that the low number of phosphorous phases in Ca-rich achondrites (i.e. HED's) is an important issue among all the simi-

larities they exhibit with MES. It seems reasonable that these phases derived from metal and not silicate phases, since the phosphate is in close contact to the metal. If we infer that most P derives from the metal rather than the silicate, we can conclude that in this case HED magmatism is similar to the mesosiderites silicate magmatism and that the metal is of different origin. Average px and plag compositions are; $F_s = 23.9 \pm 2.3$, $W_{O_3} = An_{91}$. Lithic clasts: F2l is a low Ca-px grain ($150 \times 150 \mu\text{m}$). F2h is a plag grain ($350 \times 250 \mu\text{m}$). Metamorphism and annealing is indicated by angular shaped grains. Average px and plag compositions are; $F_s = 29.9 \pm 1.1$, $W_{O_3} = An_{93}$.

Metallographic cooling rates: Many studies infer slow cooling rates for MES metal, i.e. $\sim 0.05\text{--}0.2 \text{ K/Ma}$ (e.g. [4–7]). We used central Ni measurements [2,6] in taenite to assess cooling rates for well known MES (Mount Padbury, Patwar) as well as rather un-known specimens (NWA 1242, Toufassour). In Fig. 2 we compared the results to cooling rates measured for other MES and Udei Station, an ungrouped iron meteorite from the IAB complex, which for some time was interpreted as a MES [2]. We found that for Mount Padbury and Patwar the cooling rates are in agreement with most studies and plot in the region of $\sim 0.1 \text{ K/Ma}$. However, for especially Toufassour we found cooling rates of $\sim 10 \text{ K/Ma}$ – similar to results for Udei Station [2]. More measurements have to show that the results are correct, since we performed fast Ni-measurments without complete traverses through the M-shape of taenite. Here, a geometric effect is possible. Since we took multiple spots and found that most MES agree with the literature but not Toufassour gives a hint that this MES is different. However, we emphasize, measuring metallographic cooling rates the same way in metal for MES like for irons could be misleading despite the metamorphism, brecciation and annealing history of MES.

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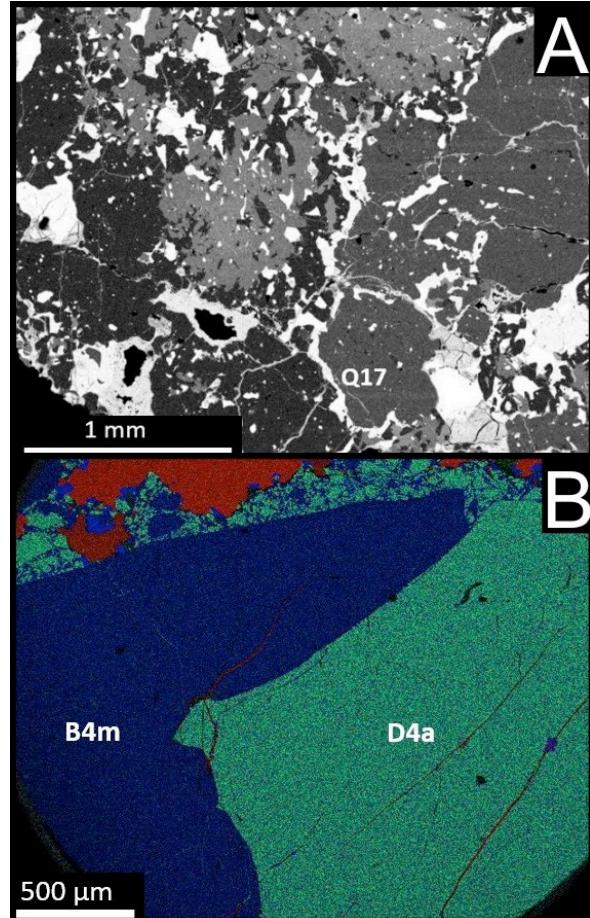


Fig.1. A) BSE image of the lithic clast Q17 in Mount Padbury showing multiple px, plag and silica grains. B) BSE image of an RGB (Fe, Mg, Si) coded area in Patwar showing a large lithic clast of intergrown Ca-px and plag.

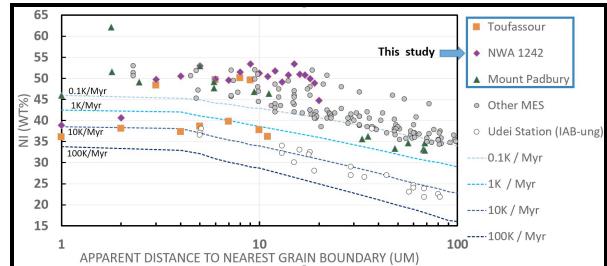


Fig.2. Ni measurements in taenite vs. the apparent distance to the nearest grain boundary of 3 MES in this study compared to MES and Udei Station data from [2] using cooling rates from [8].