CATCHING CONSTRAINS ON THE PARENT BODY GENESIS OF MESOSIDERITES AND A POSSIBLE LINK TO HED (HOWARDITE-EUCRITE-DIOGENITE) METEORITES – A NEW HOPE? B. Baecker and B. A. Cohen, NASA Marshall Space Flight Center, Huntsville, AL 35812. (bastian.baecker@nasa.gov)

Introduction: Mesosiderites (MES) are a group of enigmatic stony-iron meteorites exhibiting fragmental matrix breccias and irregular textures; e.g. [1-3]. Mesosiderites contain roughly equal volumes metal (Fe-Ni) and silicates often intimately mixed together (Fig.1). The silicates mostly consist of basaltic, gabbroic, and pyroxenitic components, and appear similar to eucrites and howardites; [4-8].

But unlike HEDs - and other differentiated parent body meteorite groups e.g. ureilites - mesosiderites contain high metal abundances. Several studies have been published to reveal the processes leading to the formation of mesosiderites and attempt to classifiy them [1], [2], [10-15]. Because the silicate inclusions in mesosiderites are often stronglymetamorphosed after formation, it is difficult to assess the origin of the silicates and implications for the differentiation process of their parent body [15-17]. Several workers have advanced a formation hypothesis for the mesosiderites where an impact between differentiated bodies occurred prior to 4.47 Ga ago (e.g. [13,18], which could explain the possible incomplete dispersal of the colliding bodies due to their low cosmic ray exposure ages and their special thermal history.

However, [13] discuss and favor the model for formation of mesosiderites with the collision of two differentiated bodies, along with disruption events and gravitational re-assembly. The mesosiderites have numerous gabbroid melt clasts with anomalous rare-earth-element (REE) - especially positive Eu - values [19, 20]. HEDs do not show the same. However, the heating mechanisms of both mesosiderites and HED's are puzzling.

Mesosiderites are remarkable, they consist of a mix of basalts, which are only found on or near planetary surfaces and undifferentiated metal [1,2]. The probable model is that an asteroid containing a metallic magma impacted onto a second asteroid covered with basalt [18,21]. The mix was then buried under an insulating regolith, and cooled slowly. During cooling and at low temperatures the redox reactions continued to occur and proceed (J.T. Wasson; in pers. comm. 2015).

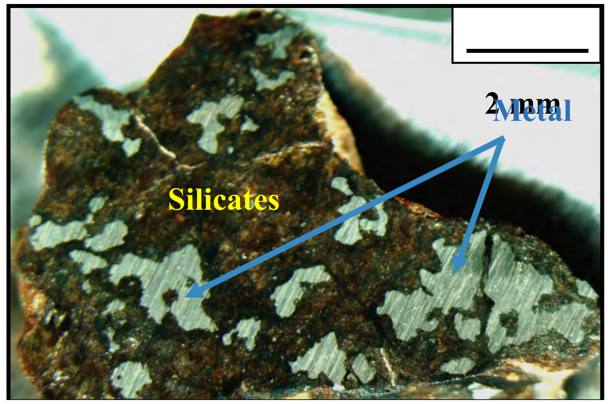

Fig.1. The type A1 MES Toufassour. Well visible are the abundant silicate and metal phases which seem to have an interstitial character.

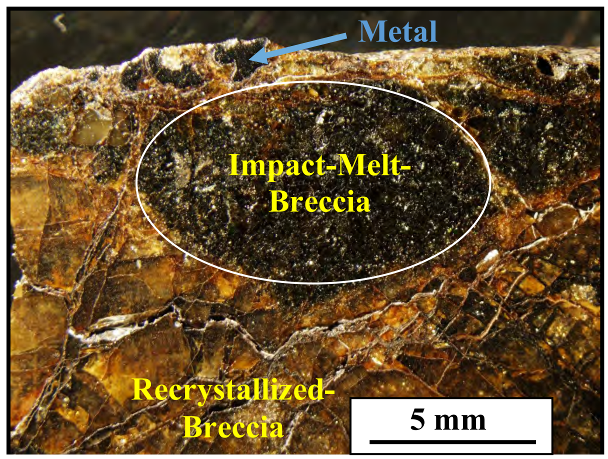

Fig.2: The higly metamorphized and recrystallized brecciated silicates of the Bondoc mesosiderite (Type B4). Metal inclusions are observable at the top.

Furthermore, [22] argued that published cooling rates on mesosiderites (e.g. [23]), at 0.2 K/Ma, are unrealistically low. Mesosiderite silicate inclusions have been dated using the Ar-Ar system to around 4.0 Ga. But their metallographic cooling rates are very slow ([18] and [23,24]). [26] argue that the relatively slow metallographic cooling rates of mesosiderites are in agreement with slow cooling of a large parent body to the closure temperature of Ar ~3.6 Ga ago. This raises the question, do the Ar-Ar ages give a closure temperature or could they be the result of later impacts? We will attempt to assess this question during this research.

Beside widely well observed and characterized MES silicate inclusions, the systematic research on the noble gas inventory along with the parent body history of mesosiderites is so far underrepresented. The noble gas compilation of [27] shows He to Ar data on 23 mesosiderites, but, however, it is lacking on Kr and Xe data. [28] report 37 mesosiderites in 2014. More efforts are needed to reveal the history of the brecciated nature of mesosiderites.

Hence, an important and still unresolved question and the main goal of this research is the parentage of mesosiderites and (as a second step) a possible link to the formation HEDs (e.g [8,19]). Several studies tried to enhance the knowledge concerning especially mesosiderites; e.g. [1, 11-13, 20]. However, do these meteorite groups have the same parent (target) body and were they hit by a different or the same (maybe differentiated) projectile? Mesosiderites contain low primordial trapped contributions in contrast to most howardites, which often show high trapped and solar contributions (e.g. Cartwright et al., 2013).

Experimental: We are attempting to recognize and choose the least recrystallized clasts in mesosiderites (Type A1, A2, B1, B2) to perform studies on the differences between silicate and metal chronology. At this time *Toufassour* / Type A1 (Fig.1), *Northwest Africa 1242* / Type A1 and the highly weathered *Northwest Africa 8561* / Type A2 are at hand. We also picked *Bondoc,* a highly recrystallized Type B3/4 mesosiderite, to be able to compare our findings (Fig. 2).

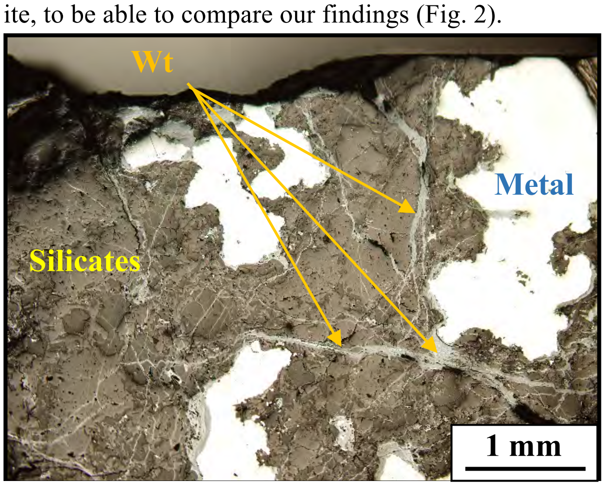

Fig.4. Reflected-light image of a part of the type A1 MES NWA 1242 in Fig. 1. Obervable are many small to large metal and brecciated silicate inclusions. The area shows abundant weathering veins (Wt) and metal overgrowths.

We will search these meteorites for clasts that consisit of orthopyroxene and plagioclase that appear to be cogenetic, or at least related to, metal blebs. We will characterize the composition and petrography of these clasts using stereo-microscopy, SEM and electron microprobe along with calculating metallographic cooling rates. We will analyze the noble-gas complement (He-Xe) of the silicate inclusions and assess Ar-Ar and cosmic-ray exposure ages using the MSFC state-of-the-art Noblesse (Nu Instruments, UK) mass spectrometer. If material allows, we will then measure Sm, Yb and Eu in the clasts to compare with HEDs. End with a hypothesis – if you see x, it means the mesosiderite clasts were y.

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