NEWS FROM THE ALMAHATA SITTA STREWN FIELD - SEVEN NEW SAMPLES: THREE UREILITES, THREE ENSTATITE CHONDRITES, AND ONE ORDINARY CHONDRITE.

A. Bischoff, A.-K. Krämer, K. I. Klemm, and S. Decker

Institut für Planetologie
Westfälische Wilhelms-Universität Münster

Address of corresponding author:

Institut für Planetologie
Wilhelm-Klemm-Str. 10
48149 Münster, Germany
E-Mail: bischoa@uni-muenster.de

WWU MÜNSTER

Introduction

After asteroid 2008 TC3 impacted Earth in 2008 many different meteorite types (achondritic and chondritic) were identified among the numerous meteorite fragments (e.g., [1-10]). Recognition of scientifically valuable samples is still ongoing [11,12]. Here, the petrography and mineralogy of 7 new samples (MS-MU-039 – MS-MU-045; Figs. 1-7) are presented.

Results – Mineralogy

The 7 new samples represent one single meteorite type (achondritic or chondritic) weighing between 2.3 g (MS-MU-045) and 7.0 g (MS-MU-041). The presence of a single meteorite type is the typical characteristic of the individual fragments, although a very interesting exception was recently described [12] showing that complex breccias also exist among the Almahata Sitta samples. However, within one of the new enstatite chondrites two different enstatitic lithologies were recognized and will be discussed below.

***E-chondrites*: The three identified enstatite chondrites are small: While two E-chondrites MS-MU-041 (7.0 g; Fig. 1) and MS-MU-044 (4.9 g) are two completely different EH_b5 chondrites (see [13] for the new classification system), the third sample MS-MU-039 (6.1 g; Figs. 2,3) is an EL_b chondrite. It consists of a small area with a well-preserved chondritic texture (El_b 3/4; Fig. 3) and a larger area with a melt texture (Fig. 2). The entire melt lithology resembles the metal-silicate-sulfide intergrowths (MSSI) that often occur as isolated nodules and aggregates in many E-chondrites (e.g., [14,15]). Metal in MS-MU-041 has concentrations of Si and Ni of ~3 and ~7.5 wt%, respectively, whereas metal within MS-MU-044 has 2.4 wt% Si and 6.8 wt% Ni. The Cr-concentration in troilite in MS-MU-041 is slightly below 2 wt%, whereas troilite in MS-MU-044 has 2.9 wt% Cr.**

***Ureilites:* MS-MU-040 (4.1 g; Fig. 5) and MS-MU-045 (2.3 g; Fig. 7) are heavily-shocked, fine-grained ureilites. MS-MU-040 olivine has Fa core contents of 15-17 mol%, while the sample MS-MU-045 has olivines with a Fa core of ~8 mol%. MS-MU-042 (5.0 g; Fig. 6) is an ureilite with a variable texture. Besides fine-grained areas, areas with relatively large olivines exist. The large olivines have cores with about 22 mol% Fa.**

***Ordinary chondrite:* MS-MU-043 (4.5 g; Fig. 4) is a H4 ordinary chondrite with equilibrated olivine ($Fa_{18.0\pm0.3}$; 20 analyses) and somewhat unequilibrated low-Ca pyroxene ($Fs_{14.0\pm4.8}$; range: 5.0-21.3 mol% Fs; 19 analyses). Based on the occurrence of shock-darkened, olivine-rich fragments the rock is brecciated.**

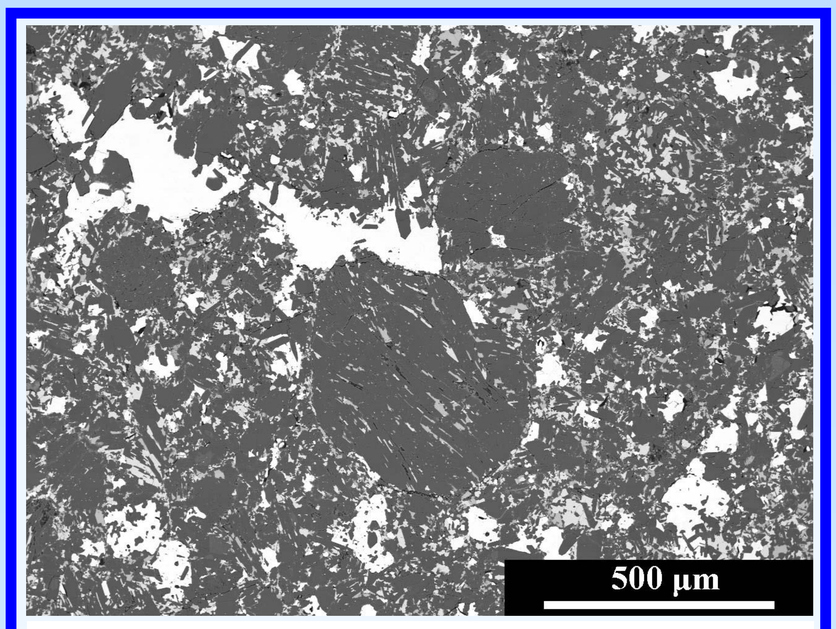

Fig. 1: MS-MU-041 is an EH_b5 chondrite with some relict chondrules; BSE-image.

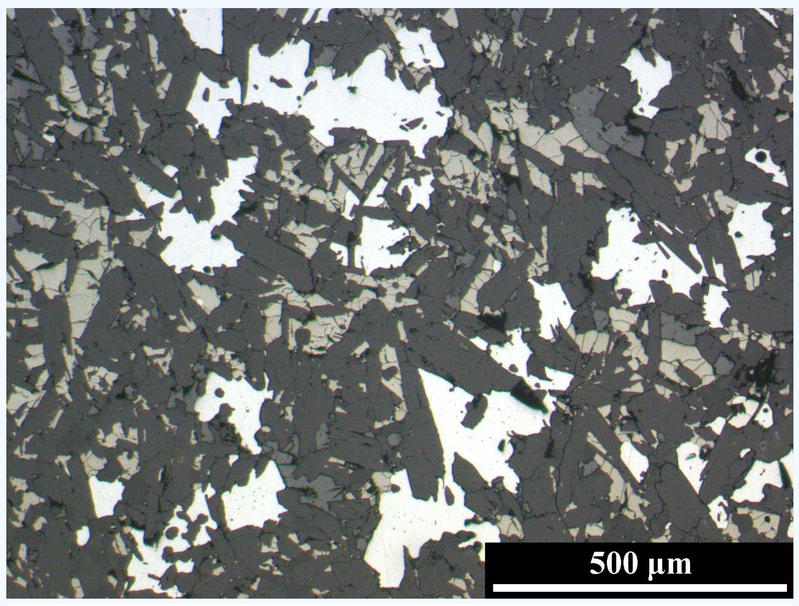

Fig. 2: MS-MU-039 (El_b-chondrite): Main area showing a melt texture with abundant enstatite laths; optical photomicrograph, reflected light.

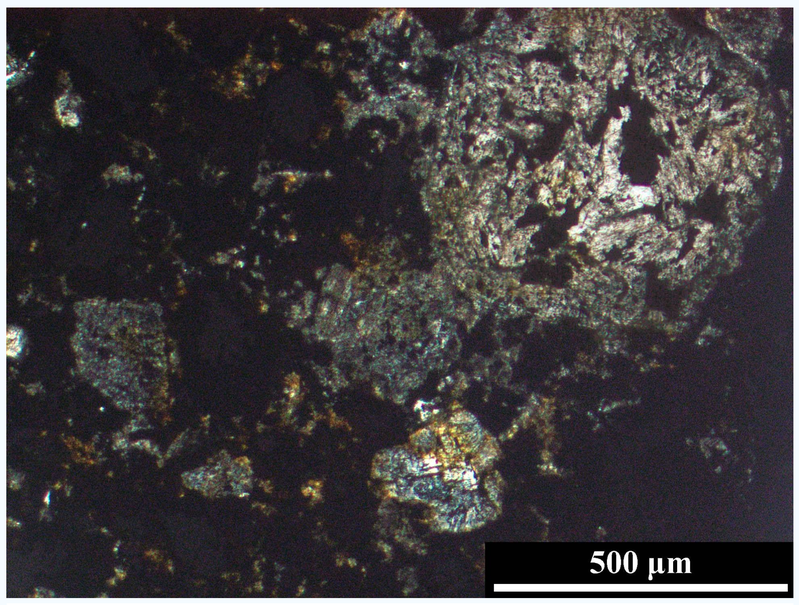

Fig. 3: MS-MU-039: Chondritic portion of the EL_b-chondrite shown in Fig. 2; optical photomicrograph.

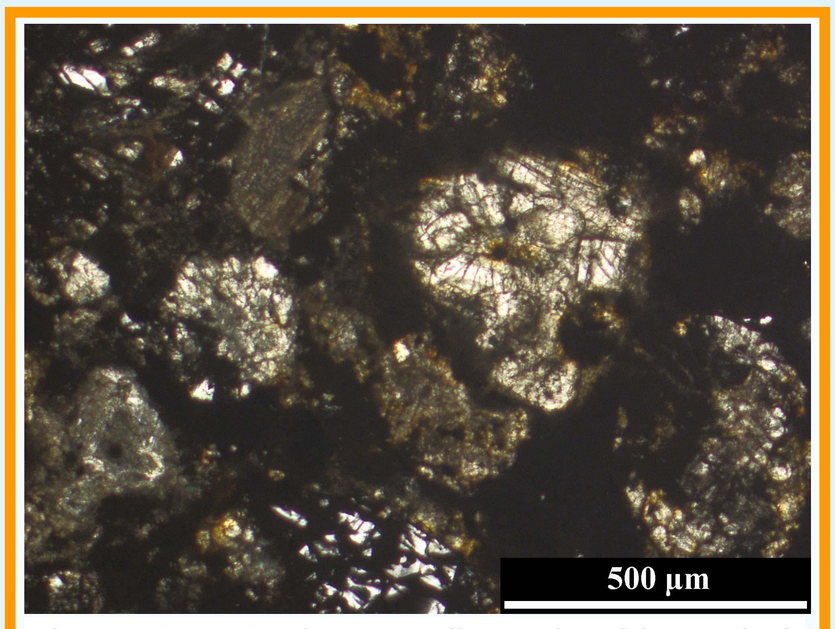

Fig. 4: MS-MU-043 is a H4 ordinary chondrite; optical photomicrograph.

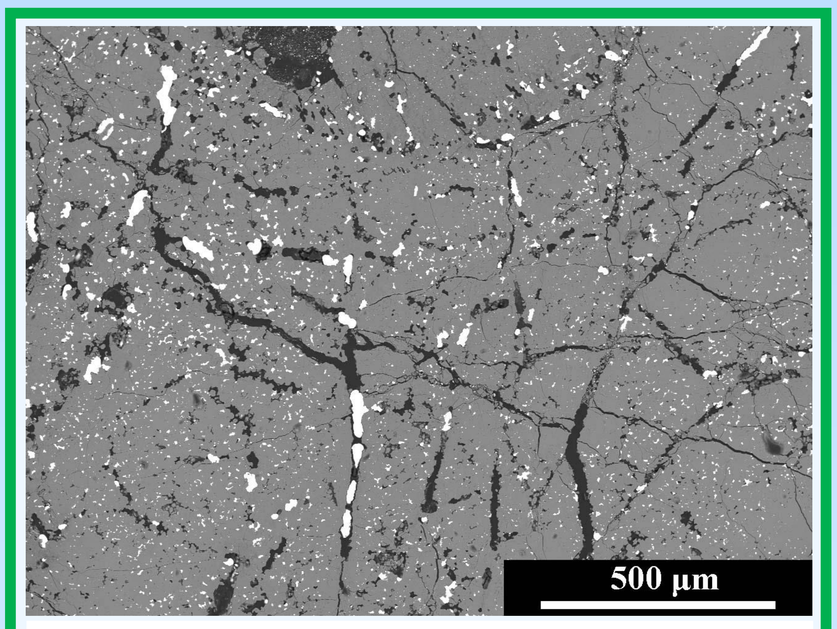

Fig. 5: MS-MU-040 is a heavily-shocked, fine-grained ureilite; BSE-image.

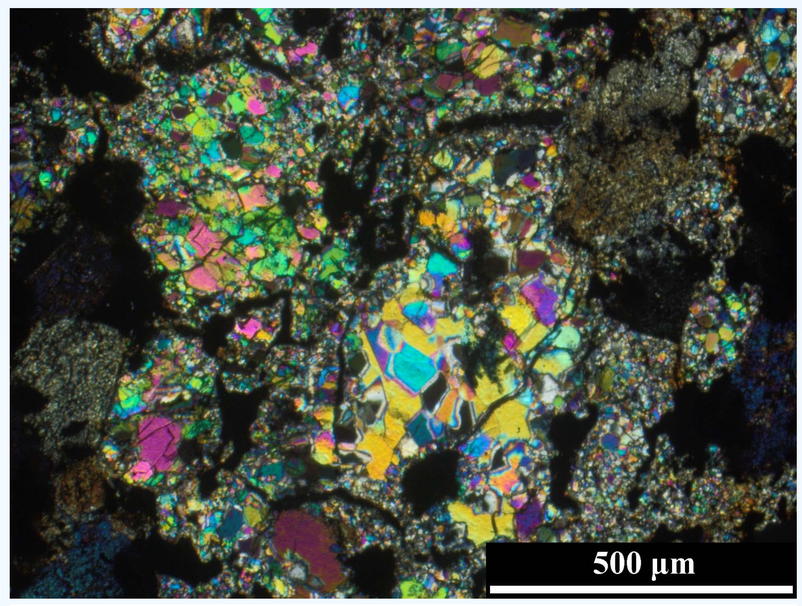

Fig. 6: MS-MU-042: Ureilite with an unusual texture showing distinct areas with different grain-sizes; optical photomicrograph, polarized light.

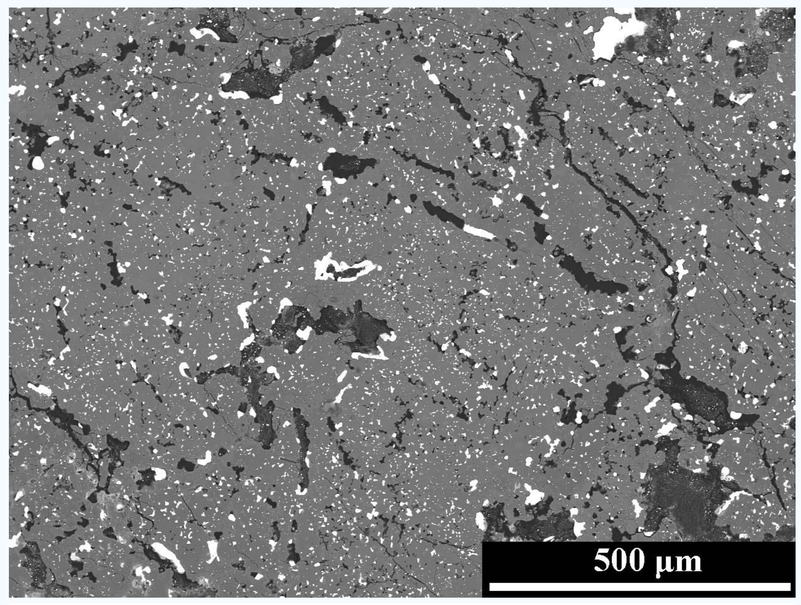

Fig. 7: MS-MU-045 is a heavily-shocked, fine-grained ureilite; BSE-image.

Conclusions

Again, very valuable meteorite samples from the Almahata Sitta strewn field are available for scientific work. The finding of a large melt lithology resembling MSSI in other E-chondrites may support the results of [14] that the MSSI nodules formed pre-accretionary as melts rather than being condensates [15]. Every new sample confirms the importance and peculiarity of asteroid 2008 TC3 considering mixing of meteoritic materials and regolith processing.

References:[1] Jenniskens P. et al. (2009) *Nature* 458:485-488. [2] Bischoff A. et al. (2010) *Meteoritics & Planet. Sci.* 45:1638-1656. [3] Horstmann M. and Bischoff A. (2014) *Chemie der Erde – Geochemistry.* 74:149-184. [4] Goodrich C.A. et al. (2014) *Elements* 10:31-37. [5] Bischoff A. et al. (2012) *Meteoritics & Planet. Sci.* 47:A71. [6] Horstmann M. et al. (2010) *Meteoritics & Planet. Sci.* 45:1657-1667. [7] Zolensky M.E. et al. (2010) *Meteoritics & Planet. Sci.* 45:1618-1637. [8] Horstmann M. et al. (2012) *Meteoritics & Planet. Sci.* 47:A193. [9] Bischoff A. et al. (2014) *Proceed. National Academy Sciences* 111:12689-12692. [10] Bischoff A. et al. (2015) *Meteoritics & Planet. Sci.* 50:#5092. [11] Fioretti A.M. et al. (2017) *Lunar Planet. Sci.* 48:#1846. [12] Goodrich C.A. et al. (2018) *Lunar Planet. Sci.* 49:#1321. [13] Weyrauch M. et al. (2018) *Meteoritics & Planet. Sci.* 53:394-415. [14] Horstmann M. et al. (2014) *Geochim. Cosmochim. Acta* 140:720-744. [15] El Goresy A. et al. (2012) *Meteoritics & Planet. Sci.* 47:A125.