CHARACTERIZATION OF SPECTACULAR LITHOLOGIES FROM THE ALMAHATA SITTA BRECCIA: M. Horstmann and A. Bischoff, Institut für Planetologie, Wilhelm-Klemm-Str. 10, D-48149 Münster, Germany (e-mail: marianhorstmann@uni-muenster.de).

Introduction: October 7, 2008, the asteroid 2008 TC_3 detected in space impacted the Earth in the Nubian Desert of northern Sudan. Several hundred of mostly small meteorite fragments were recovered and the meteorite called Almahata Sitta was classified as a polymict ureilite [1]. In a detailed study more than 30 small pieces from different fresh fragments collected within the Almahata Sitta strewn field were investigated and about 20 different lithologies were found. Based on these findings and on studies of short-lived radionuclides Bischoff et al. [2] suggest that Almahata Sitta is not only a ureilitic meteorite, but a spectacular breccia containing clasts of chondritic and achondritic lithologies.

Results: The mineralogy and texture of the fragments were studied by light and electron optical microscopy. A JEOL 6610-LV electron microscope was used to resolve the fine-grained textures and to analyse the mineral constituents using the EDS attached (INCA; Oxford Instruments).

Besides the occurrence of abundant different coarse-grained and fine-grained ureilitic lithologies in Almahata Sitta, so far, 13 chondritic fragments were identified [2]. Here, we report on the mineralogical characteristics of some of these different chondritic lithologies and on a niningerite-bearing ureilitic fragment.

Unique chondrite (MS-CH): This is a type 3.8±0.1 chondrite with a chondrule/matrix ratio of about 1.5 (Fig. 1a). Olivine is mainly Fa_{35-37}, some more Fo-rich grains (up to Fo_{81}) have been observed. The low-Ca pyroxenes are variable in composition Fs_{3-26}. The rock has a considerable abundance of mainly Ni-rich metal (Ni: ~38.5 wt%; Co: ~2 wt%) and minor kamacite (Ni: ~6 wt%; Co: ~1.5 wt%) ruling out a relationship to CK- and R-chondrites, which also have similar high Fa-values in olivine.

EL3/4-chondrite (MS-17): This is an unequilibrated enstatite chondrite (Fig. 1b) having abundant chondrules (some have minor forsteritic olivine). The enstatites contain minor, but variable Fe-contents (Fs_{0-1}). The metals have Si-, Co-, and Ni-concentrations of about 0.5, 0.7, and 6.3 wt%, respectively. Other phases include Ca-pyroxene, plagioclase, an SiO_2-phase, graphite, alabandite, oldhamite, and troilite.

EL6-chondrite breccia (MS-D): The rock is a highly recrystallized enstatite breccia with several clasts up to 5 mm (Fig. 1c). Some of these clasts contain significant abundances of Ca-pyroxene. The metals have Si-, Co-, and Ni-concentrations of about 0.9, 0.5, and 5.5 wt%, respectively. Other phases include plagioclase, troilite, oldhamite, Zn-bearing alabandite, and keilite.

Shock-darkened EH4/5-chondrite (MS-13; Fig. 1d): Most enstatites have small, but significant Fs-contents (up to 1.6 mol%). The metals have Si-, Co-, and Ni-concentrations of about 2.7, 0.7, and 5.5 wt%, respectively. Other phases include plagioclase, niningerite, troilite, oldhamite, graphite, and an SiO_2-rich phase.

EH3 chondrite (MS-14, Fig: 1e): This pyroxene-rich chondrite with abundant metal has highly variable compositions of low-Ca pyroxene ($Fs_{0.2-13}$; mean $Fs_{3\pm4}$) and also contains minor forsteritic olivine. The metals have Si-, Co-, and Ni-concentrations of about 3.1, 0.7, and 4.2 (range: 3.2-6.5) wt%, respectively. Other phases include plagioclase, an SiO_2-phase, perryite, schreibersite, daubreelite, oldhamite, troilite, niningerite.

Niningerite-bearing, fine-grained ureilite (MS-165; Fig. 1f): Within this fragment dominated by fine-grained ureilitic lithologies an area was identified, which contains abundant niningerite and metals that have compositions (Ni: ~3.5 wt%, Si: ~4.4 wt%; Co: ~0.3 wt%) similar to those in EH-chondrites. As additional phases low-Ca pyroxene (up to En_{99}), Cr-bearing troilite, and an SiO_2-phase were found.

Discussion: We are convinced that most if not all different lithologies belong to the Almahata Sitta meteorite fall. The main reasons for this conclusion are given by [2]. The niningerite-bearing fragment may be a link between the most abundant ureilitic and enstatite chondritic lithologies within this polymict breccia. Thus, after the polymict breccia Kaidun [3] Almahata Sitta is a new extraordinary breccia for future studies on the complex evolution of small asteroidal planetesimals.

References:

[1] Jenniskens P. et al. (2009) *Nature, 458,* 485-488. [2] Bischoff A. et al. (2010) *LPSC* 41, #1763*, this issue*. [3] Zolensky M. and Ivanov A. (2003) *Chem. Erde 63*, 185-246.

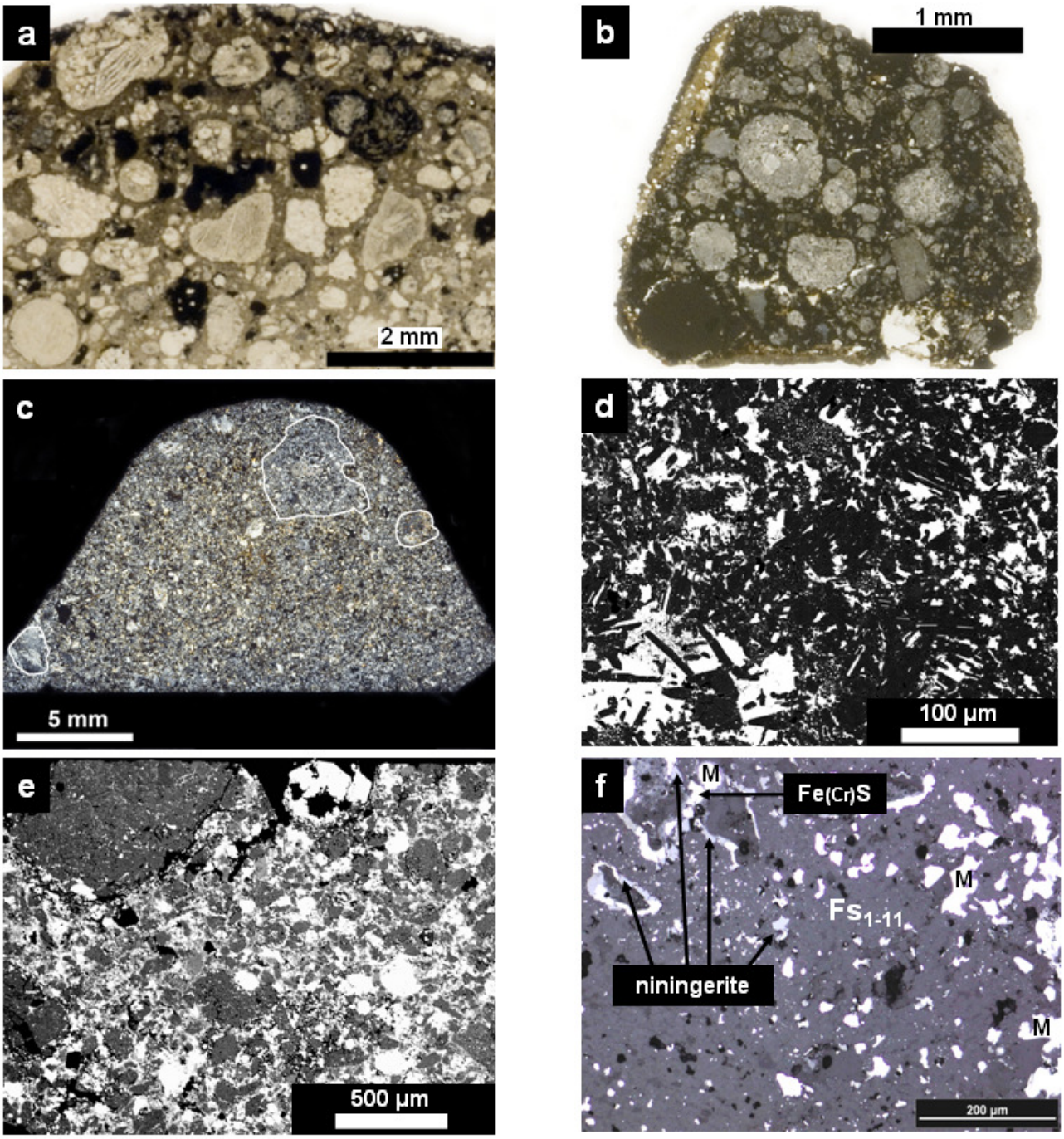

Figure 1: Optical photomicrographs in transmitted light of the unique chondrite (MS-CH; (a)) and the EL3/4 chondrite (MS-17; (b)); note the melt crust in the upper left of (b); (c) MS-D is an EL6 chondritic breccia. Some large fragments are indicated (transmitted light, crossed polarizers); (d) BSE image of the shock-darkened EH chondrite (MS-13); (e) BSE image of the EH3 chondrite (MS-14); (f) reflected light photomicrograph of the niningerite-bearing, fine-grained ureilitic fragment MS-165; M = metal.