ALMAHATA SITTA SAMPLE MS-MU-011: A RAPIDLY-CRYSTALLIZED BASALT FROM THE CRUST OF THE UREILITE PARENT BODY.

A. Bischoff[1], M. Horstmann[1], A. Pack[2], D. Herwatz[2], and S. Decker[3]. [1]Institut für Planetologie, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany. E-mail: bischoa@uni-muenster.de. [2]Universität Göttingen, Geowissenschaftliches Zentrum, Goldschmidtstr. 1, 37077 Göttingen, Germany. [3]Meteorite-Museum, Oberstr. 10a, 55430 Oberwesel, Germany.

Introduction: Ureilites are primitive achondrites whose oxygen and osmium isotopes link them to the carbonaceous chondrites [1,2]. They are interpreted to represent predominantly asteroidal mantle restites dominated by olivine and pyroxene and lack feldspar [e.g., 3,4]. Ureilite petrogenesis is poorly understood and heavily debated [e.g., 3,4]. Although minor feldspathic fragments have been reported in polymict ureilites [3,5], a fully crusted sample of the basaltic melt complementary to the mafic ureilites representing crustal material from the ureilite parent body has so far never been found. Recently, Almahata Sitta provided numerous fresh meteorite fragments including both various chondritic and achondritic (ureilitic) lithologies representing a wealth of different parent lithologies [6-9]. Among new Almahata Sitta samples one feldspar-rich fragment, MS-MU-011, was indentified. Here, first results on its mineralogy, mineral chemistry, and oxygen isotope compositions are presented.

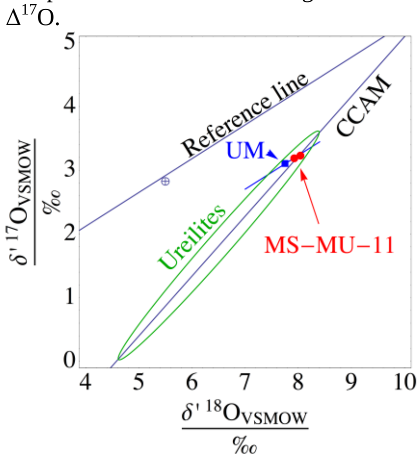
Mineralogy: Based on its greenish color the 24.2g MS-MU-011 specimen was, although having a melt crust, at first considered as a doubtful meteorite specimen. The thin section inspection revealed that it is a basalt having abundant (~60 vol%) subhedral zoned plagioclase laths (~An_{10-55}) embedding Ca-pyroxene (~$Fs_{20}Wo_{37}$) and Ca-poor pyroxene (~$Fs_{35}Wo_{8}$). In most cases the Fe/Mn ratio is 15-20. As minor phases, so far abundant euhedral Cl-apatite laths, whitlockite, ilmenite, Ti,Cr,Fe-spinel, FeS, and metals are identified. The metals are basically Ni-free. Rare pockets of fine-grained FeS-metal intergrowths (up to ~30 µm) were detected. Based on the fast cooling SiO_2-normative melt inclusions (~4.5 wt% K_2O) were formed within large crystals (e.g., pyroxene) and fine-grained intergrowths of albitic plagioclase ($An_{<10}$), skeletal pyroxene and a SiO_2-normative melt (with up to 4.5 wt% K_2O; perhaps glassy) occur in the interstices between the major minerals. Similar mineral parageneses were found by [10]. .

Oxygen Isotopes: The oxygen isotope compositions of two samples were obtained by IR laser fluorination. The results of $\delta'^{18}O$ = 8.08 ‰, $\delta'^{17}O$ = 3.23 ‰, $\Delta^{17}O$ = -1.061 ‰ and $\delta'^{18}O$ = 7.96 ‰, $\delta'^{17}O$ = 3.19 ‰, $\Delta^{17}O$ = -1.040 ‰ are clearly consistent with an ureilitic origin. The external reproducibility of the analyses is ±0.01 ‰ in $\Delta^{17}O$. The data fall on the CCAM with $\delta'^{17}O = 0.94\ \delta'^{18}O - 4.3$ ‰.

Discussion: The oxygen isotope data show that MS-MU-011 is related to ureilites. The mineralogy suggests that this is the first large sample representing the ureilite crust.

References: [1] Clayton R. N. and Mayeda T. K. 1996. *GCA* 60:1999-2017. [2] Rankenburg K. et al. 2007. *GCA* 71:2402-2413. [3] Goodrich et al. 2004. *Chemie der Erde* 64:283-327. [4] Warren et al. 2006. *GCA* 70:2104-2126. [5] Bischoff et al. 2006. *MESS II*:679-712. [6] Bischoff et al. 2010. *MAPS* 45:1638-1656. [7] Bischoff et al. 2012. *MAPS* 47:A71. [8] Horstmann et al. 2010. *MAPS* 45:1657-1667. [9] Horstmann et al. 2012. *MAPS* 47:A193. [10] Cohen

Oxygen Isotopes: The oxygen isotope compositions of two samples were obtained by IR laser fluorination. The results of $\delta'^{18}O$ = 8.08 ‰, $\delta'^{17}O$ = 3.23 ‰, $\Delta^{17}O$ = -1.061 ‰ and $\delta'^{18}O$ = 7.96 ‰, $\delta'^{17}O$ = 3.19 ‰, $\Delta^{17}O$ = -1.040 ‰ are clearly consistent with an ureilitic origin. We report our data relative to a reference line that passes through the origin (VSMOW) with a slope of 0.5305. The external reproducibility of the analyses is ±0.01 ‰ in $\Delta^{17}O$. The data fall on the CCAM with $\delta'^{17}O = 0.94\ \delta'^{18}O - 4.3$ ‰. The depleted mantle from which MS-HU-011 was extracted had a composition with $\delta'^{18}O$ being ~0.15 ‰ lighter with identical $\Delta^{17}O$.



Discussions: The oxygen isotope data show that MS-MU-011 is related to ureilites. The mineralogy and chemical composition suggests that this is the first sample representing the ureilite crust. The putative corresponding residual mantle ("UM") plots toward the upper end or the ureilite field [Clayton & Mayeda, 1988; Rumble et al., 2010]. The $\Delta^{17}O$ of –1 ‰ coincides with the majority of ureilites recovered from the Almahata Sitta strew field [Rumble et al., 2010]. The relation between $\Delta^{17}O$ and Mg# in ureilites [Clayton & Mayeda, 1988; Rumble et al., 2010] suggests that the corresponding mantle olivine had fo_{78}. High degrees of partial melting suggested for ureilites would result in a crust with high MgO similar to olivine-rich komatiites. A higher FeO in the extracted melt (as compared to Earth mantle and komatiites) explains the absence of olivine in MS-MU-011.