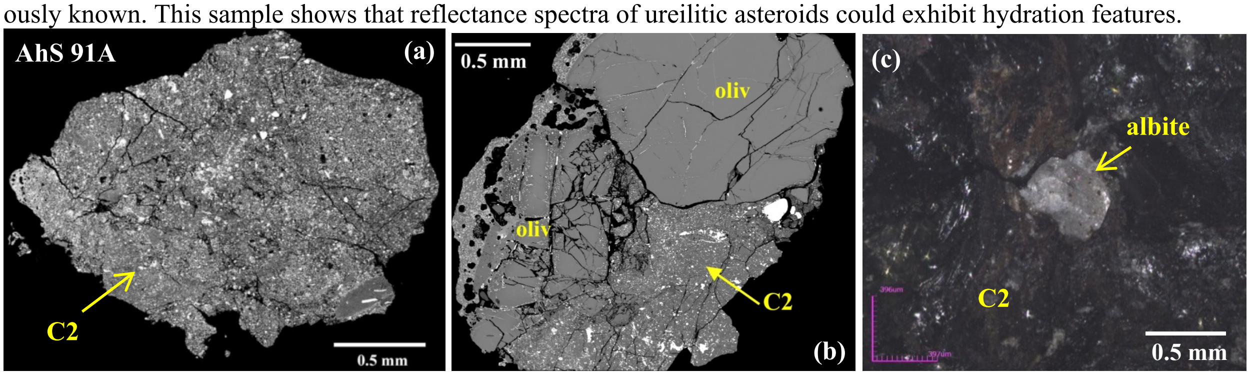
A BRECCIA OF UREILITIC AND C2 CARBONACEOUS CHONDRITE MATERIALS FROM ALMAHATA SITTA: IMPLICATIONS FOR THE REGOLITH OF UREILITIC ASTEROIDS. C.A. Goodrich[1], A. M. Fioretti[2], M. Zolensky[3], M. Fries[3], M. Shaddad[4], I. Kohl[5], E. Young[5], and P. Jenniskens[6]. [1]Lunar and Planetary Institute, Houston TX, USA (goodrich@lpi.usra.edu); [2]CNR – Istituto di Geoscienze e Georisorse, Padova, Italy; [3]ARES, NASA JSC, Houston TX, USA; [4]Dept. Physics, Univ. of Khartoum, Khartoum, Sudan; [5]Dept. Earth and Planet. Sci., UCLA, Los Angeles CA, USA. [6]SETI Institute, Mountain View, CA, USA.

Introduction: The Almahata Sitta (AhS) polymict ureilite is the first meteorite to originate from a spectrally classified asteroid (2008 TC_3) [1-3], and provides an unprecedented opportunity to correlate properties of meteorites with those of their parent asteroid. AhS is also unique because its fragments comprise a wide variety of meteorite types. Of ~140 stones studied to-date, ~70% are ureilites (carbon-rich ultramafic achondrites) and 30% are various types of chondrites [4,5]. None of these show contacts between ureilitic and chondritic lithologies. It has been inferred that 2008 TC_3 was loosely aggregated, so that it disintegrated in the atmosphere and only its most coherent clasts fell as individual stones [1,3,5]. Understanding the structure and composition of this asteroid is critical for missions to sample asteroid surfaces. We are studying [6] the University of Khartoum collection of AhS [3] to test hypotheses for the nature of 2008 TC_3. We describe a sample that consists of both ureilitic and chondritic materials.

Sample and Methods: We received ~0.8 g of AhS 91A (paired with AhS 91) as multiple fragments of various sizes. So far we have studied 7 of these by optical microscopy, FE-SEM, EMPA, Raman, and CT scans, and an 8th fragment is being analyzed for oxygen isotopes. Cr isotopes have been analyzed in a 9th fragment [7].

Results: The dominant lithology in AhS 91A is a fine-grained C2 carbonaceous chondrite consisting of phyllosilicates (tentatively, serpentine and saponite), magnetite, carbonate (magnesite), fayalitic olivine, ilmenite, Ca-phosphate, pyrrhotite and pentlandite (Fig. 1). As shown in multiple fragments (Fig. 1b,c), this lithology contains coarse-grained clasts of olivine (up to ~1.8 mm), pyroxenes (up to ~0.5 mm), and albite (~0.5 mm) having compositions and textures consistent with being ureilitic. The olivines have characteristic ureilite reduction rims/zones [8] and exsolved chromite+pyroxene symplectites [9]. At least two different core olivine compositions were observed in different fragments: Fo ~79-80 and Fo ~84, both with high CaO (0.3-0.4 wt%) and Cr_2O_3 (~0.6-0.7 wt. %) typical of ureilites. Two different pyroxene fragments have compositions: mg# ~79, Wo 9 and mg#~85, Wo 9, typical for ureilitic pigeonite. The albite grain is Ab 96-99, consistent with plagioclase in the ureilitic "albitic lithology" in polymict ureilites [10,11] and the ureilitic andesite in AhS [12,13]. One fragment of the C2 lithology also contains a coarse-grained clast of olivine, pyroxenes and feldspathic material whose affinity is uncertain – mineral compositions are consistent with ureilites but its texture is not familiar. In addition, a CT scan of one fragment of AhS 91 shows a clast that appears to contain multiple chondrules, suggesting that possibly an OC lithology is also present.

Discussion: The grain sizes and compositions of the olivine, pyroxene and albite clasts in 91A are not consistent with their belonging to the C2 lithology, and strongly suggest that they are ureilitic. AhS 91A is the first observed occurrence of ureilitic and chondritic materials in the same AhS stone [1-5], but it does not show a simple contact between two lithologies. Rather, it appears to be an intimately mixed breccia of C2 material (and OC?) with clasts from several different ureilitic lithologies. It could represent extensively gardened regolith from the immediate parent asteroid of 2008 TC_3. [5]. Cr isotopes [7] indicate that the C2 lithology is a type of CC-like material not previously known. This sample shows that reflectance spectra of ureilitic asteroids could exhibit hydration features.



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