THE FOREIGN CLAST POPULATIONS OF ANOMALOUS POLYMICT UREILITE ALMAHATA SITTA (ASTEROID 2008 TC_3) AND TYPICAL POLYMICT UREILITES: IMPLICATIONS FOR ASTEROID-METEORITE CONNECTIONS.

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Introduction: Almahata Sitta (AhS) is the first meteorite to originate from an asteroid (2008 TC_3) that had been studied in space before it hit Earth [1,2]. It is also unique because the fallen fragments comprise a variety of types: ~69% ureilites (achondrites) and 31% chondrites [3]. Two models have been proposed for the origin 2008 TC_3: 1) an accretionary model [3,4]; or 2) a regolith model [5,6].

Typical polymict ureilites are interpreted to represent regolith, and contain a few % foreign clasts [7,8]. The most common are dark (CC matrix-like) clasts similar to those in many meteoritic breccias [9]. A variety of other chondrites, as well as achondrites (angrites), have also been reported [7,9,10]. We have been working to determine the full diversity of these clasts [10-13] for comparison with AhS. We discuss implications for mixing of materials in the early solar system and the origin of 2008 TC_3.

Discussion: Polymict ureilites are noted for their diverse foreign clasts [7-9]. Our results [10-13] show variety also within each class/group, and within small volumes of regolith. They suggest that RC and L/LL are the most abundant (excluding dark clasts), while E and H chondrites are rare.

This diversity indicates that either: 1) ureilitic regolith was particularly efficient at preserving fragments of impactors; 2) ureilitic regolith was exposed to a range of heliocentric distances during orbital migration [6]; or 3) impactors into ureilitic regolith were complex breccias.

There are significant differences between foreign clasts in typical polymict ureilites and non-ureilitic materials in AhS. In AhS, EC dominate and dark clasts are absent. These differences may not preclude formation of AhS and typical polymict ureilites on the same asteroid because 1) CC matrix-like clasts in AhS may have disintegrated in Earth's atmosphere; and 2) different volumes of regolith can be dominated by material(s) from different impacts. If the regolith model for 2008 TC_3 [6] is correct, most remaining ureilitic material is in the inner asteroid belt or Earth-crossing orbits.

References: [1] Jenniskens P. et al. 2009. Nature 458, 485. [2] Shaddad M.H. et al. 2010. MAPS 35, 1618. [3] Horstmann M. & Bischoff A. 2014. Chemie der Erde 74, 149. [4] Gayon-Markt J. et al. 2010. Monthly Notices Royal Astr. Soc. 424, 508. [5] Herrin J. et al. 2010. MAPS 45, 1789. [6] Goodrich C.A. et al. 2015. MAPS 50, 782. [7] Goodrich C.A. et al. 2004. Chemie der Erde 64, 283. [8] Downes H. et al. 2008. GCA 72, 4825. [9] Bischoff A. et al. 2004 in MESS II. 679. [10] Goodrich C.A. 2015. 78th MSM, #5018. [11] Goodrich C.A. 2015. 78th MSM, #5048. [12] Goodrich C.A. et al. 2015. LPSC 46, #1214. [13] Goodrich C.A. et al. 2016. LPSC 47, #1617.