

ASTEROID 2008 TC3: A REVIEW AND A LOOK FORWARD. P. Jenniskens¹, M. H. Shaddad², and Almahata Sitta Consortium. ¹SETI Institute, 189 Bernardo Ave, Mountain View, CA 94043 (Petrus.M.Jenniskens@nasa.gov), ²Department of Physics, University of Khartoum, P.O. Box 321, Khartoum 11115, Sudan (shaddadmsh@yahoo.com).

Introduction: On October 6, 2008, a small 4-m sized asteroid called 2008 TC3 was discovered in space and tracked to an impact location in northern Sudan [1]. The asteroid shape and spin state were derived from its lightcurve and the surface reflection properties were measured in the 554 - 995 nm range. Over 600 meteorite fragments were recovered in four dedicated University of Khartoum organized field searches along the impact trajectory [2]. This was the first asteroid detected in space before impacting Earth, which turned out also to be the first freshly recovered polymict ureilite. This rare meteorite type is now firmly linked to a rare class of asteroid reflectance spectra. Surprisingly, the polymict ureilite was found to contain an admixture of 20-30% ordinary and enstatite chondrites.

Research to date: First results from the analysis of these diverse meteorites were presented at the 2008 TC3 Workshop held at the University of Khartoum in December of 2009 [3]. Results were published in the 2010 October-November special issue of Meteoritics and Planetary Science. The research to date has shed light on the nature of the Ureilite Parent Body, the asteroid fragment size following a massive disruption of the original parent body just before differentiation, the diversity of ureilitic materials in a polymict ureilite, including loosely stacked grains with pore space that was coated with vapor deposits, the admixture of other meteorite types into the daughter asteroids, the exchange of volatiles between ureilites and non-ureilites in the daughter asteroids, the presence of extraterrestrial amino acids, the age when 2008 TC3 itself was released from a larger parent, as well as the possible source region of ureilites in the asteroid belt.

These first results have raised many new questions and the study of the 2008 TC3 meteorites is ongoing in search of answers. We are particularly curious to know when the Ureilite Parent Body broke into daughter asteroids last, and where that family of asteroids resides in today's asteroid belt.

Some answers to such questions are provided in more recent research. Since the 2010 special issue of MAPS publication, the research on Almahata Sitta meteorites has continued by members of the Almahata Sitta Consortium and others, and further results have been published. We will review these results from the analysis of individual meteorites.

Future work: We will also look forward to projected research in the near future. In particular, it is highly likely that the collection of recovered fragments of 2008 TC3 at the University of Khartoum contains unique, but yet unrecognized, materials that can provide further answers to the above questions. We will

discuss the proposed future work to fully explore the diversity of materials contained in asteroid 2008 TC3.



Figure 1: At the site of AS9, one of the first recovered fragments of 2008 TC3, during the initial expedition in December 2008. From left to right: M. H. Shaddad, S. E. M. Gasmallah, the finder of AS9 Abdelrahman A. Hassan, and P. Jenniskens.

References: [1] Jenniskens P., Shaddad M. H., Numan D., et al. (2009) *Nature* 458, 485-488; [2] Shaddad M. H., Jenniskens P., Numan D., et al. (2010) *MAPS* 45, 1590-1617; [3] Jenniskens P., Shaddad M. H. (2010) *MAPS* 45, 1553-1556.

Additional Information: Members of the Almahata Sitta Consortium are listed at the website: <http://asima.seti.org/2008TC3/>, where you can also find information about the meteorite samples that have been, and are being studied, by various techniques to date.