ORGANIC COMPOUNDS IN THE TARDA C2 UNGROUPED CARBONACEOUS CHONDRITE: MTBSTFA AS A ONE-POT EXTRACTION TECHNIQUE.

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Introduction: Organic compound analysis of carbonaceous chondrites can provide a glimpse into processes that were occurring at the time of solar system formation and alteration events thereafter on asteroid parent bodies [1]. Upon reaching the Earth's surface meteoritic material becomes contaminated due to the life Earth hosts [2], making our ability to differentiate between extraterrestrial and terrestrial compounds crucial when making inferences about our early Earth and solar system. The recent fall of the Tarda C2 ungrouped carbonaceous chondrite on August 25, 2020 in Morocco offers a unique opportunity to analyze and determine the intrinsic properties of a relatively fresh carbonaceous chondrite. The majority of the fusion encrusted stones, ranging from 0.1 to 99 g in size, were collected within a few days [3]. To determine the intrinsic compounds in Tarda, hot water extracts were carried out on two specimens and derivatized using N-tert-butyldimethylsilyl-N-methyltrifluoroacetamide (MTBSTFA). MTBSTFA is a silylation reagent that reacts easily with a wide range of organic compounds [4] and provides a highly stable derivative that yields optimal GC and mass spectral peaks [5]. However, MTBSTFA has been shown to be more water sensitive than what was previously reported and reacts readily with it to create 3 major hydrolysis products: 1,3-bis(1,1-dimethylethyl)-1,1,3,3-tetramethyldisiloxane, N-methyl-2,2,2-trifluoroacetamide, and tert-butyldimethylsilanol [4]. Using methods to counteract its moisture sensitivity, we employed MTBSTFA to identify organic compounds in the Tarda specimens and characterize the performace of this derivatization technique relative to other common extraction methods.

Methods: Two Tarda specimens, weighing 3.64 g (UAlberta Collection #MET11800/1; "Tarda A") and 3.69 g (MET11800/2; "Tarda B"), along with a 7.61 g sand sample were obtained from the Tarda strewn field. Each stone is nearly enclosed in fusion crust.

Handling Conditions: Tarda specimens were processed in a Class 1000 cleanroom [6]. All materials used in handling and processing the specimens were cleaned with ultrapure water and HPLC grade dichloromethane (DCM), and if possible, were combusted at 450°C for at least 6 hours prior to use.

Sample Processing: Approximately 0.6 g of each of Tarda A and Tarda B, along with 1.5 g of the sand were subsampled. The specimens were then powdered and subsequently extracted with 20 mL ultrapure water in a 60 °C ultrasonic bath for 4 hours post DCM extraction [7]. Following the hot water extraction, the samples were centrifuged for 2 hours and taken down to dryness at low temperature using a rotary evaporator. To ensure that no water could interfere with the derivatization agent, the remainder of the procedure was conducted under nitrogen gas. Next, HPLC grade acetonitrile was doubly distilled using calcium hydride. The dried acetonitrile and the MTBSTFA were added to each extract, sealed in ampules, and heated at 100°C for 4 hours. To identify the organic compounds present in the samples, each extract was evaporated down to 0.2 mL and analyzed by gas chromatography-mass spectrometry (GC-MS).

Results and Conclusions: A total of 8 intrinsic and 43 terrestrial compounds were found in Tarda A, 6 intrinsic and 36 terrestrial compounds in Tarda B, and 20 contaminants in the sand sample. These are in addition to the compounds obtained by DCM extraction [7], with only one overlapping compound (cyclic octaactomic sulfur) indicating that the MTBSTFA method identifies a new suite of compounds in addition to those extracted by DCM. There were two terrestrial organic compounds in common between the sand sample and the two Tarda specimens: hexadecanoic acid and octadecanoic acid; both are long chain fatty acids. The extraterrestrial compounds found in the Tarda specimens were propanedioic acid, L-proline, glycine, urea, fumaric acid, methylmaleic acid, along with cyclic octaatomic sulfur and dl-theronine in Tarda A only. Using MTBSTFA as a derivatization reagent in meteoritic studies is beneficial as it allows for the potential GC identification of most groups of organic compounds in one analysis; our study shows that the "one-pot" technique is effective. If done correctly in an environment that reduces moisture, MTBSTFA provides a relatively simple way of identifying organic compounds using GC-MS while simultaneously producing derivatives with increased stability over other techniques.

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References: [1] Sephton M. A. (2002) *Natural Product Reports* 19:292–311. [2] Pizzarello S. and Shock E. (2010) *Cold Spring Harbor Perspectives in Biology* 2:a002105. [3] Meteoritical Bulletin Database. [4] Glavin D. P. et al. (2013) *Journal of Geophysical Research: Planets 118*:1955–1973. [5] Kim K.-R. et al. (1992) *Journal of Chromatography A* 605:241–249. [6] Herd C. D. K. et al. (2016) *Meteoritics & Planetary Science* 51:499–519. [7] Tunney L. D. et al. (2021) 52nd Lunar and Planetary Science Conference (abstract #1644).