SUPPLEMENTARY MATERIAL

EPA Method #556

The EPA Method #556 (Scheme 2), used previously for the analysis of the Murchison meteorite (Pizzarello and Holmes, 2009), is carried out as follows: carbonyl compounds are derivatized in water (pH = 4) by adding 1 mL of a 15 mg/mL *O*-(2,3,4,5,6-Pentafluorobenzyl) hydroxylamine hydrochloride (PFBHA) solution and heating the solution at 35°C for 2 hours. Following the derivatization step, 2-4 drops of concentrated H_2SO_4 are added to the sample to prevent extraction of excess PFBHA reagent. The PFBHA derivatives are extracted from solution with hexane and transferred to a vial containing 0.2 N H_2SO_4, as an acid-wash step. The hexane layer, containing the PFBHA derivatives, is then isolated, concentrated to a small volume via evaporation, and analyzed via GC-MS.

Table S1. A summary, adapted from Rodigast et al. (2015), of the experimental conditions used for aqueous phase derivatization and extraction of aldehydes and/or ketones.

PFBHA (mg/mL)	Derivatization time	Derivatization temperature	Extraction solvent	Extraction time (min)	Reference
0.1	40 min aldehydes, 24 h ketones	Room temp.	Ethyl acetate	–	Kobayashi et al. (1980)
0.1	2 h (longer for ketones)	Room temp.	Hexane	0.5	Glaze et al. (1989)
1	1 h aldehydes, 1 day ketones	Room temp.	Hexane	–	Yamada and Somiya (1989)
>10-fold excess	24 h	Room temp.	Hexane, MTBE	1	Le Lacheur et al. (1993)
0.75	2 h	35°C	Hexane	3	EPA Method 556 (1998)
0.8	20 s	900 W	Toluene	–	Strassnig et al. (2000)
0.5	24 h	Room temp.	Dichloromethane	–	Spaulding and Charles (2002)
0.06	4 h	60°C	–	–	Sugaya et al. (2004)
0.2	24-96 h	Room temp.	Hexane	–	Seaman et al. (2006)
0.06	2 h	Room temp.	–	–	Hudson et al. (2007)
–	4 h	Room temp.	–	–	Takeuchi et al. (2007)
0.75	10 min	Room temp.	–	–	Saison et al. (2009)
Followed EPA Method 556					Pizzarello and Holmes (2009)
0.05	<10 min	Room temp.	Chlorobenzene	2	Ye et al. (2011)
0.5	1 min	60°C	Hexane	1	Serrano et al. (2013)
–	45 min	–	Dichloromethane	–	de Marcellus et al. (2015)
0.4	24 h	–	Dichloromethane	30	Rodigast et al. (2015)

Dash line – parameter not reported

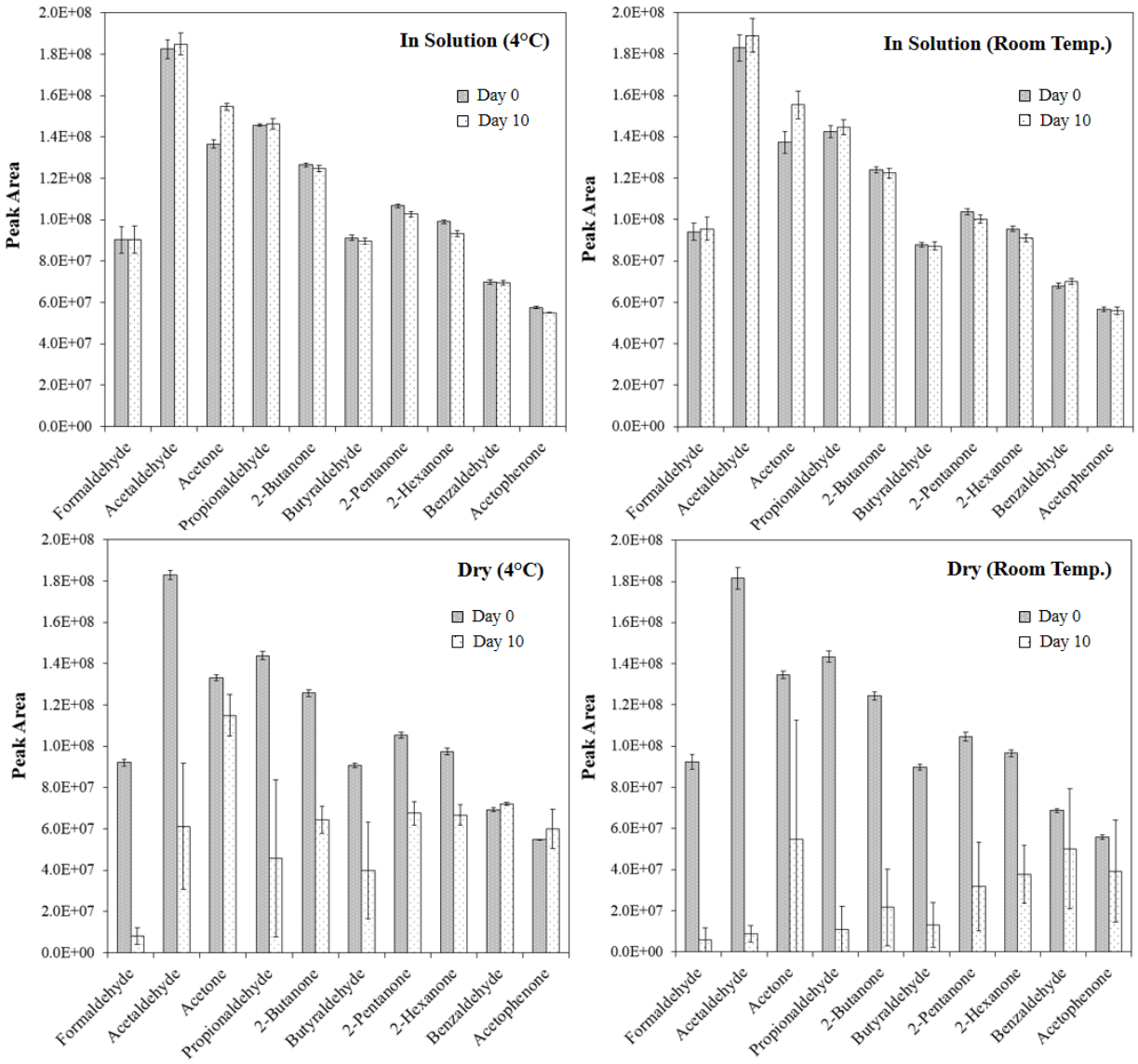

Figure S1. Abundances (GC-MS peak areas) of aldehyde and ketone derivatives (initial concentrations: 50 µg/mL) before and after storage at 4°C or room temperature. Dichloromethane was used as the extraction solvent for all samples. Solutions were evaporated to 1 mL volumes under a stream of nitrogen prior to the first GC-MS run (Day 0). Samples stored in solution were stored in their 1 mL volumes for 10 days. Samples stored dry were evaporated to dryness under a stream of nitrogen, immediately re-capped, stored dry for 10 days, and then re-constituted in 1 mL dichloromethane prior to the second GC-MS run (Day 10). All measurements were calibrated against an external standard (50 µg/mL underivatized acetophenone) to adjust for instrumental variations. Each bar represents an average of 3 replicate samples, and error bars represent one standard deviation from the mean.

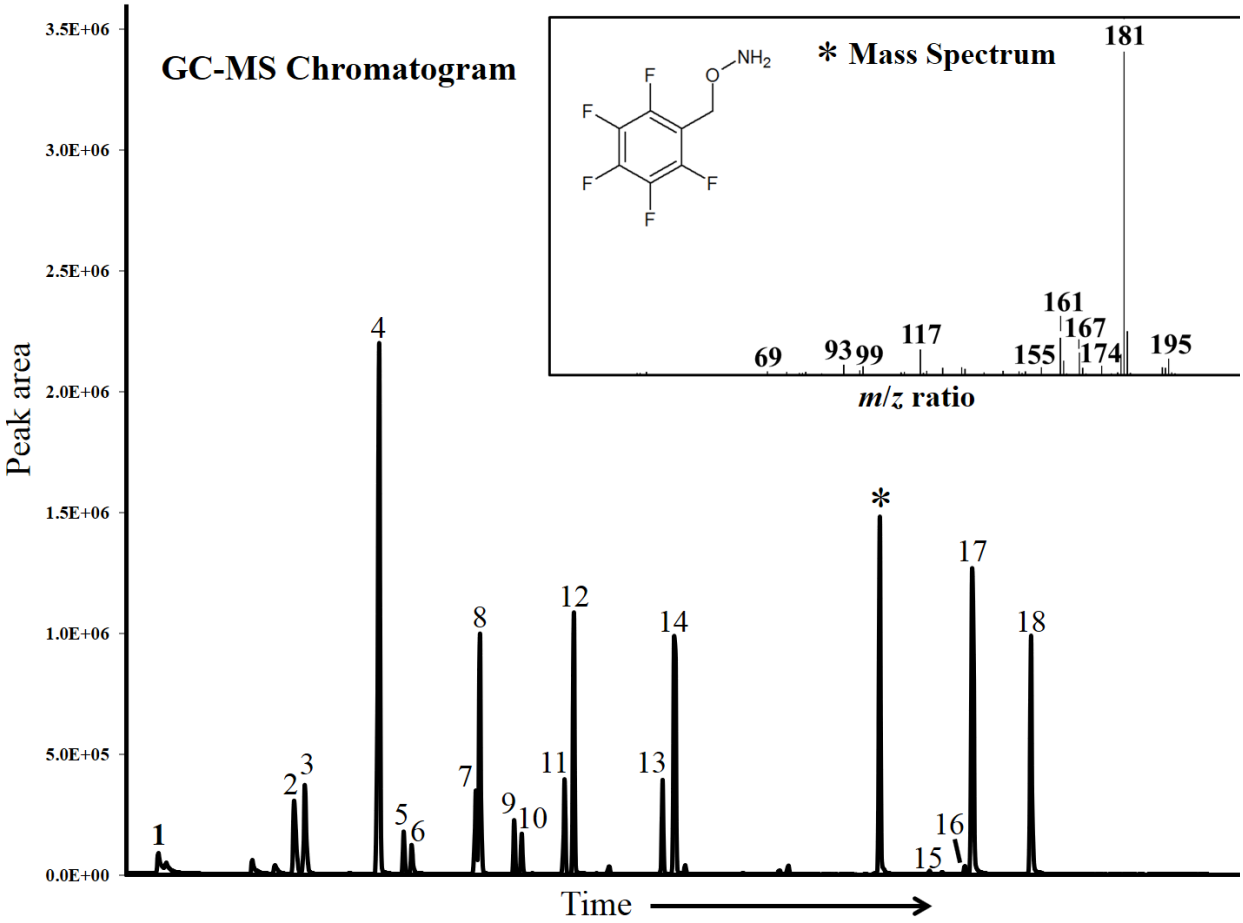

Figure S2. GC-MS chromatogram of aldehyde and ketone derivatives in dichloromethane after dry storage at 4°C for 10 days (initial concentrations: 50 μg/mL). The identities of the peaks are presented in Table 1. The GC-MS peak labeled with an asterisk is a decomposition product that was only observed in samples that had been stored dry. The mass spectrum displayed above the chromatogram represents the mass spectrum and compound identification provided by the NIST Mass Spectral Library for the decomposition product(*).

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