DATA SET FOR:

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Published in:

Liu, D., and S. P. Kounaves (2019), The Role of Titanium Dioxide (TiO_2) in the Production of Perchlorate (ClO_4^-) from Chlorite (ClO_2^-) and Chlorate (ClO_3^-) on Earth and Mars, *ACS Earth and Space Chemistry*, 3(8), 1678-1684, doi: 10.1021/acsearthspacechem.9b00134.

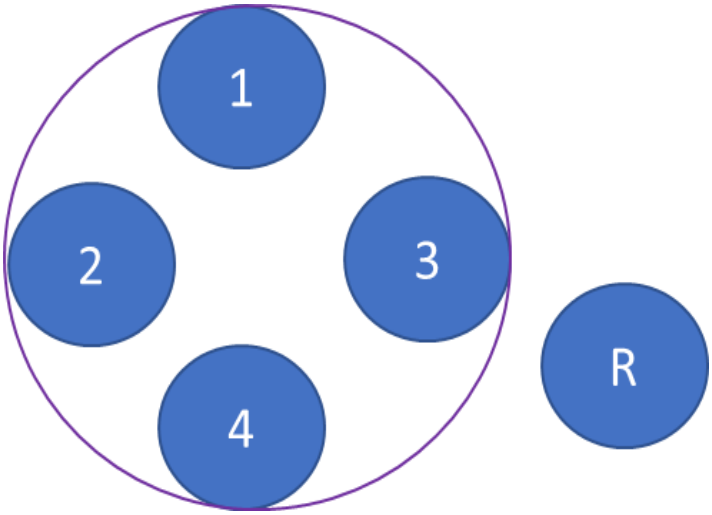

Figure 1. Layout of the irradiation setup. Sample vials 1 to 4 were placed under a UV irradiation spot. Reference vial (R) was placed outside the UV irradiation spot.

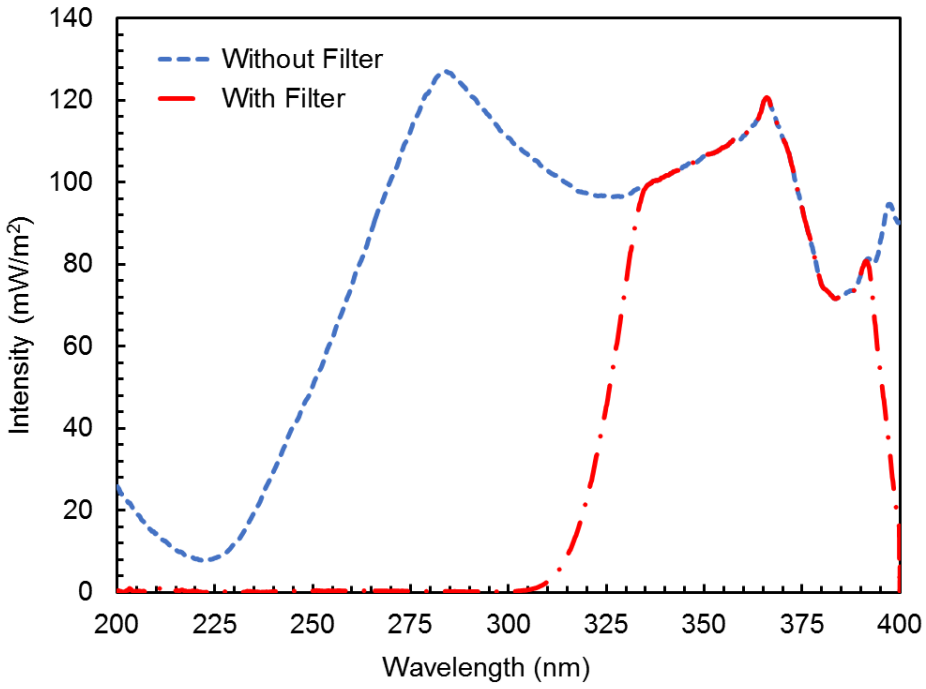

Figure 2. The photon flux produced by the XBO 450W/OFR UV lamp with and without long-pass filter between 200-400 nm. An uncertainty of 5% is assumed for the intensity to account for inconsistencies over each 1 minute recording interval.

Table 1. Quantitative analysis of 0.5 g of 880 ppm chlorite IC standard+10 g silica sand, 48 h irradiation, Mars ambient conditions.

	Without Filter, λ = 200 - 400 nm		**With Filter, λ = 300 - 400 nm**	
	average	**SD**	**average**	**SD**
Chlorite (mol)	0.00	0.00	1.4×10^{-6}	4.9×10^{-7}
Perchlorate (mol)	2.0×10^{-8}	1.6×10^{-10}	6.0×10^{-9}	3.5×10^{-10}
Chlorate (mol)	3.2×10^{-6}	3.4×10^{-7}	3.1×10^{-6}	9.7×10^{-8}
Chloride (mol)	2.8×10^{-6}	5.7×10^{-7}	1.3×10^{-6}	3.9×10^{-7}
Total (mol)	***6.0×10^{-6}***		***5.7×10^{-6}***	
Chlorite (%)	0.00	0.00	24	9
Chlorate (%)	52	6	53	2
Chloride (%)	47	9	22	7

Note: LOD = 2.5×10^{-10} mol for perchlorate

Table 2. Quantitative analysis of 0.5 g of 880 ppm chlorite IC standard+0.5 g TiO_2 +9.5 g SiO_2 sand, 48 h irradiation, under Mars ambient conditions.

	Without Filter, λ = 200 - 400 nm		**With Filter, λ = 300 - 400 nm**	
	Average (mol)	**SD**	**Average(mol)**	**SD**
Chlorite (mol)	3.2×10^{-6}	$\pm1\times10^{-7}$	3.8×10^{-6}	$\pm2\times10^{-7}$
Perchlorate (mol)	5.1×10^{-10}	$\pm2\times10^{-10}$	NA	NA
Chlorate (mol)	2.8×10^{-7}	$\pm5\times10^{-8}$	2.5×10^{-7}	$\pm1\times10^{-8}$
Chloride (mol)	1.7×10^{-6}	$\pm2\times10^{-7}$	1.3×10^{-6}	$\pm3\times10^{-7}$
Total (mol)	***5.2×10^{-6}***		***5.4×10^{-6}***	
Chlorite (%)	62	±2	70	±3
Chlorate (%)	5.5	±0.9	4.5	±0.2
Chloride (%)	32	±5	24	±6

Note: LOD = 2.5×10^{-10} mol for perchlorate

Table 3. Quantitative analysis of 0.5 g of 880 ppm chlorate IC standard+10 g SiO_2 sand, 48 h irradiation, Mars ambient conditions.

	Without Filter, λ = 200 - 400 nm		**With Filter, λ = 300 - 400 nm**	
	Average	**SD**	**Average**	**SD**
Chlorite (mol)	NA	NA	NA	NA
Perchlorate (mol)	3.6×10^{-8}	8×10^{-9}	9.6×10^{-10}	7×10^{-10}
Chlorate (mol)	no change	no change	no change	no change
Chloride (mol)	NA	NA	NA	NA

Note: LOD = 2.5×10^{-10} mol for perchlorate

Table 4. Quantitative analysis of 0.5 g of 880 ppm chlorate IC standard+0.5 g TiO_2 +9.5 g SiO_2 sand, 48 h irradiation, Mars ambient conditions.

	Without Filter, λ = 200 - 400 nm		**With Filter, λ = 300 - 400 nm**	
	Average	**SD**	**Average**	**SD**
Chlorite (mol)	NA	NA	NA	NA
Perchlorate (mol)	above LOD	NA	above LOD	NA
Chlorate (mol)	no change	no change	no change	no change
Chloride (mol)	NA	NA	NA	NA

Note: LOD = 2.5×10^{-10} mol for perchlorate

Table 5. Comparison of average UV flux on Mars with that for the XBO 450W/OFR UV lamp with and without long pass filter. An uncertainty of 5% is assumed for the intensity to account for inconsistencies over each 1 minute recording interval.

	UVA (W/m^2)	**UVB (W/m^2)**	**UVC (W/m^2)**	**Total UV (W/m^2)**
Mars*	38.39	8.38	3.18	49.95
UV Lamp	7.41	3.78	3.67	14.87
UV Lamp with long-pass filter	6.24	3.70	0.25	10.19

** Estimated as 43% of Earth's solar constant [1]*

Reference

1. Kuhn, W. R.; Atreya, S. K., Solar radiation incident on the martian surface. *J. Mol. Evol.* **1979,** *14* (1), 57-64, doi: 10.1007/bf01732367