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Supporting Information for

Space weathering induced formation of hydrogen sulfide (H_2S) and hydrogen disulfide (H_2S_2) in the Murchison meteorite

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Contents of this file

Introduction

In this supporting file, we present all detected signals in addition to those for hydrogen sulfide (H_2S) and hydrogen disulfide (H_2S_2) and tentatively assign few of them. Future investigation are planned to confirm these assignments.

Text S1.

In addition to hydrogen sulfide (H_2S) and hydrogen disulfide (H_2S_2), three additional sublimation events (Figure 4) were observed in the TPD profiles: 190 to 230 K (m/z = 18, 44, 46, 48, 58, 70, 72,76, 78, 84, 98, 112, and 128), 220 to 280 K (m/z = 212, 238, and 240), and 250 to 300 K (m/z = 212, 238, and 240). To assign each signal is not feasible at the present time since a few thousand molecular compounds were identified in the Murchison meteorite and irradiation of the sample further complicates the composition via degradation and chemical reactions. In the 190 to 230 K range, the m/z = 98 signal may be related to trisulfane (H_2S_3). Previous investigations have demonstrated high order phosphane (from diphosphane (P_2H_4) up to octaphosphane (P_8H_{10})) can be generated by electron irradiation of phosphine ice (PH_3) at low temperature (5 K) [*Turner et al.*, 2015]. Likewise, since H_2S and H_2S_2 are observed in our irradiated sample, it is reasonable to expect observation of higher order sulfane such as H_2S_3. The three pairs of signals m/z = 162 and 160, 194 and 190, and 258 and 256 in the range of 250 to 300 K are tentatively assigned to species containing one chlorine (Cl) atom since the ratio of the integrated areas in each pair is about 0.30 ± 0.05, which agrees well with the natural isotope ratio of ^{37}Cl and ^{35}Cl (0.33). Indeed, chlorine has been identified in the Murchison meteorite. Further investigation by tuning photoionization energy are planned to investigate the molecular formulae and even structures of these species [*Abplanalp et al.*, 2016b].

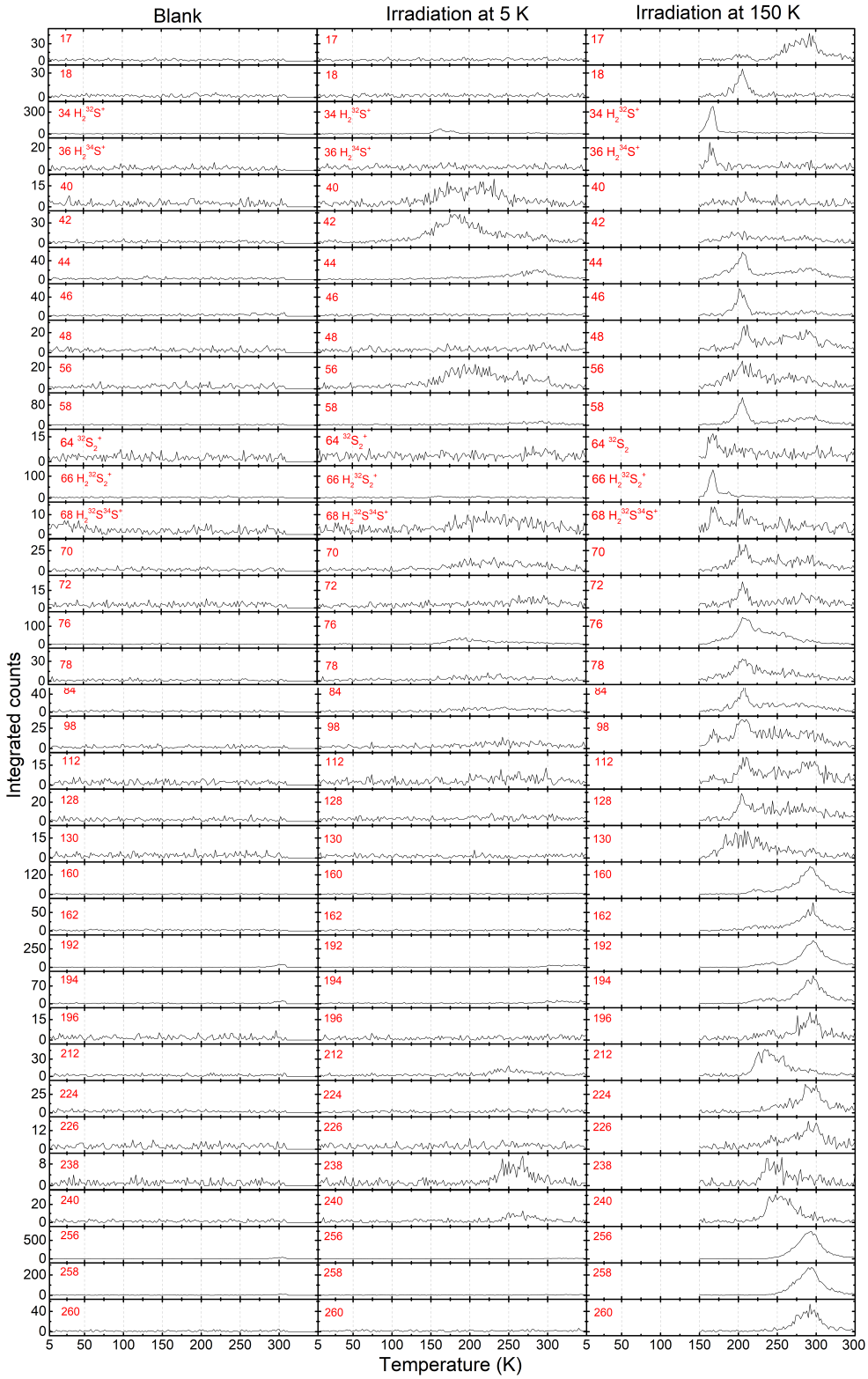

Figure S1. TPD profiles recorded via ReTOF for various masses.