

NATURALLY OCCURRING MINI-OUTBURSTS AT COMET TEMPEL 1

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In the weeks leading up to closest approach with comet Tempel 1, the Deep Impact spacecraft observed 12 outbursts with its visual imagers. These outbursts varied in size, with the largest ejecting on the order of 10^6 kilograms of material. These outbursts are directional and dissipate on ~hour long timescales. One outburst on 2 Jul 2005, was detected with Deep Impact's infrared spectrometer, HRI-IR, with an acceptable signal to noise ratio. Data were collected 0.5 hours before and 1.5 hours after the onset of the outburst. All Deep Impact data are available in the PDS.

HRI-IR operates between 1.05 and 4.85 μm and is capable of detecting emissions from water vapor, organics, CO_2 , and CO , simultaneously. After the outburst, a strong, double peaked emission band was detected at 3.6 μm . This is consistent with the organic compound formaldehyde. This emission was not detected before the outburst and only appears in the direction of the outburst. A spatial analysis also showed an enhancement of water in the direction of the outburst and may indicate continued water outgassing for hours after the outburst has subsided. CO_2 only convincingly appears at quiescent levels.

Both CO_2 and formaldehyde were detected in the Deep Impact man-made ejecta cloud at levels of 10 % and 1 % relative to water vapor, respectively. Similarly, the post outburst coma contained ~10% CO_2 and a surprising ~20% formaldehyde relative to water in large, nucleus-centered apertures. Smaller spatially distributed apertures show formaldehyde to water ratios of ~80% in the direction of the outburst. Formaldehyde can be the product of polyoxymethylene grain dissociation, though this requires day long timescales. Such a large abundance of formaldehyde that is correlated with the direction of the outburst indicates that it played a significant role in driving the 2 Jul outburst.

This research was funded through the NASA Planetary Data System Student Investigators program.