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Results from the Gas Chromatograph Mass Spectrometer (GCMS) Experiment on the Cassini-Huygens Probe

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The GCMS was part of the instrument complement on the Cassini-Huygens Probe to measure in situ the chemical composition of the atmosphere during the probe descent and coupled with the Aerosol Collector Pyrolyser (ACP) experiment by serving as detector for the pyrolization products to determine the composition of the aerosol particles. The GCMS employed a quadrupole mass filter with a secondary electron multiplier detection system and a gas sampling system providing continuous direct atmospheric composition measurements and batch sampling through three gas chromatographic (GC) columns, a chemical scrubber and a hydrocarbon enrichment cell. The GCMS gas inlet was heated to prevent condensation, and to evaporate volatiles from the surface after impact. The GCMS collected data from an altitude of 146 km to ground impact. The Probe and the GCMS survived impact and collected data for 1 hour and 9 minutes on the surface. Mass spectra were collected during descent and on the ground over a range of m/z from 2 to 141. The major constituents of the lower atmosphere were confirmed to be N2 and CH4. The methane mole fraction was uniform in the stratosphere. It increased below the tropopause, at about 32 km altitude, monotonically toward the surface, reaching a plateau at about 8 km at a level near saturation. After surface impact a steep increase of the methane signal was observed, suggesting evaporation of surface condensed methane due to heating by the GCMS sample inlet heater. The measured mole fraction of 40Ar is 4.3x10^-5 and of 36Ar is 2.8x10^-7. The other primordial noble gases were below 10^-8 mole fraction. The isotope ratios of 12C/13C determined from methane measurements are 82.3 and of 14N/15N determined from molecular nitrogen are 183. The D/H isotope ratio determined from the H2 and HD measurements is 2.3x10^-4. Carbon dioxide, ethane, acetylene and cyanogen were detected evaporating from the surface in addition to methane.