Evidence for Significantly Enriched Heavy Oxygen in Mars Atmosphere. T. A. Livengood[1], T. Kostiuk[2], T. Hewagama[3], R. L. Smith[2], G. Sonnabend[4], M. Sornig[5], T. Stangier[5]
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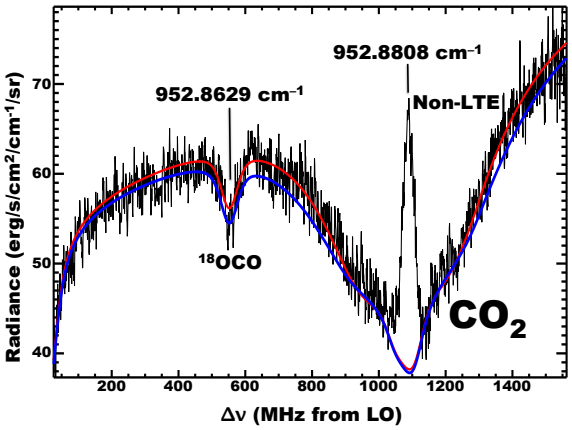
The loss of primordial atmosphere from Mars should have resulted in significant enrichment of heavy isotopes in Mars carbon dioxide, which has not previously been observed. Atmospheric isotope ratios provide important context in which to interpret the geochemistry of Mars meteorites and future returned samples. Biotic and abiotic isotope-fractionation occur relative to the available chemical reservoirs, enabling a tool to interpret chemical fossils for Mars astrobiology.

We report on high-resolution infrared spectroscopy of Mars obtained in October 2007 from the NASA IRTF, targeting the sub-solar latitude in late southern summer. The measured spectra include fully-resolved pressure-broadened absorption features due to cool tropospheric carbon dioxide above the warm surface and an absorption feature that is definitively due to the isotopologue that is singly-substituted with oxygen-18. The ratio of oxygen-18 to the normal isotope can be recovered from fitting the whole spectrum in absorption against the warm surface. The mean value of the retrieved oxygen-18 fraction differs insignificantly from the terrestrial VSMOW standard, consistent with prior in situ and remote-spectroscopy efforts, which found only modest differences from VSMOW. Comparison between the retrieved isotope ratio and the surface temperature reveals that the concentration of isotopically heavy carbon dioxide is correlated with the local surface temperature, suggesting that the heavy gas is preferentially adsorbed by the regolith at low night temperatures and released in warm day temperatures. The minimum retrieved isotope fraction is consistent with the solar wind ratio measured by the Genesis mission, indicating that any accuracy error in the spectroscopic parameters used for the retrieval must have resulted in underestimating heavy-isotope enrichment. The maximum retrieved isotope ratio is significantly enhanced relative to VSMOW and relative to prior retrievals on Mars. We provide additional evidence that enhancement has been previously detected by *in situ* measurements but was unrecognized.



Example spectrum detecting ^{18}O-substituted CO_2 in the atmosphere of Mars. Blue line is fit using standard Mars model atmosphere derived from MGS/TES. Red line is identical model atmosphere with modified maximum pressure and temperature in lowest layers, to match major CO_2 feature.