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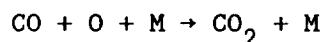
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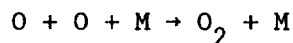
VERTICAL O₃ DISTRIBUTION AS A DIAGNOSTIC FOR EDDY DIFFUSION PROFILE; A. L. Tyler and D. M. Hunten, Lunar and Planetary Laboratory, the University of Arizona

This paper illustrates the dependence of the vertical distribution of O₃ on the height variation of eddy diffusion coefficient. O₃ abundance is a valuable diagnostic for other climatological parameters. In addition, the sensitivity of O₃ distribution to eddy diffusion may aid in determining the role of surface oxidation and recombination processes and lead to a better understanding of the volatiles released or adsorbed cyclically in the Martian regolith.

In spite of rapid photolysis of the predominantly CO₂ Martian atmosphere by solar UV, observations of CO and O₂ near the surface indicate these constituents have mixing ratios less than 0.1% (1). The rate of production of CO and O is exactly the rate of CO₂ photolysis, and because the 3-body recombination reaction:

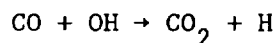


is negligibly slow, most O atoms are instead converted to O₂ by:



If no other recombination process were operating, the observed 0.1% would be produced in less than five years. Much effort has been spent attempting to explain the stability of the minor constituents against rapid increase by UV photolysis of CO₂.

Common to all current Mars aeronomy models explaining this phenomenon is that CO₂ is reformed from CO by odd hydrogen photochemistry via the reaction:

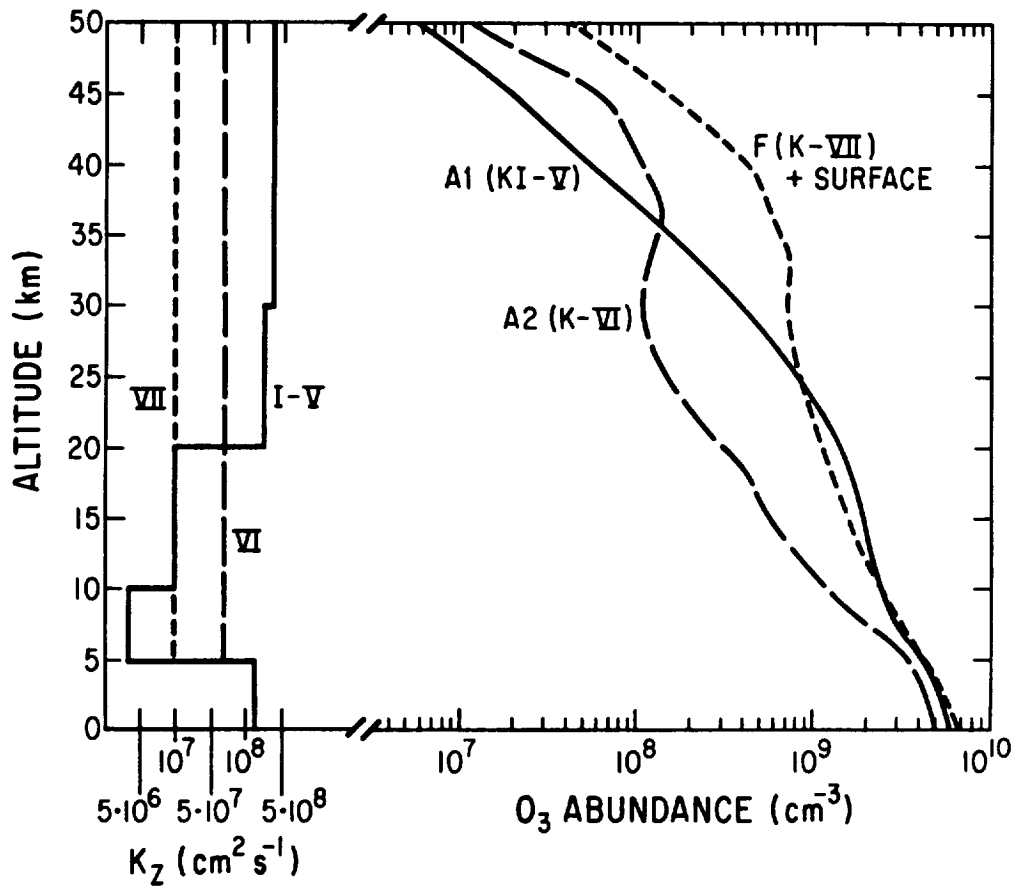


Extensive modelling has shown that various combinations of rapid downward transport of photolysis products to the region of recombination below 20 km and odd hydrogen catalysis recycling CO and O₂ to CO₂ in the presence of enhanced H₂O₂ can fit the limited observational constraints (2-5).

None of the constituents of major aeronomical interest (O₂, CO, H₂O, H₂O₂, O₃) have been measured in-situ in the lower atmosphere. It has been necessary to make assumptions about the vertical profiles of these

necessary to make assumptions about the vertical profiles of these constituents and the eddy diffusion coefficient. The figure illustrates these points with three computed profiles (7) of eddy coefficients and the corresponding ozone distribution. Additional calculations are in progress.

Vertical O₃ Distribution as a Function of Height Variation in Eddy Diffusion Coefficients (K₂)



O₃ profiles computed by Kong and McElroy (6) are plotted on the right side of the figure and correspond to the respective eddy diffusion profiles at the left.

VERTICAL O₃ DISTRIBUTION

Tyler, A. L.

Simultaneous measurements of pressure, temperature and vertical profiles of H₂O vapor, O₃, CO, and O₂ are needed before atmospheric processes can be well understood. In particular, a stellar occultation experiment which provides a high resolution vertical profile of H₂O in absorption and a dayglow limb emission detector to measure the 1.27 μm emission of O₂(¹Δ_g), the photolysis product of O₃, can provide direct evidence for the magnitude of the vertical profile of the eddy diffusion coefficient. The payload chosen for Mars Observer will not make all these measurements but a future opportunity (Mars Aeronomy Observer) is likely.

- (1) U. von Zahn and D. M. Hunten (1982) Proc. 'The Planet Mars', Leeds, (ESA SP-185) 37-45.
- (2) T. D. Parkinson and D. M. Hunten (1972) J. Atmos. Sci., 29, 1380-1390.
- (3) D. M. Hunten (1974) Rev. of Geophys. Space Phys., 12, 529-535.
- (4) M. B. McElroy and T. M. Donahue (1972) Science 177, 986-988.
- (5) M. B. McElroy and J. C. McConnell (1971) J. Atmos. Sci., 28, 879-884.
- (6) T. Y. Kong and M. B. McElroy (1977) Icarus 32, 168-189.