Lander (VL2) data on N2 and 40Ar result either from different instrument characteristics or some unknown time variable atmospheric phenomena or both.

The Martian Quadrupole Mass Spectrometer of the SAM instrument suite has determined the composition of the Martian atmosphere above Gale Crater [2,3]. The MSL/SAM measurements multiple times, all of which result in higher accuracy of data. Note, however, that unlike Viking the high capacity turbomolecular pumps of SAM enable throughput of gas, and SAM can and does repeat the measurements multiple times, all of which result in higher accuracy of data.


INTRODUCTION

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A comparison between SAM and the VL2 data (Table 1) shows that the vmr of N2 measured by SAM is 30% lower than that measured by Viking, whereas it is 21% greater for Ar (see Fig. 2 for SAM measured vs. Viking measured). Since the volume mixing ratio represents the constituent number density (or partial pressure) relative to the total atmospheric pressure, it could be argued that the differences between SAM and VL2 are due to the differences in atmospheric pressure when those data were collected. However, that does not seem to be the case, as the pressures measured at those epochs are very similar (Table 1). Since SAM’s N2, NO and CO, have lifetimes that exceed the Martian year, they are not expected to vary diurnally, but their vmr’s could still undergo seasonal variations due to the annual CO2 cycle.

The VL2 data were taken during northern summer (48°N, Ls=135°), whereas the SAM measurements correspond to the beginning of spring season (4.5°S, Ls=182-190°). Previous observations by Mars Odyssey Gamma Ray Spectrometer (ODY/GRS) over three Mars years have shown that the Ar mixing ratio increased by a factor of 2-3 over the southern polar region during winter, but a much smaller change of a factor of 2-3 was seen for northern high latitudes in the winter, as expected [8]. No significant change was seen between the equator and the midlatitude northern summer, however. Thus the difference between the SAM and VL2 do not appear to be due to changes in the seasons. On the other hand, the vmr of N2 at any latitude are expected to vary seasonally due to global CO2 cycle discussed below.

In this paper we examine the atmospheric process for possible variation in NCV’s, N2 and Ar and CO, in the atmosphere of Mars. Besides using an NCV, CO is expected to have stable level (due to biogeochemical cycling of carbon on another NCV, but unlike NO and Ar, CO’s volatility depends on its various geochemical, biogeochemical, and exobiological properties). Hence, the observed differences between the MSL/SAM and the Viking results are expected to be related to the observing conditions. The Ar/N2 ratio is an important parameter that is used together with nitrogen isotopes to assess the degree of mixing between the Martian atmosphere and the internal gas component [5-7]. Even in cases where Mars atmosphere data are not measured in a constant atmospheric condition, they are expected to change with varying season.

The observed differences between the MSL/SAM and the Viking results (Table 1) are expected to be related to the observing conditions. The Ar/N2 ratio is an important parameter that is used together with nitrogen isotopes to assess the degree of mixing between the Martian atmosphere and the internal gas component [5-7]. Even in cases where Mars atmosphere data are not measured in a constant atmospheric condition, they are expected to change with varying season. This is expected to be caused by diurnal and/or seasonal variations in the composition of the atmosphere.

The Ar/N2 ratio for nitrogen in Mars’ atmosphere can be used as a proxy for the Martian climate evolution and the geological history of Mars.