A SEARCH STRATEGY FOR ALUMINUM IN THE LUNAR ATMOSPHERE

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It's reasonable to infer the presence of aluminum in the extremely tenuous lunar atmosphere if the lunar atmosphere is produced from meteoric volatization and sputtering processes which can also involve the aluminum-rich lunar highlands. The presence of aluminum vapor in the lunar atmosphere can be sought as an emission line in the visible spectrum at 396.1 nm. Normally this line would be masked by the bright reflected solar continuum, but fortunately, it is located in the shortwave side of the Fraunhofer H line of Calcium II centered at 396.8 nm, which has an equivalent width of 1.4 nm. Hence the Aluminum I emission line should appear as a bright "spike" in the shortwave wall of the H line profile.

Figure 1 shows the hypothetical appearance of this line.

The search for this visible line would complement searches for Al I using space telescopes at 309.3 nm. The strength of the 396.1 line is about 1.5 times larger than these near-UV lines [1].

Ideally, to maximize the observed emission line intensity in the spectra, the visible light spectrum should be obtained above the lunar subsolar point when the Moon is near first or last quarter, to maximize the column depth, and additionally, when the Moon is also at a low zenith angle to minimize scattering due to the Earth's atmosphere (significant for the violet).

A search of some older photographic lunar spectra has indeed produced a discovery candidate. A plate taken 1903 May 7, when the Moon was near first quarter, shows a faint emission line at 396.1 nm. (Fig. 2). There is the barest hint of it in one other photographic spectrum taken under similar conditions.

If the aluminum vapor is emitted by meteoroid volatization and sputtering as is proposed for sodium and potassium vapor production on the Moon and Mercury [2] it would be suprathermal. This seems a likely source given the high aluminum abundance in the lunar highlands. It may also be possible that the aluminum vapor may be variable due to meteoric impacts, as is the case with sodium vapor [3], or even that the aluminum vapor is transient.

Clearly, the confirmation and measurement of aluminum vapor using the 396.1 line by modern instruments will resolve these questions.

ADDED NOTE: This search strategy was kindly used by the group of D. Hunten, A. Sprague, R. Koslowski and R. Hill in January, 1996, using the Lunar Coronagraph on Mt. Lemmon. No trace of aluminum vapor was found. The photographic spectral line was therefore spurious. However, the search strategy may be useful in looking for aluminum on other planetary bodies.
References