MICROMETEORITIC VOLATILES ON MARS

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From Ni to CO_2. We attempted to get clues about the early history of the Martian atmosphere relying on CO_2 and N_2 released by micrometeorites upon atmospheric entry, as "tracers" of this history. We did apply the "lunar" model used to predict the Ni contents of the Martian soil (*see a companion abstract*). An interesting constraint is the CO_2/N_2 ratio measured in the present day atmosphere of Mars. It looks like a remnant of an early micrometeoric atmosphere, because its value of ~100 is similar (i.e., within a factor 2) to those either measured for the Earth's atmosphere or predicted for a pure micrometeoritic atmosphere from the C and N content of micrometeorites. Two distinct components are predicted with the lunar model: **(1**) the dominant one, representing a total mass $\Phi_{LHBomb} \sim 10^{24}$ g, was mostly delivered during the "*Late Heavy Bombardment*", since the end of the formation time of the planet (approximated by that of the Earth of ~100 Myr), which corresponds in this model to the accretion of the last planetary embryo, which simultaneously blew off the pre-impact atmosphere; **(2)** the much smaller *normal* component (total mass $\Phi_{Norm} \sim 3 \times 10^{19}$ g), was delivered after the end of the *LHBomb* (i.e., over the last ~4 Gyr), by a micrometeorite flux similar to the present day flux. ***Two "cleansing" impactors on Mars?*** From the fraction of the micrometeoric mass transformed into CO_2 (about 10%), we got a partial pressure of CO_2 of about 60 bars and 2 mbar, for the *LHBomb* and the *normal* components, respectively. If the Martian atmosphere was formed during the *LHBomb*, mostly before ~4.3 Gyr ago, how could the CO_2/N_2 ratio have survived "intact" over such a long time scale, during the loss of ≥ 99.9% of this atmosphere? On the other hand, the *normal* component gives a partial pressure of CO_2 only ~4 times smaller than the contemporary value. This gives a hint that the last cleaning impactor on Mars did occur around ***t***~ 4 Gyr ago, at a time when the lunar cratering rates, ***K(t)***, were ~100 times higher than today. In the model, the integration of ***K(t)*** yield the total mass of micrometeorites accreted since ***t***, i.e., about $4\,\Phi_{Norm}$. It is much easier to explain the constancy of the CO_2/N_2 ratio through time. But the reservoir of planetary embryos was exhausted. This last impactor was possibly belonging to the "burst" of impactors, which produced the largest impact basins of the Moon, around 3.9 Gyr ago. If a large amount of frozen water is still present on Mars today (equivalent to a ~300 m thick global layer?), this water had to be fully frozen at the time of this last impact, as to be shielded from the cataclysmic blasting effect of this impact.