Variations of ion escape from the past to present at Mars

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The present Mars has thin atmosphere consisting mainly of CO_2 and does not have liquid water at the surface. The recent space missions gave some evidences for existence of liquid water in the past Mars. It suggests that Mars have experienced atmospheric loss from the past through present. One of the important mechanisms of atmospheric escape is the ion loss. The ion escape is largely controlled by the magnetic configuration, solar wind and solar XUV (X-ray and extreme ultraviolet) irradiances. Terada et al. (2009) showed that the ion escape rate was at most five orders of magnitude higher under the past active solar condition than under the present ones.

The magnetic field is also an important factor in determining the ion escape rate. The present Mars does not have intrinsic global magnetic field, but is leaving the magnetism in its crust, which is known as the crustal magnetic field. The existence of crustal field suggests that Mars had a global magnetic field of interior origin in the past and the different escape mechanism from the present. The magnitude was perhaps about 0.1 G which is corresponding to the strength of the present magnetic field of the Earth's surface (Curtis and Ness, 1988).

We present the ion escape rates calculated by different magnetic configurations and solar conditions, and compare the results with the Terada et al. (2009) ones. The three-dimension and multi-species magnetohydrodynamics (MHD) modeling are used for the simulation. We will discuss the variation of escape rate due to the differences of magnitude of magnetic field, solar XUV irradiances, and solar wind density.

References

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