



Ablation of Venusian oxygen ions by unshocked solar wind

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Venus, without Earth-like magnetic dipole, has been seriously losing volatiles into the interplanetary space due to the force of solar wind and radiation. Solar wind is shocked near Venus, and then scavenges ionospheric particles in various ways. The oxygen ion (O^+) loss rates estimated from spacecrafts' observations over decades are thought important for understanding the evolution of planetary habitability, considering the accumulation of escape over the history of solar system. However, all the previous observations were made in the shocked solar wind and/or inside the wake, though some simulations showed that unshocked solar wind can also ablate O^+ ions. Here we report Venus Express observations of O^+ ions in the unshocked solar wind during a solar minimum. These O^+ ions are accelerated by the unshocked solar wind through pickup processes. The estimated O^+ loss rates are comparable to those measured in the shocked solar wind and the wake. Our results suggest that the atmospheric loss at unmagnetized planets is significantly underestimated by previous observations, and thus the importance of Earth-like dipole for planetary habitability should be appreciated further.