The influence of Martian crustal magnetic fields on atmospheric escape

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At present the influence of Martian crustal magnetic fields on atmospheric escape rates is debated. Since Mars lacks a significant global dynamo magnetic field, the presence of strong crustal fields over a significant fraction of the surface could shield portions of the atmosphere from the incident solar wind. The crustal fields could also allow or even enhance atmospheric escape through numerous cusp regions that are magnetically connected to the solar wind. This issue is of interest because the answer has implications for how atmospheric escape has operated on Mars over the history of the planet, including earlier times when Mars was more widely magnetized or even possessed a dynamo field. It is also relevant for assessing whether a global magnetic field is important for atmospheric retention. To this point, both modeling and observational studies appear to disagree on whether crustal fields significantly influence the escape of ions.

We will present the results of a new analysis of ion measurements from the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft mission made over four years. We examine how escape rates vary as Mars rotates and as a function of the solar zenith angle of strong crustal fields, including the dependence on ion energy and species. We also explore whether ion escape rates are larger, in a global sense, above crustal fields compared to non-magnetized regions. Finally, we introduce recent results relevant for evaluating ion escape from individual cusps, including from kinetic models of Martian cusp regions.

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