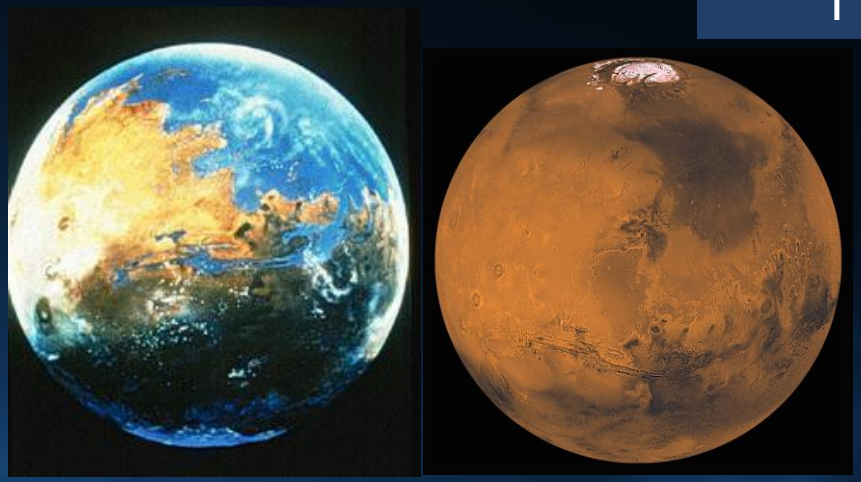
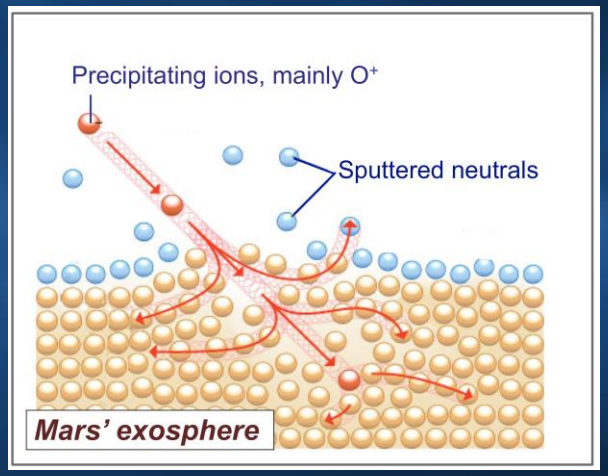
Mars Climate Change: Where Did The Gas From An Early, Thick Atmosphere Go?



Evidence points to Mars being a warmer and wetter (left) place in the past unlike the desert planet it is today (right).

Geological and mineralogical evidence suggests Mars once had a thick atmosphere and flowing liquid water. What happened? MAVEN has been examining whether processes driving loss of atmospheric gases to space were important in Mars' history. There are many ways a planet can lose some of its atmosphere. For example, chemical reactions can lock gas away in surface rocks, or an atmosphere can be eroded by radiation and a stellar wind from a planet's parent star.



One process called "sputtering" – in which atmospheric ions energized by the incident solar wind crash back into the atmosphere as illustrated left– can eject heavy atoms. Sputtering preferentially removes lighter isotopes relative to heavier ones. The ratio of argon-36, relative to the heavier argon-38 at ~200 km altitude is a particularly useful indicator of sputtering loss. The argon isotope ratios measured on MAVEN suggest about 66% of the argon gas was removed by this process. The results also apply to major atmospheric gases such as CO_2; CO_2 also has been removed by other processes, so this amount represents a *minimum* amount lost.

The MAVEN argon isotope results tell us that the majority of Mars' atmospheric gas was lost to space, changing Mars from its early warm, wet climate to the cold, dry planet we see today.

*(Jakosky et al., Science, **355**, 1408, 2017)*