

The martian atmosphere: not what we thought!

Science question: What has happened to the atmosphere of Mars over time?

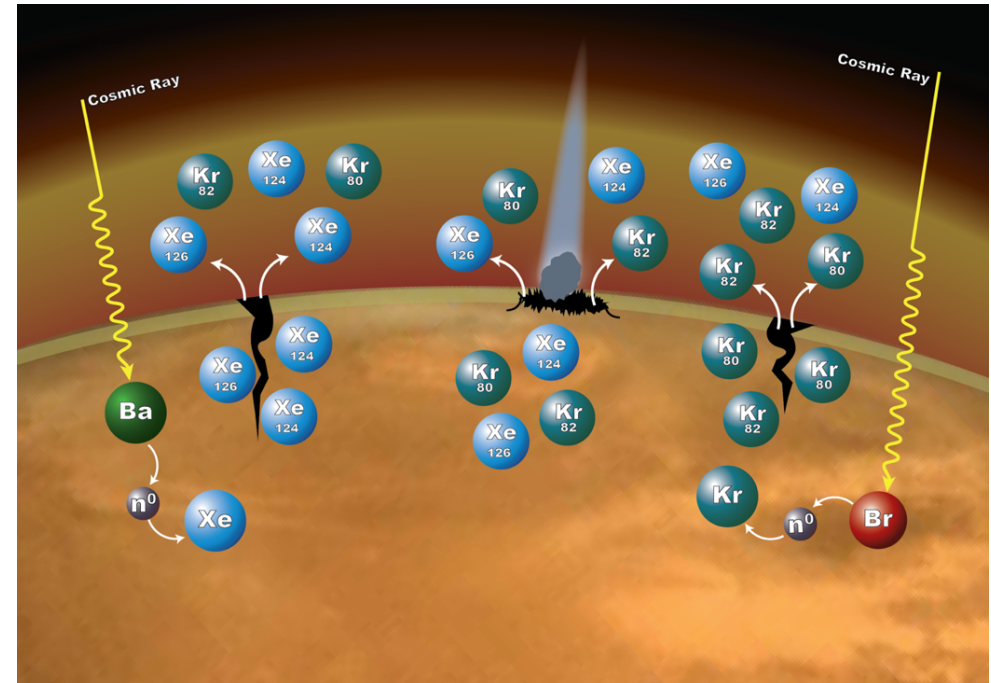
Our measurement: Goddard's SAM instrument on the Curiosity rover has measured the many isotopes of krypton (Kr) and xenon (Xe) in the martian atmosphere. Kr & Xe are big, inert atoms and their isotopes are good tracers of planetary processes.

What we learned:

- *Results from direct measurement of the martian atmosphere is a little different than results from martian meteorites!*
- We found evidence that bromine and barium interact with cosmic rays to create additional light isotopes of Kr and Xe at the martian surface! These light Kr and Xe atoms are then released into the atmosphere when the surface is disturbed by impacts and abrasion.

Impact:

- We confirm early and dramatic atmospheric loss at Mars.
- Differences between Earth and Mars atmospheres reveal how much their respective interiors have off-gassed and something about what's happened to the atmospheres AFTER they formed.
- The results make us wonder about Venus. Why do these three planets have different atmospheres when they all formed at the same time?
- We have a new benchmark for Kr and Xe measurements in the Mars atmosphere from which to compare data from meteorite studies and ultimately Venus.
- We now see that cosmic rays interact with the martian surface to increase the amounts of certain isotopes of Kr and Xe in the martian atmosphere



Why does this matter to non-scientists? It is important to understand how planetary atmospheres evolve so we can: 1) understand how much gas has escaped from the planetary interior since it formed, 2) evaluate potential habitability over time, and 3) prepare for human exploration!

P.G. Conrad, C.A. Malespin, H.B. Franz, R.O. Pepin, M.G. Trainer, S.P. Schwenzer, S.K. Atreya, C. Freissinet, J.H. Jones, H. Manning, T. Owen, A.A. Pavlov, R.C. Wiens, M.H. Wong, P.R. Mahaffy . "In situ measurement of atmospheric krypton and xenon on Mars with Mars Science Laboratory." *Earth and Planetary Science Letters* 454 (2016): 1-9.

