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Influence of suprathermal atoms on the escape and evolution of Mars' CO_2 atmosphere

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We study the escape of hot oxygen and carbon from the martian atmosphere for four points in time in its history corresponding to 1, 3, 10, and 20 times the present solar EUV flux with a Monte-Carlo model. Different source reactions of hot oxygen and carbon atoms in the thermosphere and their changing importance with the EUV flux are discussed. Furthermore, we discuss different magma ocean related and volcanic CO_2 outgassing scenarios and their interplay with thermal and non-thermal loss processes. Our results show that Mars could not have had a dense atmosphere at the end of the Noachian epoch, since such an atmosphere would not have been able to escape until today. However, early Mars could have been hot and wet during the pre-Noachian era with surface CO_2 pressures larger than 1 bar during the first 300 Myr after the planets origin.