Geophysical Research Abstracts
Vol. 12, EGU2010-9688, 2010
EGU General Assembly 2010

Aeronomical evidence for higher CO2 levels during Earth's Hadean epoch

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According to recent simulations of the Earth's thermosphere, the exospheric temperature is not expected to rise above 7000–8000 K even under extreme solar EUV conditions anticipated for the early Earth. Rather, when the solar EUV flux exceeds some critical value, the escaping flow of the bulk upper thermosphere starts cooling it due to adiabatic expansion, which results in a decrease of the exobase temperature. Under these extreme conditions, the exobase may expand above the magnetopause and the magnetosphere had not been able to protect the upper atmosphere against strong non-thermal erosion by the solar wind. It is shown that a nitrogen-rich terrestrial atmosphere with a present-day composition would have been removed within a few million years during the extreme EUV and solar wind conditions that are expected to have prevailed before the late heavy bombardment period ~ 3.8 Ga ago. Our results suggest that a CO_2 amount in the early nitrogen-rich terrestrial atmosphere of about two orders of magnitude higher than the present-time level could have confined the upper atmosphere within the shielding magnetosphere and thus might have had protected it from complete destruction.