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Atmospheric and water loss of the young Venus

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Interpretations of the Pioneer Venus mass spectrometer data on the D/H isotope ratio indicate that Venus may have had at least a water content of the order of about 0.3 % of a terrestrial ocean and even much more during and shortly after the accretion period of 1 – 300 Mrs years, depending on the unknown ratio of a continuous supply of water by comets to a blown-off and impact erosion affected atmosphere. In view of the low water abundance in Venus' present atmosphere, the planet must have lost most of its water during the early period of the active young Sun. The present study uses multi-wavelength observations by the ASCA, ROSAT, EUVE, FUSE and IUE satellites of solar proxies at various ages for the investigation of how high X-ray and EUV fluxes of the young Sun have influenced the evolution of the early Venusian atmosphere. We apply for the first time a diffusive-photochemical model and investigate the heating of the young Venus thermosphere by photo-dissociation, ionization energy and due to exothermic chemical reactions, as well as cooling due to CO_2 IR-radiation loss. Our model yields high exospheric temperatures during the first 500 Myr, which results

in dynamic blow-off and high loss for hydrogen and even high loss rates for atomic oxygen and carbon. Furthermore, we studied also non-thermal atmospheric loss rates caused by ion-pick up and photo-chemically dissociated atomic oxygen produced by dense ionospheric layers, in Venus' early atmosphere caused by high X-ray and EUV fluxes of the young Sun. We use for our pick up ion study, estimations of minimal and maximal solar wind density and velocity parameters obtained from recent astrophysical observations of Sun-like stars with different ages.