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Evidence of a transient ionopause at Mars identified with MARSIS

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Abstract

With Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) on the Mars Express (MEX) spacecraft, it is possible to measure electron densities with two methods: from the excitation of local plasma oscillations and from remote sounding. A study of the local electron density versus time for about 1000 orbits revealed that in 132 orbits it is possible to identify a very sharp step in the electron density that we interpret as an ionopause, similar to the ionopause boundary that is commonly observed at Venus. 40 of these ionopause locations are also confirmed with remote sounding data. Measurements from the Analyzer of Space Plasma and Energetic Atoms (ASPERA-3) Electron Spectrometer (ELS) and Ion Mass Analyzer (IMA) instruments on Mars Express verify that these sharp decreases in the electron density occur somewhere between the end of the region where ionospheric photoelectrons are dominant and the magnetosheath. This study shows that, although the individual ionopause cases are from a wide range of altitudes, the average altitude of the ionopause is almost constant. The average altitude is approximately 500 km up to solar zenith angles of 60^{o}, after which it shows a slight increase. The ionopause boundary shows an increase at locations with strong crustal magnetic fields.