time-independent low-L plateau observed. Internal sources or acceleration mechanisms are excluded because we did not find the signature of a source, namely, a peak in phase space density at the source location; rather, we found the signature of enhanced transport, a smooth, nearly lossless phase space profile.

For collisionless plasmas, enhanced diffusion must be caused by electric and magnetic fluctuations, yet magnetic oscillations seem unlikely for several reasons. First, sufficient wave activity has not been observed at these locations [*Takahashi and Anderson*, 1992]. Second, the magnitude of the magnetic diffusive transport goes as $|\Delta B/B|^2$ [*Fälthammer*, 1966], which for a constant ΔB, decreases as B increases closer to the Earth. We observed the opposite effect, that diffusive transport increases or remains constant with decreasing altitude. Finally, wave-particle interactions are usually more effective at causing diffusion in pitch angle than in L shell, and we did not observe much pitch angle diffusion in the data. Thus it appears that the only other option is electrostatic oscillations, changes in the electric field that are not propagating plasma waves. If the field lines are taken to be equipotentials, these fluctuations would have their origin at the footpoints in the ionosphere. Thus we argue that ionospheric electric field fluctuations are the primary cause for the enhanced diffusion below L=4.

Physically, the diffusion mechanism may be described as a resonance between the perturbation frequency of the field (electric or magnetic) and the drift frequency of the ion. At an energy of approximately 30 keV/L, the corotation $\vec{E} \times \vec{B}$ drift balances the $\vec{\nabla} B$ drift so that ions are no longer drifting around the magnetosphere. If they no longer drift, they cannot resonate with the magnetospheric fluctuations, and therefore the standard diffusion rate goes to zero. Thus there should be some energy dependence to the diffusion rate independent of the spectral power energy dependence; yet since corotation was not included in the standard model, none of the diffusion rates included such an energy dependence. A review of *Fälthammer*'s [1965] pioneering paper shows that he assumed particle energies were high enough to neglect any electric field drifts. That is, he developed diffusion coefficients for radiation belt particles that are inappropriate for ring current energies, particularly energies close to the "stall" energy of the ions. Thus the discrepancy in the "loss" region may be due to convection electric field effects that modify the diffusion coefficients. To understand this better, we must first develop a diffusion theory that incorporates static or nearly static electric fields, and then we must find a source of electric field fluctuations at the low altitudes where we have disagreement. This is the subject of the second paper.

We list our major conclusions below.

1. The quiet time ring current, as defined by energy density, is dominated by H^+, with an $1/e$ points bracketing 3–6 R_E. O^+ can often dominate the number density between L=4–5, but with a much softer spectrum and with great temporal variability.

2. Losses dominate the ring current below L=4, while convection dominates below a sharply defined edge (Alfvén layer) at ~30 keV/L. Charge exchange reactions with H^+ and He^+ in addition to neutral H were found to be important. The effect of a finite magnetospheric electron temperature was also significant, modifying the Coulomb drag losses, as well as increasing the He^+ ionization losses. Wave-particle interactions that isotropize the pitch angle distribution (e.g., ion-cyclotron waves) were found to be minimal and not included in the current model. Nor did the data display any features that could be mapped to bounce resonant waves scattering ions out of the ring current.

"convection energy edge" where drift orbits are connected to magnetotail; that is, diffusion in the standard model is only prop defined for orbits inside the Alfvén layer that can resonate oscillations. But even on closed drift orbits, where the m should be valid, we were unable to model the relatively large below L~4. We interpret this to be a failure of the model to incl the effects of ionospheric static and fluctuating electric fields.

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