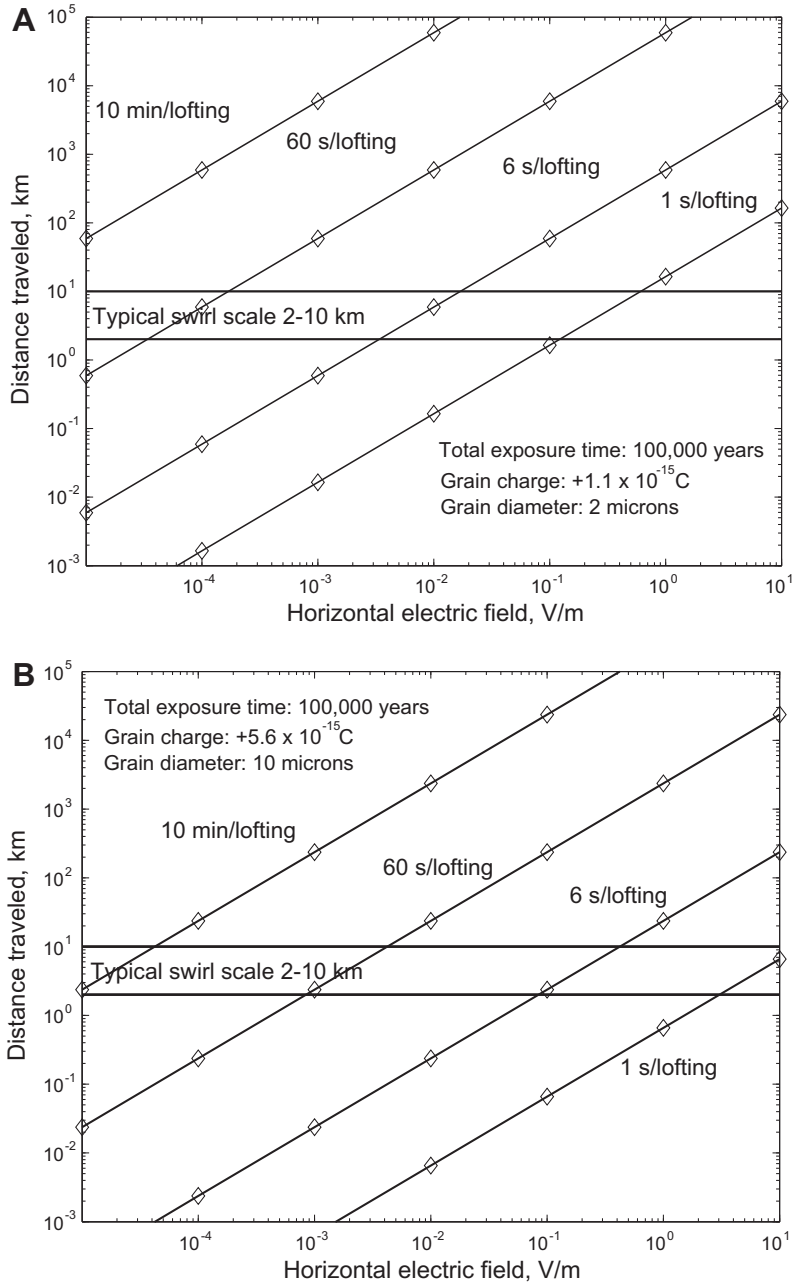

Fig. 6. Distance traveled for a grain lofted from the surface and horizontally accelerated by an electric field. The 100,000 year timescale in both figures represents the total time the grain spends exposed on the surface and assumes two loftings every 295 days, equivalent to a lofting probability of 0.1 each lunar day. The typical length scale of most lunar swirls (2–10 km) is indicated. Lofting times from 1 s to 10 min are explored. (A) Grain diameter of 2 μm. (B) Grain diameter of 10 μm.

While the above null-field models for dark lane formation are broadly consistent with observations and the dust transport model, they are admittedly speculative, and cannot be strongly constrained with available data.

4. Discussion

4.1. Implications

The net result of dust transport is removal or deposition of fine grains from a region. If every 10^5 years the minimum 2–10 μm of material are removed or deposited in a swirl region (Section 3.3), the predicted topographic change is only 8–40 cm (assuming minimal packing efficiency) after 4 By, which is the approximate maximum age of lunar features. This topographic difference may be detectable by careful studies of mare swirls with a sufficiently accurate laser altimeter. However, it is likely that topography of at least several meters would be required to resolve the features in laser altimeter tracks.

Several aspects of the dust transport model and the solar wind stand-off model can be further constrained with high-resolution spectral data that will soon be available. These include, (1) modeling mare swirl spectra as mixtures of fine grained highlands material and mare material (Bell and Hawke, 1987), which requires models that address the nonlinear effects of particle size differences, (2) measuring the spectral properties of dark lanes to constrain their relationship to normal local soil, (3) comparing soil maturity trends within swirls to those of local soils, and (4) measuring young (<100,000 year old) features not affected by the