THE MARTIAN SURFACE REVISITED: INTEGRATION OF PATHFINDER WITH GLOBAL REMOTE-SENSING AND VIKING LANDER RESULTS. B.M. Jakosky, Laboratory for Atmospheric and Space Physics and Dept. of Geological Sciences, University of Colorado, Boulder, CO 80309, email jakosky@argyre.colorado.edu.

The Mars Pathfinder images of the martian surface appear at first glance to be similar to the images obtained at the Viking landing sites two decades ago. All three sites show surfaces that consist of rocks, fine material accumulated locally, crusted material that has been cemented together, and blocky material that may be more strongly bonded. The Viking results were used in conjunction with global remote-sensing data from the Viking orbiter and from Earth-based observations to determine the global nature of the martian surface layer. Both from the scientific perspective and from the perspective of planning for future rover missions, the martian surface layer was generally thought to consist of these materials mixed and matched in various proportions.

However, there is one fundamental difference between the Pathfinder site and the Viking sites. The geology at the Viking sites was not thought to connect up to the 100-meter-scale geology that was seen from orbit. That is, features could not be recognized at the surface that were thought to have been produced by the same processes that were responsible for having produced the features seen in orbiter images.

For example, the Viking-1 landing site lies near the terminus of flows from some of the catastrophic floods, and on terrain that, from orbit, appears to be volcanic in origin. Yet, at the surface, there is nothing that is obviously identifiable as either flood-related or volcanic. At the time of Viking, there were suggestions that the rocks and other deposits at the landing site had been produced by erosion of materials deposited either by floods or volcanism, but nothing specific could be identified. This led to the sense that the meter-scale features had been produced by different processes, and that the meter-scale geology was in some sense decoupled from the hundred-meter-scale geology.

At the Pathfinder site, however, features are seen at the ground that were produced by the same processes as produced the hundred-meter-scale features seen from orbit. In particular, undulations are seen at the 10-m scale that are likely to have been produced by the flooding that permeated the area. Also, rocks seen at the landing site are lined up one against another in a manner suggestive of imbrication, in which the rocks are pushed one against another during the period in which the flood waters were diminishing. Both of these features suggest that the meter-scale geological features were produced by the same processes as were responsible for producing the 100-m-scale features--catastrophic flooding--and that the surface has been modified sufficiently little during the intervening billion or so years that these features are still fully recognizable.

The fact that these features can be seen at this site suggests that the post-Viking interpretation is not quite accurate. It suggests that the surface cannot be represented as simply a mixture of different types of materials in different abundances. Rather, it suggests that other sites might allow the underlying geology to show through at the surface.

How would we reinterpret the Viking results in this context? Without further information, it is hard to arrive at a unique interpretation. The most likely scenario is that the surfaces of the two Viking landing sites actually do show evidence for the same processes that can be seen from orbit, but that it cannot be recognized.

The significance of this difference is two-fold:

First, the martian surface cannot automatically be thought of as simply having various combinations of the different materials. Rather, the surface layer must in some sense reflect the physical properties of the underlying geology. This underlying bedrock geology may be partly or entirely masked by subsequent processes, including deposition and removal of dust, formation of duricrust, physical or chemical weathering of surface materials, and so on.

Second, surface trafficability by a rover may be much more complicated than simply trying to move around in a field that consists of various amounts of these different materials. This is especially important for the upcoming rover missions, as they will be attempting to visit geologically interesting sites in a desire to find evidence of present or past life. The geologically interesting sites, if they in fact do reflect the underlying geology, may be especially difficult to traverse. For example, a volcanic landing site that might be searched for evidence of hydrothermal systems may reflect volcanic topography that a meter-scale rover might not be able to traverse. If the Mars Surveyor ‘01 and ‘03 rovers visit such interesting sites, which one would hope that they would, they may not be able to travel the tens of kilometers required in order to get from the landing location to the specific sites of interest; they may not be able to go more than a small fraction of that.