Pathfinder *(from p. 3)*

the west before the lander came to rest at its present location.

Five prominent horizon features and two small craters were identified in both lander horizon and Viking Orbiter images, enabling the lander to be located within 100 m of other surface features at 19.13°N, 33.22°W in the U. S. Geological Survey reference frame. Because the Pathfinder's location has also been determined in inertial space from two-way ranging and Doppler tracking results, it is the best-known location on Mars and provides a tie point for locating surface features on Mars.

Many characteristics of the landing site are consistent with its being a plain composed of materials deposited by the Ares and Tiu catastrophic floods. The rocky surface is composed of subangular to subrounded pebbles, cobbles, and boulders that generally resemble depositional surfaces produced in terrestrial catastrophic floods. The Twin Peaks appear to be streamlined hills in lander images, consistent with interpretations of Viking Orbiter images of the region, which suggest the lander is on the flank of a broad, gentle ridge or debris tail deposited in the wake of Twin Peaks. Rocks in the Rock Garden may be imbricated or inclined blocks generally tilted in the direction of flow. Troughs visible throughout the scene may be primary features produced by the flood, or they may result from the late-stage drainage of water after deposition. Large rocks appear tabular, subrounded, and many are perched, consistent with deposition by a flood. Except for eolian activity that may have deflated the surface by 5-7 cm, the site appears little altered since it formed up to a few billion years ago.

A variety of soil types have been found at the site and appear consistent with poorly crystalline or nanophase iron-bearing materials. Elemental compositions of soil units measured by the Alpha Proton X-Ray Spectrometer (APXS) are generally similar to those measured at the Viking sites. Because the Pathfinder and Viking landers are widely spaced, the similarities in soil

A closeup Sojourner image of a rock called Souffle at the Mars Pathfinder Landing Site

compositions suggest that the compositions are influenced by globally distributed materials on Mars, such as the airborne dust. The similarity in compositions among the soils implies that the differences in color may be due to either slight differences in iron mineralogy, differences in particle size and shape, or the fact that the soils are likely complex mixtures of a variety of weathering products

In general, the rocks are dark gray with discontinuous coatings of bright dust and/or weathered surfaces. The rock chemistry measured by the APXS is similar to basalts, basaltic andesites, and andesites on Earth. Generally linear relationships between the red/blue ratio of the rocks, their silica or sulfur content, and the average soil composition suggest that dark, high-silica rocks are coated with sulfur-rich dust. This relationship allows a dust-free rock composition to be calculated, which is andesitic in composition and distinct from the mafic and relatively silica-poor martian meteorites found on Earth. The chemistry and normative mineralogy of the sulfur-free rock are similar to those of common terrestrial anorogenic andesites, such as icelandites, which formed by fractional crystallization of mantle-derived parent materials. Rover close-up and lander images show rocks with a variety of morphologies, textures, and fabrics such as pitted, smooth, bumpy, layered, and lineated, suggestive of a variety of rock types. Some of the rocks may be conglomerates, composed of rounded pebbles with reflective hemispheric pockets or indentations where pebbles originally embedded in a finer matrix have fallen out. Rocks such as these could be the source of numerous loose rounded pebbles and cobbles on the surface. If the rocks are conglomerates, they require running water to smooth and round the pebbles and cobbles over long periods of time. The rounded materials would then be deposited into a finer-grained sand and clay matrix and lithified before being carried to the site. This evidence suggests a warmer and wetter past in which liquid water was stable and the atmosphere was thicker.

The magnetic properties experiment shows that airborne magnetic dust has been progressively deposited with time on most of the magnetic targets on the lander. The dust is light yellowish brown and has a magnetization and chemistry consistent with composite clay-sized silicate particles with a small amount of a very magnetic mineral, believed to be maghemite, as stain or cement. The favored interpretation of these results is that iron was dissolved out of crustal materials in water, suggesting an active hydrologic cycle at some time on Mars, and that the maghemite is a freeze-dried precipitate.