localized deposits of young materials are possible in the highlands, and mature, winnowed sediments are possible in the plains. Interpretation of chemical anlyses of fan materials without corresponding petrologic comparison will be challenging.

In all probability, the final choice of a landing site will be a level lowland within the planatiae. A sedimentary surface of an essentially monomineralic, eolian (sand or loesslike) material or a lacustrine deposit should not be a surprise.

References: [1] Scott D. H. and Tanaka K. L. (1986) *USGS Misc. Inv. Ser. Map I-1802-A.* [2] Greeley R. and Guest J. (1987) *USGS Misc. Inv. Ser. Map I-1802-B.* [3] De Hon R. A. and Pani E. A. (1993) *JGR, 98,* 9129–9138. [4] Wilhelms D. E. (1976) *USGS Misc. Inv. Ser. Map I-895.* [5] Rice J. W., this volume. [6] Rice J. W. and De Hon R. A. (1994) *USGS Misc. Inv. Ser. Map I-2432.*

OPPORTUNITY TO SAMPLE SOMETHING DIFFERENT: THE DARK, UNWEATHERED, MAFIC SANDS OF CERBERUS AND THE PATHFINDER 1997 MARS LANDING.

K. S. Edgett[1], R. B. Singer[2], and P. E. Geissler[2], [1]Department of Geology, Box 871404, Arizona State University, Tempe AZ 85287-1404, USA, [2]Planetary Image Research Laboratory, Department of Planetary Sciences, University of Arizona, Tucson AZ 85721, USA.

Dark Material Critical to Understanding Mars Surface: A very important surface component, typically described as "dark gray material" [1], was not seen at the Viking lander sites, but is common to all low-albedo regions on Mars. Dark material probably includes unaltered mafic volcanic and/or crustal rock and soil not coated by dust, weathering rinds, or varnish [2].

A Pathfinder landing in Cerberus (9°N–16°N, 194°W–215°W) will guarantee examination of materials that are distinctly different from the two Viking lander sites. *In situ* study of dark material will provide vital ground truth for orbiter-based observations like those anticipated from Mars '94/'96 and Mars Global Surveyor.

Surface Properties and Regional Context: The Cerberus region is (1) not as rocky as the Viking sites, (2) not blanketed by dust, and (3) offers sampling of a range of rock and soil types including lava flows of different ages, ancient crustal rock, dark sand, bright dust, and possible fluviolacustrine materials. Cerberus lies between 0 and –1 km elevation (±1 km; USGS 1991 topography), and is large enough to meet our main objective within the landing ellipse constraints. Cerberus is an active eolian environment, but major dune fields are absent and activity is not as vigorous as in Syrtis Major [3]. The landing will occur in northern summer, a period when predicted winds are not at their strongest in the region [4].

The dark surfaces have low albedos (<0.15) and intermediate thermal inertias [5] (300–400 J m^{-2} $s^{-0.5}$ K^{-1}), which indicate that much of this material is sand (100–1000 µm). Rock abundance [6] varies from ~12% in the east, where the surface has many knobs and mesas, to ~1% in the west, with average over most of Cerberus ~7%. (Viking 1 rock abundance was ~10% and Viking 2 was ~20% [5]).

The dark soil of Cerberus is superposed on several different geomorphic features. Central and western Cerberus is underlain by Early Amazonian volcanic flows originating on the Elysium Rise [7]. Cerberus is bounded in the south and east by interpreted paleolake deposits [7,8] and very recent (0 to 700 Ma) lava flows [9]. Eastern Cerberus includes a smooth surface of Late Amazonian fluvial, lacustrine, and/or volcanic deposits [7–9] and Noachian(?) mesas and knobs of the Tartarus Colles [7].

Dark Material and Source: Dark sand has been transported through and deposited within Cerberus [3,10,11]. Lateral variation in sand deposit thickness is probable, with sand filling low areas on and between lava flows. Dark material has blown from east to west over the lava flows of southern Elysium, perhaps making Cerberus similar to the Amboy volcanic field of Southern California. Amboy has lava flows overlain by windblown sand stripped from an upwind dry lake [12].

Dark material might be eroded from sediments of the proposed lacustrine basin [8] east of Cerberus. Alternatively, the sand may have a volcanic source, perhaps pyroclastic material from the Elysium volcanos or from eruptions along the Cerberus Rupes fractures. Dark material appears to emanate from some Cerberus Rupes fractures ([11], Viking image 883A09). Do the fractures expose a layer of dark material that is now eroding [10,11]? Did dark material from the east fill the fractures, and now is being deflated? Or were the fractures the sites of pyroclastic eruptions? One fracture seen in the upper left corner of Viking frame 385S23 has a dark, semi-elliptical mantle deposit similar to pyroclastic deposits on the Moon and Io.

Pathfinder Science: Cerberus is large enough that several landing sites could be chosen. Although any landing in Cerberus will satisfy our main objective, we suggest a site near 13°N, 200.5°W (see Viking frame 883A06), because it has both dark material and proximity to the three major geomorphic units in the region (lava flows, possible lake sediments, and knobs of ancient crust). In addition, at this site there is a dark lobe that appears to emanate from a Cerberus Rupes fracture (Viking frames #883A04-06) that might be one of the youngest, unaltered lava flows on Mars. Although not reporting on this specific flow, Plescia [9] proposed that the Cerberus Rupes were the source of some very young lava flows (<700 Ma).

The main objective for a Cerberus landing will be to determine the composition and physical properties of dark soils thought to be derived from unaltered primary igneous crustal material. Characterization of the size, shape, and mineralogy of dark grains 0.1 mm to 10 cm will allow assessment of sediment maturity. Is martian sand formed of ancient, resistant mineral grains or fresher, easily altered material? The answer to this question will place constraints on chemical weathering and eolian abrasion rates. Bright wind streaks in the lee of craters in Cerberus suggest that dust might also be available for sampling, particularly in the lee of meter-scale obstacles. Finally, the presence of sand or granule wind ripples would provide insight into the nature of surface-atmosphere interactions on Mars.

References: [1] Arvidson R. E. et al. (1989) *JGR, 94,* 1573–1587. [2] Singer R. B. et al. (1979) *JGR, 84,* 8415–8426. [3] Lee S. W. (1986) *LPI Tech. Rpt. 87-01,* 71–72. [4] Greeley R. et al. (1993) *JGR, 98,* 3183–3196. [5] Christensen P. R. and Moore H. J. (1992) in *Mars,* 686–729, Univ. of Arizona, Tucson. [6] Christensen P. R. (1986) *Icarus, 68,* 217–238. [7] Tanaka K. L. et al. (1992) *USGS Map I-2147.* [8] Scott D. H. and Chapman M. G. (1991) *Proc. LPS, Vol. 21,* 669–677. [9] Plescia J. B. (1990) *Icarus, 88,* 65–490. [10] Head J. N. et al. (1991) *BAAS, 23,* 1176. [11] Head J. N. et al. (1992) *LPS XXIII,* 509–510. [12] Greeley R. and Iversen J. D. (1978) in *Aeolian Features Southern California: A Comparative Planetary Geology Guidebook,* 23–52, NASA.