Potential Landing Sites in Margaritifer Basin, Margaritifer Sinus, Mars; John A. Grant, *SUNY College at Buffalo, Earth Sciences, Buffalo, N.Y., 14222, jgrant@hq.nasa.gov..

Overview of Proposed Landing Sites: Two landing sites (10.00^0S, 21.79^0W and 10.85^0S, 21.62^0W) within the confluence plain of Samara, Parana/Loire, and Margaritifer Valles are proposed for either the 2001, 2003, or 2005 Mars Surveyor Lander. Both of the proposed landing sites are approximately 1 km above the planetary datum (1). Observation and sampling of a portion of this depositional plain, hereafter referred to as Margaritifer Basin, should help constrain the origin of the enigmatic valley systems and help define the water and climate cycle during the early history of the planet (see below). Moreover, the high probability of directly sampling water-lain deposits derived from a broad area of the Martian highlands maximizes the likelihood of identifying possible evidence of biotic or pre-biotic processes. The opportunity to sample material ejected during formation of nearby craters or exposed in erosional remnants adjacent to the sites enhances the possibility of achieving these objectives.

The long axis of the expected landing ellipse will be 10-15 km (2) and fits well within relatively low relief (at coarse topographic scales) sections of the areally extensive basin surface characterizing both sites. Viking images, IRTM, and albedo data for the sites (3-6) suggest the surface is characterized by minimal eolian cover and a rock abundance that fits in a range of possible values. Estimated surface rock abundance is between 2-20%, but actual values on the lower relief landing site surfaces may lie towards the lower end of this range. While the "best" estimate of rock abundance is ~8-20%, this value may reflect the coarse scale of the data that incorporates relief punctuating portions of the confluence plain (mainly erosional remnants and outliers of collapse associated with nearby Margaritifer Chaos). Unfortunately, the best Viking Orbiter images of the landing sites possess resolutions <100 m/pixel and are not sufficient to evaluate the detailed morphology, thereby helping to better refine estimates of block abundance. Collection of MGS MOC and TES data of the sites is therefore considered a high priority.

Estimated thermal inertia, rock abundance, and other parameters that help to characterize the proposed sites are listed below. Predicted radar reflectivity and RMS slope are poorly constrained, but could be improved using recent radar data for the region (7).

· **Latitude:** 10.00^0S, 21.79^0W (northern) and 10.85^0S, 21.62^0W (southern)

· **Elevation:** Approximately 1 km above planetary datum (both sites)

· **Thermal Inertia:** ~8-10 (10^{-3}cal cm^{-2}s$^{-1/2}$K^{-1})

· **Albedo:** ~0.15 (approximate)

· **Rock Abundance:** 2%-20% (best estimate 8-20%?)

· **Radar Reflectivity:** ~3%-9% (estimated from data in 4)

· **RMS Slope:** ~1.5-3 (estimated from data in 4)

Regional Drainage Networks: The basins of the northwest draining Samara and Parana/Loire valley systems cover a combined area of 535,550 km^2 and incorporate some of the best integrated valleys on Mars (8-15). By contrast, Margaritifer Valles is the terminal segment of an integrated meso-scale outflow system heading south of Uzboi Valles and draining northeast through Holden Crater, Ladon Valles, and Ladon Basin. The confluence plain at the terminus of these systems straddles the axis of the Chryse Trough and both landing sites together with nearby Margaritifer Chaos may comprise the source region for some of the fine sediment transported along Ares Vallis to the vicinity of the Sagan Memorial Station (16). As a depositional plain formed at the confluence of valley networks and a meso-scale outflow channel, Margaritifer Basin likely contains a diverse assemblage of sediments recording the geologic and climatic evolution of the Martian highlands.

Sequence of Geologic Events: Geologic mapping of Margaritifer Basin at 1:500,000 (MTM quadrangles -10012 and -15022) is underway as part of a NASA funded effort. Assessment of morphologic and stratigraphic relationships in the region is assisted by interpretation of crater statistics (compiled using methods described in 13, 17) and results of other studies (*e.g.*, 18-23). The oldest recognizable features are the degraded Holden, Ladon, and Noachis multi-ringed impact basins (21, 22) whose structural elements influenced the location of the later forming valleys and channels. Three events resurfaced portions of the region after formation of these basins: the first two were during the early-Noachian period of heavy bombardment (21) with the second drawing to a close at an N5 age of 1400 (number of craters larger than or equal to 5 km in diameter per 1,000,000 km^2). The third resurfacing event began during the mid-Noachian (N5 of 500) and drew to a close in the late-Noachian (N5 of 300) coincident with waning highland volcanism (21).

Formation of all valley networks, the nearby Uzboi/Holdon/Ladon/Margaritifer meso-scale outflow system, and their associated depositional sinks (including Margaritifer Basin) followed the third resurfacing event and occurred between the late-Noachian and early-Hesperian (N5 of 300 to 150). The low albedo markings on the floor of Margaritifer Valles extend across a portion of the basin and suggest flow from the outflow system dominated the last stages of basin infilling. Margaritifer Chaos lies at the northern end of the basin and began to form near the end of the third resurfacing event with collapse likely continuing into the latest-Hesperian/earliest-Amazonian (21). A final, more localized resurfacing event emplaced materials that always embay valleys and continued through much of the early and mid-Hesperian (N5 ages 200 to 70). More recent events include localized eolian and mass wasting modification.

Summary: The proposed landing sites occur within a portion of the Martian highlands preserving a long and complex history of geologic activity. Observation and sampling of materials emplaced within Margaritifer Basin during the late-Noachian and early-Hesperian should lead to a refined understanding of early Mars climate during formation of valley networks and would help calibrate crater production models (*e.g.*, 24-26). Collectively, this information would help constrain the global water cycle.

Finally, landing on the materials forming the confluence plain suggests a diverse assemblage of water-lain materials may be directly sampled and could help evaluate the possibility of past biotic activity on Mars. Distinction between the better of the two sites awaits further definition of the allowable latitude band for landing and analysis of radar and higher resolution MGS TES and MOC data. Research supported by NASA grant NAG5-4157.

References: **(1)** US Geological Survey, 1991, *Atlas of Mars* I-2160, USGS, Flagstaff, AZ. **(2)** Mars Surveyor 2001 Project, 1998, 14-25, *in* Mars Surveyor 2001 Landing Site Workshop, NASA-Ames Research Center, Moffett Field, CA. **(3)** Pleskot, L.K. and Miner, E.D., 1981, *Icarus*, **45**, 179-201. **(4)** Christensen, P.R., 1986, *Icarus*, **68**, 217-238. **(5)** Christensen, P.R. and Moore, H.J., 1992, 686-729, *in* Kiefer, H.H., *et al*., *Mars*, Univ. Arizona Press, Tucson, AZ. **(6)** Zimbelman, J. R., 1986, *NASA Tech. Memo*. **88784**, p. 271-572. **(7)** Haldemann, A.F.C., *et al*., 1998, 13, *in* Mars Surveyor 2001 Landing Site Workshop, NASA-Ames Research Center, Moffett Field, CA. **(8)** Carr, M.H., 1981, *The Surface of Mars*: New Haven, Conn., Yale University Press, 232p. **(9)** Carr, M.H., and Chuang, F.C., 1997, *J. Geophys. Res*., **102**, 9145. **(10)** Carr, M.H. and Clow, G.D., 1981, *Icarus*, **48**, 91. **(11)** Pieri, D.C., 1980, *Science*, **210**, 895. **(12)** Baker, V. R., 1982, *The Channels of Mars*: Austin, Texas, University of Texas press, 198p. **(13)** Grant, J. A., 1987, *NASA Tech. Memo.* **89871**, p. 1-268. **(14)** Grant, J.A., 1997, *LPSC XXVIII*, 451-452 LPI, Houston, Texas **(15)** Grant, J.A., 1998, *LPSC XXIX*, LPI, Houston, Texas (in press). **(16)** Golombeck, M.P., *et al*., 1997, *Science*, **278**, 1743. **(17)** Grant, J. A. and Schultz, P. H., 1990, *Icarus*, **8**4, 166. **(18)** Craddock, R.A., *et al*., 1997, *J. Geophys., Res*., **102**, 13,321. **(19)** Goldspiel, J.M., and Squyres, S.W., 1991, *Icarus*, **89**, 392. **(20)** Goldspiel, J.M., *et al*.., 1993, *Icarus*, **105**, 479. **(21)** Scott, D.H. and Tanaka, K.L., 1986, USGS Map I-1802-A. **(22)** Schultz, P.H. and Glicken, H., 1979, *J. Geophys. Res*., **84**, 8033. **(23)** Saunders, S.R., 1979, *USGS Map* I-1144 (MC-19). **(24)** Soderblom, L.A., *et al*. 1974, *Icarus*, **22**, 239-263. **(25)** Neukum, G. and Wise, D.U., 1976, *Science*, **194**, 1381-1387. **(26)** Neukum, G. and Hiller K., 1981, *J. Geophys. Res*., **86**, 3097-3121.

Present Address: NASA Headquarters, Code SR, 300 E Street, SW, Washington, DC, 20546.

.