RATIONALE FOR A MARS ROVER/SAMPLE RETURN MISSION TO CHRYSE PLANITIA AND THE VIKING 1 LANDER; Robert A. Craddock, Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, DC 20560

As a precursor to a sample return mission and/or manned mission to Mars, landing sites that are both safe and scientifically interesting must be determined. Potential sites could ultimately affect spacecraft design and development and determine the range of scientific objectives possible. The earlier potential sites are selected, the more cost and time efficient mission planning and operations will be. However, Mars has as much land surface area as the continental crust of the Earth and exhibits a wide variety of geologic processes and features thus making site selection an arduous task.

So why go back to Chryse Planitia, an area previously explored by the Viking 1 Lander? One of the best reasons is that we have already been there. Viking 1 landed successfully, proving that it is safe and providing us with valuable ground-truth observations of the martian surface. For example, Viking Lander 1 data have provided information useful in determing the physical properties of the martian surface materials [e.g., 1]. Observations such as these will undoubtingly be incorporated into any future spacecraft design--no matter where the designated landing site is located. In addition, Chryse Planitia still represents one of the lowest spots on the surface of Mars (>2 km below mean Mars datum; 2), providing more atmosphere to slow down a landing vehicle. Its equatorial location (~20° N lat.) allows contact with both polar and equatorial orbiting spacecraft along with direct line-of-site communications with the Earth, an added bonus when sending commands to a moving vehicle. The extensive photographic coverage of Chryse Planitia by the Viking Orbiters and Earth-based radar observations have provided 100 m resolution topography in the vicinity of the Viking 1 Lander [e.g., 2]. Analysis of these data and lander photographs indicate that Chryse Planitia may be unique in that features >50 km away from the lander (such as the rims of Lexington and Yorktown craters) are visible over the horizon [3]. This information could potentially provide a valuable check for determining the location of the spacecraft on the surface and aid in roving vehicle navigation.

Ideally a landing site should include access to as many different geologic units as possible. In addition to the materials debouched into the Chryse basin by the large martian channel complex [e.g., 4], the Hesperian age ridged plains covering much of region [5] may represent the single most important geologic unit needed for age-dating materials on Mars. Composing ~3% of the total Mars surface area [6], the ridged plains are fairly widespread in comparison to other geologic units and, more importantly, are the Hesperian epoch referent [7]. Because the Hesperian epoch represents the interval of time immediately following the period of heavy bombardment (~3.8 Ga; 8), an absolute age determined from a ridged plain sample would allow estimates of the post-heavy bombardment impact flux on Mars to be calibrated. It may then be possible to determine the absolute ages of every younger geologic unit on Mars based on crater statistics. In addition, materials washed down from the highlands <u>may</u> be present in the vicinity of Lander 1. Although the absolute ages of these materials almost certainly correspond to the period of heavy bombardment, analysis of their composition could provide some insight into the early geologic history of Mars. Also the distribution of the materials in Chyrse Planitia as determined by a manned or unmanned traverse may be indicative

of the channel formation mechanism. For example, catastrophic flooding would lead to a Bouma sequence deposit in the Chryse basin [9]; in liquefaction, an accretionary lobe in the debouching area results in larger particles dropping out first with smaller particles being transported greater distances [10].

Because of the likelihood of running water debouching into Chyrse Planitia in the past, the Viking 1 landing site was considered an ideal place to look for complex organic molecules [11]. Although the Viking biological experiments did not identify the presence of organic life [12], controversy still exists as to the meaning of the Label Release Experiment [13]. Knowing the position of Viking 1 on the surface to within 50 m [14], it would be possible to navigate to the landing site and obtain the same soil samples investigated by the lander. Rocks seen in lander images could also be returned to Earth, answering questions concerning their compositional and erosional properties. A piece or pieces of Lander 1 itself could be obtained! Especially easy to recover is the small latch pin released when the lander sampler shroud was jettisoned. This 8.2 cm long and 0.6 cm diameter pin fell within 1 m of the lander, weighs 11.3 g, and has been exposed to the martian environment for a known period of time. No special tools would be needed to obtain the latch pin, and analysis upon return to earth would provide erosion rates and other information useful in understanding geologic processes. In situ erosional analysis of Lander 1 itself could also have implications on the development of future martian spacecraft materials. In addition, it may be possible to navigate from the lander to the crater caused by the jettisoned Viking aeroshell. Ejecta from this fresh crater would represent Chryse stratigraphy at depth, providing a possible alternative if a drill sample is determined impractical for the early sample return missions. Yorktown, a 7.9-km-diameter "rampart" [15] or "fluidized ejecta" crater [16], is ~45 km northwest of the Viking 1 landing site as well. Samples of the ejecta from Yorktown could determine how much volatile material is involved in rampart crater formation [e.g., 15], if any at all [17]. Following the Xanthe Dorsa ridge north for ~34 km from the Viking 1 Lander to the crater San Juan, Yorktown is ~22 km to the west. An active seismic or sounder experiment operated along the Xanthe Dorsa ridge traverse could provide clues to the ridge structure and the underlying Chryse basin stratigraphy.

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