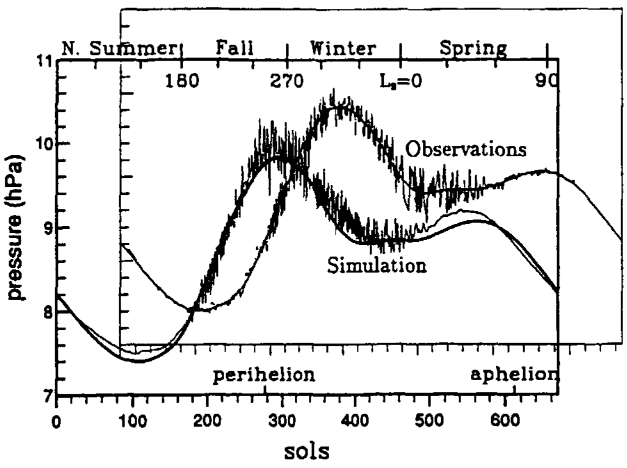

Fig. 1. Observations and simulation of the VL2 site surface pressure.

particular point of view, much could be learned from a future lander located in the southern hemisphere. As we were able to simulate the surface-pressure variation from any point on the planet, we have used the LMD GCM to investigate the climatological properties of the different possible landing sites. Figure 2 shows the surface pressure as simulated at three different points in Isidis Planitia. As in the other possible landing areas, the amplitude of the transient eddies is found to decrease with latitude. Longitudinal differences between the areas below 0 km are small, except that the VL1 site in Chryse Planitia seems to be surprisingly more active than any other possible landing site at the same latitude. The seasonal meteorological component of the annual pressure cycle is minimum at the

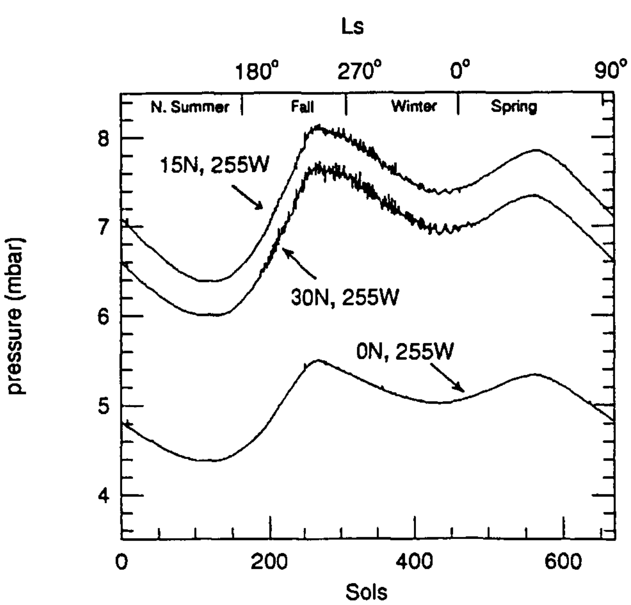

Fig. 2. Simulation of the surface pressure of Isidis Planitia.

equator, thus the local pressure oscillations should reflect the oscillation of the planetary averaged surface pressure, providing a more accurate estimation of the total atmospheric mass than with the Viking data. Such a location near the equator would extend the latitudunal coverage of the Viking Landers. It should also be interesting to observe the behavior of the atmospheric waves and local winds, where the Coriolis force is negligible. Therefore, from a meteorological point of view, we think that a landing site located near or at the equator would be an interesting choice.

References: [1] Talagrand et al. (1991) *BAAS, 23,* 1217. [2] Hourdin et al. (1993) *J. Atmos. Sci., 50,* 3625–3640.

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PATHFINDER LANDING SITES AT CANDIDATE SNC IMPACT EJECTION SITES. M. P. Golombek, Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA 91109, USA.

If Mars Pathfinder were able to land at a site on Mars from which the SNC meteorites were ejected by impact, the Pathfinder mission would essentially represent a very inexpensive sample return mission. If this were possible, a particularly significant benefit to Mars science would be having a radiometric age date on a sample from a known location on Mars, which would enable a more precise assignment of absolute ages to the crater/stratigraphic timescale for Mars. Providing such a date would substantially improve our interpretation of the absolute age of virtually all events in the geological, climatological, and atmospheric evolution of Mars. This abstract evaluates the possibility of landing at potential SNC ejection sites and the ability of Pathfinder to identify the landing site as the place from which a SNC meteorite came. Unfortunately, although considerable information could be gained from Pathfinder that might support the hypothesis that the SNC meteorites have indeed come from Mars, it is likely not possible to uniquely identify a site on Mars as being a SNC meteorite ejection site.

Shergottites, nakhlites, and Chassigny (SNC meteorites) are unique mafic to ultramafic meteorites with young crystallization ages that are believed to have been ejected from the martian surface by impact and traveled to Earth [1,2]. Recent interpretations suggest that the shergottites have different crystallization ages and cosmic ray exposure times from Chassigny and the nakhlites (180 m.y. and <2.5 m.y. vs. 1.3 b.y. and 11 m.y. respectively), implying different impact ejection events on Mars [see 3 and references therein]. The young ages of these meteorites and crater-absolute age timescales [4] related to martian stratigraphy [5] limit their place of origin on Mars to Upper Amazonian (shergottites) and Middle or Early Amazonian (Chassigny and the nakhlites) volcanics on Mars. Tharsis is the only area on Mars that has regionally extensive lava flows of Middle and Upper Amazonian age with fresh impact craters larger than 10 km diameter, required to eject the rocks from Mars [6]. Nine fresh (young) impact craters greater than 10 km diameter have been identified on Amazonian volcanics around the Tharsis region [6]. Of these, craters 1 and 2 are below 2 km elevation and within 10° latitude of 15°N. In addition, two other craters in Middle Amazonian lava flows of Amazonis Planitia, northwest of Olympus Mons, are possible SNC craters that are between 20°N and 30°N latitude and below 0 km elevation. Geologic units in which these craters are found could be visited by Pathfinder. These four sites are described below.

Crater 1 is 11.6 km in diameter, located at 10.8°N, 135.2°W (1.5 km elevation) on Upper Amazonian lava flows (Unit Aop [7]) around Olympus Mons. This unit is composed of some of the youngest lava flows on Mars with crater densities suggesting ages of less than 250 or 700 m.y. (depending on crater-absolute age timescale [4]), which makes the crater a candidate ejection site for the shergottites. A 200-km × 100-km landing ellipse would easily fit in this unit. From the crater, the Olympus Rupes scarp is about 1° above the horizon and Olympus Mons is about 1.5° above the horizon, which would register on 15 and 26 pixels respectively in the Imager for Mars Pathfinder (IMP). Landing on unit Aop directly adjacent to Olympus Rupes would result in 9° of scarp above the horizon (or ~160 IMP pixels). As a result, imaging of a large scarp (and any exposed stratigraphy) and volcano (and clouds referenced to an altitude) should be possible at this landing site, provided they are not obscured by local obstacles or topography.

Crater 2 is a 29.2-km-diameter oblique impact crater located at 24.8°N, 142.1°W (0 km elevation) on Upper Amazonian Olympus Mons aureole material (unit Ae [7]). This unit is also very young, although the origin of the aureole material is quite uncertain. Landing on unit Ae directly adjacent to Olympus Rupes (100 km away due to landing uncertainty) would result in ~5° of scarp above the horizon (or 85 IMP pixels), although Olympus Mons would not be in view.

Two other craters 26 km and 28 km in diameter located at 29.5°N, 153°W and 23.5°N, 152°W (elevations between -1 km and -3 km) respectively are located in Middle Amazonian lava flows (unit Ae3 [7]) in Amazonis Planitia, northwest of Olympus Mons. These craters, originally proposed for the SNC meteorites by Jones [8], were dismissed by Mouginis-Mark [6] due to their mantling by smooth plains of apparent windblown origin. Nevertheless, geological relations nearby indicate this smooth material is underlain by lava flows, so that impacts into this unit by these two fairly large craters could have easily excavated underlying lavas.

Pathfinder is equipped with three instruments that could help identify the rock types near the landing site. The alpha proton X-ray spectrometer (APXS) will determine the elemental abundances of most light elements except hydrogen. This instrument, mounted on the rover, will measure the composition of rocks and surface materials surrounding the lander. In addition, the cameras on the rover will take millimeter-scale images of every APXS measurement site, so that when combined with the spectral images from the lander IMP, the basic rock type and its mineralogy should be decipherable. For the most part this data should be enough to determine if the rocks at the Pathfinder landing site are consistent with SNC mineralogy; i.e., are the rocks mafic to ultramafic cumulates or fine-grained lavas? If the answer is affirmative, the observation significantly strengthens the interpretation that the SNC meteorites do, in fact, come from Mars. Unfortunately, this does not by itself establish that the SNC meteorites came from the Pathfinder landing site. Establishing this may be difficult if not impossible for a remotely operated lander on Mars. The kinds of tests required might include minor- and trace-element chemistry, as well as oxygen and carbon isotopes, and it is not clear that these measurements, by themselves, uniquely identify that the SNC meteorites came from a particular site as opposed to coming from Mars in general. In addition, most lava flow fields are heterogeneous on a local scale, exhibiting a variety of mineralogies in close proximity. Thus, landing on a flow that has a mineralogy closely matching that of a SNC meteorite would be serendipitous.

Geologic units that contain four potential impact craters from which SNC meteorites could have been ejected from Mars are accessible to the Mars Pathfinder lander. Determining that SNC meteorites came from a particular spot on Mars raises the intriguing possibility of using Pathfinder as a sample return mission and providing a radiometric age for the considerably uncertain martian crater-age timescale. Pathfinder instruments are capable of determining if the rock type at the landing site is similar to that of one or more of the SNC meteorites, which would strengthen the hypothesis that the SNC meteorites did, in fact, come from Mars. Unfortunately, instrument observations from Pathfinder (or any remotely operated landed vehicle) are probably not capable of determining if the geologic unit sampled by the lander is definitively the unit from which a SNC meteorite came from as opposed to Mars in general or perhaps a particular region on Mars.

References: [1] Wood C. A. and Ashwal L. D. (1981) *Proc. LPS 12B*, 1359–1375. [2] McSween H. Y. (1985) *Rev. Geophys., 23*, 391–416. [3] Treiman A. H. (1994) *LPS XXV*, 1413–1414. [4] Hartmann W. K. et al. (1981) in *Basaltic Volcanism*, 1049–1127, Pergamon, New York; Neukum G. and Wise D. U. (1976) *Science, 194*, 1381. [5] Tanaka K. L. (1986) *Proc. LPSC 17th*, in *JGR, 91*, E139–E158. [6] Mouginis-Mark P. J. et al. (1992) *JGR, 97*, 10213–10225. [7] Scott D. H. and Tanaka K. L. (1986) *USGS Map I-1802A*. [8] Jones J. H. (1985) *LPS XVI*, 408–409.

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STRATEGY FOR SELECTING MARS PATHFINDER LANDING SITES. R. Greeley[1] and R. Kuzmin[2], [1]Department of Geology, Arizona State University, Box 871404, Tempe AZ 85287, USA, [2]Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Kosygin Street, 19, Moscow, 117975, Russia.

Many feasibility studies have been undertaken for martian roving vehicles. Most studies assumed rovers that would be capable of traversing tens, hundreds, or even thousands of kilometers over diverse terrains. Such capabilities are scientifically desirable but operationally unrealistic with current budget limitations. Instead, attention must focus on rovers traversing less than a few hundred meters and involving a relatively limited scientific payload. Consequently, a strategy for Pathfinder site selection must be developed that is fundamentally different from most previous considerations. At least two approaches can be identified.

In one approach, the objective is to select a site representing a key geologic unit on Mars, i.e., a unit that is widespread, easily recognized, and used frequently as a datum in various investigations. An example is a site on Lunae Planum (20°N, 61°W; +1 km elevation). This site is on Hesperian-aged ridged plains, a unit that is widespread on Mars and serves as a key datum for geologic mapping. This material is of very high priority for a future sample return in order to obtain an absolute age for the base of the Hesperian system. Although ridged plains are inferred to be volcanic and interpreted to be basaltic lava flows, this interpretation is based on analogy with lunar mare units and is open to question. Compositional measurements and observations of rocks at the site via a rover would address the origin of ridged plains and contribute substantially to understanding martian history. For example, should ridged plains not be