MORPHOLOGY OF ROCKS WITHIN AND NEARBY ROCK GARDEN: MARS PATHFINDER LANDING SITE, A. T. Basilevsky[1], W. J. Markiewicz[2], and H. U. Keller[2], [1]Vernadsky Institute, Kogygin Str. 19, 117975, Moscow, Russia, abasilevsky@glasnet.ru, [2]Max Planck Institute for Aeronomy, Katlenberg-Lindau, Germany

Introduction: This study follows first published results of the Pathfinder mission data [1,2,3] as an attempt of a detailed analysis of some parts of the visible scene. Our study is mostly based on analysis of stereo images of rocks within and nearby Rock Garden taken by the rover forward cameras with 0.5 to 1 mm/pixel resolution. The rocks are Chimp, Half Dome, Moe, Stimpy, Flat Top, and several smaller rocks. Lander camera images were also used. Emphasis of our study is analysis of 3-D views which give a vision different in important details from the monoscopic images of the same scene.

CHIMP. The lander camera shows Chimp as a flat-top prism about 1 m wide and 0.35 m high. Its flat top appears lightened with fine material looking similar to bright wind-blown tails seen behind many rocks in its surroundings.The side facets of Chimp are close to vertical except the left one which looks stepwise and is semi-rounded. The close-up stereo views of Chimp taken by rover cameras show this semi-rounded side of the rock. It is composed mostly of relatively dark densely pitted material. The pits look equidimensional to irregular with very sharp edges and have from 1-2 mm to 1-2 cm in diameter. This sharp micro relief is present on the surfaces of different orientation including interiors of some hollows and at the very foot of the visible part of the rock. In the upper partof Chimp the areas having lighter shading and deficit of pits are seen. These seem similar to the top surface of Chimp covered with bright material. No concentration of rock fragments at the foot of Chimp is seen.

HALF DOME. The lander camera shows Half Dome as semiangular rock about 30 cm high and 60 cm wide. At its foot no concentration of small rock fragments is seen. The close-up stereo view of Half Dome taken by rover cameras shows the side seen by lander but with slightly different geometry of viewing. On these images the rock looks covered with cm-sized darker spots and lighter areas. The stereo view shows that the first ones are shadowed parts of pits while the latter are either Sun-illuminated slopes of those pits, or dust-covered spots, or both. Some of the pits look as empty segments of spheres and ellipsoids but others are more irregular and complicated in shape. Some pits look as flutes. On rover camera images a few-cm wide strip of soil is seen at the foot of Half Dome. Surface roughness of the rock on the contact with soil is the same as in other of its parts.

MOE. This rock, about 25 cm high and 50 cm wide, looks on lander images as roughly pyramidal and semiangular. At the contact of the rock and soil, surface of the latter is almost free of small rock fragments while in close vicinities they are abundant. The close up stereo view of Moe taken by the rover cameras shows the upper two thirds of the rock made of generally massive material. Its surface is sculptured with numerous flute-like depressions of a few mm to 1-2 cm across. It is seen in stereo that orientation of the depressions is variable. In contrast in the monoscopic images, the illuminated by Sun slopes of the depressions make an impression that the latter are preferably orientated. If to ignore sculpturing of Moe with the depressions its shape looks semirounded. A few percent of the Moe surface is occupied by irregular to equidimensional pits typically less than one cm across. The pits are deeper than the flute-like depressions and do not show regular relations with the latter.

STIMPY looks on lander images as a dome of about 35 cm high and 60 cm wide. Surface of the rock issaturated with shallow planimetrically equidimensional or irregular depressions of 5 to 10 cm across showing no preferable orientation. No concentration of small rock fragments at the foot of Stimpy is seen. The close up stereo view taken by the rover cameras shows NE side of Stimpy. The rock surface is complicated with numerous pits of about 1 to 3 cm across. The general shape of the visible part of Stimpy looks rounded. The pits are planimetrically irregular, show no trend in orientation, and cover the surface rather uniformly occupying about 30 % of it. The pits are both shallow and deep. Their edges look sharp down to the resolution limit.

FLAT TOP looks on lander images as angular rock of prismatic shape with roughly flat upper facet covered with thin mantle of bright fine material. The rock is about 20 cm high and 50 cm wide. The rock edges look sharp. The soil surface at the rock foot is almost free of small rock fragments. The close up stereo view taken by the rover was made when Sojourner was east of rock Flat Top and looked to the west. The side facets look steep, almost vertical and complicated with gentle-sloped prominences and shallow depressions of about 5 to 7 cm across.They are covered with pits of about 1 cm across and less, occupying about 10 % of the surface. Their areal concentration vary without any correlation with the above mentioned prominences and depressions. No noticeable difference in the rock surface texture between the upper, middle, and lower (including lowermost 1-2 cm) parts of the side facets are seen. The top facet of the rock, seen very obliquely, looks bright due to thin layer of bright fine material. The facet has shallow flute-like depressions of 5 to 15 cm across with rather sharp boundaries.

SMALLER ROCKS BEHIND SHARK. These were imaged by rover when it moved behind rock Shark. This area is barely seen by lander camera so we describe it analyzing rover camera images only. The most prominent in the front part of the visible scene is a rock about 10 cm high and 15#cm wide. It is of roughly ovoidal shape so we call it

OVOID. Its facets in the lower part of its camera-looking side are overhanging and shadowed. The upper part of rock Ovoid is a combination of cm-sized shallow depressions and knobs. On the background of this irregular surface are seen a few relatively deep pits of 1 to 3 cm in diameter. Their boundaries look very sharp. The pits are both in the depressions and within prominences.

About half a meter northward of rock Ovoid there is a rock about 15 cm high and 35 cm wide. It has rather flat horizontal top, overhanging right part with sharp tip, and steep normal (not overhanging) left slope. Its peculiar shape resembles half of anvil so we call it **HALF ANVIL**. The visible edge of the overhanging part of Half Anvil looks very sharp down to the limit of resolution. The visible surface of Half Anvil looks rough with pits and knobs of cm size thus resembling surface of neighboring rock Ovoid. On flat horizontal top of Half Anvil, which looks relatively bright probably due to presence of bright fine material, there are three dark knobs, each about 3#cm across, looking as small rock fragments.

DISCUSSION. The described rocks can be ranked in the following ways: In relation to roundness: the most rounded Stimpy and Ovoid, semirounded to semiangular Chimp, Half Dome, and Moe, angular Fat Top and Half Anvil. In relation to density of pits: the most pitted Chimp, then Stimpy, Ovoid, and Half Anvil, less pitted Half Dome and side facets of Flat Top; the least pitted Moe. In relation to presence of flute-like features: they are abundant on Moe, less abundant on Half Dome; present on upward-looking facet of Flat Top; not reliably identified on Stimpy, Ovoid, Half Anvil, and Chimp.

This ranging shows that roundness of the rocks does not correlate with density of pits on their surfaces. This means that these two characteristics are controlled by different processes. Because pitting is hardly to be a process operating in the flood current and is either pre-depositional (gas bubbles in lava) or post-depositional (weathering combined with eolian deflation) this absence of correlation favors the hypothesis of rock rounding in the valley-forming current. The ranging shows also that degree of the rock surface pitting and amount and prominence of flute-like features are in negative correlation. This, however, has probably not formational but observational cause: Shallow elongated depressions better fit definition of flutes and the flutes are better seen if the surface is not densely pitted. The flute-like features may be either the result of eolian abrasion or traces of collisions in the flood current. Because these features show no preferable orientation the second option looks preferable. This agrees with the observation that the lowermost parts of the rock facets, which are expected to be the most sensitive to abrasion by the saltating sand particles, have the same surface textures as other parts of the rocks. Absence of accumulations of small rock fragments at the feet of the described rocks can be taken as evidence that desquamation of the rocks was not effective here.

References. 1) Golombek M. P. et al., Science, 278, 1743-1748, 1997. 2) Rover Team, ibid, 1765-1768. 3) Smith, P. H. et al., ibid, 1758-1764