MEVTV Newsletter

Number 3 May 1988

Quarterly report of the
Mars: Evolution of Volcanism, Tectonics and Volatiles Study Project

REPORT OF THE FIRST MEVTV WORKSHOP

—B. Sharpton

Ninety scientists from North America and abroad gathered at the Clarion Inn in Napa, California, December 4-5, 1987 for MEVTV's first workshop on the "Nature and Composition of Surface Units on Mars." Sean Solomon, MEVTV Project Chairman, was the convener. The workshop's goals were to assess the current understanding of the composition, distribution and origin of martian surface materials and to provide a common starting point to the many planning and data synthesis efforts arising under the MEVTV project. Topics of discussion included SNC meteorites, remote sensing and Viking Lander measurements, photogeological constraints, and surface-atmosphere interactions. Each major topic was the subject of a half-day session introduced by invited tutorials followed by discussion of unresolved issues and suggestions for further work. Attendees were encouraged to bring a few slides or viewgraphs to illustrate any points raised. Contributed posters rounded out each session. The four sessions are summarized below. Following the workshop, potential meetings of two working groups were discussed by the steering committee. Announcements of these meetings begin on page 10.

IN THIS ISSUE

Session I: SNC Meteorites

—E. Stolper

The first session of the workshop, co-chaired by John Longhi (Yale University) and Edward Stolper (California Institute of Technology), was devoted to discussion of the so-called SNC meteorites. These igneous meteorites—the shergottites (S), nakhlites (N), and chassignites (C)—have been suggested to be fragments of Mars blasted off the planet by impact. The goal of this session was to describe the features of these meteorites and, if a martian provenance is accepted, to explore what they tell us about the composition and differentiation of Mars.

John Longhi presented an extended tutorial on the petrology and geochemistry of these meteorite groups, followed by brief presentations by John Jones (NASA Johnson Space Center) on their chronology and radiogenic isotope geochemistry, by Alan Treiman (Boston University) on aspects of their textures and analogies to terrestrial komatiites, and by Lucy McFadden (University of California, San Diego) on their alteration products and martian soils.

The principal message delivered during this phase of the workshop was that the SNC meteorites came from a complex, highly evolved planet with igneous activity spanning most of solar system history. In this respect they are more similar to terrestrial igneous rocks than to other igneous meteorites that come from simpler, presumably much smaller parent bodies that differentiated soon after the formation of the solar system and then shut down. Both Longhi and Jones stressed the interpretation that the shergottites represent relatively recent (≤1.3 b.y.) melts of a mantle source previously depleted by melting early in the planet's history; geochemical and petrological evidence suggests that these magmas were contaminated by passage through the planet's incompatible element enriched crust. Strong analogies were drawn to terrestrial Archean magmas, including komatiites, many of which show geochemical and petrological evidence of similar histories. The analogy to komatiites was made directly by Treiman who showed that some of the textures of SNC meteorites are similar to those of terrestrial ultramafic lava flows.

As tantalizing as these meteorites are, they are no substitute for a sample return mission to Mars.

Many questions were raised that remain unanswered: Why are nearly all of the SNC meteorites crystal cumulates? What was the role of volatiles in the evolution of these igneous rocks? If, as has been suggested, they were somewhat hydrous, why are no vesicles observed? Could impact-induced melting have played a role in the evolution of these meteorites? If these meteorites come from Mars, does the extensive planetary differentiation they imply tell us anything about the presence and/or characteristics of an early atmosphere?

It would be difficult to overemphasize the futility of trying to accurately reconstruct the evolution of a complex planet even to zeroeth order from a handful of random samples taken out of geological context. Nevertheless, if the SNC meteorites are from Mars, they tell us of a complex, highly evolved planet, more similar to Earth in composition, internal evolution, and gross structure than the parent planet of any other nonterrestrial igneous rocks yet studied. Even if these meteorites are from Mars, the consensus and probably the unanimous sense of the participants was that as tantalizing as these meteorites are, they are no substitute for a sample return mission to Mars.

Session II: Remote Sensing

—J. B. Adams, R. E. Arvidson, and R. B. Singer

This session was co-chaired by John B. Adams (University of Washington) and Ron Greeley (Arizona State University), and contained reviews by Adams, Bob Singer (University of Arizona), and Ray Arvidson (Washington University).

Much of our current information about the composition of Mars comes from Earth-based spectral measurements. While no single technique is without

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EDITOR
Buck Sharpton..........................(713)486-2111
PUBLICATIONS OFFICE........................486-2188
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some uncertainty, reflectance spectroscopy has been very productive for exploring Mars. To first order Mars has two classes of surface materials: bright, heavily altered materials and dark, less altered materials. Their distributions generally have no simple correlation with regional geomorphologic units. While spectral interpretation of the martian surface is complicated by effects of atmosphere and dust, there is still a wealth of information present. On the scale of telescopic spatial resolution (>300 km) regional variations have been observed within both bright and dark units.

All surface regions on Mars have an intense but relatively featureless Fe^{3+} absorption edge from the near-UV to about 0.75 μm. The slope is steeper for bright regions than dark regions, indicating more ferric iron in the former. This absorption edge is attributed to combinations of Fe^{3+} crystal-field and charge transfer absorptions. Mars does not exhibit the distinct absorption features characteristic of well-crystallized ferric oxides and Fe^{3+}-bearing clay minerals. The best (but not perfect) spectral analogs are amorphous iron-silica gels (certain palagonites) that form by low-temperature alteration of mafic volcanic glass. Recent work indicates that extremely fine-grained hematite might be the coloring agent in these palagonites and on Mars. Regional and temporal variations in observed bright regions also indicate that at least some of the nonmobile weathered deposits also contain unweathered mafic components.

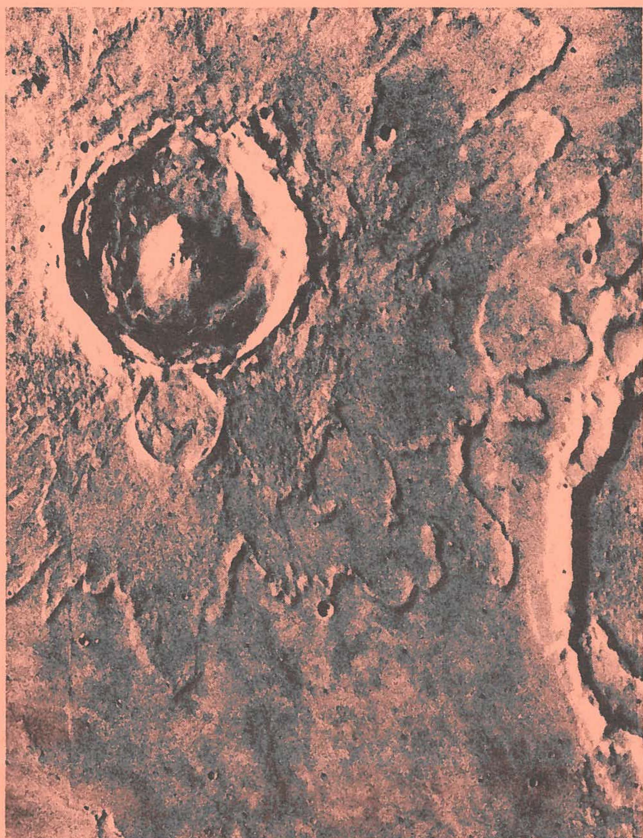
The martian surface certainly contains some molecular water and OH, as attested to by a deep "3-μm" absorption envelope. The surface is nevertheless quite desiccated relative to Earth. Structural OH and molecular water features near 1.4 and 1.9 μm have not been seen for Mars. Although complicated by atmospheric CO_2 absorptions, deep water/OH bands should be apparent if present. At 2.36 μm there is a very weak absorption generally attributed to structural Mg-OH bonds, but with at least a factor of 3 less band depth than expected for a well-crystallized clay (or other OH-bearing) mineral. Either crystalline clays are a minority phase mixed with other materials (e.g., palagonite), or the bright soils are homogeneous but structurally intermediate between amorphous palag-

From a variety of spectral observations the martian crust appears to be dominated by basaltic, but not necessarily ultramafic, rock.

NEWSLETTER CONTRIBUTIONS

In an effort to keep the Study Group informed about the latest meetings, activities, and other news relevant to MEVTV's goals and Mars in general, contributions to the MEVTV Newsletter are cordially invited. Contributions should be brief and written in newsletter style. Submissions may be either typewritten or transmitted as standard ASCII text files either over the telephone or by sending a standard DSDP diskette (along with a hard copy of the article) to: MEVTV Newsletter, LPI Publications Office, 3303 NASA Road One, Houston, TX 77058-4399.

To send contributions via electronic mail, your modem should be set to either 300 or 1200 baud; to reach the LPI VAX dial (713)-486-8214 or 486-9782. The username is "MAILBOX," the password is "LPI" (after each entry hit RETURN). When the prompt "$" appears on your screen, type "MAIL." All contributions should be addressed to "SHARPTON." When you complete your message hit CTRL-Z and then type "EXIT" in response to the prompt ">." When the symbol "$" returns to your screen, type "LOG" and then hang up. For electronic mail, any PC or terminal will theoretically work; however, best compatibility is achieved by using or emulating a DEC terminal.



Yuty Ejecta—*(Crater centered at 22.21° N, 33.99° W; Viking Orbiter frame 003A07)*

onites and crystalline clays. New telescopic observations throughout the 3-μm region indicate that observed soils are at least somewhat more crystalline than the most amorphous palagonite analogs.

There has been much interest in the possible occurrence of carbonates and other salts such as sulfates and nitrates. A variety of telescopic and spacecraft observations has yet to find any absorptions due to these minerals, placing a rough upper limit of a few weight percent carbonate if well mixed in the regolith. Orbital mapping spectroscopy (e.g., Mars Observer VIMS) is required to look for possible small regional exposures of these minerals.

From a variety of spectral observations the martian crust appears to be dominated by basaltic, but not necessarily ultramafic, rock. There is no indication of more silicic crust, although reflectance spectroscopy is less sensitive to such materials. Much of the observed mafic material is crystalline and relatively unaltered, as evidenced by unambiguous pyroxene absorptions near 0.95–0.99 μm for most dark region observations. For some regions a characteristic pyroxene band somewhat above 2 μm has also been observed. The most straightforward interpretation indicates a high-iron subcalcic augite as the most common pyroxene, although further refinement is necessary. Olivine and/or basaltic glass is also possibly evident in some observations, but is more controversial. The prospects for more detailed study of crustal composition from Mars Observer are excellent.

Viking Lander images (six bandpasses) and Orbiter images (three bandpasses) have insufficient spectral resolution to make unique mineral or rock identifications on Mars; however, the image spectra place constraints on possible materials, and provide a rich spatial context for interpretation. When Mars is viewed through the Viking Lander spectral bandpasses there is a remarkable similarity of the materials at both of the Lander sites and in an Orbiter mosaic that includes the Lander 1 site. Nearly all of the spectral variation in these images is explained by the presence of two main materials, a bright dust similar to some terrestrial palagonites, and dark, gray rock similar to terrestrial basalts/andesites. These results are broadly consistent with the telescopic spectra that cover much larger areas at higher spectral resolution.

The Lander images reveal a few small patches of the surface that are redder than the bright dust, and that have been interpreted as being enriched in hematite. The origin of this material is not known. Other spectral variations in the dust and in the rocks are indistinguishable from mixtures of dust and rock, textural differences caused by shading and shadow, or lighting artifacts such as spectral phase-effects.

Textural changes in the dust include rough dust/soil in trenches dug by the Landers and duricrust, which is consistent with compacted very fine-grained soil. The spectral class of gray rock includes the prominent rocks on the surface and those areas of the soil that have a rougher texture as revealed by the higher fraction of shade/shadow. The rougher, rock-like soil has been interpreted as unweathered rock or tephra that may be locally derived. The bright dust, in contrast, coats the rocks and appears to be moved and deposited by wind. No spectral or contextual evidence links the origin of the dust to the rocks in the Lander images; therefore the palagonitic dust is likely to have been formed elsewhere, perhaps in the geologic past.

A mosaic of Viking Orbiter images that includes the Lander 1 site has been calibrated and compared to

Lander images and telescopic spectra. Spectral variations in the Orbiter images can be explained by the presence of the same materials, dust and dark rock, that are present in the Lander 1 and 2 images, along with differences in the surface topography and texture as expressed by the amount of subpixel shade/shadow. Three main spectral units are present.

Dark gray unit. This unit is exposed in Acidalia Planitia against topographic barriers and within Kasei Valles, and as dark splotches and streaks in Xanthe Terra and Oxia Palus. It has high thermal inertia. The spectrum is similar to laboratory reference spectra of mafic rock with minor palagonite and a significant fraction of shade/shadow.

Dark red unit. This unit is exposed south of Acidalia, in Lunae Planum, Xanthe Terra, and Oxia Palus. It has intermediate thermal inertia. The spectrum is similar to a mixture of mafic rock and palagonite and a major fraction of shade/shadow.

Bright red unit. This unit is exposed in Tharsis and Arabia, and at borders between dark gray and dark red materials. It has the lowest thermal inertia. The reflectance is that of palagonite with minor shade/shadow.

There is little correlation of surficial units and bedrock geology. Rather, distribution of these materials is correlated with topography at regional and local scales. Regionally, dark gray materials are at lowest elevations, dark red materials are at intermediate elevations, and bright red materials are at highest elevations. Locally, bright red and dark gray materials are associated with craters, cliffs, and other topographic obstacles.

These Orbiter units can be geologically interpreted as: *bright red* materials are dust deposits—aeolian suspension load; *dark gray* materials are saltation and traction load, along with some immobile deposits. Lower entrainment velocities associated with lower elevations (high atmospheric densities) ensure self-cleansing of dust and continual exposure of lithic fragments; *dark red* materials are part of an immobile substrate over which dark gray and bright red materials migrate. Dark red material is perhaps aeolian lag, but thermal inertias are less than those for dark gray exposures. Dark red exposures are perhaps rough, indurated, deflated dust deposits. Induration may be associated with formation of duricrust. Rougher topography at microscale associated with disrupted duricrust plates may lead to accumulation of dust as dust-laden winds traverse from dark gray to dark red exposures. This hypothesis would explain the bright red borders found between dark gray and dark red materials. Aeolian processes appear to dominate the distribution of the geologic units. Topographic control is important on regional, local and perhaps even microscales.

Session III: Photogeological Inferences of Martian Surface Compositions

—R. Greeley and J. E. Guest

This session was chaired by John Guest and John Adams and involved reviews by R. Greeley, Steve Baloga (Jet Propulsion Laboratory), J. Guest, and Peter Mouginis-Mark (University of Hawaii). Presentations included an overview of various photogeological mapping programs for Mars, mechanisms of lava flow emplacement, and discussions of how one could assess the composition of materials as inferred from volcanic landforms and lava flows.

The most recent global, systematic geologic mapping of the planet is by David Scott, Kenneth Tanaka (both from the U.S. Geological Survey), Greeley, and Guest, coordinated by the U.S. Geological Survey. The mapping uses the new 1:15-million-scale base maps and will serve as a key frame of reference for other studies and for the Mars Observer Mission in the early 1990s. About 90 different units have been distinguished on these maps. From this and other mapping it is shown that more than half the surface of Mars appears to involve volcanic materials derived from a wide variety of volcanic eruptions.

An assessment of the general morphology of terrestrial volcanoes and their compositions shows a potential simplistic correlation. For many years, it has been recognized that volcanoes composed of high-silica lavas have steep flanks, whereas mafic flows produce low-profile volcanoes. For example, volcanic domes are usually composed of rhyolitic or dacitic flows, and shields and lava plains typically are basaltic. This is explained in part as a consequence of lava viscosities. High-silica lavas typically are more viscous and do not spread far from their vents; mafic lavas are generally more fluid and travel a longer distance from their vent. However, there are many exceptions to this correlation and a wide variety of morphologies can be found for even a narrow range of compositions. For example, basalts can include not only lava plains and shields, but also steep-sided volcanoes, domes, and pyroclastic plains. On the other hand, silicic lavas seldom form large, low-profile volcanoes.

During the last 15 years various empirical and theoretical models have been formulated to explain lava flow development and the final morphology. Empirical models relate, for example, effusion rate to maximum length of flow. Theoretical models treat lava as a non-Newtonian material and are used to determine such characteristics as yield strength and other rheological properties. However, because many complex factors control the flow of lavas, no theoretical model has yet been developed to take all parameters into account. Composition is only one of the critical parameters and thus knowledge of the rheological behavior of a lava does not necessarily specify the composition.

Several investigators have studied possible correlations between composition and the morphology of individual flow features, such as lava channel levees. As reviewed by Baloga, most of these studies are based on the influence of silica content on the flow properties of lavas and development of certain features such as levees. Although the models that have been developed appear to be valid for application on Earth, lack of adequate data make the application to other planets difficult. For example, most inferences of lava composition based on the morphology of lava levees apply only to those levees formed by single-stage flows. However, many levees are accretionary and result from multiple overflow of the channel banks. Unfortunately, image resolution is inadequate to assess single- versus multiple-stage levee formation on martian lava flows.

Other models to derive composition (i.e., silica content) from flow morphology depend on knowledge of levee height, flow margin thickness, flow-festoon dimensions, or other features. These models have been applied to the study of some martian lava flows. Although there are limitations in the data that cause uncertainties, the general results for Mars predict low-silica lavas such as basalts, which is consistent with other predictions.

In addition to assessing the morphology of volcanoes and individual lava flows in recent years, attention has focused on studying sets of lava flow or *lava flow fields.* As discussed by Guest, Mt. Etna is a good laboratory for such studies because it has a long historical record. Since the mid-18th century the output of lava at Etna has been remarkably constant, indicating that the "plumbing" conditions in the volcano have remained the same during this period. It has been pointed out by Geoff Wadge (University of Reading) that during this time, the long duration eruptions have all occurred on the east and southeast sector of the volcano. Flank eruptions elsewhere have tended to be less than 25 days duration. Correspondingly, in the south and southeast sector the volumes of individual flow fields are large and the eruptions have had low effusion rates. Examination of the morphology of flow fields on Mt. Etna shows a wide range despite the fact that the composition of the flows has been the same and they are broadly similar in their petrography. Thus, the different forms of flow fields are likely to have developed from lava of similar rheological properties and it appears that the flow field morphology may result more from the eruptive conditions than the rheology. The two most common forms of flow during the last 250 years have been either long thin flows or broad complex flows. These two forms appear to be more related to the "plumbing" system than to any other characteristic of the erupting lava. Thus, on Mars, different flow-field morphologies may be a useful way of assessing "plumbing" conditions, but not necessarily lava composition.

Based on present knowledge, volcanic morphology is not a definitive means to determine the composition of the lavas, but it can . . . provide clues.

Theoretical studies show that explosive volcanism is a likely style of activity to have occurred on Mars. Volcanism almost certainly has occurred on Mars from the earliest stages of crustal evolution and there is abundant evidence for the presence of water early in martian history. Consequently, phreatic eruptions very likely occurred. Moreover, ground ice and ground water probably have been present through much of Mars' history and would provide ample opportunity for

Polar Deposits—*(Largest crater in image is 49 km in diameter and is at 79.1° S, 232.0° W; Viking Orbiter frame 383B67)*

hydromagnetic eruptions, as presented by Mouginis-Mark. Certain volcanic areas on Mars show erosional channel networks, indicating the presence of material that was readily eroded; such materials may well be pyroclastic deposits. However, even with explosive activity driven by juvenile volatiles, a wide variety of eruptions could have been involved, including Strombolian, Plinian, and other activity—all relatively independent of magma composition.

In conclusion, photogeologic mapping shows that a wide variety of materials are present on Mars, many of which appear to be of volcanic origin. However, the knowledge of the composition of this material is very poorly constrained. Based on present knowledge, volcanic morphology is not a definitive means to determine the composition of the lavas, but it can place broad constraints and provide clues. The large shield volcanoes and the extensive flows on Mars (e.g., those of several hundred kilometers length) are most likely to have been formed from relatively fluid lavas, which on Earth are mafic in composition. Inferences drawn from the morphology of individual flows, flow fields, and total accumulations suggest that most of the martian materials had rheological properties similar to basaltic or other mafic magmas at the time of their emplacement.

Session IV: Volatiles and Surface-Atmosphere Interactions

—S. M. Clifford

This session began with an overview by session co-chairman Fraser Fanale (University of Hawaii). To assess the role of volatiles in weathering, Fanale identified a number of key questions: What was the original state and distribution of volatiles on Mars and how has it changed through time? By what processes and to what extent has primary rock been weathered by direct contact with the atmosphere? How might impacts and endogenic magmatism alter a volatile-rich crust? What mineral phases are likely to be produced by these interactions and how would they be distributed? Finally, how do volatiles and weathering products interfere with remote sensing?

Fanale led off the discussion by reviewing our current understanding of the volatile history of Mars. Evidence that the early climate may have differed substantially from that of today comes from the dissection of the planet's heavily cratered terrain by integrated networks of small valleys. If these valleys are ancient runoff channels, then calculations indicate that the early atmosphere must have contained between 2 and 3 bars of CO_2. Although evidence for such a massive early atmosphere is scarce, it is clear that if a massive atmosphere did exist, it could not have persisted for long. Mass loss from hydrodynamic escape, atmospheric erosion by large impacts, carbonate formation,

The martian climate has apparently undergone little change over the past 4 b.y.

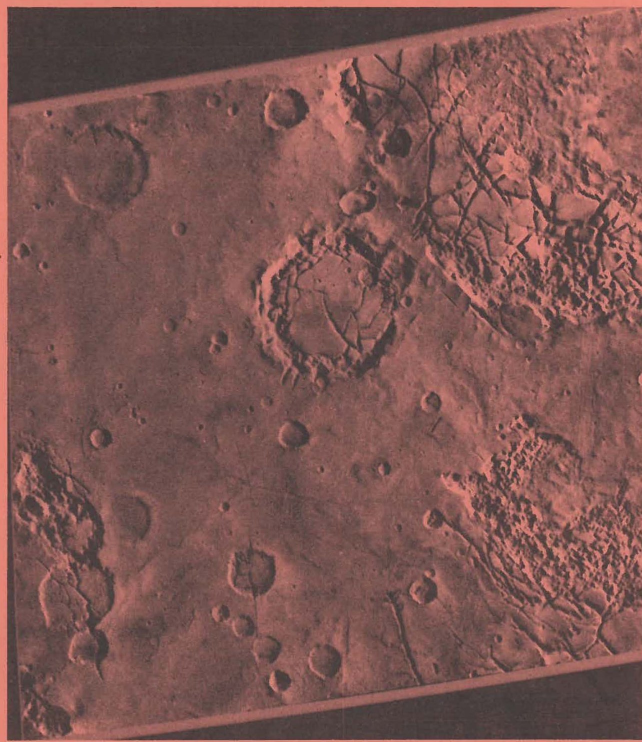
and adsorption by the regolith would have quickly reduced the surface pressure to something approaching its present value. Thus, with the exception of periodic fluctuations forced by time-varying orbital and rotational parameters, the martian climate has apparently undergone little change over the past 4 b.y.

Although conditions may have once favored the global distribution of regolith H_2O on Mars, those conditions did not survive the transition to the present climate. At equatorial latitudes, current mean annual temperatures exceed the frost point temperature of the atmosphere by as much as 20 K. As a result, equatorial ground ice will sublime, resulting in an inexorable transfer of H_2O from the comparatively warm equatorial region to the colder latitudes poleward of 40°. Confirmation of the desiccated state of the equatorial regolith may come from the distribution of softened terrain, a type of landform degradation attributed to ice-enhanced creep that is found only at high latitudes.

Atmosphere-surface interactions were discussed by Bruce Fegley (Massachusetts Institute of Technology). Because of differences in atmospheric composition and surface pressure, the weathering of exposed rock on Mars is expected to be qualitatively different from that occurring on Earth. To understand this interaction, the physical properties and mineralogy of the exposed rock must be characterized, as well as the reactive atmospheric constituents (e.g., O_3, H_2O_2, Co, etc.). Although some analyses, such as atmospheric compositional measurements, can be performed *in situ* by automated landers, Fegley concluded that any serious attempt to characterize the nature of the surface must await the return of samples for study in terrestrial labs.

Horton Newsom (University of New Mexico) spoke on the potential role of impact weathering on Mars. Studies of terrestrial impact sites, such as the Ries crater in West Germany, indicate that postimpact hydrothermal alteration of ejecta and fallback can result in the production of an appreciable quantity of clay (10–20 wt%). Therefore, if Mars is indeed water-rich, impact-generated clays should constitute a significant fraction of the regolith. This conclusion is consistent with the results of several Viking Lander experiments, which indicated that smectite clays might dominate the composition of the soil.

Volcanism has also clearly played an important role in the geologic evolution of Mars. As discussed by Mouginis-Mark, an important consequence of the interaction of iron-rich basaltic magma with ground ice is the production of palagonite, an altered volcanic



Chaotic Terrain—*(Crater is 62 km in diameter and located at 0.3° S, 22.7° W; Viking Orbiter frame 651A81)*

glass rich in smectite clay. One location that may have witnessed such activity is Elysium Mons. Northwest of the volcano and approximately 250 km downslope, several major channels emerge from structural features located at the volcano's periphery. The most probable origin for the water that carved these channels is ground ice melted by volcanism.

Roger Burns (Massachusetts Institute of Technology) discussed the geochemical implications of sulfide oxidation in an aqueous martian environment. Groundwater that participates in this type of reaction will become highly acidic, ultimately developing high concentrations of dissolved silica, Fe, Ca, Al, Mg, Ni, and sulfate ions through interaction with the host rock. Subsequent hydrolysis and oxidation could then result in the precipitation of clay silicates, silica, ferric sulfate, and iron oxyhydroxides. On Earth, such reactions frequently produce rust-colored iron-rich oxidized coatings on sulfide-bearing rocks. Martian surface rocks and duricrust have a similar appearance, a possible result of the same geochemical process.

However, a multispectral analysis of the martian surface suggests that its appearance may have a simpler explanation. By treating each pixel of a Viking Lander image as a potential mixture of spectrally distinct materials, Adams described how he and his colleagues used the six Lander bandpasses to establish that only three spectral endmembers—rock, soil, and shade—were necessary to reproduce the observed pixel-to-pixel spectral variation. Comparisons with laboratory reference spectra reveal that the characteristics of the rock component are similar to those of Hawaiian basalt, while the soil component most closely resembles palagonite. This analysis further suggests that the oxidation and hydration of old flows that happen on Earth do not occur on Mars, although this interpretation may need revision once the visual and infrared mapping spectrometer aboard the Mars Observer spacecraft begins its operation in 1992. M

MARS SLIDE SETS AVAILABLE

Volcanoes on Mars. This slide set, mentioned in the previous issue, is the first in the new series on Mars. A total set of 20 slides, it contains some of the best examples of Viking Orbiter images that include constructional volcanic landforms. Almost half of the slides deal with the large shield flows on the flanks of the volcanoes.

Stones, Wind, and Ice: A Guide to Martian Impact Craters. This set of 30 slides, compiled largely from Viking Orbiter and Lander images, illustrates both the diversity of impact craters on Mars and the significance of these features in understanding the geological evolution of this complex planet. Many of the landforms produced by the interaction of the cratering process with the martian environment are seen virtually nowhere else in the solar system. Impact craters also provide a means of deducing the sequence and timing of events that have shaped the Martian surface.

These slide sets are sold through the LPI Order Department; requests for prices or additional information should be directed to: Order Department, Lunar and Planetary Institute, 3303 NASA Road One, Houston, Texas 77058.

Photos in this issue are extracted from the *Stones, Wind, and Ice* slide set.

PARTICIPATION IN THE MEVTV STUDY GROUP

An invitation is extended to join the MEVTV Study Group. If you are conducting research that you consider relevant to the goals of MEVTV but are funded via other sources and would like to join the Study Group, please let us know. Simply write to the Steering Committee through the LPI Projects Office outlining the nature of the relevant research so that your name will be added to the mailing list. Please include your electronic mail addresses with your letter.

MEVTV ELECTRONIC MAIL LIST

In order to expedite the exchange of information among the participants in the MEVTV Study Group, a list of electronic mail addresses is being compiled at the LPI. Several nodes now exist that facilitate the transmittal of mail between networks. Along with the list of mail addresses, LPI can provide a list of examples showing how to communicate between various networks. If you would like to be included on the MEVTV electronic mail list, simply send a message to Buck Sharpton containing your mail addresses. The following examples show how to send a message to LPI via three separate networks.

From SPAN—
To: LPI::SHARPTON

From BITNET—
To: SHARPTON%LPI.SPAN@JPL-VLSI.ARPA

From Telemail (message sent to POSTMAN/NASA)—
To: SHARPTON%LPI@AMES-IO.ARPA

UPCOMING WORKSHOPS ANNOUNCED

Early Crustal Evolution

Working Group Formed

A working group on early crustal evolution has been set up to focus attention on the early ("pre-Tharsis") tectonic and volcanic evolution of Mars. Chaired by Herb Frey (NASA Goddard Space Flight Center), the group presently consists of Matt Golombek (Jet Propulsion Laboratory), Greeley, Roger Phillips (Southern Methodist University), Pete Schultz (Brown University), Tanaka, and Jim Zimbelman (National Air and Space Museum).

Others interested in participating are welcome.

An initial meeting of the working group was held at the Napa, California MEVTV Workshop, and several specific programs were discussed.

Early Tectonic and Volcanic Evolution of Mars Workshop Planned for October '88

The group is planning to convene two meetings within the next year. The larger of these will be the next major workshop for the MEVTV program and will be held in early October of 1988. The theme of this workshop will be "Early Tectonic and Volcanic Evolution of Mars" and will address topics ranging from the problem of the martian crustal dichotomy to conditions leading to the formation of the Elysium and Tharsis volcano-tectonic complexes.

Early Mars Special Session at Spring AGU

In support of the October meeting a special session on "Early Mars" will be held at the Spring AGU meeting. Abstracts of these presentations are published in *EOS, 69,* pp. 389–390. For additional information, contact Herb Frey.

Crustal Dichotomy Workshop Planned

A second workshop is also being organized to deal directly with what is known and not known about the martian crustal dichotomy. Attendance will be restricted to an "around the table" size group specifically interested in and working on the problem of the origin and nature of the fundamental crustal dichotomy. Anyone interested should contact Herb Frey. The crustal dichotomy workshop will be held in late spring or early summer, perhaps following the 1988 Spring AGU meeting in Baltimore.

For additional information, contact:
Herb Frey
Code 622
NASA Goddard Space Flight Center
Greenbelt, MD 20771
(301-286-5450)

Rampart Ejecta—*(Central peak crater near center of image is 13 km in diameter and located at 34.3° N, 258.6° W; Viking Orbiter frame 538A03)*

Mars Volcanology

Working Group Objectives

A Mars volcanology working group has been formed recently within the NASA MEVTV program. The overall objective of this working group is to assess the current understanding of volcanic evolution on Mars and to identify the most promising areas for future research. This working group consists of MEVTV participants who are actively engaged in research on Mars volcanism. The formation of this working group has been encouraged by Baloga, Mouginis-Mark, and Greeley to promote a detailed interaction among volcanological researchers during the MEVTV program.

The immediate scientific issues of concern to the working group include:

- How did individual volcanoes and provincial volcanism evolve over geologic time and why?

- Is there evidence for transitions between explosive and effusive volcanism?

- Is there morphologic or theoretical evidence for differentiation or other physical/chemistry changes in the sources of magma?

- What are the relationships between volcanic evolution on Mars and other large-scale influences such as tectonism?

- Are the morphologic, dimensional, and experimental data good enough to resolve these issues?

First Meeting Planned for June '88

The first working group meeting is planned for June 1988 on Oahu, Hawaii. The meeting will consist of presentations on the scientific issues above, extended seminar-like discussions, and several short field trips to study classic examples of terrestrial volcanoes in the context of martian volcanism.

For additional information, contact:
Steve Baloga
MS 183-501
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

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Universities Space Research Association
LUNAR AND PLANETARY INSTITUTE
3303 NASA Road One
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