Viking Orbiter Completion Mission and Viking Lander Monitor Mission

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This report covers the period from 1 February 1980 through 31 March 1980 and continues reporting on DSN Viking Tracking Support for the same period.

I. Viking Operations

A. Mission Overview

The primary Viking Mission was terminated on 15 November 1976, at the time of solar conjunction, due to the loss of the communications link between Mars and Earth. At the end of the solar conjunction period the communications link was reestablished, and the Viking Extended Mission (VEM) commenced on 15 December 1976.

The objective of the Viking Extended Mission was to make use of the functioning spacecraft to observe seasonal variations on Mars, to provide long-duration sampling for experiments that require it, and to obtain data not possible during the primary mission because of time constraints and observational limitations. The VEM was terminated on 31 May 1978.

Since both Orbiters and Landers were still operational at the termination of the VEM, funding was approved for a Viking Continuation Mission (VCM). The objectives of the VCM were essentially the same as those of the extended mission, but with a shift of emphasis more towards the Orbiters than the Landers. The major goal was to complete one full Mars year of observation of the planet, including filling in the season that was obscured by solar occultation at the end of the primary mission, and also to make a start on determining the extent to which weather conditions repeat in succeeding years.

During the VCM both Landers were in the automatic mission mode, performing repetitive observations on 37 day cycles, so that no more than one command load was required for each Lander during the entire period. Data was acquired from Imaging, Meteorology and Seismology experiments. The Inorganic analysis experiment continued to provide data on its final surface samples, but no new samples were acquired.

Radio Science investigations, including the occultation experiment, the local gravity anomaly experiment and Lander ranging, continued; and in December 1978, and January and February 1979 (solar conjunction), the Solar Corona and Relativity experiments were repeated.

All three Viking Orbiter 1 (VO-1) science experiments continued during the VCM, but their observational sequences were simpler and more repetitious than previously.

From late March until July, 1978, the Viking Orbiter 2 (VO-2) mission was seriously hampered by gas leaks in both halves of the Attitude Control Reaction System. Except for a brief science sequence in June and a final one in July, VO-2 was confined to a gas-conserving housekeeping mode. The efforts to extend the VO-2 mission through the June/July sequences were dictated by the strong desire of the Viking Science Team to acquire specific visual imaging subsystem and infrared coverage at those times. The efforts were rewarded in that adequate coverage was obtained in the June/July sequences to satisfy the data closure needs of the scientists. On 25 July 1978, approximately four days into the final VO-2 science sequence, the attitude control gas was depleted and VO-2 began to drift off sun line. After a short sequence to establish the final engineering status of the vehicle, the ground command was issued to turn the VO-2 transmitters off, ending the VO-2 mission.

Lander automatic sequences for the VCM were designed to consign all science data playbacks to relay links because of the higher data rates achievable and, therefore, the more efficient utilization of station playback time. The initial sequences included periodic playbacks to both VO-1 and VO-2 for both landers. Owing to the onset of VO-2 gas leakage problems and the consequent uncertainty as to the future status of VO-2, the sequences were redesigned to purge them of all VO-2 relays. With only VO-1 as a relay, playbacks were limited to 25 to 30 day centers for each lander, with a consequent reduction in the total amount of science data which could be returned from each lander.

Finally, an earlier-than-planned termination of the Viking Lander 2 (VL-2) seismology experiment was necessitated by the failure of the VL-2 data storage memory (DSM), required for the effective accumulation and storage of the seismology data.

Even with operational deficiencies of the sort cited, the VCM was an active and productive period for the several orbiter and lander science experiments carried into the VCM. The Viking Continuation Mission concluded on 25 March 1979.

The fourth phase of the Viking Mission, known as the Viking Survey Mission (VSM), began on 25 March 1979. The objectives of the VSM were to acquire high-resolution contiguous coverage with the Visual Imaging Subsystem of a region on the planet that is likely to contain the landing sites for the next Mars mission. The Lander Mission objectives were to take advantage of the unique capability of a transponder on a planetary surface to make frequent radio ranging measurements and to conduct a long-duration monitoring of weather conditions and surface changes at the Lander 1 site. The Viking Survey Mission terminated on 31 October 1979.

At the end of the VSM there was still approximately 0.454 kilograms of attitude control gas remaining in the orbiter. In response to urgent requests by some of the Viking scientists, NASA Headquarters allocated some FY-80 funds to extend Orbiter operations through June 1980. This final phase of Viking Orbiter operations has been designated the Viking Orbiter Completion Mission (VOCM).

Because of the capability of the Viking Lander 1 to continue operating long after the termination of the Orbiter, the Lander Mission has been separated from the Orbiter Mission and as of 1 November 1979, has been designated the Lander Monitor Mission (LMM). The Viking Lander 1 spacecraft should be capable of returning Mars data through 1990.

Due to the failure of the direct link transmitters on Lander 2, data collection from Lander 2 will cease after the termination of the Orbiter Mission.

B. Spacecraft Status

1. **Orbiter.** During this reporting period, the Orbiter 1 spacecraft continued to operate normally, collecting and returning weather data and moderate resolution Mars surface photos to Earth, as well as relaying data from the Lander-2 (VL-2) spacecraft.

As of 3 March, the remaining attitude control gas has been estimated at approximately 0.272 kilograms plus or minus 0.09 kilograms. With a daily usage of 0.0027 kg and with the uncertainties of the gas supply, the orbiter termination could occur anywhere from May to September 1980.

2. **Landers.** The Viking Landers continued to operate as expected during this reporting period. All Lander-1 essential subsystems are healthy as the spacecraft collects imaging and meteorology data for weekly transmission to Earth, whenever a Deep Space Station (DSS) is available. All Lander 2 essential subsystems are healthy, except for the transmitter. This transmitter, which supports transmission of telemetry data directly to Earth and the Data Storage Memory (DSM) unit, intermittently causes loss of data.

The DSM problem is believed to be a thermal problem related to the high temperatures during the Martian summer.

All data from Lander-2 are transmitted to Orbiter-1 and then relayed to Earth using the Orbiter transmitter.

II. Radio Science

Radio Science activity increased in March as the Project continued with the occultation experiments. These experiments were reimplemented in November and December 1979, after the start of the Viking Orbiter Completion Mission. Geometrically, the spacecraft (as viewed from Earth) is occulted by Mars every 24 hours for about 23 minutes. Acquisition of data from occultations will provide new information on seasonal atmospheric fluctuations at the 5 km level, the correlation of ionosphere plasma temperature with solar activity and improved characterization of several Martian topographic features.

III. Network Support

Table 1 shows the DSN tracking support from August 1979 through March 1980.

In January the Orbiter science instruments were shut down and the spacecraft configured to the low-gain antenna due to the lack of a sufficiently bright star to maintain high-gain antenna pointing. DSN tracking support returned to normal in February and March after the spacecraft was configured back to the high-gain antenna.

Table 1. DSN Viking Mission tracking support

DSS	1979 – 1980							
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
11	*a* – *b*	1 6	1 3	2 11	–	2 15	3 15	3 21
12	–	–	–	–	–	–	–	3 15
14	22 91	15 65	12 62	8 64	6 52	2	7 49	–
42	1 5	2 10	–	–	–	–	–	–
43	1 5	1 1	1 6	–	2 13	2 8	1 8	2 17
44	4 18	–	3 12	–	–	–	–	1 5
61	–	–	–	–	–	–	–	1 11
62	2 2	1 4	–	–	–	6 41	3 20	2 10
63	29 131	27 105	19 104	15 119	16 142	2 14	11 101	17 158
Total	59 252	47 191	36 187	25 194	24 207	14 78	25 193	29 237

[a]Total number of Viking tracks.

[b]Total Viking station support in hours.