VIKING MARTIAN SEISMOLOGY: A SUMMARY OF CURRENT STATUS

D. L. Anderson[1], S. Cook[2], A. M. Dainty[3], F. K. Duennebier[4], N. R. Goins[5], R. L. Kovach[6], G. V. Latham[7], A. R. Lazarewicz[4], W. F. Miller[1], Y. Nakamura[7], G. H. Sutton[4], M. N. Toksöz[5], [1]Calif. Inst. Tech., Pasadena, CA 91125, [2]Martin Marietta Aerospace Corp., Denver, CO 80201, [3]Georgia Inst. Tech., Atlanta, GA 30332, [4]Univ. of Hawaii, Honolulu, HI 96822, [5]Mass. Inst. Tech., Cambridge, MA 02139, [6]Stanford Univ., Palo Alto, CA 94305, Univ. of Texas, Galveston, TX 77550

A three-component, short-period seismometer has been operating on the surface of Mars at Viking-2 landing site in the Utopia Planitia region since September 4, 1976 (1). The sensitivity of the instrument is approximately equal to those of the best WWSS network stations on the earth, although it is about two orders of magnitude less than those of the Apollo lunar seismic stations. The primary objective of the experiment is to obtain reconnaissance measurements of background noise and the level of seismic activity.

As expected from the mode of installation of the instrument, the wind noise predominates the observed signals. The signal correlates well with wind speed, and its amplitude is proportional to the square of wind speed, as appropriate for turbulent flow. An extrapolation of the data indicates that a future seismometer set up on the ground will be virtually free from wind noise even at a sensitivity equivalent to those of the Apollo seismometers.

The appearance of the observed wind noise varies widely depending on wind, sometimes continuous and sometimes impulsive. A sudden wind gust generates a signal that has characteristics quite similar to those of a seismic signal from a local earthquake. Some such signals have been observed without meteorology data to indicate whether or not a sudden wind gust existed at the time. Some of them may represent a real local marsquake.

The global level of the martian seismic activity may be compared with those of the earth and the moon by estimating the number of teleseismic events expected when a seismicity level equivalent to the earth or the moon is assumed and comparing it with the observation. Figure 1 shows such a comparison. For example, if Mars is seismically as active as the earth, and if the internal structure, particularly the seismic attenuation, of Mars is similar to that of the earth, then, on average, 17 teleseismic events are expected to be detected annually by the Viking seismometer on Mars. To date (January 6, 1978), we have examined a total of 1500 hours of seismic data in favorable conditions (negligible wind disturbance and in a mode of operation suitable for event detection), and have detected no teleseismic event. Thus, we are now 95% confident that Mars as a whole is not seismically as active as the earth. With additional observations within this year, we will be able to tell whether or not Mars is at least an order of magnitude less active than the earth. A meaningful comparison with the moon is not likely to be accomplished with the present instrument.

Reference: (1) Anderson, D. L. et al. (1977) J. Geophys. Res. 82, p. 4524-4546.

VIKING MARTIAN SEISMOLOGY

Anderson, D. L. et al.

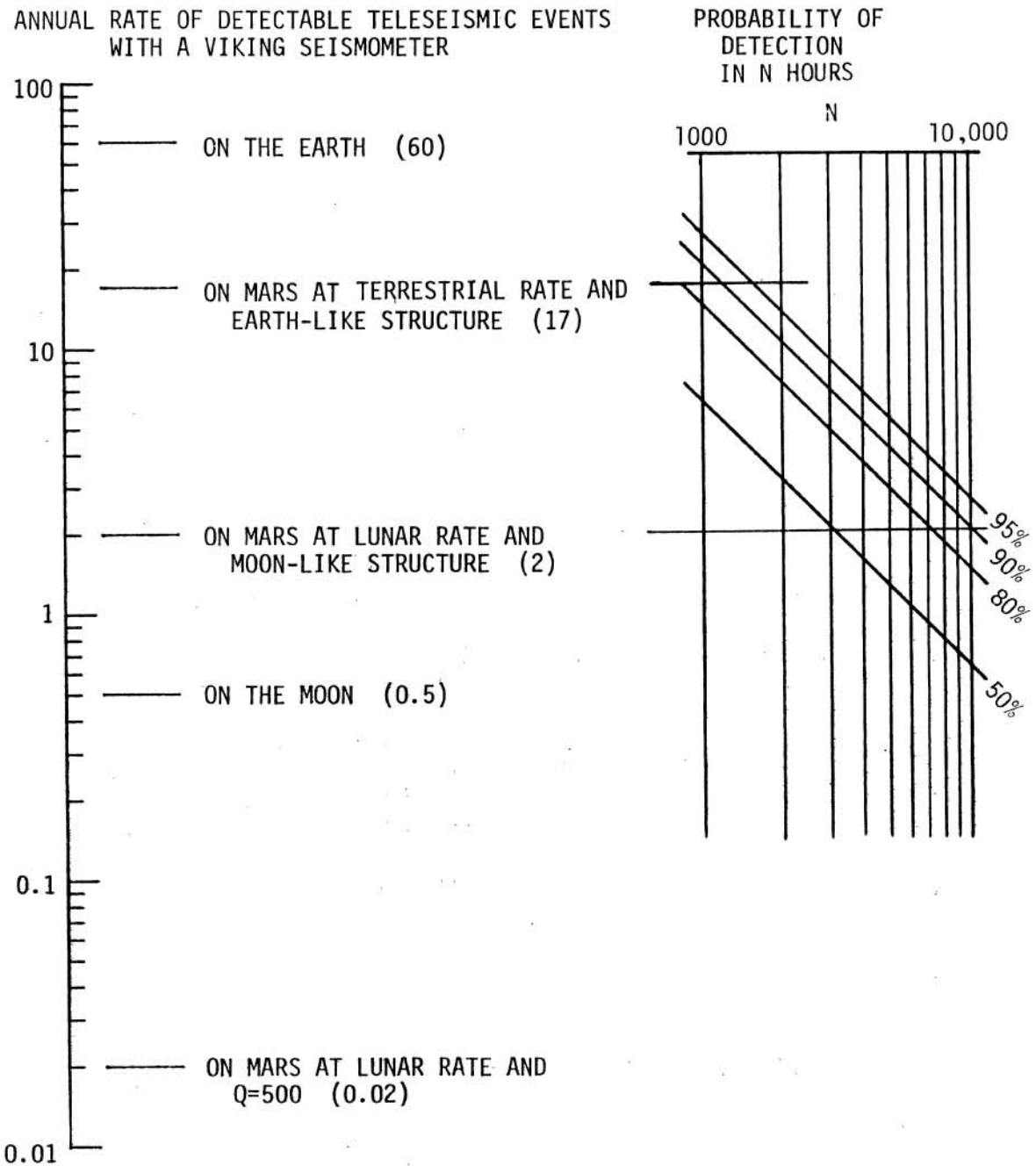

Fig. 1. Estimated number of detectable teleseismic events with a Viking seismometer on the earth, the moon and mars under various assumptions, and the probability of detecting at least one event in a given hours of observation.