GROUND-ICE DETECTION AND POTENTIAL LANDING SITES FOR THE MARS 94 MISSION.

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I - INTRODUCTION.

The soviet mission named Mars 94, which must be launched in October 1994, will include a balloon deployed from the descent module (1). Scientific payload include a radar, several cameras and in-situ measurement devices ...

The detection of water or ice on Mars constitute a real challenge for the next planetary missions. Radar experimentation (PRISM) on the Mars 94 mission would be able to detect and to characterize martian ground-ice (2).

According to topographic and engineering constraints such as low surface roughness or atmospheric criteria, a selection of potential landing sites have been proposed between 40°N to 60°N (3). The aim of this study is to propose and to evaluate some potential landing sites between 40°N to 60°N for a radar experimentation during the Mars 94 mission.

II - GROUND-ICE IN NORTHERN PLAINS.

Several authors have suggested the presence of a large amount of ground-ice on Mars. It might be subsurface ground-ice in the northern plains (4,5,6).

In order to evaluate potential landing sites for a ground-ice detection by radar echoes, a study of rampart crater distribution is proposed. Northern plains concentrate most of rampart craters observable on Mars. Such a high density of rampart craters involves a continuous, a permanent and a near-surface ground-ice (7).

In order to estimate the depth of ground-ice table, the minimum diameter of impact crater with flow lobes is taken into account. According to rampart crater studies, Acidalia Planitia and Utopia Planitia exhibit a ground-ice table at a depth of 30 m to 150 m at the time of impact event (fig. 1).

Detailed morphological studies of rampart craters in Acidalia Planitia and Utopia Planitia and their spatial relation with the morphology indicate the presence of an ice-rich sedimentary deposit at the mouth of outflow channels (6,8,9) which overlay a ground-ice with less volatile content. This volatile-rich layer of sediments is estimated to be 450 m to 800 m thick (Fig. 2).

Some theoretical models confirm the fact that northern plains are volatile-rich. Actually, at latitude higher than 40°N the soil never reach the frost point during the year and is therefore in equilibrium with the atmosphere. In such a case, water is always stable as ice (4). Acidalia Planitia and Utopia Planitia should be good places to optimize the chance of detecting near-surface ground-ice.

III - PERIGLACIAL FEATURES.

In such northern plains, the analysis of very high resolution Viking pictures (12 m/pixel) indicates many curvilinear and polygonal patterns of grooves and troughs, small pits, ridges, flow lobes and pseudocraters (10,11,12,13). By

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comparison with terrestrial periglacial regions, the occurrence of such features on northern plains implies the presence of a volatile-rich stratified deposit which seems to contain major amount of massive icy beds (14).

IV - CONCLUSION.

According to morphological and theoretical considerations northern plains such as Acidalia Planitia (25°N 75°N, 350°W 60°W) and Utopia Planitia (25°N 75°N, 220°W 290°W) seem to be good potential landing sites for a radar experimentation. During the flight, radar measurements would be able to give some informations about ground-ice discontinuities (ground-ice table, ice-liquid discontinuity, massive icy-beds ...) in relation with the surface morphology.

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References: (1) Blamont J. (1987) in Acta Astronautica 15, 8: 523-525 . (2) Debouzie G. et R.S Kremnev. (1989) in Tech. Report, CNES, GLASKOSMOS. (3) Costard F. et al. (1991) in Cospar Colloquium . Pergamon Press. In press. (4) Fanale F.P. et al. (1986) in Icarus 67, 1-18. (5) Kuzmin R.O. et al.(1988) in Lunar and Planet. Sci. Conf. XIX 657-658 . (6) Jons H.P. (1987) in Lunar and Planet. Sci. Conf. XVIII 404-405. (7) Costard F.M. (1989) in Earth, Moon & Planets 45: 265-290. (8) Costard F.M. (1988) in 19th Lunar and Planet. Sci. Conf. 211-212. (9) Lucchitta B.K. et al. (1986) in J. Geophys. Res. 91, E166-E174. (10) West M. (1974) in Icarus 21, 1-11. (11) Gill M.C. (1985) in Lunar and Planet. Sci. Conf. XVI, 534-535. (12) Pechmann J.C. (1980) in Icarus 42, 185-210. (13) Zimbelman J.R. et al. (1989) in Proc. of the Lunar and Planet. Sci. Conf. XIX 397-407. (14) Costard F.M. (1990) in Lunar and Planet. Sci. Conf. XXI 232-233 .

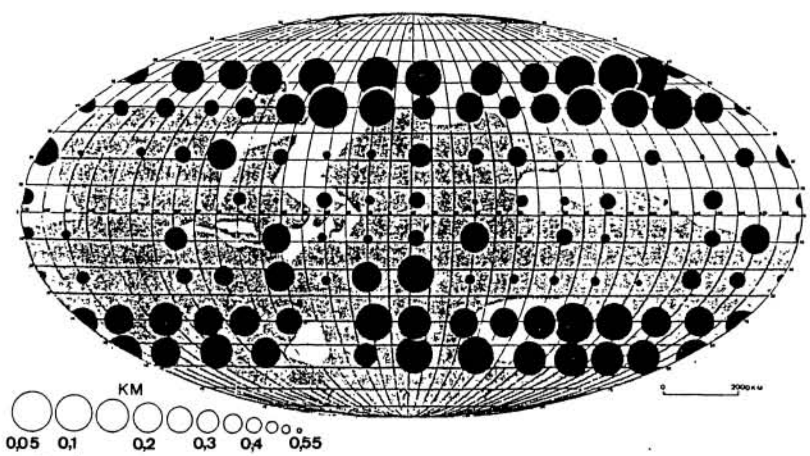

Fig 1: Ground-ice table on Mars. Ground-ice depths are extracted from rampart crater measurements.

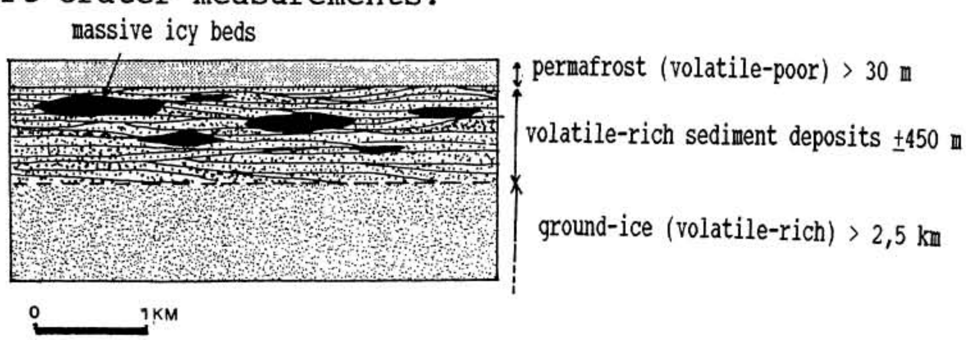

Fig 2: Proposed model of martian ground-ice in northern plains (40°N 60°N).