STRATEGY FOR THE IN SITU SEARCH OF EVAPORITE AND CARBONATE DEPOSITS IN GUSEV CRATER WITHIN THE 2003 MER A LANDING ELLIPSE. Edmond Grin and Nathalie Cabrol. NASA Ames Research Center, Space Science Division, MS 245-3. Moffett Field, CA 94035-1000. Email1: egrin@mail.arc.nasa.gov; Email2: ncabrol@mail.arc.nasa.gov, Giovanni Leone Università di Lecce, Lancaster University, Email: giovanni.leone@le.infn.it,, and Vincenzo Orofino Università di Lecce. Email: orofino@le.infn.it.

Introduction

The Mars exploration strategy calls for the investigation of sites where minerals indicative of aqueous environments conducive to the support of life, or the preservation of biomarkers, could be identified. Key minerals of astrobiological interest may be trapped as evaporitic deposits in such environment. Most mineral detection are limited by the orbital infrared spectral interpretation of surfaces that do not reproduce the spectral signature of subsurface aqueous sedimentary layers such as fluvio lacustrine materials that may content carbonate and sulfate [1].

1. Evaporites and Carbonates: A Closed, deep, paleolake basin such as Gusev crater which is a top priority site for the 2003 MER A mission could be a reasonable candidate for the search and identification of carbonates and evaporites. When measured between the lowest level of the sedimentary deposits on Gusev floor (- 1899 m, MOLA aph 10856, 15^0 48 S, 184^0 37 W) and the lowest gap level of the northern crater rim (-1383 m, MOLA aph 10440, 13^0 22 S, 184^0 99 W), the revised bathymetric model of Gusev established using MOLA profiles [2] shows that the crater lake was probably deeper than initially proposed [3]. From the new bathymetric estimation, a maximum body of water about 500 m deep could be inferred from these two levels.

Given a mean area of 11,000 km^2 for a 120 km diameter crater lake, the volume of water could have reached at once 5,500 km^3. The filling of sediment estimated from MOLA data is approximately 15,000 km^3 with an inferred thickness of 1,100 m. This value suggests a substantial sedimentary activity by sustained flow rates in Ma'adim Vallis [3]. Such large amount of water and transported fluvial material advocates for the concept of past wetter, and warmer climate episodes than today. In the earliest period of the Ma'adim/Gusev interaction, the CO_2-rich atmosphere must have interacted with rivers and lakes to form carbonate deposits in bodies of water such as lacustrine basins [4]. An earlier model suggested a carbonate precipitation in Gusev at a concentration of 50 ppm for both calcium and magnesium cations and a bulk carbonate density of 2.5 g cm^{-3}. Such concentration would have led to the precipitation of a volume of minerals equivalent to a 60-meter thick layer spread uniformly over the crater floor [5]. The ratio between the thickness of the fluvial sediment deposited and the mineral precipitation leads to a mineral content of about 6% in the aqueous sediment. It can be mentioned here that Pathfinder spectroscopic measurements averaged a soil content of SO_3 of 5% in weight [6].

2. Where to search: TES has recorded signatures of surface silicate and hematite (Christensen et al.) [7]. However, the thermal emission spectrometer has been less productive in locating signatures of deposits of key minerals such as carbonates and sulfates, although these minerals are predicted to be present. In short, the current hypotheses for the lack of positive identification of carbonates and minerals are that: 1) the materials were never formed, 2) they were buried, 3) they were altered by UV radiation, 4) they occur in small deposits at less than one-tenth of TES field of view. With these alternatives, it cannot be precluded that key minerals may have been deposited in layers and mixed with lacustrine material because of the activity of Ma'adim Vallis which spanned over three main fluvio-lacustrine stages [8] and two billion years of Mars history.

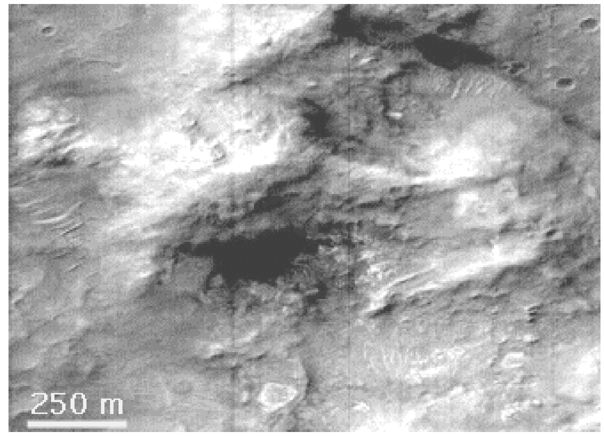
The rate of suspended mineral deposition in lacustrine sediment is likely to have been increased in lowest topographic areas where the water resided longer. If they were formed, residual carbonate layers and other minerals have a higher probability to be discovered at high concentration in these lowest regions of the landing ellipse. They may have survived until present days preserved in packs of layers within outcrops or trapped in the ancient lakebed. The in situ investigation for evaporite deposits should be made in the landing ellipse on exposed faces of outcrops located in the lowest topographic points as well as at the contact with shorelines and residual playas.

3. Suggested Targets: A preliminary analysis of 15 E-W oriented topographic profiles at latitudes ranging between 14.32S and 15.62S and a constant spacing of 10 seconds between adjacent profiles suggests that in the vicinity of 14.52 S the relatively flat topography of the lakebed is indicative of a sedimentary deposition established in the absence of strong sublacustrine currents. This setting would be favorable for the preservation of undisturbed sedimentary sequences and the identification of carbonate and evaporitic minerals.

This analysis has just been initiated and will list all potentially favorable sites analogue to this one within the landing ellipse as a guide for the MER mission rover. The analyzed site is centered at 14.80^0S/184.50^0W and covers nearly 20 km^2 near the sweet spot at the proximity of the MER A landing ellipse center (see the figure) [8].

The poster will detail the analysis of this region of the ellipse as well as any other sites that will have been identified.

References: [1] Kirkland et al.(2001) SPIE 4495. [2]] Carter B.L. et al.(2000) LPSC XXXII # 2042. [3] Grin E. A. and N. A. Cabrol, (1997) *Icarus* 130, 461- 474. [4] Haberle et al.(1998) *Icarus* 109 102-120. [5] Goldspiel J. M. and S.W. Squyres (1991) *Icarus* 89, 392- 418. [6] Steewen et al. (1999) Am. Geophys. Union paper 98JE02551. [7] Christensen P.R. and al. (2000) J. Geophys. Res. 105, 9632-9642 [8]. Cabrol at al.(2001), Third MER 2003 Landing Site Worshop.



Caption:
Detail of MOC EO3-0012 at 2.86 m/pxl (14^0 73 S, 184^0 50 W) illustrating a central portion of the MER A landing ellipse where an elongated outcrop is located on the flat deep bed of the late lacustrine stage of Gusev. Note the nearly 100 m diameter bright patch on the bottom center of the image. Its morphology could suggest an evaporite deposit. The shape of this elongated ridge located in the axis of Ma'adim Vallis is consistent with a sublacustrine deposition of sediment through an unidirectional current.