ROCK STRATIGRAPHY IN GALE CRATER, MARS. K. S. Edgett and M. C. Malin, Malin Space Science Systems, P.O. Box 910148, San Diego CA 92191-0148, USA.

Introduction: A layered mound in Gale Crater (5.4°S, 222.2°W) appears to be a remnant of a more extensive sequence that likely filled the crater (and possibly the terrain beyond the crater rim). The material is representative of the suite of layered outcrops exposed throughout equatorial Mars that are interpreted by the authors as ancient (Noachian) sedimentary rock units. Gale Crater provides an opportunity for a detailed look at the type of geologic record preserved and presently exposed at the surface of on Mars.

Approach and Results: We used a single Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) image (of scale comparable to terrestrial aerial photographs) and a topographic profile acquired by the Mars Orbiter Laser Altimeter (MOLA) at the same time to map rocks exposed in Gale (Fig. 1). Tops and bottoms of lithostratigraphic units are recognized; units are distinguished by planimetric configuration, relief, brightness/tone, texture, pattern (such as layering, thickness of beds, etc.), and context. Eleven units occur in a vertical sequence nearly twice as thick (~2.3 km) as the Paleozoic formations of the North American Grand Canyon. Lower units are horizontally-bedded with many layers exposed in stair-step fashion. Upper units are massive and distinguished by lighter tones relative to lower units. The most significant finding is an erosional unconformity between the uppermost layered (#6 in Fig. 1) unit and lowermost massive units (#7 and #8 in Fig. 1). The unconformity is indicated by impact craters and an old channel—all presently being exhumed—on the upper surfaces of the layered unit. Their presence indicates that a considerable amount of time (duration unknown, but long enough for many craters to accumulate in a small area) passed between the time when lower layered and upper massive units were deposited. This work is the beginning of a larger effort that is possible, because many more pictures, now covering most of the Gale Crater mound, have been acquired by MOC.

Unit Descriptions: Gale Crater mound geologic unit descriptions; thicknesses estimated from the MOLA profile and cross section (Fig. 1).

Unit 1— Intermediate-to-dark-toned layered(?) unit; thin layers evident in upper portion near contact with unit 2; rugged surface; thickness unknown because it is at the bottom of the sequence.

Unit 2— Light to intermediate-toned layered-to-massive(?) unit between units 3 and 1; ~40 m thick.

Unit 3— Intermediate- to-dark-toned; possibly layered (uncertain); apparently overlain by unit 6 and unconformably overlain by units 4 and 5; surface somewhat rugged with sharp-topped mounds at the decameter scale; thickness uncertain, might be ~400 m.

Unit 4— Intermediate-toned channel-fill and ridge/mound-forming unit; occupies channel cut into unit 6; thickness probably a few 10s of meters, at most.

Unit 5— Thin, intermediate-toned, nearly-flat unit immediately adjacent to and embaying ridge material of unit 4; upper surface exhibits faint rippled pattern and is about 5-10% covered by nearly-circular, dark-floored pits; thickness likely > 30 m.

Unit 6— Thick, intermediate-toned, layered unit; most layers have similar thickness, tone, and smooth upper surfaces; some layers expressed as narrow ledges, on others as cliff-bench; beds horizontal; upper surface cratered, some craters only partly-emergent from beneath units 7 and 8; unit also cut by channel largely filled by unit 4; thickness ~600–950 m.

Unit 7— Layered-to-massive, intermediate-toned, relatively thin unit above unconformity at contact with unit 6. Extent beneath unit 8 is unknown, might not be continuous; surface expression smooth at meter to decameter scale; mounds characterize surface erosional expression; thickness may be ~20-30 meters or less.

Unit 8— Massive, light-toned; surface dominated by large, sharply-tapered ridges and intervening furrows; ends of ridges point up and down slope with sharper end downslope; ridge orientation varies from NE-SW to NW-SE in < 3 km lateral distance; contact with unit 7 might be sharp and/or unconformable (unknown); thickness ~150–500 m.

Unit 9— Massive, intermediate-toned; surface includes sharp-edged, tapered and approximately parallel ridges separated laterally by 10s ~200 m of flatter, smoother, darker-surface terrain; ridge orientation approximately N-S and somewhat up-down slope; thickness may be up to ~400 m.

Unit 10— Uppermost unit; massive with intermediate to light tone surface with poorly-organized pattern of sharp-edged, low ridges and scarps separated laterally by 100s of m of smoother terrain; ridges trend up-down slope; several craters occur on or in unit but are severely degraded; thickness indeterminate because top of section is probably not present.

Unit 11— Light-to-intermediate-toned thin, possibly mesa-forming unit (because contact with unit 1 is along a low scarp approximately <10 m high; lies above upper surface of unit 1; contact with unit 1 might be unconformable (not certain).

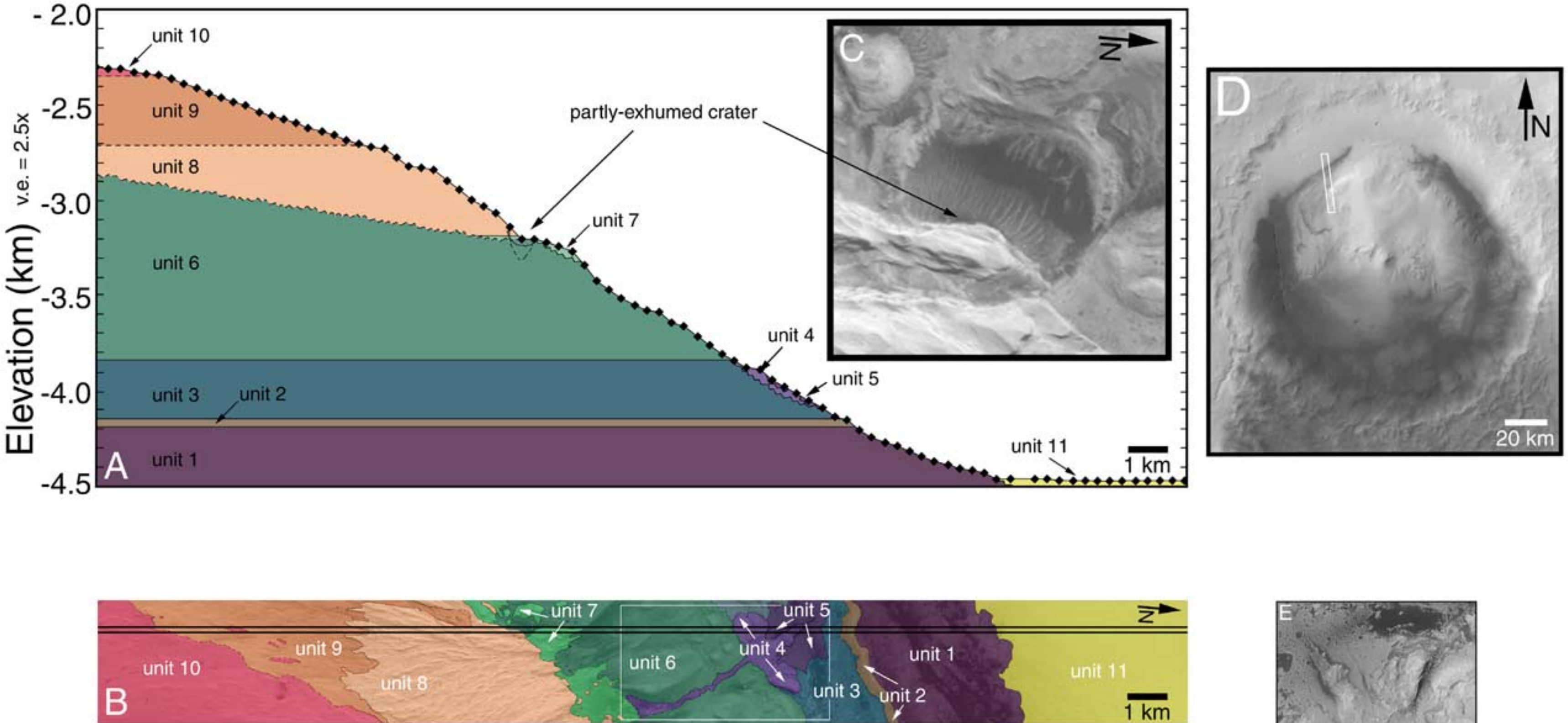

Figure 1. (A) Cross section through Gale Crater mound based upon geologic mapping of MOC image M03-01521 and simultaneous MOLA topographic profile. Vertical exaggeration is 2.5x. Elevations are relative to the martian datum. Black diamonds indicate locations of MOLA laser shots. **(B)** Geologic map, produced at 1:8,000 scale and reduced in size for this publication, based on MOC image M03-01521. Units defined by tops and bottoms of strata and numbered in inferred stratigraphic order (1= oldest). **(C)** Partly-exhumed crater atop unit 6 marks location of erosional unconformity. **(D)** Gale Crater context image, white box shows location of map area; portion of a mosaic of MOC red wide angle images M01-00352 and M01-00740. **(E)** Detail of filled and exhumed channel cutting layered unit 6; like the crater in (C), this observation marks the location of an erosional unconformity.