AN EMERGENT, NEW PARADIGM FOR MARS GEOLOGY. M. C. Malin and K. S. Edgett, Malin Space Science Systems, P.O. Box 910148, San Diego, CA 92191-0148 USA (malin@msss.com).

The planet Mars revealed by the Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) is not the Mars we all thought we knew from the Viking and Mariner missions. One of the most fundamental (and usually unstated) assumptions about martian geology is the notion that the planet's heavily cratered terrain is like that of the Moon—a megabreccia of primordial crust, perhaps consisting of the same lithology throughout (*e.g.*, lunar anorthosite). The additional unstated assumption is that "heavily cratered terrain" formed on the surface of Mars, and then "stuff happened" to this terrain—such as mantling, volcanic plains formation, and processes involving running water—to provide the configuration of landforms that we see today. Nearly all pre-MGS efforts to classify, quantify, map, and date these surfaces on the basis of apparent stratigraphic relationships and crater counts have made this basic, though simplifying, assumption.

MOC images reveal that the upper crust, everywhere that it is exposed in outcrop form, is layered (*e.g.*, Figs. 1, 2). In retrospect, the Mariner 9 and Viking Orbiter images also demonstrate this fact, often in dramatic ways that did not make sense until now. Additionally, the surface properties of Mars, such as the regional albedo patterns and the distribution of dunes, yardangs, rocks, and dust, are all manifestations of this layered upper crust and subsequent weathering and redistribution of its materials.

MOC images show that there are different types of layers, some with different albedo and some with different resistance to erosion. They also hint that some of the layers must be of sedimentary origin, and might have a regional extent that implies that processes occurred on ancient Mars that are completely unlike the processes that occur there today. Layered rocks (especially sedimentary rocks) on Earth tell tales of entire seas and mountain ranges that have formed, evolved, and vanished.

The presence of a layered crust suggests that planet Mars was once unlike anything that anyone has ever described. This Mars existed at a time when impact crater formation was still frequent, and probably existed at a time that predates all of the major volcanic and tectonic features of the Tharsis/Syria rise. This is an early Mars that pre-dates all of the landforms previously attributed to "early Mars"—for example, valley networks—and the surface that has been described prior to MGS is simply that found within the final few chapters in a diverse and previously unrecognized martian history. This Mars is just barely accessible to spacecraft, and will likely require careful exploration by human geologists operating in the field for many decades to fully reveal and appreciate the complex and rich history of this terrestrial planet.

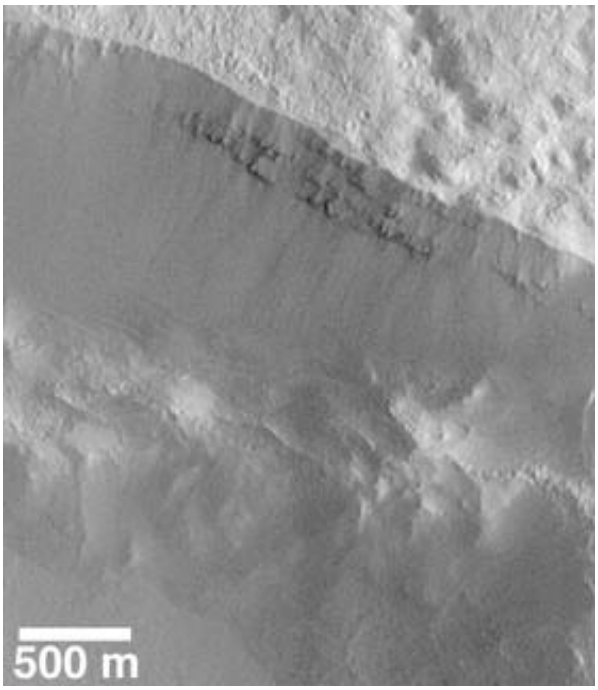

Figure 1. Layered outcrop exposed in wall of eroded impact crater that is superposed on a fretted terrain valley in northern Arabia Terra. Image located near 38.3°N, 320.8°W. North is approximately up, illumination is from the right. Subframe of MOC SPO2 image 46502.

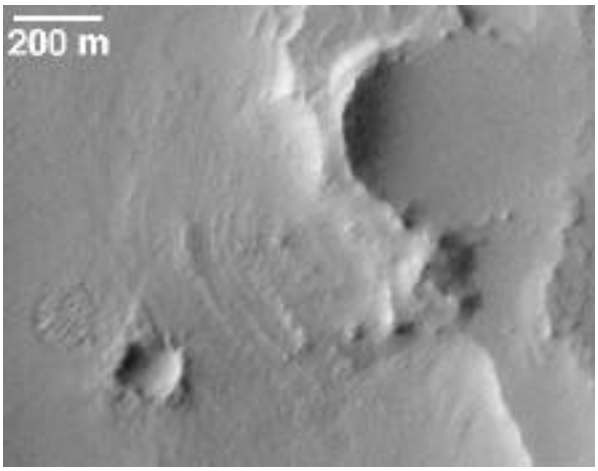

Figure 2. Layers expressed as terraces with three different craters in three different states of exposure or exhumation in the heavily cratered terrain of central Arabia Terra. Image located near 19.2°N, 353.6°W. North is approximately up, illumination is from the left. Subframe of MOC SPO2 image 53403.