A REASSESSMENT OF THE MARS OCEAN HYPOTHESIS. T. J. Parker, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, timothy.j.parker@jpl.nasa.gov.

Introduction: Initial work on the identification and mapping of potential ancient shorelines on Mars was based on Viking Orbiter image data (Parker et al., 1987, 1989, 1993). TheViking Orbiters were designed to locate landing site for the two landers and were not specifically intended to map the entire planet. Fortunately, they mapped the entire planet. Unfortunately, they did so at an average resolution of greater than 200m/pixel. Higher resolution images, even mosaics of interesting regions, are available, but relatively sparse. Mapping of shorelines on Earth requires both high-resolution aerial photos or satellite images and good topographic information.

Three significant sources of additional data from missions subsequent to Viking are useful for reassessing the ocean hypothesis. These are: MGS MOC images; MGS MOLA topography; Odyssey THEMIS IR and VIS images; and MER surface geology at Meridiani and Gusev. Okay, my mistake: Four.

MOC images: MOC images are comparable in resolution to high altitude aerial photographs, and have been very useful for making comparisons with Viking Orbiter-based maps. But MOC images typically cover areas of a few tens of square kilometers. Mosaics do exist, but these take considerable time for acquisition of repeat imaging of a specific target, particularly at the equator. So, placing observations into regional context is difficult.

MOLA topography: As mentioned above, Pre-MGS topography of Mars was far too coarse to be of use in testing the horizontality of proposed shorelines. MOLA topography is high enough in resolution to make testing of horizontality and continuity of mapped shorelines a straightforward process. MOLA topography could probably be described as the most important contributor to the analysis of proposed shorelines on Mars. MOLA topography has enabled the identification of what appear to be erosional terraces at the highlands margin that might have been carved by coastal erosion. The highest such terrace clearly identified lies at +1400m elevation, nearly 3km higher than the Opportunity landing site.

THEMIS IR and VIS: THEMIS IR data, particularly the daytime IR images, are about 100m/pixel, already better than twice the resolution of the average from Viking Orbiter, and should be global by the end of the Odyssey mission. Already, sufficient data exists to make nearly continuous regional basemaps of scientifically interesting areas. THEMIS VIS images are better than 20m/pixel, and in some areas can already be assembled into regional mosaics. But even without contiguous coverage from VIS, an individual THEMIS VIS image can provide a regional context for disconnected MOC images (figure 1). These data are being assembled into mosaics of key areas previously studied in Viking data, to test the shoreline hypothesis at higher resolutions.

Mars Exploration Rovers: The landing sites for Spirit and Opportunity were selected to “follow the water” to the best of our abilities, given the knowledge gained from orbiter instruments and the limitations of the landing system to deliver the rovers safely to the surface. While “scientifically interesting” is inversely proportional to “safe for landing”, it was still possible to select landing sites with high potential to deliver on the “follow the water” promise. And deliver they did!

Meridiani Planum. Prior to landing, the regional, hematite-bearing deposit was interpreted either as a subaqueous precipitate or a volcanic ash or other volcanic deposit subjected to hydrothermal alteration by groundwater. The landing site placed the rover in a small crater with immediate access to sulfate-rich sediments with clearly recognizable subaqueous depositional structures (e.g., water-formed current ripples). To date, Opportunity has found this sedimentary deposit to be remarkably uniform in composition and stratigraphy over the 750 meters between Eagle Crater and Endurance Crater. The evaporite composition and finely laminated stratigraphy over this region implies subaqueous deposition in a large body of shallow water. The regional extent and topographic placement of the Meridiani Planum deposit requires either a very large lake or playa environment (for which the entire northwest confining topography is absent) or a northern plains ocean (with evaporite platform deposition at its margin at equatorial latitudes).

Gusev Crater: Spirit landed on cratered plains on the floor of Gusev Crater. This plains surface is comprised of basaltic blocks – likely ejecta from the numerous small primary and secondary craters on the floor of Gusev – and soil at the top of a regional flow feature emerging from the mouth of Ma’adim Vallis. This flow could be an old lava flow, or a debris flow with basalt clast composition. Examination of the interior of Bonneville Crater failed to reveal any in situ outcrops that might have help to settle this question. Recently, Spirit made the transgression from this plains surface to the base of the Columbia Hills, and is currently examining it's first exposures of in situ outcrop material. Preliminary examination of the hills suggests that these outcrops are layered, but the nature of deposition and the composition of the layered material isn't known at the time of this writing.

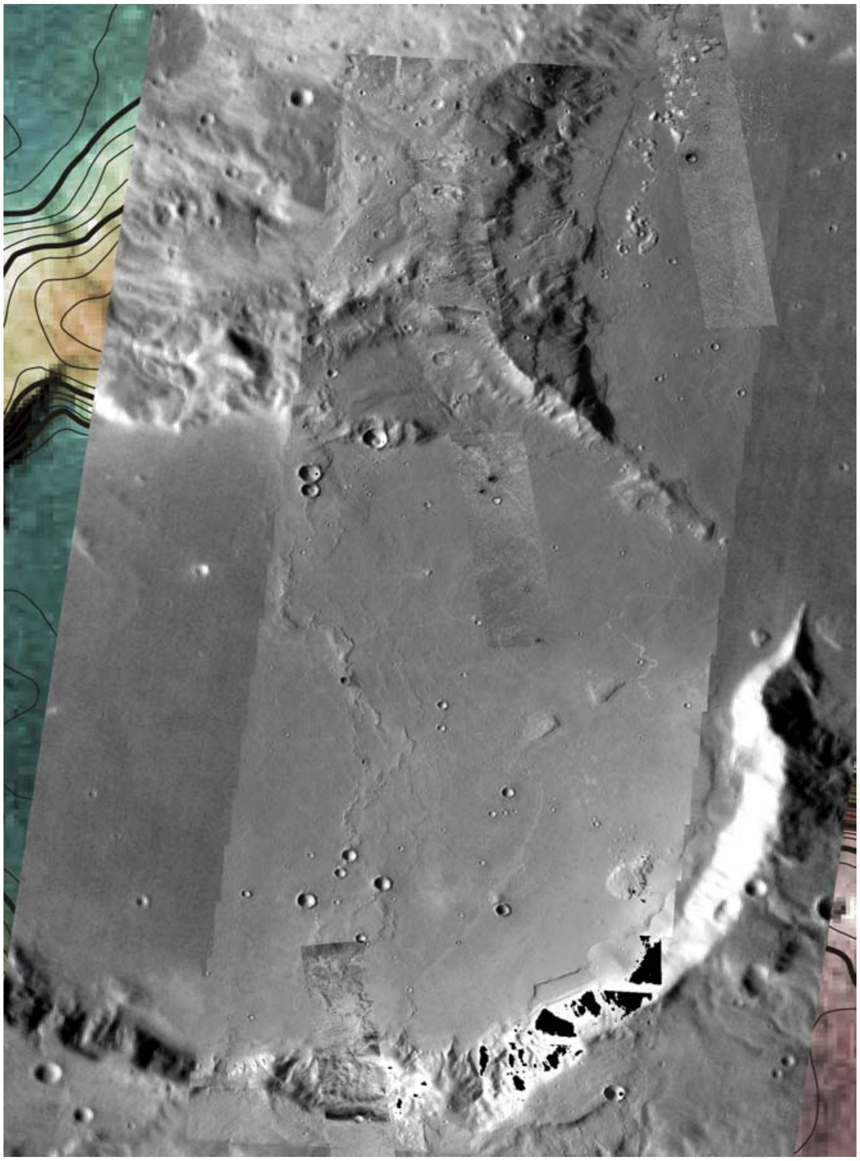

Figure 1: Compilation of MOLA topography on Viking MDIM (background) with THEMIS IR (100m/pixel), VIS (18m/pixel) and MOC (1.5-4.5m/pixel) of an area along "contact 1" or the "Arabia Level" mapped by Parker et al., 1989, based on Viking MDIM resolution.