THE SEDIMENTARY ROCKS EXPOSED IN TERRA MERIDIANI. R. E. Arvidson[1], [1]Washington University, St. Louis, MO 63130, arvidson@wunder.wustl.edu.

Introduction: In this abstract the observations acquired by the Mars Exploration Rover, Opportunity [1], and the orbital data acquired by the Mars Express OMEGA hyperspectral imager for the sedimentary rocks in Terra Meridiani [2-5] are jointly analyzed, and a model is presented for the formation and modification of the deposits.

Observations: The traverses and observations completed by Opportunity show that the Meridiani plains consist of sulfate-rich sedimentary rocks that are covered by poorly-sorted basaltic aeolian sands and a lag of granule-sized hematitic concretions. Orbital spectra obtained by OMEGA over this region are dominated by pyroxene, plagioclase feldspar, crystalline hematite (i.e., concretions), and nano-phase iron oxide dust signatures, consistent with Pancam and Mini-TES observations. Mössbauer Spectrometer observations indicate more olivine than observed with the other instruments, consistent with preferential optical obscuration of olivine features in mixtures with pyroxene and dust.

A ~1 km vertical section of etched terrain and hematite-bearing plains materials and nearby cratered terrain surfaces was mapped in the northern portion of Meridiani Planum (~390 km to the northeast of Opportunity) using OMEGA data. The oldest materials are the cratered plains, which are dominated by a mix of low and high calcium pyroxenes. Etched plains materials overlie this unit and are exposed within a 120 km NW-SE trending valley to the south of the cratered plains. Lower etched plains materials exhibit a kieserite-like signature on a plateau-forming horizon and polyhydrated sulfate-like signatures on the main valley floor. The upper etched plains unit exhibits signatures consistent with hydrated iron oxides and is covered by a relatively thin layer of basaltic sand and hematitic concretions. The youngest unit consists of ejecta deposits from a cluster of six craters that mantle the eastern portion of the study area.

Model: The most plausible regional-scale model for formation of the Meridiani deposits is one in which the water table rose relative to the dissected cratered terrain surfaces, resulting from tectonic subsidence and/or enhanced recharge of the cratered terrain highlands to the southwest. A regime of relative uplift and dissection switched to one of relative subsidence and sedimentary accumulation onto the cratered terrains. The several kilometers of relief between the cratered highlands to the northwest and the dissected cratered terrains to the southeast would have produced the hydrostatic head necessary for regional-scale ground water flow. In fact, regional scale modeling of ground water flow indicates that the Meridiani area would be one where ground water would upwell toward the surface [6]. Sulfur and other volatile species were introduced to the hydrologic system as a consequence of extensive volcanism from Tharsis (and other) volcanoes and/or by weathering of pre-existing sulfur-bearing deposits and would have produced an acid-sulfate ground water system.

Relative rise of the groundwater table resulted in the development of springs and playa lakes of high ionic strength within local topographic depressions. Desiccation of these local, shallow water bodies would have provided a ready source of “dirty evaporite” deposits dominated by sulfates and weathered siliciclastic components. Evaporation of pore fluids within the capillary fringe, or surface water within playa lakes, would have precipitated evaporite minerals as cements that bound siliciclastic grains together [7,8]. During dry periods, erosion and redistribution of these cemented mudstones would have occurred by aeolian processes and during wetter periods by water flow. Preservation would have been assured as the ground water table continued to rise, with associated diagenetic processes and cementation of deposits within the capillary fringe. New evaporite and related deposits would have continued to accumulate at the depositional surface as the water table continued to rise, and rose to form shallow pools that became evaporitic playas.

After the Meridiani hydrologic system ceased operating, aeolian processes would have taken over as the dominant process. The modern Meridiani plains formed via wind erosion of the sulfate-dominated sedimentary deposits, and accumulation of a thin veneer of aeolian basaltic sand advected into the region. Hematitic concretions formed as lag deposits as the softer sulfate rocks were eroded by wind. Occasional sulfate outcrops were exposed via cratering and in-between aeolian ripples, where the basaltic sand cover is thinnest.

References: [1] Squyres S. W. et al. (2006) *JGR*, submitted. [2] Arvidson R. E. et al. (2005) *Science, 307*, 1591-1594. [3] Bibring J. -P. (2005) *Science, 307,* 1576–1581. [4] Arvidson R. E. et al. (2006) *JGR,* in press. [5] Griffes, J. L. et al. (2006) *JGR*, in press. [6] Hanna J. C. and Phillips R. J. (2006) *LPS XXXVII*, Abstract #2373. [7] Grotzinger J. P. et al. (2005) *EPSL*, *240*, 11-72. [8] McLennan S. M. et al. (2005) *EPSL*, *240*, 95-121.