SEDIMENTARY ROCKS OF MARS: DISTRIBUTION, DIVERSITY, AND SIGNIFICANCE J. P. Grotzinger, Division of Geological and Planetary Sciences, California Institute of Technology, 1200 E. California Blvd., Pasadena, CA 91125 grotz@gps.caltech.edu

Mission results over the past decade have demonstrated that a diverse suite of sediments and sedimentary rocks exists on the surface of Mars that represent eolian, fluvial, and possibly lacustrine environments [1]. Sedimentary rocks on Mars can be classified based on broadly-defined attributes that usefully characterize particular types of strata. These include tone/albedo, apparent thickness of stratification and presence of apparent cyclicity, weathering character (rough, blocky vs. smooth), larger-scale textures and patterns (e.g. polygonal, or recticulated), and spectral signature as seen in visible-near infrared and thermal infrared data, including the distinct lack of signatures most often attributed to dust, but possibly also associated with a distinct class of sedimentary rocks possibly composed of ancient lithified dust. These strata form as relatively thin (tens to humdreds of m thick) fluvial deposits in smaller crater basins; thicker deposits (hundreds to thousands of m thick) of uncertain origin in larger crater basins; and as widespread, locally complexly folded strata within the lower depths of Vallis Marineris and also of uncertain origin. Widespread sheets of strata occur within the Arabia region, not obviously confined within a topographic depression, and also at Terra Meridiani.

Sedimentary materials were formed during erosion of older, presumably basaltic, rocks to form siliciclastic sediments and sedimentary rocks, deposited mostly as alluvial fans or eolian sand sheets. In areas affected by volcanism, reworking of volcanic deposits to form volcaniclastic sediments and sedimentary rocks may have occurred. Finally, where water was available and also charged with dissolved ions, evaporation of possibly shallow bodies of water or discharging groundwaters to form chemical sediments appears to have occurred over relatively widespread regions. These deposits of chemical origin are dominated by sulfates and possibly chlorides, though the search for large carbonate reservoirs continues [2]. Chemical and fine-grained siliciclastic sediments and sedimentary rocks are viewed as prime targets for future *in situ* geobiological analysis or sample return [3].

In situ studies at Meridiani Planum and in Gusev Crater featured analysis of ancient eolian/fluvial and volcaniclastic deposits at meter to millimeter scales and, in large part, with fidelity that is comparable to many of the detailed stratigraphic studies that have been carried out on Earth [4]. In a complementary fashion, orbiters have demonstrated the regional extent and geologic context of various types of sedimentary rocks [5]. Both scales of observation provide important constraints on the composition, stratigraphy, and geologic history of Mars.

Mars may have a distinct history of aqueous events that left distinct time-dependent patterns embedded within the rock record [2]. The current hypothesis is that the long-term environmental evolution of the planet is delineated in the history of mineral assemblages, from a planet characterized by aqueous alteration of impact-brecciated ancient crust forming phyllosilicate minerals, to a planet marked by vast terrains of bedded sulfate minerals, and that this was followed by a terminal shift to the current dry state during which anhydrous iron oxide minerals accumulated.

The principles of sequence stratigraphy also are applicable to Mars [6]. High resolution stratal geometries can be mapped using sequence stratigraphic principles has been shown for SW Melas Chasma. HiRISE, MOC, and CTX imagery will permit detailed mapping of this particular succession of strata, and others like it; the results will likely shed light on the origin of the strata and facies distributions within the succession. In the future, construction of Digital Elevations Models from HiRISE image data will allow mapping of stratal geometries at meter scale, laterally, for distances of hundreds to thousands or meters of more.

1. McLennan, S., and Grotzinger, J. P., 2008, *in* The Martian Surface, Cambridge University Press, 541-577.
2. Bibring J.-P. *et al*., 2006, *Science* 312, 400-404 .
3. **Gr**otzinger, J. P., 2009, *Nature Geo*., v. 2, p. 1-3.
4. McLennan, S. M., et al, 2005, *EPSL*, v 240, 95-121. Grotzinger, J.P., et al.,, 2005, *EPSL*, v. 240, p. 11-72.
5. Malin, M.C. & Edgett, K.S. *Science* 302, 1931-1934 (2003).
6. G. Dromart, et al., 2007, *Geology* **35**, 363-366.