MARS EXPLORATION ROVER OPPORTUNITY MISSION RECENT RESULTS FOR MERIDIANI PLANUM. R. E. Arvidson[1], S. W. Squyres[2], S. L. Murchie[3], and the Athena Science and CRISM Teams, [1]Earth and Planetary Sciences, Washington University in Saint Louis, Saint Louis, MO, 63130, USA (arvidson@wunder.wustl.edu), [2]Department of Astronomy, Cornell University, Ithaca, NY, USA, [3]JHU/Applied Physics Lab, Laurel, MD, USA.

Introduction: Opportunity has been traversing the Meridiani plains since January 2004 and after reaching Santa Maria crater on December 16, 2010 had traveled over 26.5 km (based on wheel odometry) (Fig. 1). This abstract focuses on recent key scientific results.

Atmospheric Dynamics: Opportunity-based Ar atmospheric mixing ratios derived from APXS data show minimum values at Ls=90 degrees [1]. This occurred during the period when Mars Odyssey GRS data show the highest Ar concentration over the growing south polar seasonal cap [2]. Opportunity Ar mixing ratios increased rapidly as Odyssey data showed the south polar concentrations decreased. Peak Opportunity-based values were reached during late southern winter to early spring seasons. Ar mixing ratios then decreased, reaching a broad low between 270 to 320 degrees Ls (northern winter season). These trends were simulated with the NASA Ames global circulation model, which reproduced the broad patterns discussed above, including the sharp decrease and increase in Opportunity-based values associated with the south polar winter cap formation and sublimation. The broad low associated with formation and sublimation of the northern winter cap was also reproduced.

Aeolian Ripples: The ubiquitous ripples within the regions traversed by Opportunity have a dominant strike of north-south, based on examination of HiRISE data and azimuths measured from Pancam and Navcam data. The Raleigh crater (Fig. 2) is an example of a number of small craters that must have formed after the last major phase ripple migration ceased, since the crater cuts across the ripples and exposes layers perpendicular to the ripple crest. The layers dip slightly toward the west. This pattern is consistent with ripple formation by easterly winds in which sand was trapped on the leeward faces and the ripple migrated over the deposits, producing layers that dip slightly toward the leeward direction**.** Global circulation models do not show strong easterlies associated with modern atmospheric circulation patterns. We interpret these results to indicate that when the spin axis of Mars was at a higher orbital obliquity, enhanced solstice Hadley cell circulation produced strong easterlies that generated the north-south oriented ripples.

Meteorites and Ejecta Cobbles and Boulders: Five basic types of rock fragments have been found and characterized in detail: a. Local impact ejecta that consist of sulfate-rich sedimentary material (e.g., Chocolate Hills); b. Basaltic materials that are likely impact ejecta fragments (e.g., Bounce Rock) from distant sources; c. A mix of sulfate and basaltic materials that are likely impact melt products (e.g., Arkansas); d. Stony-iron meteorites (e.g., Barberton); and e. Iron-nickel meteorites (e.g., Block Island). The measurements indicate varying degrees of physical and perhaps chemical modification since emplacement.

Sedimentary Bedrock: Since Opportunity landed the vehicle has made measurements within Eagle, Endurance, Erebus, and Victoria craters, together with outcrop exposures on the plains that were focused on characterizing the formation and modification of the Burns formation sulfate-rich sandstones. Results continue to show compelling evidence of sand deposition by wind, with local reworking within ephemeral lakes, and subsequent aqueous alteration during periods of rising ground water. Extensive lacustrine evaporitic facies have not yet been found, although particular emphasis has been placed on finding these putative materials. Detailed measurements of the upper strata within Endurance and Victoria craters show a vertically-downward enrichment in Cl and decrease in Mg and S, consistent with regional-scale aqueous alteration after emplacement and initial alteration of the sedimentary deposits.

Santa Maria is a ~90 m wide impact crater with rays and ejecta blocks preserved, indicating that it is a very young feature (Fig. 3). Opportunity, as of early January 2011, is conducting an extensive imaging campaign to characterize the geomorphology and structure of this crater. The rover will spend solar conjunction on the southeastern side of the crater, where CRISM "super resolution" observations indicate the presence of relatively fresh exposures of monohydrated sulfate-bearing rocks (Fig. 4). The expectation is that this spectral signature is associated with rocks too young for their surfaces to have been coated or altered in the current Mars environment.

Look Ahead to Endeavour's Rim: After leaving Santa Maria Opportunity will traverse ~ 6 km (straight line distance) across the plains to Cape York, the closest rim segment of the Noachian-aged Endeavour crater. Previous and new "super resolution" CRISM data show the presence of hydrated minerals in sedimentary rocks adjacent to Cape York (area called Botany Bay) and Fe-Mg smectite clay minerals on the rim [3,4]. Accessing the hydrated rocks near Endeavour's rim and clay minerals on the rim proper will open a new chapter for Opportunity by allowing characterization of materials not yet encountered during the mission.

References Cited: [1] Arvidson R. E. et al. (2010) *JGR*, doi:10.1029/2010je003746, in press. [2] Sprague A. L. et al. (2007) *JGR, 112*, E03S02, doi:10.1029/2005JE002597. [3] Wray J. J. et al. (2009) *GRL*, *36*, L21201, doi:10.1029/2009GL040734. [4] Fraeman A. et al. (2011) *LPS XLII*, this volume.

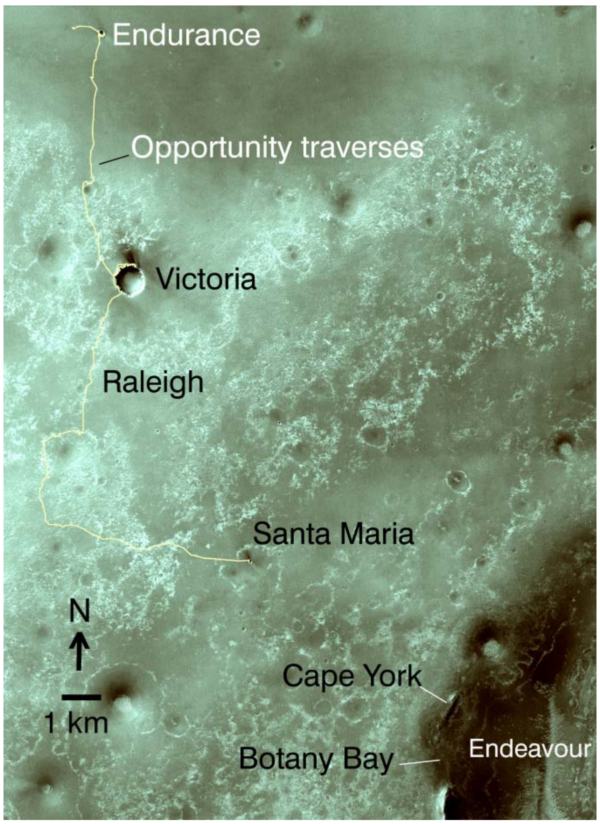

Fig. 1 – Regional-scale view showing Opportunity's traverses from landing to Santa Maria crater. CTX mosaic used as base map, with key craters labeled.

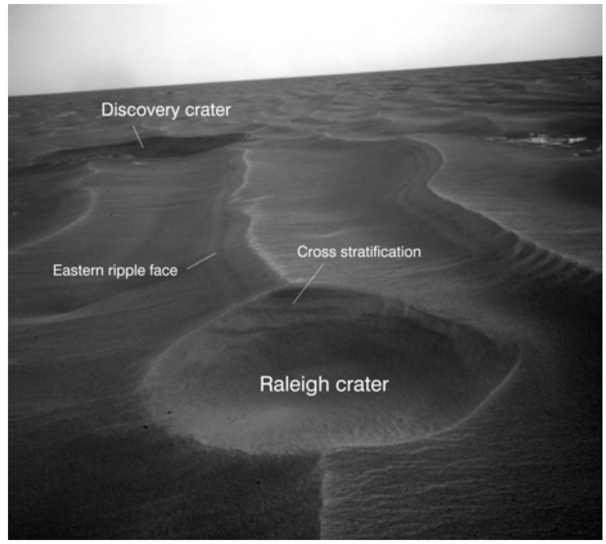

Fig. 2 – Raleigh crater seen in a Navcam image looking to the south.

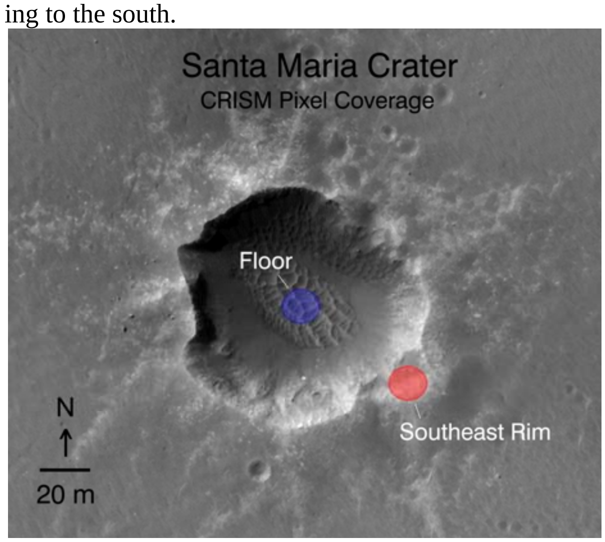

Fig. 3 – HiRise view of Santa Maria showing the location of pixels for which CRISM spectra were retrieved. HiRISE frame PSP_009141_1780_red.JP2.

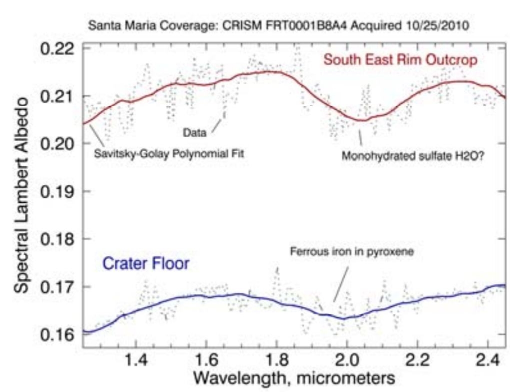

Fig. 4 – CRISM-based spectra retrieved for the floor and southeast rim of Santa Maria. FRT0001B8A4.