LATERAL MINERALOGICAL AND GEOCHEMICAL VARIATIONS AT HOME PLATE: IMPLICATIONS FOR FLUID FLOW AND HYDROTHERMAL ALTERATION. M. E. Schmidt[1], W.H. Farrand[2], R. Gellert[3], J. Hurowitz[4], J.R. Johnson[5], T.J. McCoy[1], and the MER Athena Science Team [1]Department of Mineral Sciences, Smithsonian Institution, MRC-0119 PO Box 37012 Washington, D.C. 20013-7012, schmidtm@si.edu, [2]Space Science Institute, 4750 Walnut St., Boulder, CO 80301, [3]Dept. of Physics, University of Guelph, Gordon Street, Guelph, ON N1G 2W1, Canada, [4]Jet Propulsion Laboratory, Pasadena, CA 91109, [5]USGS Astrogeology Team, 2255 N. Gemini Drive, Flagstaff, AZ

Introduction: The Mars Exploration Rover Spirit recently completed a circumnavigation of Home Plate, an ~80 m platform of layered clastic rock. Textures such as a bomb sag, and compositional characteristics, like an enrichment in volatile elements led to the interpretation that Home Plate is pyroclastic and likely hydrovolcanic in origin [1, 2]. We summarize systematic spectral, mineralogical, and compositional differences that have been found across Home Plate and suggests they are the result of hydrothermal alteration.

Spirit's Traverse: Spirit first examined the Barnhill section at the northwest corner of Home Plate (sols 744-768). The Barnhill section is ~2 m-tall and includes a lower, coarse-grained unit and an upper, eolian reworked, cross-bedded unit. After spending its second winter on Mars at the northeastern slope of Low Ridge, Spirit next examined Home Plate at its eastern edge at the ~1 m Pesapallo section (sols 1206-1216) of poorly-sorted, cross-bedded strata that correspond to the upper unit at Barnhill. Spirit then climbed on top of Home Plate and went south to examine the target TexasChili (sols 1325-1326) and to the west edge at PecanPie (sol 1368). Spirit finished its traverse at the north edge of Home Plate at the dusty target Chanute (sol 1410), where the rover will spend its third Martian winter.

Results: Remote and in situ observations made by Spirit tell a coherent story of lateral differences between the east and west sides of Home Plate.

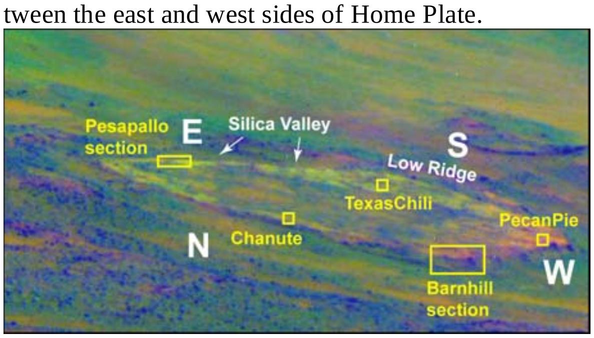

Figure 1. Pancam false-color image acquired near the summit of Husband Hill (Sol 595) of Home Plate indicating color differences around its rim. Red = 432-754 nm spectral slope; Green = 432 nm reflectance; Blue = 754-1009 nm spectral slope. Target localities and important geographic features are indicated.

Pancam observations. The first indication that the west and east sides of Home Plate are distinct came from remote Panoramic (Pancam) camera observations (Fig. 1). Up close, VNIR spectra taken of Rock Abrasion Tool (RAT) brush spots indicate that western targets have greater band depths at ~535 and ~601 nm [2]. This indicates that the western side of Home Plate is more oxidized than at its eastern edge. The spectral variations observed by Pancam are in agreement with those from the HiRISE orbital camera [2].

Mössbauer Results. The Fe mineralogy as indicated by Mössbauer Spectrometer [3, 4] agrees with the Pancam observations that the west side of Home Plate is more oxidized than the east. Among the targets of the Pesapallo and Barnhill stratigraphic sections, there is little internal variability, but the two section are mineralogically quite distinct. The Barnhill section has almost equal proportion of nanophase Fe oxide (npOx), pyroxene (Px), magnetite (Mt), and olivine (Ol), while the Pesapallo section is dominated by magnetite (up to 54%) and pyroxene with lesser amounts of npOx, hematite, and olivine (Fig. 2). Combined with the targets from the upper surface of Home Plate, the npOx and olivine content systematically increases from east to west-northwest.

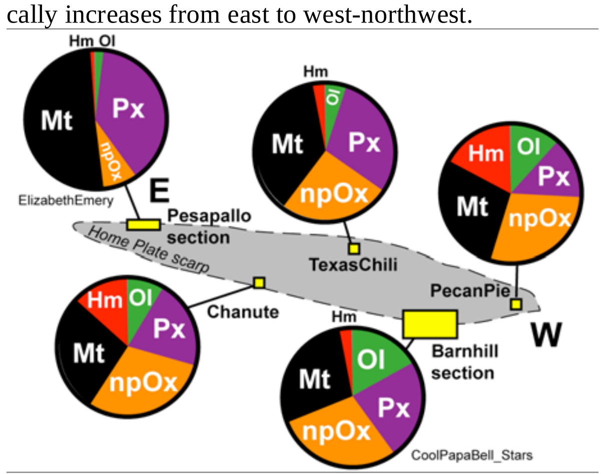

Figure 2. Series of pie charts showing the relative proportions of Fe in mineral phases around the rim of Home Plate.

Alpha Particle X-Ray Spectrometer (APXS) Results. Compositional variations from east to west Home Plate are subtle in comparison to the Pancam and Mössbauer results. Home Plate consists of alkali-rich basaltic tephra (45-47% SiO_2) similar in composition to nearby scorieaceous basalts of the Irvine class. Concentrations of conservative major elements (such as Al, Ti, and Fe) at Home Plate do not appear to vary with east-west position. In contrast, water-soluble trace elements (Fig. 3) do show significant geographic variation, where Zn, Ni, and K concentrations are greatest in the east at Pesapallo and Cl and Br concentrations are greater to the south and west at TexasChili, Barnhill, and PecanPie. The greatest Zn, Ni, and K concentrations in the Home Plate vicinity were found in hematite-rich rocks at Low Ridge during Spirit's 2nd Martian winter campaign [5].

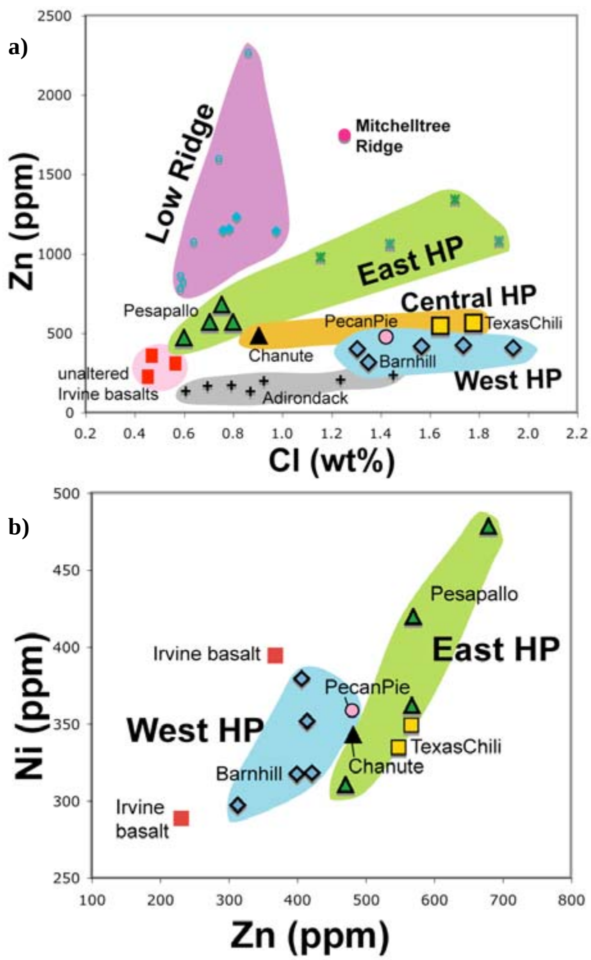

Figure 3a. Zn vs Cl concentration for rocks in the vicinity of Home Plate (HP). Fields correspond with position. Unlabeled rocks are layered units found just to the east and southeast that belong to basaltic to ultramafic units stratigraphically below Home Plate. **3b.** Ni vs. Zn concentration.

Discussion: The mineralogical and compositional lateral variations that were observed by multiple instruments at Home Plate are likely not related to different degrees of dust cover or to a weathering rind because: 1) no opaque coating was observed, and 2) mineralogical variations are systematic for both RAT brushed and unbrushed rock targets. Also, distinct layers within the upper unit of Home Plate have been traced around the north and east escarpment, suggesting that the east and upper unit at the northwest belong to the same stratigraphic unit. Eolian reworking of the upper unit would have homogenized the distribution of primary "igneous" minerals. But different proportions of pyroxene and olivine within this unit were found that also cannot be easily explained by magmatic processes such as fractional crystallization and differential density settling over horizontal distance of only 10s of meters. Because the mineralogy is consistent between multiple targets within the Barnhill and Pesapallo sections, variable oxidation was probably not incurred during the energetic volcanic eruption that formed Home Plate. We instead suggest that the lateral differences at Home Plate are related to post-depositional hydrothermal alteration overprinting basaltic hyaloclastite tephra.

A greater proportion of easily weathered olivine at the western side of Home Plate suggests that it is less altered than in the east. This is in spite of higher Fe^{3+}/Fe_{total} and higher npOx content, a likely devitrification product of volcanic glass in the west. A negative correlation between magnetite and npOx (R^2=0.94) suggests that they are linked by a redox reaction, potentially caused by reducing fluids.

Chloride complexes of Zn and Ni are more soluble in aqueous fluids at higher temperatures. It follows that the decrease in Zn and Ni concentrations (Fig. 3b) from east to west reflects a decrease in temperature (~150-250˚C difference) and lateral fluid flow. Higher volatile metal and inferred temperatures at the eastern side of Home Plate are intriguing given its proximity to amorphous silica deposits in Silica Valley (Fig. 1) that are thought to be hydrothermal in origin [5].

Conclusions: Remote and in situ observations made by multiple instruments onboard the Spirit rover agree that mineralogy and composition vary systemically across the Home Plate structure. Higher temperatures and less olivine found in the east suggest a closer proximity to a hydrothermal fluid source.

References: [1] Squyres S.W. et al. (2007) *Science,* 316, 738-742. [2] Farrand, W. (2008) *LPS XXXIX, this issue.* [3] Morris et al. (*in prep.) JGR.* [4] Schröder, C. et al., (2008) *LPS XXXIX, this issue.* [5] Ming D.M. et al. (2008) *LPS XXXIX, this issue.*