HYDROVOLCANO ON MARS? A COMPARISON OF HOME PLATE, GUSEV CRATER AND ZUNI SALT LAKE MAAR, NEW MEXICO. M.E. Ennis[1], M.E. Schmidt[2], T. McCoy[2], W. Farrand[3], N. Cabrol[4], [1]Department of Physical Sciences and Geology, Morehead State University, Morehead, KY 40351, menni01@morehead-st.edu, [2]Department of Mineral Sciences, National Museum of Natural History, Smithsonian Insititution, Washington, DC 20560-0119 schmidtm@si.edu, [3]Space Science Institute, 4750 Walnut St., Boulder, CO 80301, [4]SETI Institute, Space Science Division, MS 245-3, NASA Ames Research Center, Moffett Field, CA 94035-1000

Introduction: The discovery of Home Plate, a light-toned ~80 m. diameter, ~2 m tall platform of layered rock by the Mars Exploration Rover Spirit has been the most exciting so far in Gusev Crater. Textures at Home Plate, including a bomb sag and rounded potential accretionary lapilli, are consistent with its formation by a hydrovolcanic eruption, whereby magma exploded violently upon encountering abundant ground or surface water [1, 2]. An alternative hypothesis for the origin of Home Plate holds that its upper cross-bedded unit (Figure 1) was emplaced by eolian reworking and deposition [1].

To test whether Home Plate was formed by a hydrovolcanic eruption as a single event, or by eruption and subsequent eolian reworking, deposits at Home Plate were compared with Zuni Salt Lake Maar, New Mexico.

Methods: We created detailed measured stratigraphic columns for both the Barnhill outcrop of Home Plate and a section of Zuni Salt Lake Maar, New Mexico at comparable 2-3 m. scale. At Zuni Salt Lake, we were able to document cm-scale variations in tephra grain size, shape, and composition as well as bed thickness and cross bedding by taking field notes and photos along our traverse. Our evaluation of the Barnhill outcrop of Home Plate was much less detailed by nature of doing field geology on Mars. Even so, images of Barnhill made by the rover's cameras, including the Pancam and the Microscopic Imager (MI) revealed details about grain size, shape, and bedding (publicly available at http://marswatch.astro.cornell.edu/pancam_instrument/ and http://marsrovers.jpl.nasa.gov/gallery/all/spirit.html).

Two Field Sites: The Barnhill outcrop of Home Plate was examined from Sols 746-751 and revealed its basaltic composition with abundances of Cl, Br, Ge, and Zn [3] and microscopic textures. Two main units make up Barnhill (Figure 1), an upper fine-grained cross-bedded unit and a lower, coarser grained, laminated to massive unit [4, 5]. The uppermost surface of Home Plate is covered by (up to 1 m.) vesicular to massive basalt blocks that may or may not be related to the layered units.

The ~90 ka Zuni Salt Lake Maar [6] is ~2 km in diameter and the eruption excavated a nearly 200 m deep crater into sandstone and fossiliferous limestone units. The eruption alternated between hydroclastic (wet) and strombolian (dry) styles. Clasts at Zuni Salt Lake thus include accidental sandstone, limestone, juvenile basalt scoria, blocks, and ash, and palagonitized basalt (Figure 2). The waning stage of the eruption constructed two small scoria cones on the crater floor. Saline groundwater later infiltrated the crater and evaporated to produce a deposit of salt.

Comparison:

Similarities. Features in common at Zuni Salt Lake and Home Plate imply formation by a wet volcanic eruption.

• Low angle cross bedding results from the tephra spreading turbulently outwards from the volcanic vent as a base surge.

• Accretionary lapilli are round grains of accumulated ash thought to be due to steam in the eruption column.

• Bomb sags are created when a volcanic bomb impacts cohesive (i.e. wet) tephra beds, deforming the underlying layers.

• Possible vesicles at Barnhill are like those found at Zuni Salt Lake that were caused by degassing of the lava during deposition.

• Vesicular to massive basalt blocks cap both Home Plate and Zuni Salt Lake.

• Alternating layers of coarse and fine clasts or tephra reflect pulses in the eruption intensity.

• Beds dip toward the center of the edifice up to 6˚ at Home Plate [2] and up to >30˚ at Zuni Salt Lake.

Differences. Features such as slumps and high proportion of accidental clasts found at Zuni Salt Lake are characteristic of a maar volcano and are missing at Home Plate. We instead suggest that Home Plate is a tuff ring that requires a greater magma supply rate and built above the land's surface rather than excavating into it.

• Collapse features such as slumps are present at Zuni Salt Lake, but absent at Home Plate

• Accidental (bedrock) material is abundant at Zuni Salt Lake, but is so far rare at Home Plate.

• Palagonite is abundant at Zuni Salt Lake, but has not yet been found at Home Plate. This may reflect the dry Martian atmosphere or differences in eruptive fO_2.

• Zuni Salt Lake is ~25 times larger than Home Plate. The scale of the eruption that produced Home Plate may have been smaller or the Home Plate edifice does not reflect the full extent of the deposit.

Conclusions: Features found at Home Plate are consistent with a hydrovolcanic origin as a tuff ring, which can account for textures including the cross bedding by single volcanic event, rather than by later eolian reworking. This style of eruption indicates that there once was water at or below the surface of Mars.

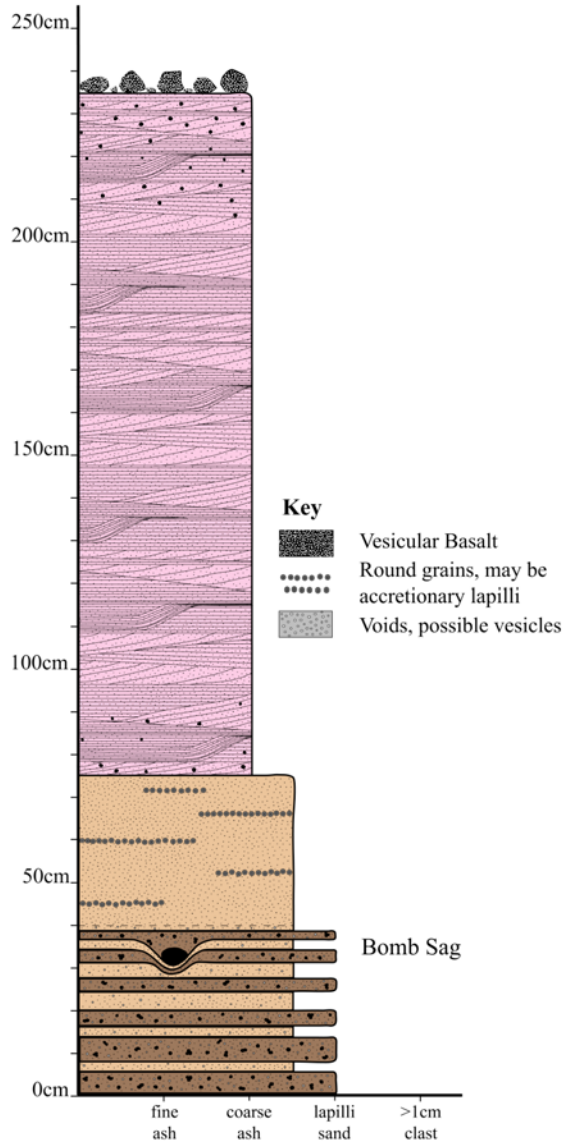

Figure 1. Stratigraphic column of Barnhill outcrop of Home Plate.

References:

[1] Squyres, S.W. et al (in review) Science; [2] Rice, J. et al (2006) AGU abstract #P44W-1274; [3] Schmidt, M.E. et al (2006) AGU abstract # P44A-07; [4] Aharonson, O. et al (2006) AGU abstract #P44A-05; [5] Cabrol, N. (2006) AGU abstract #P44A-06; [6] Crumpler, L. S. and Aubele, J. C. (2001) New Mex. Mus. Nat. Hist. & Sci Bull., 18, 5-15.

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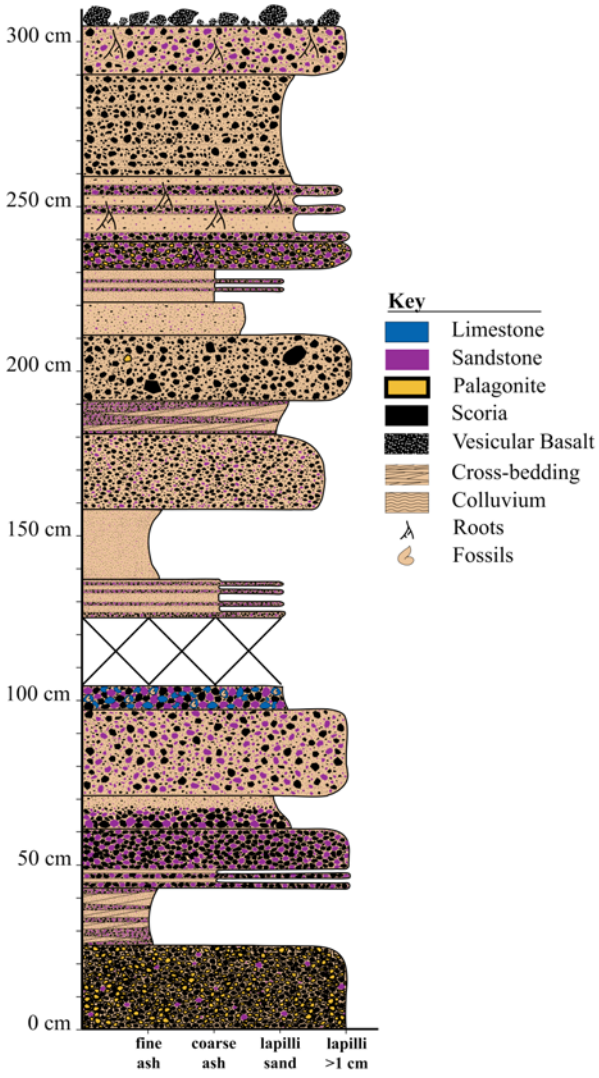

Figure 2. Measured stratigraphic column for section of Zuni Salt Lake Maar, New Mexico.