WATER AND IMPACT GLASS INTERFACES ON ANCIENT MARS. K. M. Cannon[1] and J. F. Mustard[1], [1]Brown University, Department of Earth, Environmental and Planetary Sciences, Providence RI, USA, kevin_cannon@brown.edu

Introduction: Microbial communities colonize rapidly quenched silicate glasses on Earth [1-3], and these glasses may have been an ideal and widely available biological substrate on ancient Mars. While glass-rich impactites present on Mars today are likely too young to have interacted with water in warm environments, the extent and better preservation of these younger impactites can be used as analogs for Noachian and pre-Noachian environments favorable for microbial-style glass colonization.

Approach: To explore martian impact materials, we are continuing to link laboratory measurements of relevant samples with remotely sensed spectral observations of Mars. Specifically, we have focused on the regolith breccia Northwest Africa (NWA) 7034 [4,5] and synthetic glasses with martian compositions, fused at appropriate oxygen fugacity conditions for Mars. These measurements have been incorporated into a spectral unmixing model to identify glass-rich impactites and map them spatially on the martian surface [6]. Our remote observations provide clear evidence and context for where impact glasses and breccias may have been in intimate contact with water in the past.

Glass-Water Settings: The following environments are suspected to have featured glass-water interfaces early in Mars' history (Fig. 1).

Crater-lakes with melt linings (Fig. 1a): We observe many well-preserved medium-sized (D = 10-100 km) craters with glass-rich impactites lining the crater floor and draped over central uplifts. These are distinct from the older, degraded craters that once hosted open or closed-basin lakes [e.g., 7], but by analogy we infer that pre-Noachian and Noachian crater bottoms were likely lined with quenched glassy layers before possible infill by water or the onset of hydrothermalism.

Distal strewnfields on land and water (Fig. 1b): Distal strewnfields analogous to terrestrial tektite/spherule beds have long been inferred to exist on Mars [8-11]. Using OMEGA data we have identified that low-albedo features like the Amenthes streak indeed have a glass-rich composition. In the past these glassy materials would have been deposited ballistically into open water bodies such as lakes or seas, or on land in contact with atmospheric water vapor.

Fluid circulation through regolith breccias (Fig. 1c): The major low-albedo regions of Mars are more spectrally consistent with NWA 7034, a regolith breccia, than with the basaltic SNC meteorites [5]. NWA 7034 contains significant amounts of impact melt clasts and spherules, and a thick layer of this type of material may have served as a porous substrate for crustal fluid circulation on ancient Mars [12].

Future work will combine laboratory studies and remote sensing to constrain the chemistry and iron oxidation state of impact glasses on present-day Mars, and study the aqueous alteration of these materials.

References: [1] Fisk M. R. et al. (1998) *Science*, *281*, 978. [2] Sapers H. M. et al. (2014) *Geology*, *42*, 471. [3] Izawa M. R. M. et al. (2010) *P&SS*, *58*, 583. [4] Agee C. B. et al. (2013) *Science*, *339*, 780. [5] Cannon K. M. et al. (2015) *Icarus*, *252*, 150. [6] Cannon K. M. and Mustard J. F., *under review*. [7] Goudge T. A. et al. (2012) *Icarus*, *219*, 211. [8] Schultz P. H. and Mustard J. F. (2004) *JGR*, *109*, E01001. [9] Lorenz R. D. (2000) *Icarus*, *144*, 353. [10] Wrobel K. E. and Schultz P. H. (2007) *7th Int. Conf. Mars*, Abstract #3093 [11] Schultz P. H. and Wrobel K. E. (2012) *JGR*, *117*, E04001. [12] Parmentier E. M. and Zuber M. T. (2007) *JGR*, *112*, E02007.

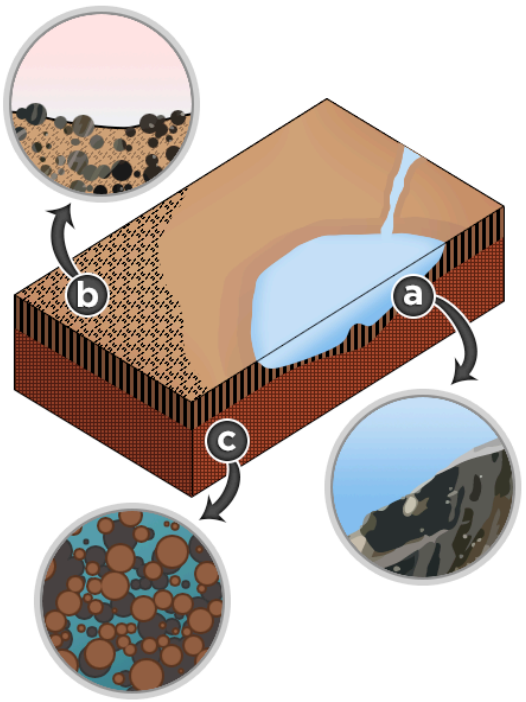

Figure 1. Schematic diagram of probable glass-water interfaces early in martian history: (a) crater-lake bottoms, (b) distal strewnfields in humid air, and (c) fluid flow through porous regolith breccia layer.