ORGANIC ENTRAINMENT AND PRESERVATION IN VOLCANIC GLASSES. M. B. Wilhelm[1,2*] & L. Ojha[1*], A. E. Brunner[3], J. Dufek[1], J. J. Wray[1]. [1]Georgia Institute of Technology, Atlanta, GA; [2]NASA Ames Research Center, Moffett Field, CA; [3]CRESST and NASA Goddard Space Flight Center, Greenbelt, MD *(mbwilhelm@gatech.edu, luju@gatech.edu).

Introduction: Unaltered pyroclastic deposits have previously been deemed to have "low" potential for the formation, concentration and preservation of organic material on the Martian surface[1]. Yet volcanic glasses that have solidified very quickly after an eruption may be good candidates for containment and preservation of refractory organic material that existed in a biologic system pre-eruption due to their impermeability and ability to attenuate UV radiation[2]. Analysis using NanoSIMS of volcanic glass[3] could then be performed to both deduce carbon isotope ratios that indicate biologic origin and confirm entrainment during eruption.

Terrestrial contamination is one of the biggest barriers to definitive Martian organic identification in soil and rock samples. While there is a greater potential to concentrate organics in sedimentary strata, volcanic glasses may better encapsulate and preserve organics over long time scales, and are widespread on Mars. If volcanic glass from many sites on Earth could be shown to contain biologically derived organics from the original environment, there could be significant implications for the search for biomarkers in ancient Martian environments.

Background: Previously, organics (hydrocarbons, aromatics, aldehydes, ketones, alcohols) have been detected in gas samples from active fumaroles and hydrothermal fluids[4-7]. This hot material may have either been supporting active biological systems or have volatilized pre-existing biological material. Carbonaceous material has been detected surrounding cracks or grain boundaries of mantle xenoliths, namely olivine, and is thought to be derived from a biogenic source after cooling[8]. ToF-SIMS analysis of the grain boundaries of amphibolites from depths of ~5-9 km have revealed that hyrdocarbons are produced during retrograde metamorphism[9]. Also, isotopic biomarkers have been discovered in micron-size tubules thought to be created by microbes boring into Archean-aged basalt glass[10-13]. Abiotic macromolecular carbon has been determined to be ubiquitous in martian basalts in meteorite samples[14] and bound in maskelynite inclusions in the minimally contaminated Tissint meteorite[15].

Application & Merit in Martian Environments:

(*1) Minimizing terrestrial contamination*: With the right detection techniques, organics found preserved in volcanic glass would imply entrainment shortly after solidification, thereby ruling out later contamination by subsequent environments or sampling.

(2) Original setting/dating: Volcanic deposits can be dated, and organics found in volcanic glasses could be linked to not only the timing of the event, but also the approximate location and setting during their entrainment.

(3) *Containment and preservation*: Most organic material degrades or disappears over long time scales of exposure to radiative environments and/or later aqueous alteration, making detection in ancient Martian sedimentary units difficult. During an eruption, magma temperatures would likely exceed 500°C, causing volatiles to be released and transforming preexisting organic material into a potentially more stable form as well as leaving behind refractory organics. If this residual organic material was encapsulated in a cooling glass, it would essentially be trapped and partitioned off from the external environment. Glass also offers protection from incident radiation.

Proposed Analog Sites: Earth has three dominant types of volcanic sites that contain large sections of volcanic glass that may have incorporated organics: pyroclastic density current (PDC) vitrophyres, glass from lava domes, and silicic lava flows that have low volatile content. Vitrophyres can be found near the base of many large PDCs in the western United States. They are typically formed through the rapid quenching at the base and top of PDCs, and might be more likely to entrain organics, although the slower moving lava flows may also entrain and interact with their substrate and existing organics.

The following examples are a subset of proposed field locations. This initial study will include glass-rich sites that are diverse in age, type, and pre-eruption environment.

Site Name	Eruption Type	Age (Ma)	Pre-eruption Environment
Eocene Ione Formation, CA	Rhyolitic	28-31	Auriferous gravel, sand, & minor clay)
Obsidian Cliffs, Three Sisters, OR	Rhyodacitic	0.1	Flank of a mafic composite volcano
Newberry Volcano obsidian flows, OR	Shield: basaltic-rhyolitic	1-10	

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