PUTATIVE MICROBIAL BIOSIGNATURES IN A MARS-ANALOGUE HYDROVOLCANIC ENVIRONMENT – FORT ROCK VOLCANIC FIELD, OREGON. Catheryn H. Ryan[1,2], Mariek E. Schmidt[3], and Roberta L. Flemming[1,2], [1]Institute for Earth and Space Exploration and [2]Department of Earth Sciences, Western University, London, ON (email: cryan73@uwo.ca), [3]Department of Earth Sciences, Brock University, St. Catharine's, ON.

Introduction: Early planetary habitability research is crucial to guiding investigations of the potential for life's existence beyond Earth. To that end, the study of traces of microbial life in geologic environments that mimic early (>3.5 Ga) Earth and Mars is a key tool to constraining the conditions best suited to promoting habitability under primordial conditions. These life traces, or biosignatures, can be contextualized within a geochemical and mineralogical micro-environment in a rock, providing clues for which conditions within a rock support life and which do not.

Methods: We studied Pleistocene-aged mafic tuff samples from the Fort Rock Volcanic Field in Oregon, United States of America, the site of a pluvial alkaline lake during this time period [1, 2]. These samples were collected from tuff cones and tuff rings, structures that form during phreatomagmatic eruptions near the water's surface [1]. Orbital imagery and *in situ* sample analyses by rovers have indicated the likelihood of this type of environment existing on Mars during its highly dynamic first billion years [3]. Samples are glass-rich and hydrothermally-altered to varying degrees, containing palagonite, calcite, and zeolites as secondary products. Many samples contain microscopic tubule structures within the glass (figure 1), the morphologies of which are consistent with biotically-generated structures found in numerous ocean floor basalt glasses and other mafic tuff glasses [4 - 10]. We are working to analyze the mineralogy and trace-element geochemistry found both near these microtubules, and in samples collected from the same outcrops that do not contain microtubules. We also are conducting morphological analyses of these microtubules.

Implications: Correlations exist between tubule morphology, fluid and glass composition, and temperature that can be used to constrain the ideal conditions for tubule proliferation – and thus, microbial colonization – in this environment. Such constraints will be used to develop a set of exploration criteria for future Mars astrobiological investigations.

References: [1] G. H. Heiken [1971] *J. Geophys. Res.*, **76**: 23, pp. 5615–5626. [2] M. P. C. Nikitczuk *et al.* [2016] *Geol. Soc. Am. Bull.*, **128:** 7–8, pp. 1270–1285. [3] P. Brož and E. Hauber [2013] *J. Geophys. Res. Planets*, **118:**8, pp. 1656–1675. [4] K. E. Metevier [2011] University of Kansas Thesis. [5] H. M. Sapers *et al.* [2014] *Geology*, **42:**6, pp. 471–474. [6]M. Fisk and N. McLoughlin [2013] *Geosphere*, **9:**2, pp. 317–341. [7] N. McLoughlin *et al.* [2009] *J. Geol. Soc. London.*, **166:**1, pp. 159–169. [8] N. R. Banerjee and K. Muehlenbachs [2003] *Geochemistry, Geophys. Geosystems*, **4:**4, p. 1037. [9] M. R. M. Izawa *et al.* [2010] *Planet. Space Sci.*, **58:**4, pp. 583–591. [10] C. S. Cockell *et al.* [2009] *Geobiology*, **7:**1, pp. 50–65.

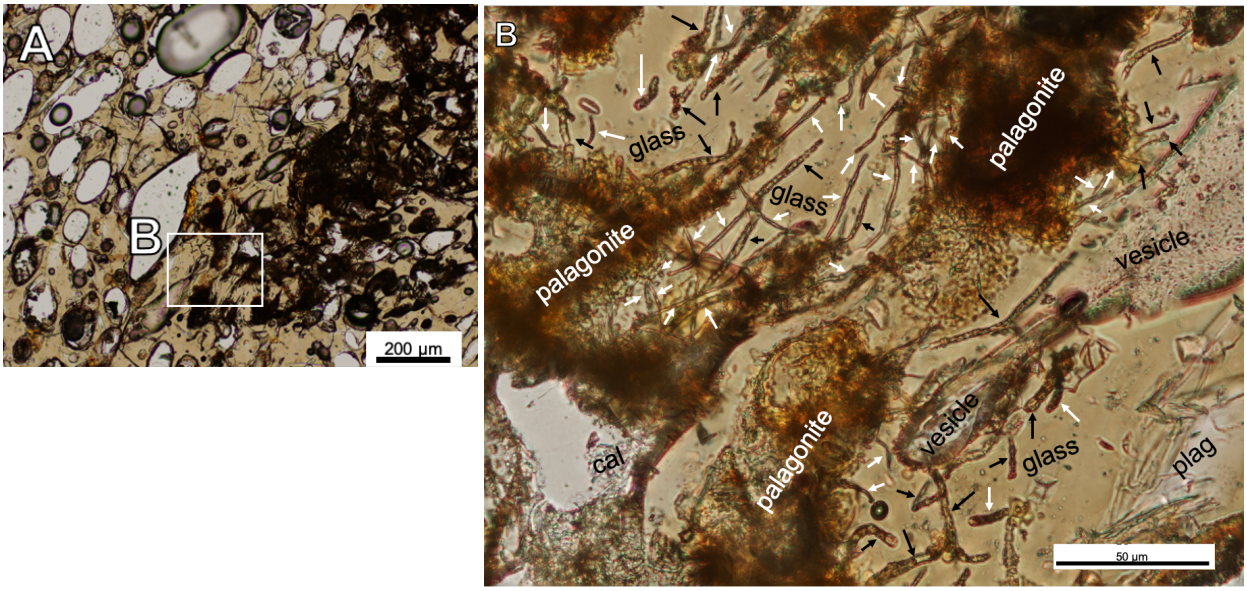

Fig. 1: A) *Contextual microscopic image of palagonitized, vesiculated tuff glass. Scale bar is 200 µm.* ***B)*** *Focus-merged microscopic image stack of microtubules (identified with arrows) in altered glass. Black arrows denote microtubules with more complex morphologies such as interior septae or ovoid bodies, or terminal enlargements (morphological terms from [6]). White arrows denote simple, curvilinear, empty tubules. Many tubules originate at the boundaries between granular palagonite and glass, or from vesicles. The glass contains plagioclase microphenocrysts (lower right corner). One vesicle (lower left corner) is rimmed with granular palagonite and calcite crystals. Scale bar is 50 µm.*