MAGMATIC INTRUSIONS INTO SULFUR-RICH SEDIMENTS: AN EXPOSED POTENTIAL SUBSURFACE HABITABLE ENVIRONMENT AS AN ANALOG FOR THE MARTIAN CRUST. J. Filiberto[1,2], J.R. Crandall[1], S.L. Potter-McIntyre[1], S.P. Schwenzer[2], K. Olsson-Francis[2], J.C. Bridges[3], [1]Southern Illinois University, Geology Dept, MC 4324, Carbondale, Il 62901, USA Filiberto@siu.edu, [2]School of Environment, Earth, and Ecosystems Sciences, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK, [3]Space Research Centre, Leicester Institute for Space and Earth Observation, University of Leicester, LE1 7RH, UK.

Introduction: Magmatism is one of few geologic processes to provide major changes and energy influx to the Martian surface and subsurface past the Noachian [1]. Eruption and degassing of mafic magmas contribute to the surface volatile species, as well as nutrients and energy that are needed for biologic processes [e.g., 2, 3]. Among the volatile species (e.g., water, carbon dioxide), sulfur is especially important because of its several redox states, which can be utilized as a chemolithotrophic energy source. On Earth, few mafic magmas intrude sulfur-rich clastic sedimentary rocks, forming unique environments by baking and altering the sediments. On Mars, however, soils have been found to contain abundant S-species. Since the high sulfur-concentrations and sulfate minerals in Martian soils appear to be global [e.g., 4], and there is ample evidence for magmatism (extrusive and intrusive) throughout Mars' history [e.g., 1], intrusion of a magma into the sulfur-rich Martian crust is to be expected. In fact, at every landing site volcanic rocks have been found in association with sulfur-rich sediments [5-9]. Further, proposed landing sites for the NASA Mars 2020 and for the ESA ExoMars missions have a potential volcanic capping unit that is directly in contact with sulfate-sediments (Mawrth Vallis and Jezero Crater) [10-14]. Therefore, studying such a scenario on Earth where magma capped/intruded sulfate-bearing sediments is vital for Mars exploration and interpreting the potential habitability of current and future mission sites. Here, we will present results of an Earth analog, in the San Rafael Swell on the Colorado Plateau, for such a scenario of mafic magma intruding sulfur rich sediments and place constraints on the potential habitability of such an environment.

Methods: Instruments were chosen to investigate mineralogy and petrology to mimic those on current and future space craft missions, as well as to do an in depth investigation of the mineralogy and petrology of the igneous dikes and sills, the metamorphic contact zone, and the sulfate veins. Further, current microbial diversity is being investigated.

Results: Five mafic dikes on the San Rafael Swell of the Colorado Plateau were sampled for detailed investigation. Samples of the dike, metamorphic baked zone, and sulfate veins were sampled for analyses. The dikes are mafic in composition similar to those surface basalts at all landing sites. The dikes intruded the Entrada Sandstone and the Carmel Formation. The Entrada Sandstone is primarily an eolian sandstone deposited proximal to the Western Interior Seaway in a tidally-influenced environment [15]. The Carmel Formation is stratigraphically below the Entrada Sandstone and was deposited in a coastal sabkha environment resulting in thick (> 24 m) gypsum beds [15, 16]. The intruded dikes baked and metamorphosed the host rock changing the mineralogy and remobilized fluids producing a potentially habitable environment.

Implications: Our study of igneous intrusions into sulfate-bearing substrates on the Earth provides an important analog for Martian sites at Meridiani Planum and Gusev Crater where we have investigated mafic magmas in association with sulfur rich deposits. This study will also allow for a better preparation for the new missions ExoMars (ESA/Europe) and Mars2020 (NASA/USA) where volcanic capping units are in direct contact with sulfate-sediments.

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