Nevada Space Grant 2022 Virtual Poster Competition Abstract –
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Fe-rich Amorphous Material Formation and Persistence in Ultramafic Soils Consistent With Cold and Wet Conditions on Early Mars

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X-ray amorphous material comprises between 15-73 wt.% of ancient sedimentary rocks and modern eolian sediments measured by the CheMin X-ray diffractometer on the *Curiosity* rover in Gale crater, Mars. Chemical data indicate that the amorphous material is siliceous, Fe-rich, and contains volatiles, and it is therefore likely to be at least partially composed of incipient weathering products. Despite its prevalence, however, little is known about the nature of the Fe-rich amorphous material or its relationship with the crystalline phases present. To better understand the implications of this material on Mars, we have investigated amorphous material formation and longevity within terrestrial Fe-rich soils of different ages within mediterranean, subarctic, and desert climates using bulk and selective dissolution methods, Rietveld refinements of powder XRD patterns, and transmission electron microscopy. We show that *in-situ* aqueous alteration concentrates Fe into the soil clay-size fraction and is required for formation of abundant Fe-containing amorphous material. Cooler climates promote the preservation of Fe-rich amorphous material while warmer climates promote the formation of crystalline Fe-(oxyhyrdr)oxide and smectite phases. Amorphous material in our soils is highly heterogenous, containing complex mixtures of Fe, Mg, and Si oxides as well as globular packets of pure SiO_2. Fe-rich amorphous material formation and persistence on Mars therefore likely indicate past cool, water-containing conditions followed by long-term cold and dry conditions.