EXAMINING WEATHERING OF MAGNESITE IN AN ARID ENVIRONMENT: IMPLICATIONS FOR JEZERO CRATER. A. W. Provow[1], E. M. Hausrath[1], T.S. Peretyazhko[2], E. Rampe[3], [1]Department of Geoscience, University of Nevada, Las Vegas, Las Vegas, NV, USA (provow@unlv.nevada.edu), [2]Jacobs at NASA Johnson Space Center, Houston, TX, USA, [3]NASA Johnson Space Center, Houston, TX, USA.

Introduction: Orbiter data indicate the presence of carbonates in several locations on the surface of Mars [1], but Jezero crater, landing site of the *Perseverance* rover, is the only known location where carbonates appear coincident with evidence of fluvial and lacustrine activity [2]. On Earth, carbonates in close proximity to these paleoenvironments may indicate the presence of past microbial life, like stromatolites [3], that could result in biosignatures [2]. However, in other cases, carbonates can also form through the alteration of mafic material with the introduction of carbonic acid [4]. Hydrated magnesites have also been found in evaporative environments along lake shores, and in playas [5,6,7]. Correctly interpreting past carbonates on Mars is therefore critical in the search for past signs of life.

In Jezero crater, both the northern and western fans have Mg-rich carbonates intermixed with olivine-rich material [8]. According to CRISM data, magnesite ($MgCO_3$), along with hydromagnesite ($Mg_5(CO_3)_4(OH)_2 \cdot 4H_2O$), are potential candidates for these Mg-carbonates [2]. Considering the spatial context with olivine, there are multiple potential explanations for the presence of Mg-carbonates in this location including *in-situ* formation via alteration of olivine-rich material with carbonic acid, transportation from farther up in the watershed, or precipitation of lacustrine carbonates [2].

The formation of hydromagnesite rather than magnesite is favored when Mg^{2+} saturated solutions have a high CO_3^{2-}/HCO_3^- ratio, which, on Earth, is thought to be caused by inflow of groundwater [4]. Additionally, Mg-carbonates tend to precipitate under high pH conditions and are unstable at lower pH conditions [5]. Hydromagnesite is stable at atmospheric CO_2 pressure and temperature conditions common to most Earth surface environments [9]. However, it is subject to transformation to magnesite after dehydration and concomitant brucite formation or dissolution and reprecipitation [10]. Previous research suggests that hydrated carbonates, including hydromagnesite, can form as weathering products of mafic minerals in the presence of H_2O and CO_2 in subfreezing temperatures and would not dehydrate under Martian atmospheric conditions [11, 12].

It is critical to understand the formation conditions of Mg-carbonates because of the different implications for the past history of Martian environments. Therefore, in this work we are investigating the weathering of Mg-carbonates in arid environments to help better understand Mg-carbonates in Jezero crater.

Study Area: The Ala-Mar Mines (East and West) near Ely, NV are the site of multiple magnesite deposits found within a calcareous tuff formation that overlies Tertiary aged volcanic rocks. Here, magnesite is formed via the alteration of the calcareous tuff and occurs in nodules, veins, and lenses [13]. Previous work suggests magnesite deposits are associated with faults [13]. Within the West Mine, magnesite can be found in two main contexts: (1) relatively circular zones of cauliflower-like material found within (2) a more massive lens that is heavily fractured on the surface.

Methods. Samples of both the cauliflower texture and more massive material were collected at Ala Mar West Mine. Both samples were then powdered, sieved and analyzed with an inXitu Terra Portable XRD. The program QualX was used to identify potential mineral phases [14]. Both samples were also optically inspected using 10x and 20x hand lenses.

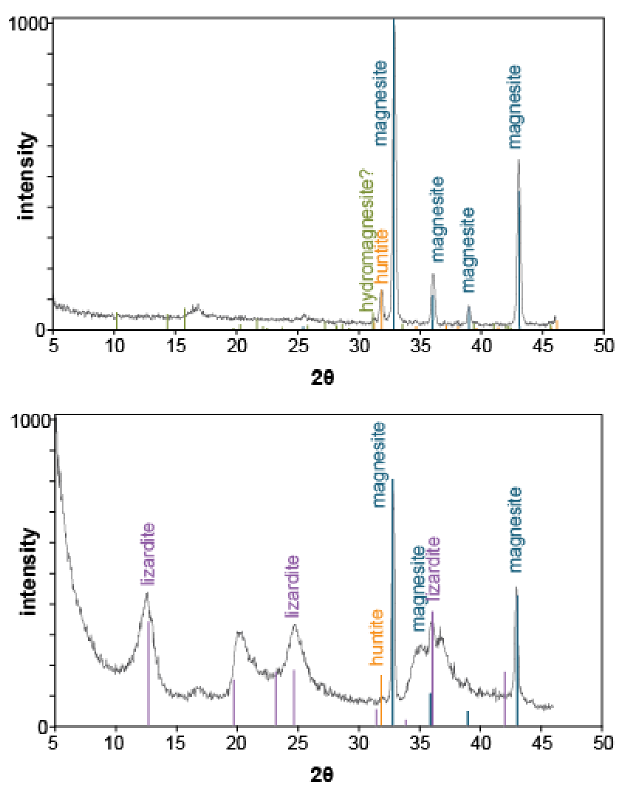

Figure 1. XRD patterns for the cauliflower magnesite (top) and massive magnesite (bottom).

Ongoing and future work on the samples discussed above includes scanning electron microscopy (SEM), electron microprobe analysis (EMPA), and near-infrared spectroscopy to determine whether hydromagnesite is present. Separation and analysis of the clay-size fraction by XRD will help to better identify any phyllosilicate phases present.

Results and Discussion: Both textures are a white to light tan with a porcelain luster on weathered surfaces, along with minor iron staining in some areas. Likewise, both textures are white with a porcelain luster on fresh surfaces. When broken apart, the massive magnesite shows macroscopic crystals, unlike the cauliflower magnesite.

XRD analysis shows that both samples have high concentrations of magnesite with lesser amounts of the carbonate mineral huntite ($Mg_3Ca(CO_3)_4$; Figure 1). The more massive sample contains a serpentine-group mineral, with lizardite being a potential candidate. The cauliflower sample has several minor peaks that may correspond to hydromagnesite (Figure 1), although more work is needed to confirm this. Additionally, the cauliflower deposits closely resemble hydromagnesite deposits found in southwestern Turkey, formed via microbialites [15]. As such, it is likely that more aqueous alteration or weathering is occurring at the locations where the cauliflower magnesite is present. However, additional field work will need to be conducted to confirm this hypothesis.

Conclusions and Future Work: Future work will include field mapping of fault locations and additional sampling of the different magnesite types as well as of the calcareous tuff material. We will also look specifically for potential weathering products of magnesite in this arid location, which may yield important insight into the Mg-carbonates located in Jezero crater. XRD analyses on a PANalytical XRD using non-ambient stages will be used to investigate the stability of hydromagnesite at different humidities and temperatures, which has implications for samples to be returned to Earth in the future. Additionally, thermal and evolved gas analysis of magnesite and hydromagnesite will be compared to results from Gale Crater to help interpret the mineralogy in that location [16]. The results of this research will further our understanding of carbonate formation in volcanic settings and their weathering processes in arid environments.

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