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Investigating the source of unusual kaolinite-spinel float rocks in Jezero crater, Mars, and their implications for Mars crustal processes.

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Since Landing in Jezero crater, the Mars 2020 *Perseverance* rover has encountered over 4,000 light-toned float rocks ("float") scattered across the dark-toned, mafic to ultramafic crater floor and volcaniclastic Jezero delta. To date (Sol ~1100), no outcrop of these light-toned float has been found. Here, we use imaging, chemical, and mineralogical data from the SuperCam and Mastcam-Z instruments onboard the *Perseverance* rover to constrain the potential origins of these unusual float.

Geochemical data acquired from the SuperCam laser induced breakdown spectrometer (LIBS) shows that these rocks are rich in Al_2O_3 (up to 44 wt%), with low abundances of MgO, FeO_T, CaO and Na_2O (averages <2 wt%) and an unusually high abundance of Ni, Cr, and Cu. Al_2O_3 abundances in these rocks are negatively correlated with SiO_2 and hydration. Mineralogical data provided by SuperCam Visible Near-Infrared spectrometer show that the main minerals present in these rocks are likely kaolinite (strong signature in one target) and spinel, with potential accessory sulfates, zeolites, Al-smectite/illite, and hydrated silica or alumina.

Kaolinite horizons overlying Fe/Mg smectite clay horizons have been detected in multiple places in the Jezero crater watershed suggesting that a possible formation mechanism for the high Al_2O_3 abundances and low MgO, FeO_T, CaO, and Na_2O, and the mineralogical observation of kaolinite could be due to pedogenic leaching in a warmer and wetter ancient Mars [1]. However, the low hydration observed by both LIBS and IR spectra in many of these targets suggests they are rich in metakaolinite, a metastable dehydroxylated kaolinite. Temperatures from 450-700°C are required to form metakaolinite [2]. Spinel is also known to form from high temperature metamorphism of Al-bearing rocks [e.g., 3]. Possible sources of heat in the Jezero crater watershed or crater rim include impact or volcanic processes. Due to the presence of a kaolinite-bearing megabreccia block and several detections of light-toned boulders on the Jezero crater rim in long-distance images, we suggest impact metamorphism of a kaolinite weathering horizon is the most likely source of these light-toned float.

[1] Ehlmann et al., 2009 https://doi.org/10.1029/2009JE003339
[2] Sperinck et al., 2011 https://doi.org/10.1039/C0JM01748E
[3] Wang et al., 2021 https://doi.org/10.1007/s00710-021-00743-1