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Thermal history and water contents in the Seitah igneous rocks in Jezero, Mars

YANG LIU[1], PAUL D ASIMOW[2], MARIEK SCHMIDT[3], ALLAN TREIMAN[4], NICOLAS RANDAZZO[5], JUAN DAVID HERNÁNDEZ-MONTENEGRO[2], ARYA UDRY[6], CHRISTOPHER D.K. HERD[5], ABIGAIL ALLWOOD[7], JOEL HUROWITZ[8], DAVID ARGE KLEVANG PEDERSEN[9], JESPER HENNEKE[9], JUSTIN I. SIMON[10], ADRIAN J. BROWN[11] AND MORGAN CABLE[7]

[1]Jet Propulsion Laboratory, California Institute of Technology
[2]California Institute of Technology
[3]Brock University
[4]Lunar and Planetary Institute
[5]University of Alberta
[6]University of Nevada Las Vegas
[7]NASA-Jet Propulsion Laboratory
[8]Stony Brook University
[9]Technical University of Denmark
[10]NASA Johnson Space Center
[11]Plancius Research

Presenting Author: Yang.Liu@jpl.nasa.gov

The western portion of the Jezero crater floor consists of an olivine-rich unit (named Séítah formation) and a pyroxene-rich unit (Maaz formation), which has been investigated by Perseverance rover [1]. The measurements using proximity and remote instruments on the rover revealed that the olivine-rich unit consists mostly of olivine [2-4]. Two outcrops (named Brac and Issole) were measured for high-resolution texturally correlated chemical maps by PIXL which enables the quantification of different mineral phases in a petrographic context. Results reveal poikilitic texture, in which olivine grains are partial to fully enclosed by individual clinopyroxene grains. Crystalline mesostasis make up the regions between olivine and clinopyroxene in one of the Brac outcrops [2] and feldspar lies between the other grains in the Issole outcrop. Additionally, olivines in these samples contain melt inclusions. Collectively, these textures suggest these rocks are olivine cumulate formed through multi-stage cooling.

To constrain the thermal history, we use different geothermometers in [5] to estimate the temperatures at which olivine crystallized, olivine equilibrated with clinopyroxene, and mesostasis formed. The temperature at which olivine crystallized is constrained by the inferred chemistry of the melt into which the olivine settled. We will also assess the application of different hygrometers to these samples [6-8]. For example, using the temperature for mesostasis, we will assess water contents in the mesostasis where different feldspars are present and the plagioclase hygrometer can be applied [7, 8]. These results will help to constrain the thermal history of these rocks, and possibly provide further information on the magmatic volatiles in these samples.

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