

MINERALOGICAL AND TEXTURAL INFLUENCES ON CHISEL MARKS SEEN IN ABRADED ROCK PATCHES, JEZERO CRATER. T.L.J. Henley¹, M.E. Schmidt¹, T.V. Kizovski¹, I.K. Brockie², L.A. Wade².
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Introduction: The rotary-percussive drill with rock abrading bit [1] is an essential tool for the M2020 Perseverance payload because it reveals fresh rock surfaces that can be analyzed by the PIXL (Planetary Instrument for X-ray Lithochemistry) [2] and SHERLOC (Scanning Habitable Environments for Raman and Luminescence for Organics & Chemicals) [3] instruments by removing surface dust coatings and rinds. To expose the freshly abraded surface the gDRT (Gas Dust Removal Tool) [4] blasts compressed N₂ to remove abrasion fines. The accompanying high-resolution microscopic images by the SHERLOC-WATSON and the Autofocus and Context Imager (ACI) allow for detailed analysis of texture and mineralogy of abrasion targets.

The abrading bits aboard Perseverance have three tungsten carbide teeth engineered for optimal impact distribution during application and reduce tooth marks on the abraded surface [1]. The abrasion process, however leaves behind surficial scratches, called chisel marks as well as the coarser abrasion fines not blown away by the gDRT, which obscures rock textures and interferes with interpretation. In order to assess the mineralogical and textural influences on the distribution and abundance of chisel marks on abraded rocks examined in Jezero crater, we compare microscopic images with mineralogy and texture determined by elemental variations in PIXL map scans

Methods: To measure the percentage of abrasion marks associated with each mineral type, WATSON images were examined using Adobe Illustrator, and visible chisel marks were traced.

PIXILISE is data visualization software to analyze x-ray spectral, spatial, and compositional variations in PIXL scans. We here used it to identify minerals and grain boundaries in PIXL map scans, which were then imported and traced Adobe Illustrator. Abrasion marks were then clipped at the mineral boundaries and grouped by mineral.

Image analysis software ImageJ is then used to

For abrasion patches with more than one PIXL scans, such as Dourbes (Sols 258 and 270), weighted averages are calculated.

The present abstract focusses on the character and abundance of abrasion marks in the Dourbes target; the presentation to follow will also include other abraded rock targets.

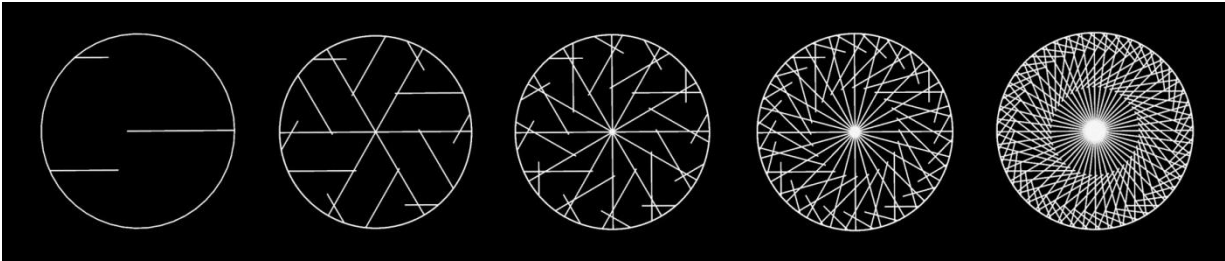
Results: Dourbes is interpreted to be a crystalline olivine cumulate rock with major phases including euhedral olivine, poikilitic pyroxene, interstitial feldspar, and secondary carbonate [5]. Abrasion patch chisel marks are densest in the middle, coincident with the sol 258 Dourbes PIXL scan, and follow a radial pattern moving outwards, similar to the patterns seen in Figure 1. Chisel mark traces and mineral maps for the Dourbes target are presented in Fig. 2. Chisel marks Table 1 lists the weighted aerial averages for Dourbes PIXL scans. The most abundant mineral, including olivine and pyroxene host the largest percentage of chisel marks. Feldspar and carbonate are found in lower abundances and host the lowest percentage of chisel marks.

Table 1. Weighted modal and chisel abundances for Dourbes.

Mineral	Mineral Mode (%)	Abrasion % in PIXL map	Abrasion % / Mode %
Olivine	60%	67%	1.11
Pyroxene	19%	20%	1.03
Feldspar	12%	7%	0.63
Carbonate	9%	6%	0.68

Discussion:

The two PIXL map scans in Dourbes demonstrate how chisel mark abundances are positively correlated with mineral properties, including hardness (H) and cleavage and fracture. Olivine (H=6.5-7) hosts the highest abundance of chisel marks in the Dourbes target, see Table 1. Olivine’s hardness and conchoidal fracturing allow grains to resist abrasion and make them more likely to preserve chisel marks. Pyroxene is less abundant in Dourbes but records the second high-



quantify mineral
Figure 1. Rotary-Percussive Drill radial chisel mark pattern, Courtesy NASA/JPL-Caltech.

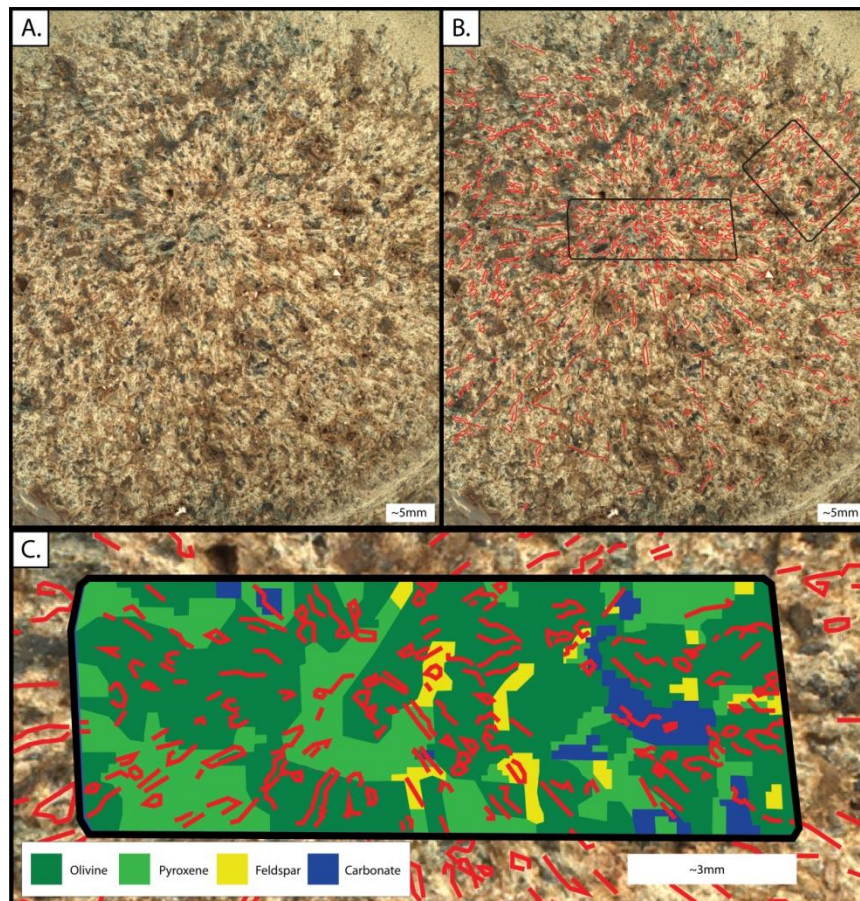


Figure 2(A.)Original Watson image (SII_0253_0689424526_882FDR_N008000000SRLC 00033_000095101) (B.) Watson image with traced chisel marks, red, and PIXL field of view, black rectangle. (C.) Mineral map within PIXL sol 258 map scan (4x12 mm).

est abundance of abrasion marks, this is thought to be the result of the smooth cleavage planes forming during abrasion. The moderate hardness of pyroxene ($H=5-7$), paired with smooth cleavage planes make it resistant to abrasion and more likely to preserve chisel marks. Feldspar will also form these smooth cleavage planes and has a similar hardness to pyroxene, between 6 and 7, but is only found in minor amounts in Dourbes and hosts significantly less abrasion marks. Feldspar grains in other targets may host greater abundances of abrasion marks but the limited grains present in Dourbes prevent further conclusions from being made at this time. Carbonates are the least abundant minerals present in Dourbes and, like Feldspar, host minimal abrasion marks. Carbonates are significantly softer than the mafic minerals present in Dourbes, hardness between 3 and 4, making them an easier material to abrade and explains the decreased abundance of chisel marks.

Conclusion: The methods developed to assess chisel marks and mineralogy as well as the results presented will be significant for understanding the distribution and abundance of chisel marks in future abrad-

ed rock targets. As discussed, chisel marks interfere with the interpretation of rock textures but may also provide insight into mineral competencies.

Acknowledgements: The M2020 mission is supported by NASA. This work was supported by a Canadian Space Agency M2020 Participating Scientist grant to Mariek Schmidt.

References:

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