LOCALISATION AND STUDY OF IMPACT MELTS IN THE SOUTH POLAR REGION OF THE MOON.
S. Gagnon[1], M. Lemelin[1], C. Neish[2,3], F. Diotte[1]. [1]Département de géomatique appliquée, Université de Sherbrooke, Sherbrooke, QC, Canada. [2]Department of Earth Sciences, University of Western Ontario, London, ON, Canada. [3]Institute for Earth and Space Exploration, University of Western Ontario, London, ON, Canada, (samuel.gagnon6@usherbrooke.ca)

Introduction: Impacts melts are found across the solar system and are formed when an impactor strikes the surface of a solid body. With sufficient velocity, an impact may generate enough heat and pressure, causing the rock to melt. The resulting molten material then cools and solidifies in a range of textures, from glassy to crystalline material depending on the cooling rate and chemical composition of the melt [1, 2]. On the Moon, impact melts are well preserved due to the lack of erosional processes, making them valuable for understanding the early solar system and the history of impacts on the Moon. In its Artemis III Science Definition Team Report, NASA has identified the sampling of impact melts at the heart of investigations that could help (1) test the cataclysm hypothesis and (2) understand changes to the Earth-Moon bombardment rate [3]. In this abstract, we aim to identify and characterize lunar impact melts near the lunar south pole and Artemis III landing site candidates.

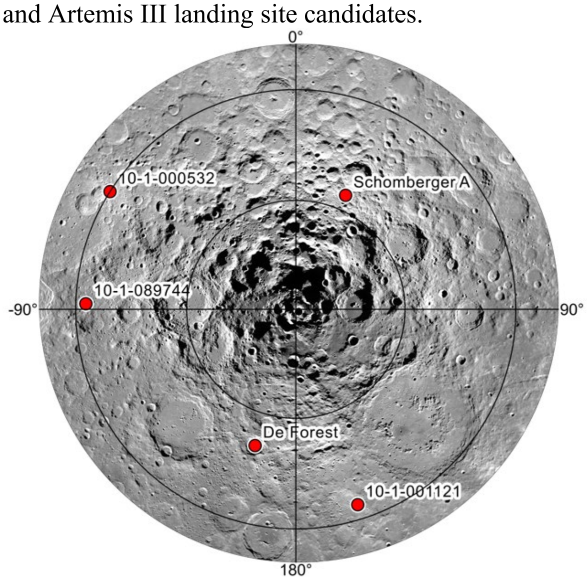

Figure 1: Map highlighting the emplacements locations where impact melt deposits were identified in the lunar south polar region. Latitude line interval is 10°.

Method: We seek to identify impact melt deposits near the lunar south pole, which may be targets of interest for future crewed exploration of the Moon. Furthermore, we wish to determine if the mineral composition of lunar impact melts is different from the regolith in their surrounding ejecta. To accomplish this, we focused on craters in the lunar south pole that had high circular polarization ratios (CPRs) in Mini-RF images (15 m/pixel). Craters with high CPR are rough at the decimeter scale and are indicative of younger, better-preserved craters [4]. After identifying these craters, we used images from the LRO-NAC (0.5 m/pixel) to map impact melts in the vicinity of five craters: Schomberger A (-78.598°, 23.552°), De Forest (-76.978°, 196.614°), 10-1-001121 (-71.312°, 162.440°), 10-1-127238 (-72.133°, 133.770°) and 10-1-000532 (-70.006°, 302.421°). Unnamed craters are listed with the IDs attributed to them by Robbins *et al.* (2018) [5]. We visually drew polygons in QuickMap over the features of interest. In Table 1 we list the areas of the different features. Figure 2 displays how impact melts (red) and ejecta (blue) were mapped.

Table 1 : Areas of mapped features (km²)

Crater	Impact Melt	Ejecta	Nearby Regolith
Schomberger A	57.1325	3660.76	758.07
De Forest	16.8625	18562.75	929.64
10-1-001121	9.9625	523.56	161.27
10-1-127238	0.985	276.88	57.67
10-1-000532	2.2225	623.87	400.32

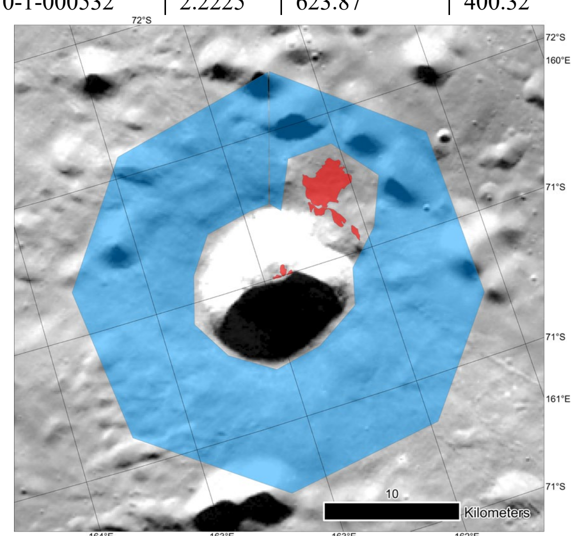

Figure 2: Example of impact melt (red) and ejecta (blue) mapping at crater 10-1-000532. Impact melts were identified on LRO NAC images (0.5 m/pixel).

We then used the function *Zonal Statistics as Table* in ArcGIS to extract the mineral composition of the mapped features. This function calculates the mean value of the sampled pixels, along with the standard-deviation. We used the maps created by Lemelin et al. (2022) to extract the mineral composition of the impact

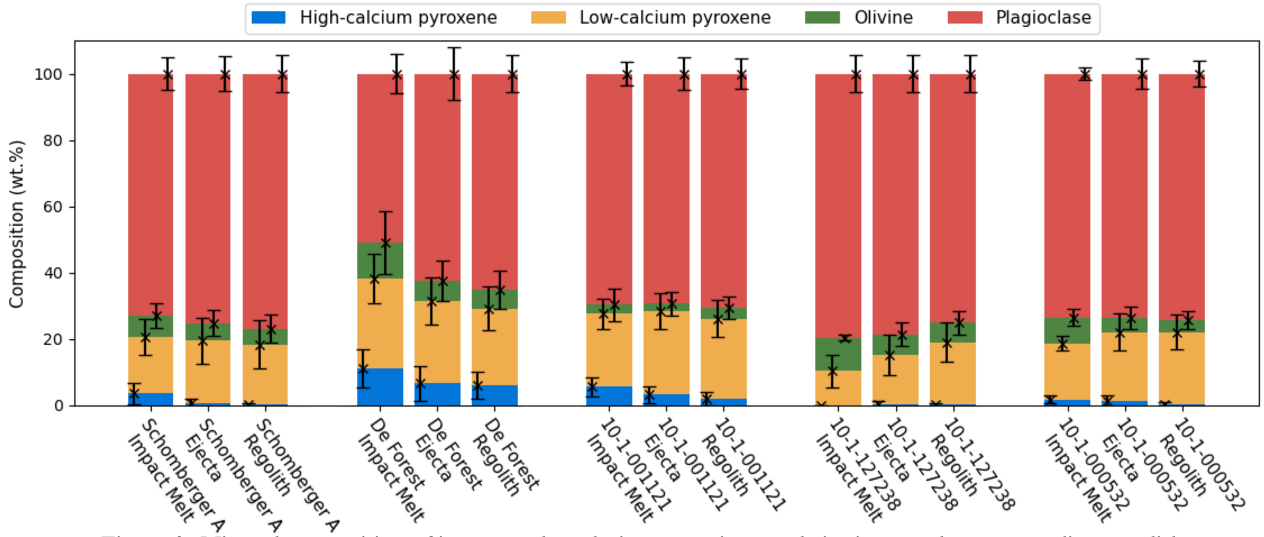

Figure 3: Mineral composition of impact melt rocks in comparison to their ejecta and to surrounding regolith.

melts, crater ejecta and a sample of regolith near the crater. The maps possess a spatial resolution of 1002 m/pixel and were created by calibrating the measurements from the Kaguya Spectral Profiler to absolute reflectance, using data from the Lunar Orbiter Laser Altimeter [6]. We extracted data of high-calcium pyroxene, low-calcium pyroxene, olivine and plagioclase.

Results and discussion: Plagioclase is the main component of the sampled material, making up between 51 - 80 ± 8 wt. % of the mineral composition. It is followed by low-calcium pyroxene (10 – 27 ± 8 wt. %), olivine (2 – 11 ± 9 wt. %) and high-calcium pyroxene (0 – 11 ± 6 wt. %). We observe very subtle variations between sampled regolith and ejecta. However, we note that concentrations of high-calcium pyroxene and olivine are typically greater in impact melts than in the surrounding ejecta or regolith.

These results seem to be in line with those of Gou *et al.* (2020), where it was found that the main components of what is suggested to be a glassy impact melt rock sampled by rover Chang'E-4 in Von Kármán crater (South Pole-Aitkens basin) were plagioclase 45 ± 6 vol.%, followed by pyroxene 7 ± 1 vol.% and olivine 6 ± 2 vol.%. The proportion of minerals are similar to our results, with plagioclase being the most common mineral.

We also note that De Forest seems to have the largest compositional differences between melt and the surrounding regolith. Lemelin et al. [6] noted that De Forest crater has excavated both high- and low-FeO material, and appears to have excavated and distributed fresh material in the Artemis region. The impact melts we identified have lower plagioclase content than the surrounding regolith, which may represent the high-FeO material excavated by the crater.

Conclusion: Several new impact melt deposits were identified near the lunar south pole, near regions of interest for human exploration. The composition of impact melt rocks and their surrounding ejecta were extracted from compositional mineral maps. The main component of all sampled material is plagioclase, with an abundance of 51 - 80 ± 8 wt. %. Sampled impact melts tend to be richer in high-calcium pyroxene and olivine than their ejecta and surrounding regolith. In future work, we seek to determine the crater depth and geological context, to determine if excavation of material from the subsurface was a driving factor in the composition of the studied impact melts. In the long term, it is expected that the results may help in choosing which impact melts could be targeted by robotic and crewed missions for sampling analysis.

Acknowledgments:

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References:

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