ASSESSING THE LITHOLOGICAL DIVERSITY OF LUNAR METEORITE NORTHWEST AFRICA (NWA) 10203. M. Baird[1], J. J. Barnes[1], Z. E. Wilbur[1], N. Kerrison[1], K. Domanik[1] and D. H. Hill[1], Lunar and Planetary Laboratory, 1629 E University Blvd., Tucson, AZ 85719 (mbaird18@arizona.edu).

Introduction: The Apollo, Luna, and Chang'e-5 sample collections include a variety of rocks that represent ancient lunar magmatic products [e.g., 1,2]. These include basalts with varying titanium, potassium, aluminum, and trace element contents, varying textures and grain sizes, and ages [e.g., 1,2]. Crucially, these samples provide a view of lunar magmatic evolution from a geographically restricted area. Remote sensing of the Moon has revealed the lunar crust is more compositionally diverse than exemplified by samples collected and returned from its surface [3]. Lunar meteorites allow us to explore some of the crustal heterogeneity as they provide a somewhat random sampling of the lunar surface [4]. Specifically, fragmental and regolith meteorite breccias provide windows into ancient magmas and crust building, impact bombardment, and space weathering records [4].

To better understand the compositional heterogeneity of the lunar crust and ancient magmatic evolution of the Moon we characterize the lithological diversity of an understudied lunar brecciated meteorite Northwest Africa (NWA) 10203 [5].

Sample: NWA 10203 was found in 2015 near the border between Mauritania and Mali having a total mass of 3.3 kg and was determined to be a polymict breccia [5]. This meteorite was found to have a high shock stage and a moderate weathering grade [5]. The lithic clasts in NWA 10203 include unbrecciated olivine gabbro, fragmental anorthite-rich gabbro-bearing breccia, fragmental gabbro-bearing breccia, and shock melt veins and pools [5].

The studied sample of NWA 10203 was purchased from Mendy Ouzillou and had an initial mass of 5.35g. We first scanned the bulk sample at the University of Texas's – High-Resolution X-Ray CT Facility. Based on the 3D scans, the sample of NWA 10203 was cut into three smaller pieces along preferred planes to best expose clasts of interest. A 0.93g piece was mounted in indium (NWA 10203, IM1) and polished using diamond powder and ethyl alcohol before analysis was conducted.

Methodology: To study NWA 10203, we utilized instruments in the Kuiper-Arizona Laboratory for Astromaterials Analysis (K-ALFAA) in the Lunar and Planetary Laboratory (LPL) at the University of Arizona.

After preparation, the sample was initially imaged using a Keyence VHX7000 Digital Microscope in reflected light. The texture and mineralogy of the sample was characterized using the Hitachi TM4000plus environmental scanning electron microscope (SEM). Both backscattered electron (BSE) imaging and energy dispersive X-ray spectroscopy (EDS) mapping were performed on areas of interest in the polished indium mount of NWA 10203. The CAMECA SX100 electron microprobe was then used to map the sample in BSE and wavelength dispersive X-ray spectroscopy (WDS) modes. In addition, we are collecting quantitative chemical data of minerals and melt in NWA 10203 using the CAMECA SX100 and we are determining the 2D modal mineralogy of individual clasts using *ImageJ* software.

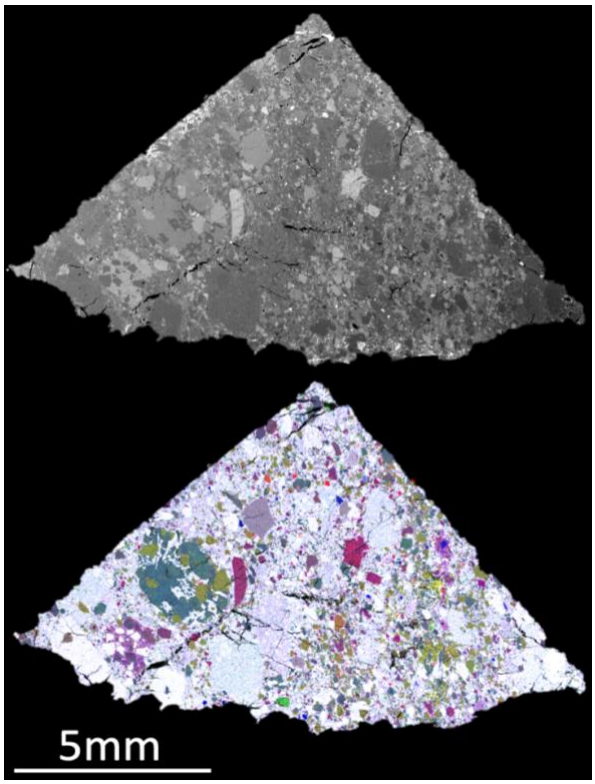

Figure 1. Top) *Backscattered electron image of NWA 10203.* ***Bottom)*** *False color X-ray composite with Fe in red, Mg in green, Si in blue, Al in white, P in cyan, Ti in pink, and S in yellow.*

Results: We have determined that the slice of NWA 10203 examined is indeed a polymict breccia and contains an abundance of rock types with a variety of textures (Fig. 1). In addition to lithic clasts, a variety of mineral fragments are present in the matrix and one spherule has been identified indicating this sample could be a regolith breccia.

With respect to the lithic clasts, we have identified fragmental breccia clasts of the anorthositic gabbro type [5] characterized by an abundance of plagioclase, fragmental breccia clasts of the gabbro type [5] characterized by almost equal abundances of olivine, pyroxene, and plagioclase (Fig. 2), and shock melt pockets and veins. We have yet to determine if the plagioclase is maskelynite. We did not observe any unbrecciated olivine gabbro in our indium mount. In addition to the gabbro and melt clasts, we identified clasts of symplectite with silica and fayalite-hedenbergite intergrowths (Fig. 3), Fe-rich clasts, and impact melt clasts of varying textures. We have observed numerous accessory minerals within clasts and within the brecciated matrix including zircon, baddeleyite, apatite, merrillite, troilite, Fe-metal, and ilmenite.

We are in the process of collecting quantitative chemical data to aid our characterization of NWA 10203 and will present those data at the meeting.

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References: [1] Heiken, G. et al. (1991) *Cambridge University Press*. [2] Che, X. et al. (2021) *Science, 374,* 887-890. [3] Heisinger, H. and Head III, J. W. (2006) *RiMG, 60,* 1-81. [4] Joy, K. H. et al. (2023) *RiMG, 89,* 509-562. [5] Bouvier, A. et al. (2017) *Meteoritics & Planet. Sci., 1,* doi: 10.1111/maps.12930.

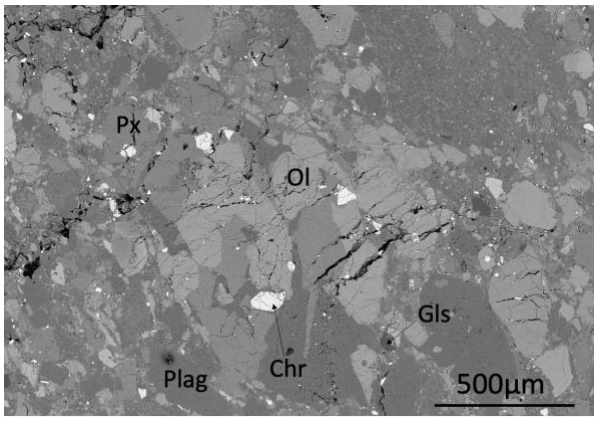

Figure 2. *Backscattered electron image of a portion of a fragmental gabbro-bearing breccia clast within NWA 10203. Where Ol = olivine, Px = pyroxene, Plag = plagioclase, Chr = chromite, Gls = glass.*

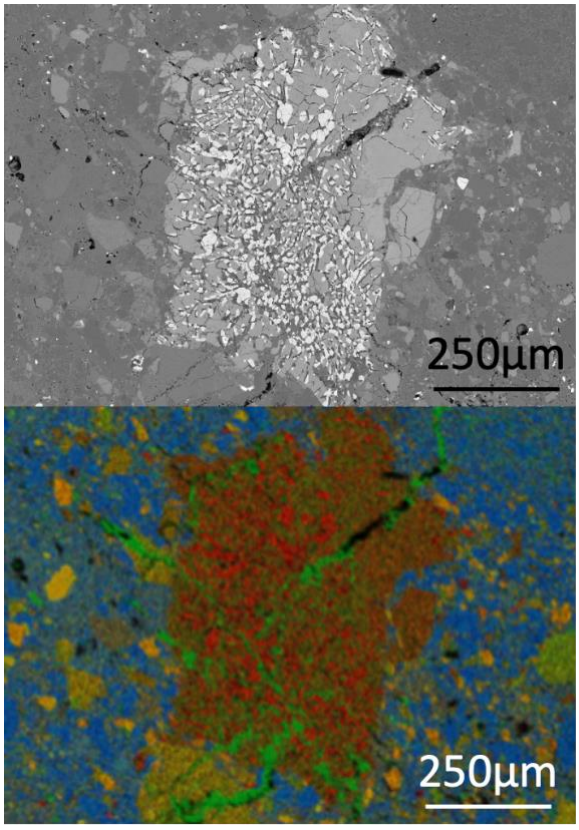

Figure 3. Top) *Backscattered electron image of a symplectite clast within NWA 10203.* ***Bottom)*** *EDS elemental map of the clast with Fe in red, Ca in green, Al in blue, and Mg in yellow.*