Geochemical and Petrologic Insights into a Lunar Basaltic Breccia: Dominion Range (DOM) 18543. A.R. Schweitzer[1], C.L. McLeod[2], B. Shaulis[3], [1]Dept. of Geology and Environmental Science, Miami University, Oxford, Ohio 45056 (schweia7@miamioh.edu) [2]Dept. of Geology and Environmental Science, Miami University, Oxford, Ohio 45056 (mcleodcl@miamioh.edu) [3]Trace Element and Radiogenic Isotope Laboratory, University of Arkansas, Fayetteville AR.

Introduction: Understanding the formation and evolution of the Moon remains a topic of considerable interest in the planetary community today. Much of current understanding comes from the precious samples gathered largely in part from two principle sources, the Apollo landings (1969-1972) and meteorites recovered from often remote locations across the surface of Earth. Lunar meteorites represent a random sampling of the lunar crust and this particular suite of samples are considered invaluable for expanding our knowledge of lunar geology as they are not restricted to the spatially constrained sampling of the Apollo program. They therefore provide a unique window into the petrology, and geochemistry, of lunar formative processes.

In 2018 the annual Antarctic Search for Meteorites (ANSMET) returned a sample suite of seven lunar meteorites gathered along the Dominion Mountain (DOM) Range in Eastern Antarctica [1]. These meteorites have been classified as basaltic regolith breccias and anorthositic, gabbroic, basaltic, and granulitic clasts [3], along with individual mineral grains, a range of mineral textures, melt veins, crystalline lunar spherules, and a well-preserved fusion crust [1-4]. Of the seven DOM samples associated with this suite (DOM 18242, 18244, 18262, 18509, 18543, 18666, and 18678), DOM 18543 is being studied here. This research aims to conduct a detailed petrographic, mineralogical, and geochemical investigation of the DOM 18543 components in order to evaluate breccia petrogenesis and consider potential sites of origin on the Moon.

Methods: Initial petrological characterization and in-situ geochemical analyses of DOM 18543 were presented by [2] and [3]. In this study we focus on thin section -09. Initial sample investigation was conducted utilizing a Leica DM 2500 polarizing light microscope. This included acquisition of a whole thin section image in both plain polar and cross polarized light (Figure 1). Textural, mineralogical, and elemental analysis via scanning electron microscopy (SEM) is currently ongoing utilizing a Zeiss Supra 35 VP FEG SEM at the Center for Advanced Microscopy and Imaging (CAMI) at Miami University. Elemental data (including compositional maps) were collected using a Bruker Xflash 5010 Energy Dispersive X-ray Spectrometer (EDS).

Results and Discussion: Current work has focused on identifying and classifying textures, identifying major, minor, and trace mineral phases, and evaluating the nature of the polymineralic clasts present in DOM 18543 (Figure 1). Clasts are comprised primarily of plagioclase and clinopyroxene within a fine aphanitic breccia matrix, along with minor Fe-Ti, and trace FeS, inclusions (potentially ilmenite and troilite respectively; Figure 2a) [4]. Three-phase symplectites are common throughout the thin section and may record the decomposition of ferro-pyroxene due to shock. (Figure 2b) [4-5]. Individual anhedral grains of fayalitic olivine clinopyroxene, plagioclase, sulfides, Fe-Ti

oxides, and silicas comprise approximately 45% of the sample with the largest individual grains approximately 1mm in length. Additionally, gabbroic clasts comprised primarily of euhedral plagioclase and anhedral clinopyroxene constitute 15-20% of the total sample with the largest gabbroic clast approximately 3mm (Figure 1). Crystalline spherules are minor and comprise less than 1% of the sample overall.

Future Work: Investigation and characterization of DOM 18543 meteorite components will continue utilizing SEM-EDS. This dataset will inform selection of sites for subsequent in-situ analysis. First, major element analysis of major, minor, and trace phases will be conducted via electron microprobe (EPMA). This will be followed by in-situ trace element analysis via laser ablation inductively couple plasma mass spectrometry (LA-ICP-MS). Combined, mineralogical, textural, and chemical data will be used to evaluate breccia petrogenesis. Compositional information will be compared to other meteorites from this particular DOM clan [2,3] and other known lunar breccias. In addition, data will be compared to mineralogical and chemical characteristics from the Apollo suite to evaluate potential provenance.

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References: [1] Korotev, R.J., Dept of Earth and Planetary Sciences, WU, 2021. [2] Gross, J., et al (2020). 51st Lunar and Planetary Science Conference 2020. [3] Zeigler, R.A., et al (2021) 84th Annual Meeting of the Meteoritical Society 2021. [4] Papike, J. et al. (1991) Lunar Sourcebook: Lunar Materials. [5] Miao, H.C., et al (2013) 76th Annual Meteoritical Society Meeting 2013.

Figures:

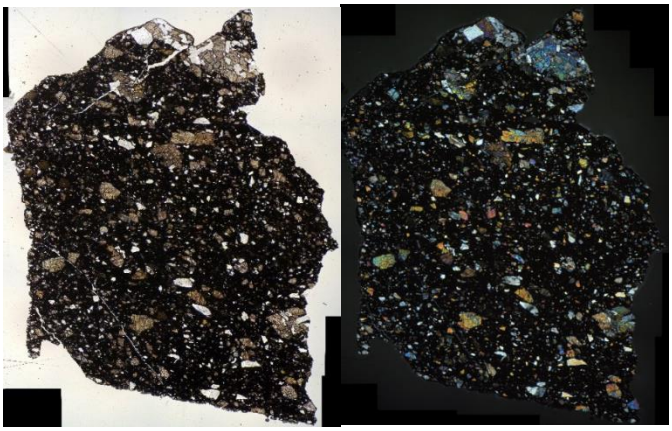

Figure 1: DOM 18543 in Plain Polarized [a] and Cross Polarized light [b]. Sample is 1.4 cm L x 1.0cm W.

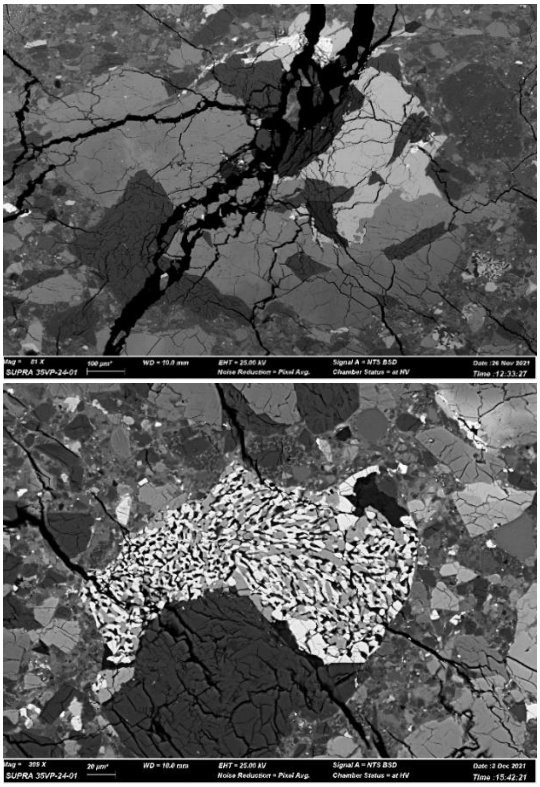

Figure 2: Gabbroic clast (a), and Symplectite textures (b)