MORE METEORITES, MORE INSIGHTS! FIVE NEW LUNAR BASALTIC METEORITES FROM THE DOMINION RANGE. C. L. McLeod[1]. B. Shaulis[2], J. T. Brum[1], A. J. Gawronska[1], [1]Dept. of Geology and Environmental Earth Science, Miami University, Oxford, OH 45056, USA. (mcleodcl@miamioh.edu) [2]Trace element and Radio-genic Isotope Laboratory (TRAIL), University of Arkansas, Fayetteville, Arkansas 72701, USA.

Introduction: The returned sample suites from the annual Antarctic Search for Meteorites (ANSMET) continues to provide exciting new opportunities for the scientific community to advance understanding of the origin, composition, and history of extraterrestrial materials.

The returned sample suite from the Dominion Range 2018 ANSMET expedition was dominated by achondritic meteorites (as reported in the August 2019 Antarctic Meteorite Newsletter, vol. 42, No. 2), and excitingly within this suite, five new lunar meteorites were documented. Specifically, these five new lunar meteorites are basaltic breccias (likely regolith breccias), range in weight from 6.8g to 45.9g, and exhibit characteristics associated with A – A/B weathering [1].

Thin sections and rock chips of each of the five new lunar meteorites (DOM 18262-9,-5, 18509-8,-5, 18543-9,-5, 18666-12,-5, and 18678-9,-5 respectively) were requested in August 2019 and received in late Fall. The aim of this work is to apply a two-pronged approach to advancing our understanding of the petrochemical, petrophysical, and petrochronological characteristics of this new suite of brecciated basaltic meteorites, i.e. their crystallization, petrogenetic, and impact histories. This will be specifically achieved through a combined micro-chemical, -structural (2D and 3D), and -chronological study of major, minor and accessory phases.

Methods: Initial study of acquired thin sections was conducted via Polarized Light Microscopy using a Leica DM 2700 P (and associated LAS X software). Entire section images in plane polarized light and cross polarized light are shown in Figures 1-5.

Results: Figures 1-5 summarize the mineralogy and textures of the new DOM suite of lunar meteorites. The majority of samples are dominated by porphyritic, brecciated, textures associated with fine-grained, glassy groundmasses and individual mineral grains. Individual grains throughout the sample suite are predominantly plagioclase feldspars and pyroxenes with minor olivine and oxide phases. No intact clasts are observed with fragmented clasts observed. These are rare and only observed in DOM 18543. Clasts are therefore estimated to constitute <1% of this meteorite suite. The clast in DOM 18543 (Figure 6) is subrounded, elongate, and measures 4mm by 1.2mm. It is composed of two minerals, plagioclase feldspar and clinopyroxene (a gabbroic clast), both equant in habit and (in places) exhibit a poi-kilitic relationship. They are present in near equal abun-dance (50%) although the number of feldspar grains is greater and they are typically smaller (<500 μm). In the 18262 section a melt droplet is also observed. No melt droplets are observed in the other sections.

Future Work: Subsequent study of these thin sections will involve hyperspectral imaging via SEM at the Center for Advanced Microscopy and Imaging (CAMI) at Miami University, OH. Acquired elemental maps will then be used to identify the crystal populations that exist throughout the sample and guide further *in-situ* elemental quantification via EPMA and LA-ICP-MS.

Chips of each lunar basaltic breccia will be analyzed via micro Computed Tomography (μCT). Proposed μCT analyses will take place at the MicroCT Imaging Consortium for Research and Outreach (MICRO) facility as part of the Center for Advanced Spatial Technologies (CAST) at the University of Arkansas. This approach will allow the generation of both 2D and 3D visualizations of each samples internal petrographic and mineralogical features. The application of μCT to geological materials, particularly to lunar rocks, is relatively new [2,3,4] thus this proposed work continues to develop the exciting new application of non-destructive technology to rare sample suites. Specifically, μCT datasets generated for the DOM meteorites requested here would be used to evaluate the 3D distribution of clasts within each sample, the mineralogy of each clast (the density differences between plagioclase, pyroxene, olivine, and Fe-Ti oxides are distinct enough to allow these phases to be distinguished via μCT [4], and the modal mineralogy of each clast and bulk sample. From this, the number of different clast types that are present in each meteorite will be determined. This information will then be used to evaluate the potential number of basaltic lithologies that were present in the impact region from which the clasts were derived. From this, volumetric constraints with respect to mineralogy will be able to be placed on not only each clast, but the meteorite sample as a whole. As more 3D data is acquired via this technique and shared publicly, comparisons and contrasts between other basaltic lunar meteorite (and Apollo) suites will be enhanced, thus working towards furthering our understanding of the petrogenesis of meteorites, their components, and potentially their source regions on the lunar surface.

Suitable phases for geochronological investigation will also be targeted. This will allow both the crystallization history of the clasts/minerals within the breccia to be investigated as well as constraining the timing of lunar impacts. Specifically, U-bearing phases will be targeted, (e.g. zircon, baddeleyite, Ca-phosphates), and likely to a lesser extent, rutile, zirconolite, and tranquillityite (if found). All the phases listed here can be dated by *in situ* U-Pb dating techniques.

References: [1]Righter K. (2019) *AMN 42(2)*; [2]Blumenfeld E. H. et al. (2017) *LPSC XLVIII* #2874; [3]Blumenfeld E. H. et al. (2019) *LPSC L* #3056; [4]Gawronska A. J. et al. (2019) *LPSC L*, #1660.

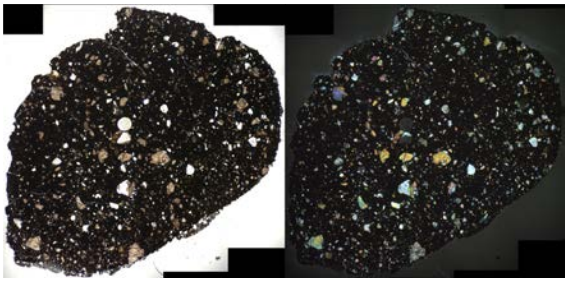

Fig. 1: PPL and XPL image of 18262 -9. FOV: 1.2x 1.2cm.

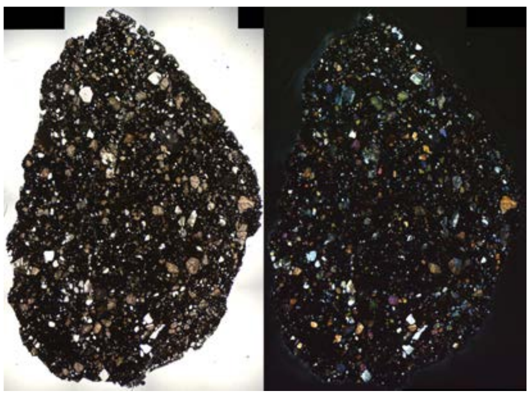

Fig. 2: PPL and XPL image of 18509 -8. FOV: 0.8x 1.4cm.

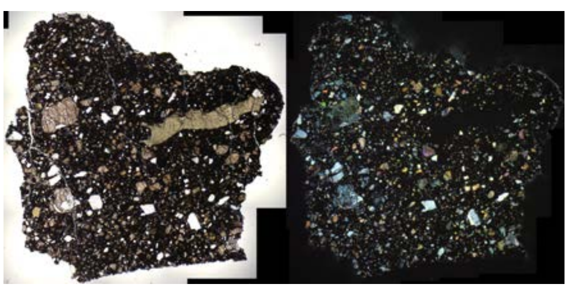

Fig. 3: PPL and XPL image of 18666 -12. FOV: 1.1x 1.1cm.

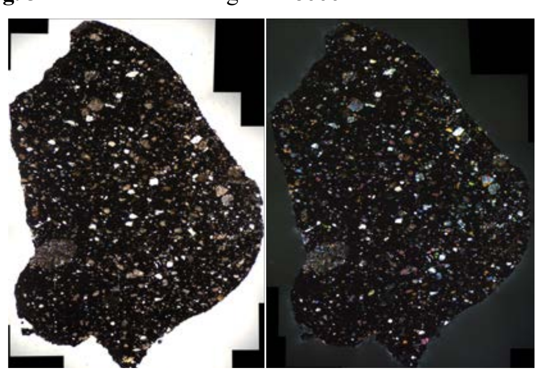

Fig. 4: PPL and XPL image of 18678 -9. FOV: 1.0x 1.5cm.

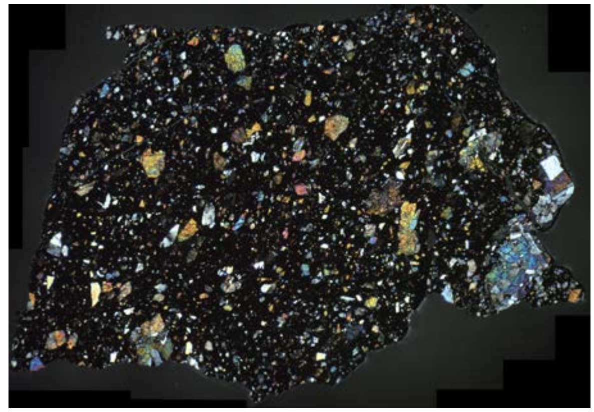

Fig. 5a: XPL image of 18543 -9. FOV: 1.4 x 1.0cm.

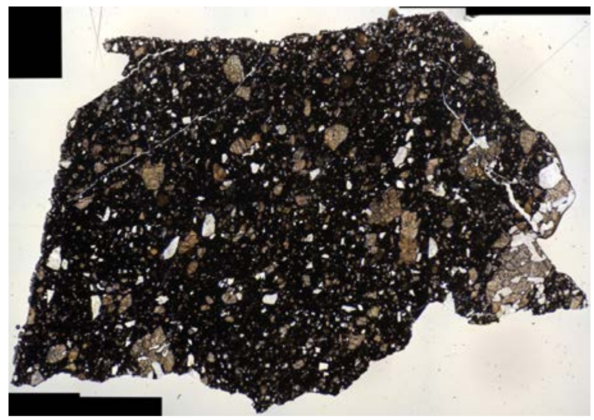

Fig. 5b: PPL image of 18543 -9. FOV: 1.4cm x 1.0cm.

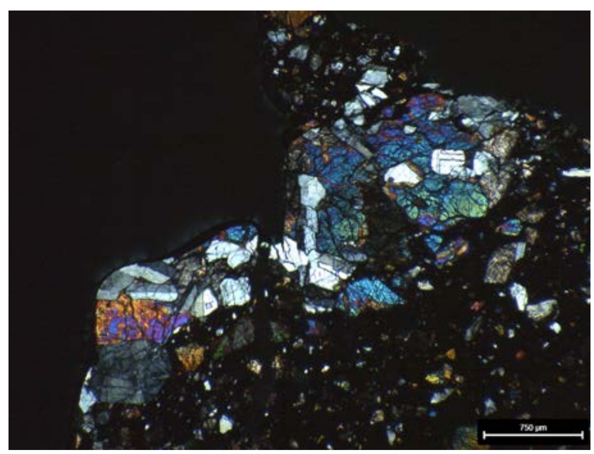

Fig. 6: XPL image of gabbroic clast in 18543 -9.